

***Factors influencing the performance and documentation of clinical
interventions by Australian community pharmacists***

Mackenzie Williams BPharm(Hons)

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Abstract

Introduction

Drug-related problems (DRPs) are a major burden on healthcare systems. Once detected, the resolution of these DRPs has the potential to reduce healthcare costs and improve patient outcomes. Community pharmacists are ideally placed to detect and prevent DRPs, with the resolution of a DRP being termed a clinical intervention.

Aims

Utilising an electronic documentation system, the aim of this project was to determine the number and nature of DRPs detected and clinical interventions performed by Australian community pharmacists. The project also aimed to identify the pharmacy and pharmacist factors that influenced the frequency with which clinical interventions were both performed and documented.

Methods

An electronic documentation system was designed and integrated into the existing dispensing software of 186 pharmacies in three States of Australia (NSW, Victoria and Tasmania) to allow pharmacists to record details about the clinical interventions they performed in order to prevent or resolve DRPs. Participating pharmacies were randomly allocated to three groups: Group One had documentation software; Group Two had documentation software plus a timed reminder to document interventions; and Group Three had documentation software, timed reminder and an electronic decision support prompt. Pharmacists were trained in the use of the software system and also completed several surveys gathering information about demographics, professional attitude, personality traits and clinical knowledge. Pharmacists classified DRPs, entered recommendations they made, and estimated the clinical significance of the intervention. An observational sub-study, which included 24 pharmacies without any documentation software, was also completed to determine current practice.

Results

Over 12 weeks, 531 participating pharmacists dispensed 2,013,923 prescriptions for 483,147 patients and documented 6,230 interventions, resulting in a median intervention rate of 2.4 interventions in 1000 prescriptions or 0.24%. Of these 6,230 interventions, 282 were attributed to the electronic prompt in Group Three and were removed prior to analysis. No significant differences were seen in the overall intervention rate between the

three groups, however the presence of the prompt in Group Three significantly increased the number of interventions performed on the prompted medications. As expected, the 'software' pharmacies had a significantly higher documentation rate compared to the 'no software' pharmacies. There was a significant decline in the number of interventions documented over the trial period.

Commonly, pharmacists' interventions were related to drug selection problems (30.7%) and educational issues (23.7%). Recommendations were often related to a change in therapy (40.1%), such as a change of drug or dose, or provision of information (34.7%). When a referral recommendation was made, this was almost uniformly to the prescriber (91.3%). Nearly half of the interventions (42.6%) were classified as having a higher clinical significance by the documenting pharmacists, with these interventions most commonly associated with undertreatment or toxicity DRPs. Drug groups most commonly subject to an intervention included antibiotics, glucocorticoids, and opioids. The antibiotics were commonly associated with DRPs due to allergies, incorrect doses and drug interactions, with the glucocorticoids and opioids often associated with dosing issues. An independent expert panel of 23 experts (5 physicians, 10 GPs and 8 pharmacists) was commissioned to assess the economic value of a sample of 200 interventions. The pharmacist's assessment of the clinical significance appeared to correlate well with the economic value ($p < 0.001$), showing that the more clinically significant the pharmacist thought the intervention was, the higher the cost saving to the Australian government.

Original prescriptions were associated with significantly more interventions than repeat prescriptions ($p < 0.001$), most likely due to original prescriptions having a higher incidence of drug selection errors, drug interactions and education requirements compared to repeat prescriptions. As expected, more interventions were performed on older patients ($p < 0.001$), most likely due to the larger number of medications they were taking. Analysis of the observational sub-study revealed that only 49% of performed interventions were documented within the electronic software system, suggesting that the number of interventions performed may actually be twice the number documented within the software.

Multiple regression analysis was used to produce a model to predict the pharmacy's intervention rate. Two models were created, the 'pharmacist workload' model and the 'prescription volume' model, however, both model fits were poor and could only explain 10.1% and 11.8% of the variance, respectively. The 'pharmacist workload' model had

three significant factors: high pharmacist workload; annual financial turnover; and, whether the pharmacy catered for aged care facilities. Pharmacies that had higher pharmacist workload, a higher financial turnover and catered for aged care facilities tended to have lower intervention rates. The 'prescription volume' model had five significant factors: high prescription volume; moderate prescription volume; annual financial turnover; location in or near a medical centre; and, participation in other pharmacy trials. Pharmacies with a higher prescription volume, a higher financial turnover and concurrent participation in other trials tended to have lower intervention rates on average, whilst medical centre pharmacies tended to have higher intervention rates on average. Despite the poor model fit, these factors would logically have a significant impact on the pharmacist's workload, indicating that the busier the pharmacy and pharmacists are, the lower the intervention rate is likely to be as there would be less time to perform and document clinical interventions. This theory was also supported by the bivariate analyses which showed that the intervention rate of the pharmacy was significantly correlated with the workload during the trial, with the busier pharmacies having a lower intervention rate. The observational sub-study also identified workload as a key factor that influenced the pharmacy's intervention rate.

A separate analysis was performed on the individual pharmacist data. The logistic regression model was 65.8% successful in predicting whether a pharmacist would have a high intervention rate using four variables: average number of continuing professional development (CPD) hours completed per year; level of software training; clinical knowledge score; and professional attitude score. The pharmacists who completed more CPD hours per year and who had a higher clinical knowledge score, higher level of training and a more positive professional attitude tended to have higher intervention rates.

Conclusions

Use of the software, including its electronic prompts, significantly increased the documentation of clinical interventions by pharmacists. Professional development strategies and policies which foster improvements to pharmacy workload and pharmacist clinical knowledge can be expected to further improve pharmacists' clinical intervention rate, and therefore decrease the healthcare costs associated with DRPs.

Acknowledgement, disclaimer and declaration

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This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief, no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

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The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University.

Mackenzie Williams

Date

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Articles

Scientific Journals

Williams M, Peterson GM, Tenni P, Bindoff IK, Curtain C, Hughes J, et al. Drug-Related Problems Detected in Australian Community Pharmacies: The PROMiSe Trial. *Annals of Pharmacotherapy* 2011; 45(9):1067-76. DOI: 10.1345/aph.1Q138

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Statement of Co-Authorship

The following people and institutions contributed to the publication of the work undertaken as part of this thesis:

Paper 1: Drug-related problems detected in Australian community pharmacies: The PROMISE trial. *M Williams (40%), G Peterson (10%), P Tenni (10%), I Bindoff (10%), C Curtain (5%), J Hughes (5%), L Bereznicki (5%), S Jackson (5%), D Kong (5%), JD Hughes (5%)*

Paper 2: DOCUMENT: A system for classifying drug-related problems in community pharmacy. *M Williams (40%), G Peterson (20%), P Tenni (20%), I Bindoff (10%), A Stafford (10%)*

Paper 3: A clinical knowledge measurement tool to assess the ability of community pharmacists to detect drug-related problems. *M Williams (70%), G Peterson (10%), P Tenni (10%), I Bindoff (10%)*

Details of the Authors roles:

Professor G Peterson instigated and designed the study (and its previous iterations), contributed to analysis of the data and reviewed the written articles prior to publication.

Dr P Tenni instigated and designed the study (and its previous iterations and contributed to analysis of the data.

Dr I Bindoff was involved in the data analysis stage and reviewed the written articles prior to publication.

C Curtain and J Hughes assisted with the design and administration of the study.

Dr L Bereznicki, Dr S Jackson, Dr D Kong and Professor JD Hughes assisted with the design of the study.

A Stafford assisted with data analysis and reviewed the article prior to publication.

We the undersigned agree with the above stated “proportion of work undertaken” for each of the above published (or submitted) peer-reviewed manuscripts contributing to this thesis:

Signed: _____

Ivan Bindoff

Supervisor

School Of Pharmacy

University of Tasmania

Gregory Peterson

Head of School

School of Pharmacy

University of Tasmania

Date: _____

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Abbreviations

AACP	Australian Association of Consultant Pharmacy (refers to a member of the society)
AACPA	A pharmacist accredited by the AACP to perform medication reviews
ABS	Australian Bureau of Statistics
ACF	Aged care facility
ACPPM	Australian College of Pharmacy Practice and Management
ADE	Adverse drug event
ADR	Adverse drug reaction
ANOVA	Analysis of variance
APESMA	Association of Professional Engineers Scientists and Managers Australia
Asst	Assistant
ATC	Anatomical Therapeutical Chemical (classification system)
BMD	Bone mineral density
CAC	Care activity codes
CDSS	Clinical decision support systems
CE	Continuing education
CGA	Computer generated alert
CI or CIs	Clinical intervention(s)
CME	Continuing medical education
CMI	Consumer medicines information
CPA	Community pharmacy agreement
CPD	Continuing professional development
DAA	Dose administration aid
DDI	Drug-drug interaction
DMAS	Diabetes Management Assistance Service
DOCUMENT	DOCUMENT DRP classification system
DRP	Drug-related problem
FTE	Full-time equivalent
F2F	Face-to-face (training)
GP	General practitioner
HMR	Home medication review
MD	Macular degeneration
MUR	Medication use review
NPS	National Prescribing Service

NSAID	Non-steroidal anti-inflammatory drug
NSW	New South Wales
OR	Odds ratio
OTC	Over the counter (does not require a prescription)
PAMS	Pharmacy Asthma Management Service
PBS	Pharmaceutical Benefits Scheme
PCNE	Pharmaceutical Care Network Europe
PGA	Pharmacy Guild of Australia
PhARIA	Pharmacy Access/Remoteness Index of Australia
PMP	Patient Medication Profile program
POS	Point-of-sale
PPI	Proton pump inhibitor
PROMISe	Pharmacy Recording Of Incidents and Services electronic documentation system
PSA	Pharmaceutical Society of Australia
QCPP	Quality Care Pharmacy Program
QUM	Quality use of medicines
Rx	Prescription (short-hand)
SHPA	Society of Hospital Pharmacists of Australia
SN	Safety Net (cards)
Std. Dev.	Standard deviation
Std. Error	Standard error of the mean
UK	United Kingdom
US or USA	United States of America
25 th %ile	25 th percentile
75 th %ile	75 th percentile
95% CI	95% Confidence interval

1 Chapter 1: Introduction

Within today's healthcare system, the use of medications or drugs form an essential part of the treatment plan for many chronic and acute medical conditions. However, the use of medications also carries the risk of experiencing an effect that was not intended, and these risks must be weighed up against the potential benefit that the patient will receive. These unwanted effects, as well as other issues with drug therapy, are often termed drug-related problems.

1.1 Drug-related problems

A drug-related problem (DRP) is broadly defined in the literature as '*an event or circumstance involving drug treatment that actually or potentially interferes with the patient experiencing an optimum outcome of medical care*'¹, and can be broadly related to errors (in prescribing and dispensing), adverse events, or adherence issues.²⁻⁴ As noted in the definition, DRPs can be *actual*, for example when the patient taking the drug is exhibiting a known adverse event, or *potential*, such as when the patient is at increased risk of a known adverse event. The definition of a DRP is therefore more encompassing than that of an adverse drug reaction/event (ADR/ADE), which the World Health Organisation defines as '*any response to a medication that is noxious, unintended and occurs at doses used for prophylaxis, diagnosis or therapy*'⁵ and therefore tends to only include the *actual* DRPs without identifying the *potential* DRPs.

1.1.1 Incidence and types of DRPs

Many studies have looked at the incidence of DRPs within both the hospital and community environment, and have attempted to quantify the expense of these DRPs, often through the extent of hospitalisation. As mentioned in the previous section, DRPs are usually referred to as ADRs or ADEs once the patient is experiencing the unwanted effects and has been hospitalised. Preventability of the ADRs is also often reported, with many being possibly prevented through adequate medication checking and patient education.

The elderly have in particular been identified as being at an increased risk of DRPs due to a combination of physiological decline (such as reduced renal and hepatic function), co-morbidities (leading to a higher incidence of drug-disease and drug-drug interactions, as well as polypharmacy), and adherence problems (often due to frailty, decreased dexterity and memory problems).⁶ Several studies have also identified that patients experiencing a

DRP are more likely to be taking a greater number of medications^{2,7}, and the elderly are often over-represented in the number of medication-related hospital admissions.^{2,8} In addition, many of the highest risk medications which are most commonly associated with DRPs (see section 1.1.2) are frequently used in the elderly, thereby greatly increasing the risk.⁶

1.1.1.1 International perspective

Internationally, ADRs are listed as a frequent cause of morbidity, hospital admission and mortality, with studies reporting anywhere between 0.4% up to 15% of admissions to medical inpatient services resulting from DRPs.^{2,3,9-14} In 1994, a US study estimated that adverse drug reactions (ADRs) were the sixth leading cause of death in the USA after heart disease, cancer, stroke, pulmonary disease and accidents, but ahead of pneumonia and diabetes^{15,16}, and ADRs continue to be a large drain on the healthcare system. Furthermore, anywhere between 37% to 60% of these admissions were considered preventable.^{9,13}

A 1998 review of US-based studies showed that the incidence of ADRs resulting in hospital admission was 4.7% (95% CI = 3.1 – 6.2), with fatalities occurring in 0.13% (95% CI = 0.04 – 0.21) of cases.¹⁵ Another US study found that 21 of the 281 admissions to a medical intensive care unit over a 19-week study period were due to an adverse drug reaction, with 18 (85.7%) being deemed preventable and 4 (19.0%) ending in patient death.¹² Another US study in a small 413-bed teaching hospital found that 290 admissions over the 3-year study period were due to ADRs, and 126 (43.5%) were deemed preventable.¹⁷ The most common causes of the ADR were overdose (85 or 67.5%, such as a documented toxic drug concentration or lab test), drug interaction (36 or 28.6%) and underdose (30 or 23.8%).¹⁷ A Dutch study found that out of 2238 acute admissions to hospital, 5.1% (95% CI = 4.3 – 6.1) were caused by an ADR, with 40% judged to be avoidable.¹⁸ A meta-analysis by Dutch researchers found that approximately 5% of all hospital admissions were drug-related, with the elderly being at the greatest risk of ADR-related admission, with up to 88% of these admissions deemed preventable.⁸ An English study found that 1225 admissions in 18820 patients were due to an ADR, with 72% deemed preventable.¹⁹ A study from Saudi Arabia identified that over a 28-day period, 14.7% of hospital admissions through the emergency department were due to or suspected to be caused by a drug-related problem, with 83% considered to be preventable.¹¹ The most common types of DRPs were failure to receive medication (47.2%), an adverse drug reaction (24.5%) and

drug overdose (11.3%).¹¹ Another study showed non-compliance as the most common cause of medication-related hospital admissions.¹⁴

Although these DRPs result in a hospital admission, they originate in ambulatory care patients within the community setting. A recent systematic review of the prevalence of ADEs in ambulatory care found 6 studies where the prevalence rates of ADEs ranged from 2.8% to 34.7% (median = 12.8%; IQR = 5.5 – 24.5).²⁰ Interestingly, the median ADE prevalence rate for two retrospective studies was 4.15% (range = 2.8 – 5.5%) versus 20.1% (IQR = 9.9 – 34.7) in the four prospective studies²⁰, perhaps indicating that retrospective studies do not capture all ADE cases. Four of these studies included data on preventable ADEs which ranged from 11% to 27.5% (median = 16.5%; IQR 12.0 – 23.8).²⁰ A US study showed that 25% of ambulatory care patients (95% CI = 20 – 29) had experienced an ADE with approximately 39% thought to be preventable. The preventable ADEs tended to be related to the central nervous system (33%), gastrointestinal events (22%), and cardiovascular events (18%), and were caused by selection of an inappropriate drug (45%), incorrect dose (10%) and incorrect frequency of use (10%).⁷

1.1.1.2 Australian perspective

As in other countries, DRPs in Australia are a major burden on the healthcare system, with many resulting in admission to hospital or visits to general practitioners (GPs) each year. In 2002, it was reported that more than 140,000 Australians were hospitalised every year as a result of DRPs, and approximately 50% of these DRPs were potentially preventable.²¹ In 2008, Roughead et al. reviewed the available literature regarding drug-related hospital admissions in Australia, identifying nine studies which found that 2-3% of all hospital admissions were reported to be medication-related and 75% of these were potentially preventable.⁴ The elderly were again identified as being most susceptible, with the number of unplanned medication-related hospital admissions rising from the average of 2-3% to greater than 30% in patients aged 75 years and older.²² ADRs tended to be the most common cause of medication-related admission, but undertreatment was also identified as a major contributor.²³

An Australian General Practice study published in 2006 estimated that 10.4% of patients visiting their GP had experienced a DRP within the last six months, with GPs classifying 23.2% (95% CI = 17.4 – 29.15) as preventable.²⁴ Another Australian study reviewed case notes of 1000 ambulatory patients and identified that 902 (90%) of patients had a current drug-related problem.²⁵ The majority of patients were experiencing more than one DRP

with their current regimen, with 33.4% requiring additional therapeutic monitoring, 27% using an inappropriate medication, 25% using insufficient medication and 21% using the appropriate medication but at an incorrect dosage or frequency.²⁵ Only 19% of patients were experiencing an ADR, highlighting the number of DRPs that could be occurring without patients experiencing any symptoms (*potential* DRPs).²⁵

1.1.2 Medications involved in DRPs

Internationally, a systematic review revealed that the majority (51%) of all *preventable* drug-related hospital admissions involved antiplatelets (16%), diuretics (16%), non-steroidal anti-inflammatory agents (NSAIDs; 11%) or anticoagulants (8%).¹⁰ The reasons for the occurrence of the DRP was also detailed, with admissions being caused by adverse drug reactions or overtreatment, undertreatment and poor patient adherence issues.¹⁰ Adverse drug reactions and overtreatment were most commonly associated with antiplatelets, diuretics and NSAIDs; undertreatment problems with antiepileptics; and patient adherence problems with diuretics, diabetic agents and antiepileptics.¹⁰ Another study found that insulin (19%), antiasthmatic agents (13%) and chemotherapeutic agents (11%) were the drugs most commonly associated with a medication-related admission.¹¹

Of the 126 preventable medication-related hospital admissions found in a US study, warfarin (37.3%) and anticonvulsants (19.8%) were found to be the most commonly implicated medications, with cardiac agents and NSAIDs also commonly implicated.¹⁷ Inpatient ADRs were also identified, with opiates (24.3%) and antibiotics (24.3%) being the most commonly implicated medications. A separate US study detailing the adverse drug reactions requiring admission to a medical intensive care unit found that aspirin was the most commonly implicated medication, being identified as the cause of 28.6% of medication-related admissions.¹² A systematic analysis of 11 years of US data showed that the drugs most frequently associated with an ADE were antimicrobials (14.0%; 95% CI = 12.0 – 16.4), hormones and synthetic substitutes (11.4%; 95% CI = 9.2 – 14.0), and cardiovascular agents (10.9%; 95% CI = 8.7 – 13.3), whereas cardiac glycosides (12.8%; 95% CI = 8.6 – 18.6), anticoagulants (11.2%; 95% CI = 7.5 – 16.3), anticonvulsants (7.0%; 95% CI = 4.4 – 11.1), and antineoplastics (6.5%; 95% CI = 3.7 – 11.2) were the most common drugs associated with medication-related hospital admissions.²

In the community setting, a systematic review of studies in ambulatory care patients found that cardiovascular, anti-infective and analgesic drugs were most commonly associated with ADEs.²⁰ A US study in ambulatory care patients found that selective

serotonin reuptake inhibitors, antihypertensives and NSAIDs had the highest number of ADRs recorded.⁷ When the numbers of prescriptions were taken into account, corticosteroids, non-narcotic analgesics and penicillins had the highest rate of ADRs.⁷ Interestingly, the highest rates of preventable or modifiable ADRs occurred with selective serotonin reuptake inhibitors, calcium channel blockers and NSAIDs.⁷

Within Australia, similar classes of medications are involved in the DRPs causing hospital admission. Anticoagulants, NSAIDs and cardiovascular drugs (including antihypertensives, diuretics, vasodilators and cardiac glycosides), antineoplastics, hypoglycaemic agents and opioids are mentioned as the most common drugs to be associated with a medication-related hospital admission.²² An Australian study in Western Australia found that the drug categories that were most commonly associated with medication-related admissions were cardiovascular agents (17.5%), analgesics (including NSAIDs; 16.5%), anticoagulants/antiplatelets (9.0%), and antibiotics (9.0%).²⁶ However, the authors noted that these were the most extreme cases of ADRs due to the incident requiring hospitalisation, and that other medications may be associated with ADRs in an ambulatory care setting. In a study in the community setting, cardiovascular (26.3%), nervous system (17.9%), alimentary tract (13.9%) and respiratory system (10.9%) medications were the most commonly implicated in DRPs experienced by ambulatory care patients.²⁵

1.1.3 Cost of DRPs

A study in the USA estimated that for every dollar spent on prescription medications, another dollar is spent on problems relating to their use.²⁷ In Australia, a 2003 study estimated that approximately 1% of health expenditure was related to ADEs,²² and as health expenditure continues to increase annually with an aging population, the amount spent on ADEs is also likely to increase. In 2009/10, the Australian Government listed 8.5 million hospital admissions throughout Australia, with the average cost of each hospitalisation estimated to be \$4133 for an average stay of 3.6 days.²⁸ If 2-3% of all hospital admissions in Australia were due to DRPs⁴, this equates to 170,000-255,000 hospital admissions per year, with nearly 75% (or 127,500-191,250) identified as being preventable.⁴ Therefore, the detection and resolution of DRPs within the community before hospital admission is necessary has the potential to save an estimated \$526 to \$790 million to the Australian healthcare system annually.

1.2 *Role of the pharmacist*

There has been considerable interest in interventions that may result in early detection and prevention of DRPs before hospital attendance or admission is necessary, thereby decreasing the associated morbidity and mortality. Many of the DRPs occur in patients who may not visit a GP or are not aware that their symptoms may be indicative of a DRP, therefore the community pharmacy may be their first contact with a health professional.²⁹

Community pharmacists are well-respected, highly-trained, and accessible health professionals, making them ideally situated to detect, prevent, and resolve DRPs in the community setting during the course of routine dispensing and counselling.³⁰ The process of a pharmacist identifying and preventing or resolving a DRP can be termed a clinical intervention. For the purposes of this project, a clinical intervention by a pharmacist was defined as *‘any professional activity by the pharmacist directed towards improving the quality use of medicines and resulting in a recommendation for a change in the patient’s medication therapy, means of administration or medication-taking behaviour’*.

Interventions can also be classified into a further two groups, reactive and proactive. Reactive interventions require the pharmacist to resolve the DRP before the dispensing process can continue, and often involve DRPs relating to drug selection, drug interactions, and inappropriate doses. Proactive interventions generally occur during the interaction with a patient and require the pharmacist to be ‘proactive’ to detect the DRPs. Proactive interventions often involve DRPs relating to undertreatment or toxicity.

1.2.1 *Routine pharmacy services*

Currently, community pharmacists detect and resolve DRPs during the course of their routine prescription-related activities. The Pharmaceutical Defence Limited’s Guide to Good Dispensing³¹ details the steps involved in the dispensing process:

- Prescription check
- Computer input
- Drug selection
- Labelling
- Label check
- Assembling prescription
- Patient collects the prescription
- Final check

These steps aim to avoid prescription errors, both from the prescriber and from the pharmacist, and potential DRPs can be detected during various stages of the dispensing process (Figure 1-1).

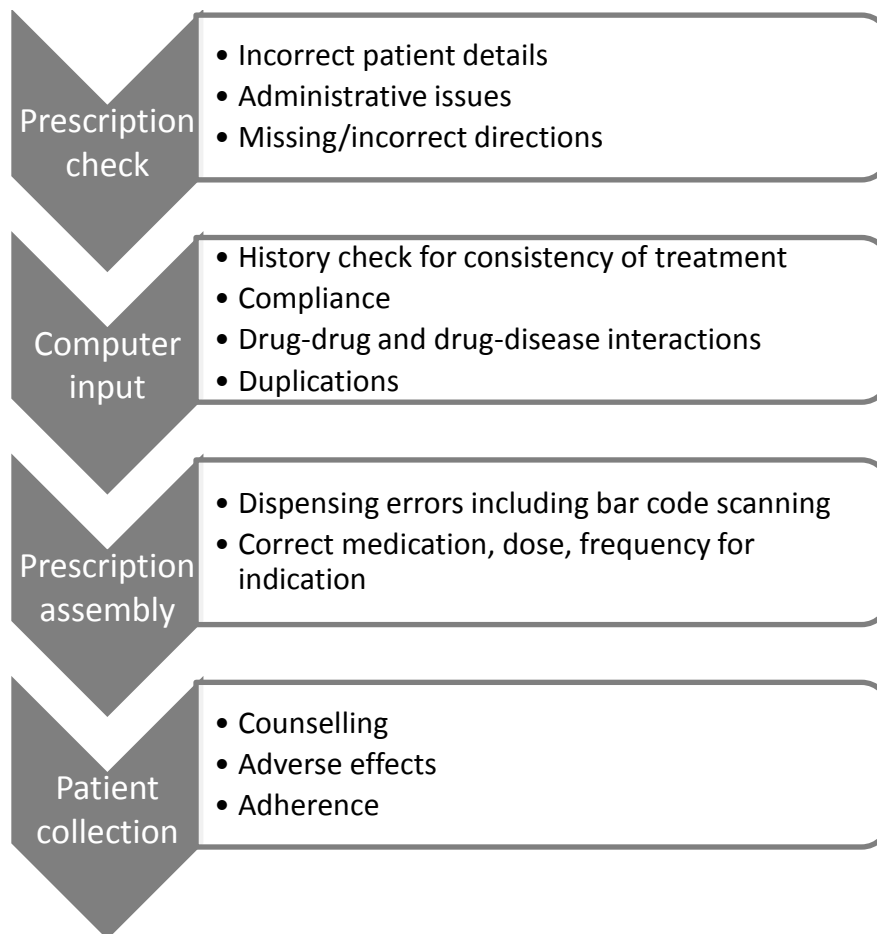


Figure 1-1: Stage of dispensing process and common DRPs identified during each stage

These basic dispensing activities often provide sufficient information to demonstrate the presence of an actual or potential DRP. The combination of the patient's dispensing history of previous prescriptions and the interaction of the pharmacist with the patient will often provide sufficient information on which to assess the presence of a DRP. Some DRPs will be evident purely from the physician's prescription (such as drug interactions and incorrect doses), while others require information from the patient (such as compliance problems and adverse effects).³²⁻³⁴

1.2.2 Additional professional services

In addition to routine dispensing practices, a broader range of strategies to reduce DRPs have also been employed within community pharmacy. These strategies are based on the

introduction of an expanded service model, where pharmacists (who have often undergone additional training) conduct a formal review of a patient's medications, or carry out other professional services as an *extension* of their normal daily dispensing activities. These additional processes and services increase the information available to the pharmacist concerning the patient and thereby, present increased opportunities to detect DRPs. For example, dispensing a prescription for an antihypertensive agent may appear to be correct, however measuring the patient's blood pressure within the pharmacy can determine if the therapy is effective and may detect a *DRP*, such as undertreatment, that would not have been visible to the pharmacist without this additional service. Provision of these additional professional activities is an extension of the pharmacist's traditional dispensing and counselling roles and it is likely that these expanded activities will increase the number of DRPs detected and resolved.

1.2.3 Examples of the expanded service model

DRPs can arise in all phases of the medicines management cycle, from the initial decision to prescribe a medication to the desired outcome being achieved (Figure 1-2), and as a result, strategies to reduce DRPs can target particular aspects of the cycle.

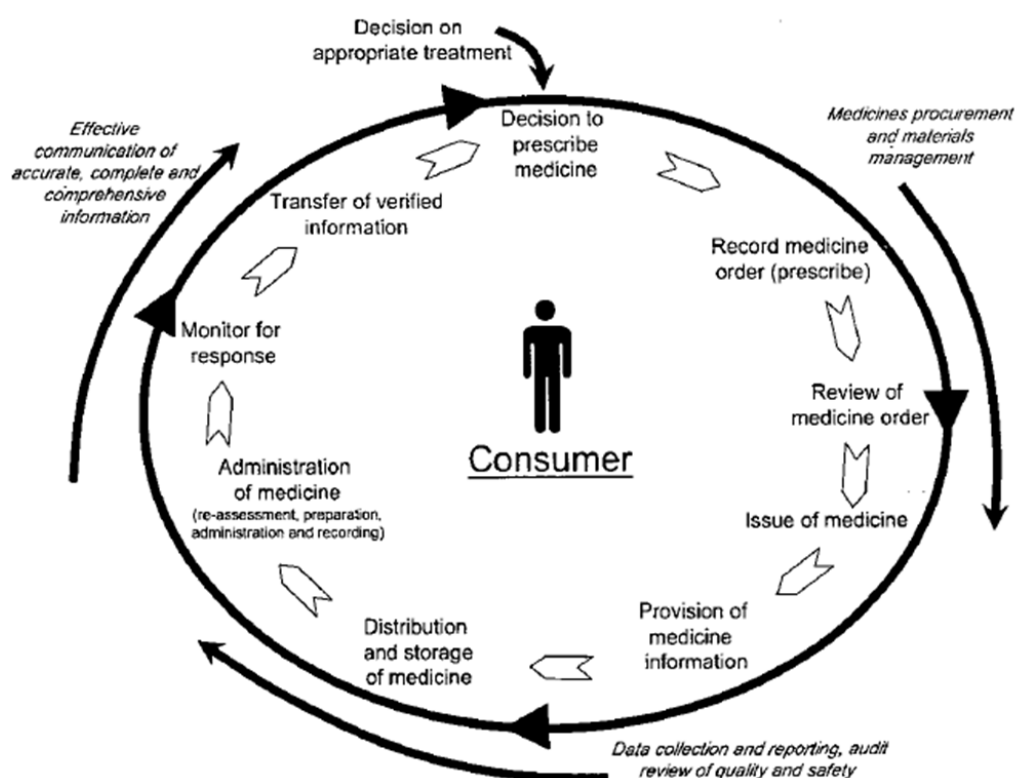


Figure 1-2: The medicines management cycle (Stowasser et al.³⁵)

Clinical pharmacy services within the hospital environment have consistently shown to lead to the detection and resolution of DRPs, and therefore have the potential to substantially reduce healthcare costs.^{36,37} This success led to the implementation of similar services for high risk community patients. Pharmacy-based services and activities that reduce DRPs have become an accepted part of the drug-related management of patients in both hospital and community settings. Many of the services involve ongoing review of the appropriateness, effectiveness and potential adverse effects of medications. As such, the involvement of pharmacists in the management of medications in various clinical settings is an established and important component of reducing DRPs. Within the community environment, pharmacists are involved in most of the steps of the medicines management cycle and there are already many strategies in place to decrease the number of DRPs.

1.2.3.1 Clinical decision support systems (CDSS)

CDSS helps prescribers and pharmacists improve drug selection errors, and therefore act within the medicine order and issue part of the medicines management cycle. CDSS mainly include drug interaction alerts that warn the prescriber and dispensing pharmacist of hazardous combinations^{38,39}, but options for additional CDSS could also improve therapeutic management for the patient. For example, CDSS can be used in the prescribing software to ensure the recommended medication is prescribed for specific conditions, such as a specific antibiotic being recommended when the prescriber selects a specific infection. In the pharmacy environment, CDSS can be used to provide alerts for recommended medications for particular conditions (for example, encouraging the use of vitamin D and calcium supplements in a patient using long-term corticosteroids) or recommending interventions that pharmacists could perform based on the patient's medication history (for example, discussing a dose decrease for a patient on a high-dose proton-pump inhibitor).⁴⁰

1.2.3.2 Computerisation

Computerisation is commonplace within both the prescribing and dispensing area, and again acts within the medicine order and issue part of the medicines management cycle. The use of computer-generated prescriptions is intended to reduce errors associated with poor handwriting.⁴¹⁻⁴⁷ This was shown by Whitehead et al., where a comparison of pharmacist interventions with handwritten and computerised prescriptions in Western Australian community pharmacies indicated a reduction of “administrative” prescribing

interventions associated with wrong package sizes or specification of dose.⁴⁸ Additional computerisation through the use of bar-code scanners to “double-check” against the prescription has also assisted in reducing human error rate⁴⁹, therefore decreasing the number of selection errors that occur in the pharmacy environment. As detailed above, computerisation has also allowed CDSS such as drug interaction alerts to become commonplace within both the prescribing and dispensing environments.

1.2.3.3 Professional services within the pharmacy

In addition to technological advances that have improved the prescribing and dispensing process, a number of professional services are now offered within the community pharmacy environment within Australia.

Consumer medicines information (CMI)

CMI are leaflets providing information about a medication, such as its use, dose and side-effects. The leaflets are created by the pharmaceutical companies that manufacture the medication and are worded in a way so that the general population can understand. The introduction of CMI into the pharmacy environment aimed to improve the medication and medical condition knowledge of consumers (or patients) within Australia, however there is a lack of data detailing consumer knowledge decreasing the risk of DRPs.

Pharmacies are encouraged to offer a CMI with every dispensed prescription and are compensated for the CMI that they print. The law in several States of Australia also details specific medications, such as isotretinoin, where a CMI must be provided to the patient on a regular basis due to the severe adverse effects. The provision of CMI aims to improve the patient’s understanding of their medications and therefore, most likely improve their compliance. Most CMI are also available online for all consumers to access.⁵⁰

Home medication reviews (HMRs)

A Home Medication Review (HMR) is where an accredited pharmacist interviews the patient about their understanding of their medications and medical conditions, either within their own home or within their local pharmacy, and forwards a report of recommendations to the patient’s GP.⁵¹ HMRs increase the amount of information provided to the patient with regards to their medication, therefore also aiming to improve the patient’s compliance with their therapies. HMRs can also improve the distribution and storage of medications, especially if the interview takes place within the patient’s home.

Medicines use review (MUR)

MURs are a new concept that is currently being trialled by the Australian Government. Essentially, a pharmacist undertaking a MUR completes a similar process of a HMR, where the pharmacist determines the patients' understanding of their medications and medical conditions, with the exception that it is undertaken within the pharmacy and the pharmacist creates a handout for the patient with no specific report for the GP.⁵² Simple measures such as this could increase the patient's understanding of their medications and therefore improve compliance. MURs have been available in the United Kingdom for several years, with the UK National Health Service⁵³ recommending MURs as a routine part of helping older consumers manage their medication.

Dose administration aids (DAAs)

Dose administration aids provide patients with their medications pre-packed on the correct day at the correct time of day. Patients usually receive one week's worth of medication at a time and the most common system used by pharmacies is Webstercare^{®54}, where the pharmacy packs and provides the medication in a sealed blister pack. Alternatively, patients can also take responsibility for their own medications and pack a dosette box (a small plastic box of varying sizes) by themselves. The use of dose administration aids (including both compartmentalised box and blister pack devices) in high risk patients has been shown to improve compliance with medications and reduce error rates during medication administration.⁵⁵ Within Australia, war veterans are eligible to receive this packing service for free⁵⁶, and for many patients, it takes a lot of confusion out of their medication management.

Disease management programs

Many pharmacies offer disease management programs, ranging from simple blood pressure monitoring to more complex diabetes and cholesterol management. The interaction with the patients aims to help them understand their medications and the monitoring required for their disease, therefore aiming to improve the management of several chronic diseases.

Summary of professional services

Professional services aim to improve patient understanding and compliance, as well as improve therapeutic management of the patient, and therefore act within the medicine order, distribution, administration and transfer of information parts of the medicines management cycle. Detecting DRPs is another professional service provided by

pharmacists within the community pharmacy environment, but its importance is often overlooked.

1.2.4 Process of identifying a DRP

Within community pharmacy, there are several aspects to the identification of a DRP, which may or may not lead to an intervention. For example, a pharmacist may identify a potential DRP, but further discussion with the patient resolves the DRP and an intervention is not required. An example of this may be the patient presenting a new prescription for a higher strength of irbesartan, but the pharmacist confirms with the patient that their blood pressure was elevated, therefore their GP increased their irbesartan dose. Alternatively, the pharmacist may ask the patient about the higher strength of irbesartan, which the patient was not expecting, leading to the pharmacist undertaking an intervention, such as contacting the GP, to determine if the change was intentional. In another example, a DRP may be present, but the pharmacist does not recognise it, perhaps due to a lack of knowledge or a lack of time, therefore an intervention does not occur. There are therefore several factors in the process of identifying a clinical intervention and the process leading to an intervention can be seen in Figure 1-3.

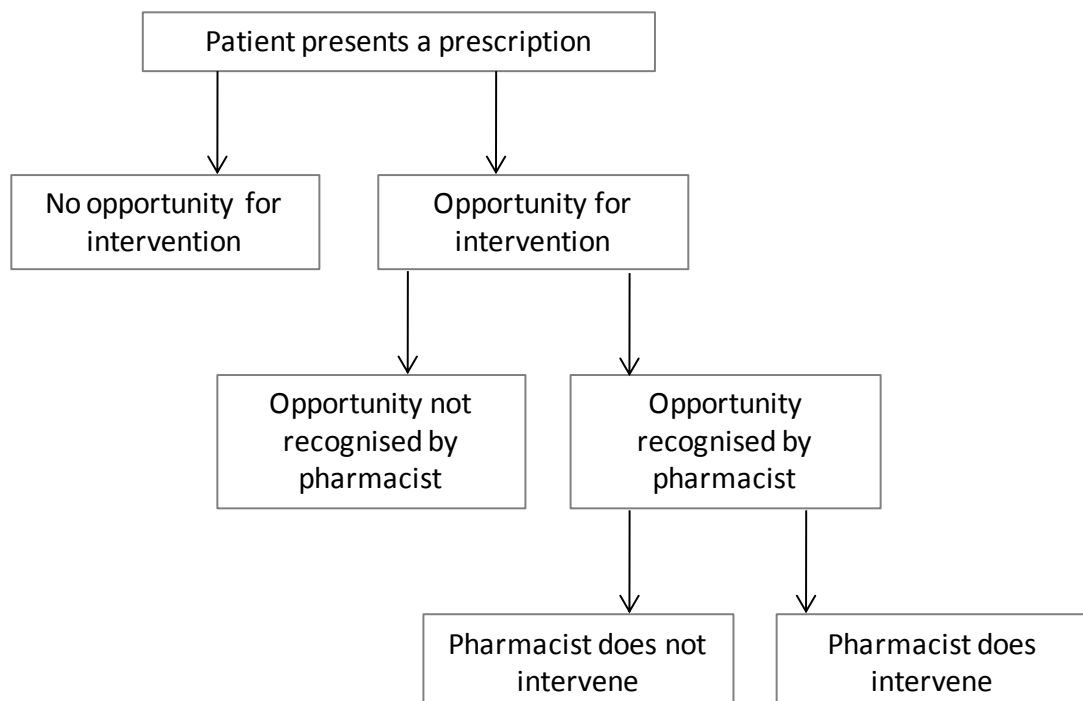


Figure 1-3: The process leading to an intervention

1.3 Community pharmacists and clinical interventions: a review of previous literature

As stated in section 1.1, the term DRP can be considered a description for situations where a drug's desired outcome is actually or potentially interfered with and is broadly related to errors, adverse events or adherence issues. As stated in section 1.2, the detection and resolution of these DRPs is termed a clinical intervention. Many studies use definitions of interventions that vary from this or specifically address prescription errors, and consequently, comparisons between studies are difficult. In addition, many of the studies are international and as community pharmacy practice differs between each country, the intervention studies also differ. Interpretation and comparisons between studies is further complicated by the use of different methodologies for the collection of the information.

In the following section, available international and Australian studies of the role of the community pharmacist in detecting and resolving DRPs are reviewed. The studies are summarised in Table 1-1 and have been further examined in the following paragraphs. Many of the studies focus on identification of problems detected directly from the prescription and therefore only report on a proportion of possible DRPs. Although using the term "clinical" interventions or DRPs, many of the studies report on interventions relating to correction of prescriptions due to administrative or legislative requirements (for example missing or incorrect patient details) which would not usually be considered clinical in nature. Therefore, where possible, a clinical intervention frequency has been re-calculated by examining the definitions used for the events documented. These clinical intervention frequencies are a more relevant method of comparison between the studies, due to the differences in definitions. The literature selected has been limited to that which involves community pharmacists' detection and resolution of DRPs in their routine daily activities, and articles that report on interventions associated with enhanced service provision models have not been included.

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Rupp, 1988 ⁵⁷	9 community pharmacies in Indiana, USA	Intern pharmacist recorded prescription errors resolved by themselves and their preceptor over 2 weeks	Anything that requires a pharmacist to interrupt their routine dispensing activities to resolve	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Prescription error report form completed by an intern pharmacist	192 interventions from 5874 prescriptions (3.27%) 95 CIs from 5874 prescriptions (1.62%)
Rupp, 1992 ⁵⁸	89 pharmacies in 5 states of the USA	Recording of interventions by an observer for 5 days	Any prescription related problem that required pharmacists to interrupt their routine dispensing activities	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based "Pharmacy Intervention Record"	683 interventions from 33,011 prescriptions (2.07%) 371 CIs from 33,011 prescriptions (1.12%)
Rogers, 1994 ⁵⁹	28 community pharmacies in the United Kingdom	Prospective recording by dispensing pharmacists for 18 months	Not stated, but included definitions of 10 categories of recordable events	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based intervention recording form	1862 interventions (denominator not reported) 1646 CIs (denominator not reported)
Dobie, 1994 ⁶⁰	4 community pharmacies in Texas, USA	Prospective recording by dispensing pharmacists for 1500 consecutive new prescriptions	Not stated, but used other techniques from Rupp ^{57,58}	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based "Pharmacy Intervention Record"	60 interventions from 6000 new prescriptions (1.00%) 34 CIs from 6000 new prescriptions (0.57%)
Irvine-Meek, 1994 ⁶¹	21 community pharmacies in New Brunswick, Canada	Prospective recording for 10 consecutive weeks	Not stated	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based "standard forms"	555 interventions from ~176,650 prescriptions (~0.31%) 199 CIs from ~176,650 prescriptions (~0.11%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Greene, 1995 ^{62,63}	23 community pharmacies in West London	Prospective self-reporting over 4 months	All possible medication and prescription related problems that might be encountered by a community pharmacist, including those arising from OTC medications.	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Incident report forms	174 incidents from 281,900 prescriptions (0.06%) 166 CIs from 181,100 prescriptions in actively participating pharmacies (0.09%)
Claesson, 1995 ⁶⁴	36 community and hospital discharge pharmacies in Sweden	Prospective recording by dispensing pharmacist for 2 weeks	Errors which, in the opinion of the dispensing pharmacist, called for an intervention	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based intervention recording form	2176 errors requiring intervention from 76,956 prescriptions (2.83%) 255 CIs from 76,956 prescriptions (0.33%)
Poston, 1995 ⁶⁵	527 pharmacies in Canada	Prospective recording by 1360 dispensing pharmacists for 2 weeks	All interventions that led to a check or change in drug therapy during the screening, dispensing and monitoring process for new and repeat prescriptions	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper-based interventions recording form	8933 interventions in ~619,164 prescriptions (~1.44%) 5467 CIs in ~619,164 prescriptions(~0.88%)
Smith, 1996 ⁶⁶	9 small hospitals and 9 health centres in 3 states of the USA	Prospective recording by dispensing pharmacists for 6 months	"Cognitive service interventions" divided into 4 broad categories (incorrect information, inappropriate drug, clinical problems and prescription clarification)	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper form or computerised quality assurance system (Resource Patient Management System)	1446 interventions (0.6%) (denominator not reported but calculated as ~241,000) 873 CIs from ~241,000 prescriptions (0.36%)
Caleo, 1996 ^{32,33}	29 community pharmacies in 3 States of Australia	Prospective recording of interventions for 4 weeks	Any change effected by a pharmacist to a PBS prescription item and/or contact with a health professional concerning a PBS prescription item	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based intervention recording form	1273 interventions from 89,326 prescriptions (1.43%) 258 CIs from 89,326 prescriptions (0.29%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Hulls, 1996 ⁶⁷	25 community pharmacies in New Zealand	Prospective recording by dispensing pharmacists for 2 weeks	Any action taken to clarify or change a prescription to optimise the patient's drug therapy and/or minimise the risk of harmful effects	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based "Pharmacy Intervention Form" modified from Rupp's study ^{57,58}	357 interventions from 19,581 new prescriptions (1.82%) 154 CIs from 19,581 new prescriptions (0.79%)
Knapp, 1998 ²⁷	31 community pharmacies in California	Retrospective analysis of all interventions for 1 year (1995)	Presumed Rupp definition ⁵⁸ with actions and outcomes also documented	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based "Pharmacy Intervention Form" modified from Rupp's work ^{57,58}	688 DRPs from 93,483 prescriptions (0.74%) 276 CIs from 93,483 prescriptions (0.30%)
Westerlund, 1999 ⁶⁸	144 pharmacists, prescriptionists and pharmacy technicians from 128 different pharmacies in Sweden	Prospective recording on alternate days, half a day at a time, for 2 months	A broad definition of DRPs- "A circumstance of drug therapy that may interfere with a desired therapeutic objective"	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Data collection form designed as a postcard	1098 DRPs from 82,200 prescriptions (1.34%); required 1469 interventions to resolve 964 prescription DRPs from 82,200 prescriptions (1.17%)
Hawthornthwaite, 1999 ⁶⁹	14 community pharmacies in England	Prospective recording by dispensing pharmacists for 1 week of each month for 1 year	Where the prescribed item could have been dispensed without contact with the prescriber – "proactive" interventions	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Not stated	Only CIs appeared to be recorded; 1503 CIs from 201,000 prescriptions (0.75%)
Van Mil, 2001 ⁷⁰	17 community pharmacies in the Netherlands	Prospective recording by dispensing pharmacists for 4 weeks	Pharmaceutical services (care activities) that resulted from computer generated alerts	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Computerised recording of care activity codes (CACs) in the medication history	12,487 CACs from 134,132 prescriptions (9.31%) 3606 CIs from 134,132 prescriptions (2.69%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Buurma, 2001 ^{71,72}	141 Dutch community pharmacies	Prospective case-control study, data collected on 1 nominated day	Prescriptions requiring modification, excluding minor administrative aspects	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper "registration form"	2014 modifications from 47,374 prescriptions (including prescribed 'non-medicines') (4.25%) 400 CIs for 36,625 prescription only medicine prescriptions (1.09%)
Westein, 2001 ⁷³	23 community pharmacies in the Zeeland region of the Netherlands	Case control study of patients - controls and interventions recorded by dispensing pharmacists for 1 week	Any action taken by a pharmacist that led to clarification or change of a prescription	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Standardised intervention log forms	337 interventions from 39,357 prescriptions (0.86%) 255 CIs from 39,357 prescriptions (0.65%)
Whitehead, 2002 ⁴⁸	18 community pharmacies in Perth, Western Australia	Prospective recording by dispensing pharmacists for 4 weeks	Any actions taken that result in a change in the patient's therapy and/or the written prescription	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Prescription Intervention Form	222 interventions from 34,491 prescriptions (0.64%) 75 CIs from 34,491 prescriptions (0.22%)
Quinlan, 2002 ⁷⁴	34 community pharmacies in England	Prospective recording by dispensing pharmacists for 2 weeks	Not stated	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Royal Pharmaceutical Society's Intervention audit form	419 interventions from 60,525 prescription items (0.69%) 248 CIs from 60,525 prescriptions (0.41%)
Leemans, 2003 ⁷⁵	124 community pharmacists in Belgium	Prospective recording by dispensing pharmacists for 2 weeks	List of 16 technical and clinical interventions provided within the article.	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based form	3552 interventions from 87,647 prescriptions (4.05%); 1044 clinical interventions from 87,647 prescriptions (1.19%) 588 CIs from 87,647 prescriptions (0.67%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Andersson, 2003 ⁷⁶	20 pharmacies in Sweden	Prospective recording by dispensing pharmacists for 2 weeks	"A circumstance of drug therapy that may interfere with a desired therapeutic objective"- as per Westerlund et al. ⁶⁸	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Postcard sized data collection form as per Westerlund et al. ⁶⁸	1465 DRPs from ~104,000 prescriptions and OTC sales (1.41%) 637 CIs from 63,929 prescriptions (1.00%)
Benrimoj, 2003 ³⁴	40 community pharmacies in Sydney, Australia	Prospective recording by dispensing pharmacists for 1 week, followed by 2 weeks of recording after an education program	Definitions for 19 different clinical interventions provided. Interventions further categorised as proactive (could be dispensed without further contact with the prescriber or patient) or reactive (could not be dispensed without further contact)	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Intervention documentation form	762 interventions from 87,130 prescriptions (0.87%) 375 proactive interventions from 87,130 prescriptions (0.43%)
Chen, 2005 ⁷⁷	9 community pharmacies in Nottingham, England	Prospective recording by dispensing pharmacists for 1 month	Any problems identified in the process of dispensing that might: 1) interfere with the dispensing of prescriptions, or 2) be potentially harmful to patients	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper based intervention recording form	196 prescribing problems from 32,403 items dispensed (0.60%) 93 CIs from 32,403 items (0.29%)
Hämmerlein, 2007 ⁷⁸	1146 community pharmacies in Germany	Prospective recording by dispensing pharmacists for 1 week (NB:- Pharmacies were allowed to choose which week they would record the DRPs)	An event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes. Definitions for 10 DRP types (with a total of 72 subtypes) were identified.	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Standardised paper form	10,427 interventions recorded from an estimated 1,833,600 prescriptions (actual number not reported) (0.57%) 6628 CIs from 1,833,600 prescriptions (0.36%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Krähenbühl, 2008 ⁷⁹	20 community pharmacies in the French-speaking part of Switzerland	Prospective recording by dispensing pharmacists for 4 weeks	An event or circumstance involving drug therapy that actually or potentially interferes with desired health outcomes. Definitions for 17 DRP types were identified and management of the intervention was also recorded.	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Computerised documentation system integrated into the dispensing software	736 technical interventions from 38,663 prescriptions (1.90%) 287 CIs from 38,663 prescriptions (0.74%)
Tenni, 2009 ^{80,81} (Previous PROMISE trial)	52 pharmacies in Melbourne, Australia	Prospective recording by dispensing pharmacists for 8 weeks	<i>Any professional activity by the pharmacist directed towards improving the quality use of medicines and resulting in a recommendation for a change in the patient's medication therapy, means of administration or medication-taking behaviour</i>	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Computerised documentation system integrated into the dispensing software	2385 CIs from 435,520 prescriptions (0.55%)
Warholak, 2009 ⁸²	68 chain pharmacies in five States of USA	Prospective recording of interventions on electronic prescriptions by dispensing pharmacists for 14 consecutive days	Any e-prescription problem that required a pharmacist to resolve	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper-based form submitted by fax or mail	113 interventions from 2690 e-prescriptions (4.20%) 51 CIs from 2690 prescriptions (1.90%)

Primary author and date of publication	Practice setting	Method and duration of recording period	Definition of documented intervention	Types of DRP recorded	Documentation method	Published frequency of DRPs and estimated/calculated clinical intervention (CI) frequency
Braund, 2010 ⁸³	20 pharmacies in Dunedin, New Zealand	Prospective recording by dispensing pharmacists for 1 week	Used an intervention grading system developed by the Pharmaceutical Society of New Zealand e.g. Grade 1 = legal aspects up to Grade 5/6 = prevented a serious threat to health such as an interaction	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper-based tally forms with data being entered by the researchers at the end of the trial	1551 interventions from 24,059 prescriptions (6.45%) 134 CIs from 24,059 prescriptions (0.56%)
Haavik, 2011 ⁸⁴	12 pharmacies in Norway	Prospective recording by dispensing pharmacists for 5 or 10 weeks	Not stated, but categories of interventions indicate any prescription errors were to be documented	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Paper-based form	2385 interventions from 85,475 prescriptions (2.79%) 405 CIs from 85,475 prescriptions (0.47%)
Sanchez, 2011 ⁸⁵	1 pharmacy in Madrid, Spain	Prospective recording by dispensing pharmacist at the end of each day for 6 months	Any problems identified in the process of dispensing that might: 1) interfere with the dispensing of prescriptions, or 2) be potentially harmful to patients	<input checked="" type="checkbox"/> Prescription Errors <input checked="" type="checkbox"/> Adverse Events <input checked="" type="checkbox"/> Adherence Issues	Computerised documentation system	355 interventions from 23,995 prescriptions (1.48%) 238 CIs from 23,995 prescriptions (0.99%)

Table 1-1: Summary of intervention studies in community pharmacy (adapted from Tenni⁸⁶)

1.3.1 Rupp et al. (United States of America)⁵⁷

Probably the earliest fully published study in the area of community pharmacists' interventions was conducted in Indiana in 1987 and published by Rupp et al. in 1988. For a two-week period, student pharmacists were asked to document any prescriber-generated problem that was identified by themselves or by their preceptor that required an active intervention by the pharmacist to correct or resolve. The intervention was documented on a 'Prescription Error Report Form' by the student pharmacist who may have been active in the resolution process, therefore this study would be considered an observational study, as the dispensing pharmacist did not have to disrupt their workflow to document the intervention. As pharmacists were often unaware of what constituted an intervention, the student pharmacists were given a list of scenarios that may require documentation on the reporting form, including scenarios where the pharmacist requires clarification from the prescriber, the pharmacist changes the prescription, the pharmacist consults drug information or literature, or the pharmacist gives verbal or written information to the patient beyond what is 'usual'.

During the study, 192 interventions (involving 153 prescription products) were identified from 5874 *new* prescriptions, resulting in an intervention rate of 3.27%. Deficiencies in the prescription (such as illegible and/or incomplete prescriptions, or prescriptions that violated legal requirements) were responsible for 97 of the 192 interventions and would not be considered a clinical intervention according to the definition in section 1.2. Therefore, the number of clinical interventions appeared to be 95, resulting in a clinical intervention rate of 1.62%. The most common errors were incorrect dose/regimen (30 or 3.16%) and the patient not understanding their regimen which required additional counselling (13 or 13.7%). The number of repeat prescriptions was not stated in the article; therefore, the frequency of errors with repeat prescriptions within this study remains unknown.

The time of day for each intervention was also noted, with a peak number recorded between 10-11am (22 interventions) and 4-5pm (23 interventions). No relationship was identified between the type of pharmacy (independent versus chain pharmacies) and the number of interventions performed. The majority of interventions occurred in female patients (64.7%) in the 19-65 year age group (60.1%).

Although over 20 years have passed since this study was conducted, this publication remains a landmark paper referred to by almost all authors in the area. The methodology was clearly presented and a number of authors have utilised some or all of the techniques in other studies, as seen in the following paragraphs. One of the most innovative aspects of Rupp's methodology was the use of observers to record the interventions, which meant that the pharmacists did not have any significant additional workload in terms of recording their activities.

Interestingly, the pilot study conducted to refine the reporting form recognised that pharmacists resolved prescription order problems so routinely that they did not recognise the resolution as an intervention. This problem was therefore first identified in 1988, yet the recognition of what constitutes an intervention has plagued several studies since. It also identified that pharmacists have poor access to the full medical profile of patients (such as accurate medical histories or test results), and that improved access may also help to identify and resolve errors within the community pharmacy environment. Rupp et al. also detailed that as the number of prescriptions increased, the number of prescription errors detected would also increase, but that there was most likely a theoretical 'cut-off point' where the dispensing workload became too high and detection rates may decrease. This discussion point was later proven by many different studies looking at intervention rates compared to workloads within the pharmacy.

1.3.2 Rupp et al. (USA)⁵⁸

The authors considered the range of pharmacies and pharmacists in the original study in 1988⁵⁷ to be limited, and used the techniques piloted to form the basis for a larger study which was conducted in 1990. The larger study involved the documentation of prescription problems by trained observers (final year pharmacy students) in 89 pharmacies in five states of the USA. Again, the observers were asked to record any prescription problem that required the pharmacist to interrupt their routine dispensing process in order to resolve it. The intervention information was collected using a 'Prescription Intervention Report' form, which included:

- general descriptive information about the prescription order, the prescriber and the patient,
- a narrative description of the pharmacist's intervention, including the reason for the intervention and the names of all drugs involved,

- a list of all prescription medications that the patient was taking at the time of the intervention,
- all sources of information that the pharmacist consulted during the intervention, and
- outcome(s) of the intervention and the final state of the prescription.

The observers also collected information about the pharmacy, pharmacists and workload statistics, such as dispensing volume.

These authors reported 683 interventions from 33,011 *new* prescriptions, resulting in a rate of 2.07%. More than one intervention could occur with each prescription; therefore, 623 prescriptions were associated with the 683 interventions. The number of repeat prescriptions dispensed was 20,930, however the number of interventions on repeat prescriptions was not specified, and therefore remained unknown. Of the 683 interventions, 312 (45.6%) related to omitted prescription information (such as incomplete or illegible prescriptions) and would therefore not be considered a clinical intervention under the definition in section 1.2. Therefore, 371 clinical interventions were recorded, resulting in an observed clinical intervention rate of 1.12%. The most common reasons for pharmacist intervention in these prescriptions were incorrect dose/regimen (142 or 38.3%), incorrect drug/indication (39 or 10.5%) and drug-drug interactions (30 or 8.08%). From the 681 drugs that were associated with the 683 interventions (some prescriptions required more than one intervention), the ones most commonly requiring a prescription intervention were anti-infectives (158 or 23.2%), dermatological drugs (75 or 11.0%), narcotic analgesics (55 or 8.1%) and hormones (36 or 5.3%). However, prescription volumes for these medications were not recorded, therefore the authors noted that it was unknown if the number of interventions were disproportionate to their relative prescription volume. Two independent evaluators agreed that the pharmacist's intervention avoided definite harm to the patient in 128 of the 623 prescriptions (20.6%).

There was no significant difference in intervention rates seen between chain and independently-owned pharmacies, resulting in the authors noting that a pharmacist's willingness and ability to intervene is more a function of the individual pharmacist in the store, rather than the store itself. Pharmacists at pharmacies with a 'low volume' of prescriptions (defined as less than 11.3 prescriptions per hour) had significantly higher intervention rates than pharmacists at pharmacies with a 'high volume' of prescriptions ($p < 0.05$), with the authors noting that pharmacists' willingness or ability to intervene decreases as the volume of dispensed prescriptions increases. The authors also noted the

possibility of selection bias within the pharmacists, as the pharmacists were all preceptors to the pharmacy student observers, and therefore may have been different from a 'typical' pharmacist in regards to willingness and motivation to participate.

1.3.3 *Rogers et al. (United Kingdom)*⁵⁹

In 1994, Rogers et al. published a study that involved reporting of clinical interventions by 28 pharmacies in the United Kingdom. Pharmacists were asked to record clinical interventions for 18 months, and return their paper-based intervention record forms every six weeks. Pharmacies provided records for 1862 clinical interventions (range = 1 – 473) during the data collection. The authors used an intervention collection form that included information on the type of intervention, the drugs involved (using the BNF classification system) and the type of patient (from a list of "at-risk" patient types, including asthmatics, CV disease, diabetics, elderly etc.). No clear definition of the events to be documented was given in the paper, but the types of clinical interventions reported indicate that the events were predominantly related to prescription modifications and errors. The category options can be seen in Table 1-2.

Category code	Number of events	Total %
Contraindicated prescribed drug	145	7.8
Contraindicated OTC drug	66	3.5
Emergency supply of prescription-only medicine	106	5.7
Drug interaction between two drugs on presented prescription	197	10.6
Drug interaction with a drug previously dispensed	278	14.9
Drug interaction with OTC medicine	35	1.9
Prescription error - incorrect drug on presented prescription	272	14.6
Prescription error - incorrect strength on presented prescription	366	19.7
Prescription error - incorrect dose on presented prescription	282	15.1
Prescription error - incomplete/incorrect patient details	110	5.9
Miscellaneous	5	0.3
Total	1862	100.0

Table 1-2: Intervention codes used and resulting frequencies found by Rogers et al.⁵⁹

Interventions involving a prescription error (incorrect strength, incorrect dose, incorrect drug or incorrect patient details) accounted for 55.3% (1030) of the interventions. A further 27.4% (510) were interventions relating to drug interactions, either with prescription or over the counter (OTC) medications (Table 1-2). There were no problems reported that related to adverse events or adherence/compliance issues. Interventions

involving emergency supply and incomplete/incorrect patient details would not be considered clinical under the definition in section 1.2, therefore removal of these 216 interventions would result in 1646 clinical interventions.

The 1862 interventions were associated with 2563 drugs, with multiple drugs being involved with some interventions. The most common drug groups involved in the interventions were cardiovascular system (657 or 25.6%), central nervous system (450 or 17.6%), infectious disease (347 or 13.5%) and respiratory system (319 or 12.5%). When the at-risk patient groups were examined, several frequent associations were found:

- Asthmatic patients (194 or 10.4%) were associated with a higher number of interventions involving contraindicated prescription products (44 from 145 or 30.3%) and emergency supplies (29 from 106 or 27.4%)
- Patients with cardiovascular disease (303 or 16.3%) were associated with a higher number of interventions involving contraindicated non-prescription products (17 from 66 or 25.8%) and drug interactions (94 from 510 or 18.4%)
- Diabetic patients (71 or 3.8%) were associated with a higher number of interventions involving contraindicated prescription products (23 from 145 or 15.9%)
- Elderly patients (330 or 17.7%) were associated with a higher number of interventions involving drug interactions (131 from 510 or 25.7%)

During the data collection, the dispensing systems of some pharmacies were computerised, whereas others were still paper-based. The authors noted that significantly more interventions were documented in the computerised pharmacies ($p < 0.01$), especially those involving drug interactions. The authors also noted that computerisation helped to overcome errors due to illegible handwriting.

Unfortunately, this paper did not report a denominator in terms of patient and prescription numbers, despite the fact that the information must have been recorded, as the authors noted that no pharmacy reported an intervention rate higher than 2%. This means an accurate intervention rate could not be calculated. Also, the long data collection period and the relatively passive data collection process led to a large variation in reporting rates. The authors mentioned that 13 of the 28 pharmacies ceased participation for the last eight months of the data collection period due to changes of ownership and/or management, which would have led to a significant decline in the amount of data collected. Given the small amount of interventions recorded, it is likely that the documented interventions were subjected to selection by the participating pharmacists.

1.3.4 Dobie and Rascati (United States of America)⁶⁰

Dobie and Rascati aimed to measure the incidence and types of interventions in four community pharmacies in rural Texas in 1994, as well as assign a financial value to these services. They used methods very similar to those used by Rupp et al.^{57,58}, however the interventions were recorded by the dispensing pharmacist rather than an observer. No definition for an intervention was provided, however presumably it was the same as Rupp's definition of 'any prescription problem that required the pharmacist to interrupt their routine dispensing process in order to resolve it', as the pharmacists were trained using tools developed by Rupp. Again, the pharmacists only recorded interventions from new prescriptions and each pharmacy continued recording until 1500 consecutive new prescriptions were dispensed (approximately two months).

Pharmacists recorded 60 interventions from 6000 *new* prescriptions, resulting in an intervention rate of 1.00%. The 60 interventions related to only 47 prescriptions, indicating several prescriptions required multiple interventions. As per Rupp's study (section 1.3.2), 26 errors (43.3%) were due to incomplete or illegible prescriptions, and therefore would not be considered a clinical intervention according to the definition in section 1.2. This resulted in 34 interventions (56.7%) that were clinical in nature, resulting in a clinical intervention rate of 0.57%. The most common reasons for a pharmacist intervention in these 34 cases were inappropriate dose/regimen/strength (10 or 29.4%), patient concern/question (7 or 20.6%) and over- or under-utilisation of the medication by the patient (14.7%). Fifty-one drugs were associated with the 60 interventions, with anti-infectives being the most commonly involved (10 or 19.6%). Of the 47 prescriptions, a pharmacist and a physician evaluator agreed that harm to the patient (such as side-effects, inadequate control, or allergy) would have occurred if 22 (46.8%) of the interventions were not undertaken by the pharmacist. After several calculations, it was determined that the cost avoidance was \$20,795, which is a cost saving of approximately \$346.60 per intervention or \$3.47 per prescription.

It is interesting to compare the overall intervention rate reported within this study (1.00%) compared to that found by Rupp et al.⁵⁸ (2.07%). Both studies used the same methodology, with the only difference being that Rupp used observers to document the activities, whereas Dobie and Rascati asked the pharmacists who performed the intervention to document it. This gives some indication of the potential difference that is achieved using the observer technique. It is possible that the number of performed

interventions increased with the presence of an observer, however the more likely scenario is that the proportion of *documentation* is different, due to the recording pharmacists not documenting the intervention either due to lack of time, lack of motivation, or not realising it was an intervention in the first place.

1.3.5 Irvine-Meek et al. (Canada)⁶¹

In 1994, Irvine-Meek et al. published a paper concerning a study of drug therapy interventions undertaken in community pharmacies in the South-Western New Brunswick region of Canada. The study was conducted over a ten week period from June to August 1992, and all pharmacies in the region were invited to participate. The authors used a “check box” recording form which involved the pharmacist selecting a major category and subcategory for each intervention. Information concerning daily prescription workload and staffing levels was also collected from each pharmacy. No definition of the types of interventions that pharmacists were asked to record was given in the paper, however, it seems from the nature of the results, that many of the recorded events were non-clinical, and involved clarification of third party payments or confirmation of dose and authenticity of the prescription.

These authors reported a total of 555 interventions in five major categories. Based on each pharmacy’s estimate of their daily prescription volume, it is possible to estimate that the total number of prescriptions dispensed during the course of the study was 176,650, giving an intervention frequency of 0.31%. The pharmacists reported that the average time to perform an intervention was 6.16 minutes.

Table 1-3 shows the interventions documented by the community pharmacists. The majority of the interventions were either related to contact with third party insurers (179 or 32.3%) or clarification of the intent of the prescriber or administrative issues with the prescription (119 or 21.4%). In addition, it is unlikely that the organising of an additional repeat prescription (92 or 16.6%) would have a clinical basis. Therefore, the clinical intervention frequency can be estimated as 199 clinical interventions from approximately 176,650 prescriptions or 0.11%.

Category of intervention	Subcategory of intervention	Number			
		Subcategory		Category	
		#	%	#	%
Clarification	Drug	26	4.7	119	21.4
	Dose	64	11.5		
	Quantity	16	2.9		
	Signature	5	0.9		
	Physician	3	0.5		
	Authenticity	5	0.9		
Changes	Drug	40	7.2	76	13.7
	Dose	35	6.3		
	Quantity	1	0.2		
	Signature	0	0.0		
Notification to physician	Drug allergy	9	1.6	139	25.0
	Drug interaction	6	1.1		
	Side effects	3	0.5		
	Drug duplication	3	0.5		
	Pregnancy	0	0.0		
	Breastfeeding	0	0.0		
	Over-compliance	6	1.1		
	Non-compliance	3	0.5		
	Additional refill	92	16.6		
	Other	17	3.1		
Involving third party insurers	Generic requests	4	0.7	179	32.3
	Non-benefit	16	2.9		
	Call third party	120	21.6		
	Income assistance	39	7.0		
Drug information	In pharmacy	7	1.3	42	7.6
	Halifax	8	1.4		
	Manufacturer	8	1.4		
	Other	19	3.4		
Total		555			

Table 1-3: Interventions recorded by Irvine-Meek et al.⁶¹

As with many other studies, there was a variation in the intervention reporting rate amongst the participating pharmacies. Using the published information for daily volume of prescriptions, it was possible to calculate an estimated intervention rate for 19 of the participating pharmacies (Table 1-4), however this rate includes all recorded interventions not just the interventions deemed clinical.

Pharmacy	Number of interventions	Approximate number of prescriptions	Intervention rate
1	10	3850	0.26
2	13	4200	0.31
3	18	12250	0.15
4	129	12950	1.00
5	13	7000	0.19
6	19	14000	0.14
7	28	6300	0.44
8	6	14000	0.04
9	32	28000	0.11
10	3	12600	0.02
11	22	7000	0.31
12	20	10500	0.19
13	27	7700	0.35
14	17	2500	0.68
15	7	8400	0.08
16	7	1750	0.40
17	5	9800	0.05
18	12	5000	0.24
19	18	5600	0.32

Table 1-4: Intervention rate for 19 of the participating pharmacies⁶¹

This calculated rate was then compared to the reported daily prescription volume, showing a significant negative correlation (*Spearman's rho* = -0.482, *N* = 19, *p* = 0.004), indicating that as the number of daily prescriptions increased, the number of documented interventions decreased. Although an increase in the number of prescriptions dispensed can present a greater number of opportunities for identification of DRPs, it also substantially increases the pharmacist's workload, reducing the available time for each prescription, and therefore reducing the time available to detect and resolve DRPs. While there are many factors involved in the frequency of reporting of interventions, this is one of the few studies with sufficient published information to enable the establishment of a relationship between workload and intervention frequency.

1.3.6 *Greene (United Kingdom)*^{62,63}

In 1995, Greene published the results of a study of prescription incidents that were recorded over a four month period (October 1986 to January 1987) by pharmacists in 23 pharmacies in West London. Pharmacists were asked to record all possible medication and

prescription related problems that might be encountered by a community pharmacist, including those arising from OTC or pharmacist recommended medications. Importantly, participating pharmacists were discouraged from recording self-evident errors, such as obvious inadvertent overdoses or “indispensable” prescriptions with missing or invalid entries (Table 1-5). This constraint was intended to restrict the intervention reports to those where the pharmacist required the use of his or her professional skills to resolve the problem and was different to other studies conducted at the time that focused solely on prescription errors. In addition, the study also excluded problems that were brought to the pharmacist’s attention by the patient, ensuring that the recorded problem was detected by the pharmacist. Pharmacists were asked to complete an incident report form and return them to the researchers at set intervals during the study.

Type of incident		Total %
Inclusions	Frequency of presentation	12.1
	Changed drug or dosage form	18.5
	Changed dose or timing	22.9
	Inappropriate dose or timing	4.7
	Drug/drug interaction	13.8
	Drug/condition interaction	10.6
	Miscellaneous	1.2
Exclusions	Self-evident errors	16.2
	Undispensable (due to a gross error)	
	Detected by patient	
Total		100

Table 1-5: Type of intervention codes used and frequencies found by Greene^{62,63}

A total of 340 incidents were reported during the entire study period (including the pilot period), of which 55 (16.2%) were deemed “self-evident” or patient detected problems (Table 1-5). The most common valid intervention type was changed dose or timing (78 or 22.9%; Table 1-5). When the interventions from the pilot period and the “self-evident” interventions were removed, 174 valid interventions remained. These were associated with an estimated 281900 prescriptions, resulting in a clinical intervention rate of 0.06%. Most interventions (64.4%) were completed within five minutes.

As with many other studies, there was significant variation in reporting rates between pharmacies, with 10 pharmacies providing less than the pre-determined threshold of one

intervention per month. The remaining 13 “active participation” pharmacies were responsible for 166 intervention reports associated with an estimated 181,100 prescriptions, resulting in a clinical intervention rate of 0.09%. This intervention frequency is one of the lowest reported in the literature and may be related to the relatively passive process for recording interventions and the strict exclusion of trivial administrative interventions.

The most common drug groups involved (according to the BNF) were CNS drugs excluding analgesics (20%; most commonly benzodiazepines and monoamine oxidase inhibitors), cardiovascular drugs (17%; most commonly nitrates, beta-blockers and potential drug/disease interactions with hypertension) and anti-infectives (13%).

Each incident report was graded according to its clinical significance as follows; 0 (trivial; 10.9%), 1 (not serious; 25.6%), 2 (serious; 47.6%) and 3 (very serious; 15.9%). Problems with prescriptions for patients taking 7 or more items were never trivial, however in contrast with other studies, the authors did not detect any significant differences between the seriousness of the incidents and the number of other medications that the patient was concurrently taking.

1.3.7 *Claesson et al. (Sweden)*⁶⁴

In 1995, Claesson et al. published a study of prescription errors identified by personnel at 36 Swedish community and hospital pharmacies during March 1992. Pharmacists were asked to record all prescription errors, including those not requiring a pharmacist’s intervention, on specially designed forms for a two week period.

The authors reported a total of 32,132 errors from 76,956 prescriptions, representing an error frequency of 41.7%. Of these, 2176 were considered by the dispensing pharmacist to require an intervention before the prescription could be dispensed, resulting in an intervention rate of 2.83%. Many of these were “errors of omission” (such as illegible or incomplete prescriptions), with only 255 of the 2176 incidents meeting the definition of a clinical intervention in section 1.2. This resulted in a clinical intervention rate of 0.33%. On average, a prescription with an error took an extra seven minutes to dispense, but varied between 1 and 180 minutes.

This study focused on prescription errors only and DRPs related to patient adherence or adverse effects were not recorded. As stated by the authors, Swedish pharmacists were

not permitted to keep pharmacy records of previously dispensed medications at the time of the study, which would further limit the range of DRPs that could be identified.

1.3.8 Poston et al. (Canada)⁶⁵

Poston et al. published the initial results of a nationwide study of community pharmacists' interventions in 1995. This paper reported on the largest single community pharmacy intervention study in the literature, with valid data being obtained from 527 pharmacies. All interventions that led to a check or change in drug therapy during the screening, dispensing and monitoring process for new and repeat prescriptions were recorded. The authors specifically excluded routine administrative interventions such as incomplete or illegible prescriptions, and routine counselling of patients. Two separate data collection periods took place for interventions relating to prescription and OTC medications, with each period lasting 2 weeks.

The authors reported 7190 prescriptions with 8933 DRPs from an approximate 619,164 prescriptions (mean of 1404 prescriptions in two weeks for each of the 441 pharmacies collecting prescription data), resulting in an approximate intervention rate of 1.44%. Of these, 3466 (38.8%) were related to drug distribution or supply issues, and therefore not considered a clinical intervention under the definition in section 1.2. The remaining 5467 interventions resulted in an approximate clinical intervention rate of 0.88%. The most common drug-related problems were the need for patient information outside routine counselling (927 or 10.4%) and drug interactions/allergies/side-effects (871 or 9.8%; Table 1-6).

Category of problem	#	%
Drug distribution and supply	3466	38.8
Patient information	927	10.4
Drug interactions/drug allergies/drug side effects	871	9.8
Formulation and product-related issues	275	3.1
Abuse/misuse	95	1.1
Therapeutic problems		
- Dose different from previous script	775	8.7
- Wrong strength/clarify strength	563	6.3
- Dose too high	437	4.9
- Wrong drug	352	3.9
- Dose too low	303	3.4
- Drug duplication	270	3.0
- Contraindications	119	1.3
- Other	480	5.4
Total	8933	100

Table 1-6: Drug-related problems reported by Poston et al.⁶⁵

The clinical intervention frequency was slightly higher than other studies at 0.88%, which may have occurred due to the inclusion of patient information requests. Although the authors collected information about participating pharmacies and pharmacists, this information was not compared to any other reported factors. However, the authors did note that the 144 independent pharmacies had a higher average intervention rate compared to the 156 chain stores, but the significance of this difference was not reported.

1.3.9 Smith and Christensen (United States of America)⁶⁶

In 1996, Smith and Christensen published the results of a study of pharmacists' interventions conducted in 18 pharmacies servicing the Native American population in three States of the USA for six months during 1992. Nine small hospital dispensaries and nine health centre dispensaries participated in the study. Pharmacists recorded interventions either on a purpose designed form or with an existing quality assurance software system if it was present in the pharmacy.

These authors grouped DRPs into four general types:

- Incorrect information, including wrong dosage, wrong dosage form, wrong interval, non-formulary medication and wrong patient
- Inappropriate drug, including suboptimal drug based on patient's condition and drug of choice

- Clinical problems, including contraindications, drug-drug interactions, drug-disease interactions, adverse drug effects and drug duplication
- Prescription clarification, including missing components and transcription errors

Over the six months, 1446 interventions were recorded, with the authors reporting an average intervention rate of $0.6\% \pm 0.42\%$ (range = 0.12 – 1.84), implying that approximately 241,000 prescriptions were dispensed. Prescription clarifications were responsible for 573 (39.6%) of the interventions, and did not appear to be clinical in nature according to the definitions provided within the article. Therefore, 873 clinical interventions were recorded, resulting in an approximate clinical intervention rate of 0.36%. This study was one of only a few that utilised an electronic intervention recording system, albeit only for some of the pharmacies involved, however the authors did not estimate the frequency of reports that were manually prepared compared to those that were submitted in electronic form.

The authors also noted a decline in intervention rates over the trial. The four pharmacy sites with the largest variation in reporting rates over the 6 month period were shown to have a statistically significant decline ($p < 0.01$ in all cases), whereas the declines in other pharmacies were not significant.

1.3.10 Caleo et al. (Australia)^{32,33}

In 1996, Caleo et al. published two papers on a study of clinical interventions recorded in 29 pharmacies in three States of Australia. Pharmacists recorded 1273 interventions from 89,326 prescription items dispensed over a 4-week data collection period, resulting in a mean intervention rate of $1.43\% \pm 1.4\%$ (median = 1.1%).

The authors further divided the interventions into reactive and proactive interventions;

- Reactive intervention: where dispensing could not have occurred without further consultation
- Proactive intervention: where dispensing could have occurred without further consultation, which may or may not have resulted in a change in therapy

Of the 1273 interventions recorded, 1015 (79.7%) were reactive and related to issues of clarification of prescription issues, such as omission of dose/directions (368 or 36.3%), omission of strength (160 or 15.8%), incorrect quantity (130 or 12.8%), and omission of quantity (121 or 11.9%). These clarification interventions are unlikely to have any clinical consequences and would therefore not be considered a clinical intervention under the

definition in section 1.2. The remaining 258 (20.3%) of the interventions were proactive, resulting in a clinical intervention rate of 0.29%. The types of proactive interventions can be seen in Table 1-7.

Category of proactive intervention	#	%
Incorrect strength	64	24.8
Drug/drug interaction	47	18.2
Incorrect dose	35	13.6
Inappropriate/incorrect dosage form	32	12.4
Dose/strength query	27	10.5
Incorrect drug	22	8.5
Side effect	14	5.4
Drug query	10	3.9
Drug allergy	7	2.7
Total	258	100

Table 1-7: Frequency and types of proactive interventions found by Caleo et al.^{32,33}

Two-thirds of proactive interventions resulted in a change to the patient's therapy. An expert panel assessed that the clinical interventions performed by community pharmacists saved the healthcare system an average of \$191.78 per 10,000 prescription items and that 84% of cases resulted in a positive outcome for the patient. The authors also noted no significant correlation between the pharmacy's intervention rate and total prescription volume, the location of the pharmacy or the number of nursing homes, and there was a significant reduction in intervention rates over time ($p < 0.01$). As with many other studies, there seemed to be no reports of problems relating to compliance, or the presence of actual or potential adverse effects.

1.3.11 Hulls and Emmerton (New Zealand)⁶⁷

In 1996, Hulls and Emmerton published the results of a study conducted in 25 pharmacies in New Zealand over a period of two weeks. The authors largely used the data collection techniques described by Rupp et al.^{57,58}, but again used self-reporting like Dobie and Rascati⁶⁰, not observers. An intervention was defined as 'any action taken to clarify or change a prescription to optimise the patient's drug therapy and/or minimise the risk of harmful effects'. Routine counselling, the use of cautionary and advisory labels, and clerical alterations for government reimbursement were specifically excluded.

Information was collected using a 'Prescription Intervention Form' that included:

- the patient's gender and approximate age,
- the reason for intervention (grouped into four categories: prescribing omission, prescribing error, drug interaction and drug therapy monitoring problem),
- the details of the problem (free text),
- the action(s) taken,
- the outcome(s), and
- the estimated time taken in resolving the problem.

The pharmacies reported 370 interventions in total, however two pharmacies that reported 13 interventions did not report any prescription volume data, therefore only 357 interventions were used to determine the intervention rate. During the two weeks, 19,581 new prescriptions were dispensed, resulting in an intervention rate of 1.82% (range = 0.3 – 6.7% per pharmacy).

Of the total 370 interventions, 216 (58.4%) were errors of omission relating to prescription requirements (such as illegible or incomplete prescriptions), therefore would not be considered clinical interventions under the definition in section 1.2. The remaining 154 interventions would be considered clinical in nature, resulting in a clinical intervention rate of 0.79%. It is important to note, however, that only the number of new prescriptions were recorded (not repeat prescriptions), therefore the actual intervention rate is likely to be much lower.

The pharmacists reported the interventions took a mean of 4.1 ± 5.1 minutes to resolve, with 83.3% being resolved in five minutes or less. Clinical significance of the interventions was determined by the researchers from six levels of significance, with the majority of interventions (66.8%) resulting in an improvement in patient care (Table 1-8).

Clinical significance classification	% of total
Intervention is detrimental to patient health	0.0
Intervention is of no significance to patient care	10.0
Intervention is significant but does not result in an improvement in patient care	23.2
Intervention is significant and results in an improvement in patient care	65.2
Intervention is very significant and prevents major organ damage or an adverse reaction of similar importance	1.6
Intervention is potentially life-saving	0.0
Total	100

Table 1-8: Clinical significance of the interventions as determined by Hulls and Emmerton⁶⁷

Although information was collected about additional factors (such as pharmacy location, number of full-time pharmacists and number of prescriptions dispensed), the authors did not compare it to the intervention rate and therefore influencing factors were not detailed within the paper. It is also interesting to note that the intervention rate was again lower than that seen by Rupp et al.^{57,58}, despite the use of similar methodology. As with the Dobie and Rascati study⁶⁰, this could be attributed to the use of self-reporting rather than the use of observers.

1.3.12 Knapp et al. (United States of America)²⁷

In 1998, Knapp et al. published the results of an intervention study that was undertaken in a pharmacy services program for 22,000 patients in California. All 31 pharmacies in the area participated as part of their contract and documented their interventions for the year of 1995, with the information being collated retrospectively. Pharmacies were required to document any problems relating to a prescription, the action taken and the outcome on forms based on the work of Rupp et al.^{57,58} Documentation of interventions was remunerated at the rate of \$40 to \$80 per intervention. No clear definition of the DRP was mentioned in the article, but as other aspects of the Rupp et al. studies were used^{57,58}, it is assumed that Rupp's definition was also used.

A total of 637 interventions were reported during the calendar year, and the authors were able to analyse information pertaining to 595 of these interventions. From these 595 interventions, 688 DRPs were identified and during the 1995 calendar year, 93,483 prescriptions were dispensed. This resulted in an intervention rate of 0.74% (range = 0 – 4.1). Many of the documented problems (412 or 60.0%) related to non-clinical drug selection issues (such as brand substitutions) or prescription errors. The remaining 276 problems were either clinical problems (209 or 30.4%) or direct patient requests for information (67 or 9.7%), resulting in an estimated clinical intervention rate of 0.30%.

Information concerning the number of interventions and prescription volumes for each of the 31 pharmacies was available (with the data from the pharmacies with the lowest performance rates being combined) and there was a wide variation between the pharmacies (Table 1-9).

Pharmacy	Number of interventions	Number of prescriptions	Intervention rate
1	16	387	4.13
2	142	3496	4.06
3	37	1154	3.21
4	27	1110	2.43
5	9	453	1.99
6	47	2443	1.92
7	164	13134	1.25
8	33	2662	1.24
9	9	732	1.23
10	7	658	1.06
11	42	4368	0.96
12-20	104	39289	0.26
21-31	0	23597	0.00
Total	637	93483	0.68

Table 1-9: Intervention rates of 31 pharmacies recorded by Knapp et al.²⁷

Analysis using this data showed a significant correlation between the number of prescriptions dispensed and the intervention rate (*Spearman's rho* = -0.56, *N* = 13, *p* = 0.049), indicating that as the number of prescriptions increased, the pharmacy's intervention rate decreased. The authors suggested three factors that could have contributed to the lower intervention rates seen in this study compared to others. Firstly, pharmacists could have intervened but not recorded, a trend which has previously been identified.⁵⁷ Secondly, the reimbursements were paid to the pharmacy, and therefore may not have been passed on to the individual pharmacists, possibly decreasing their motivation for documenting the interventions. Thirdly, although all pharmacies were represented at the training session, not all participating pharmacists attended, therefore it was unknown if they understood the documentation system. The authors stated that an increase in intervention rates would likely occur if opportunities and incentives for documentation were widely available. The authors also stated that the number of prescription errors would be likely to decrease with a decrease in the number of handwritten prescriptions due to computerisation.

1.3.13 Westerlund et al. (Sweden)⁶⁸

In 1999, Westerlund et al. published the results of a study conducted in 1996 in Sweden. For two months, 128 pharmacies recorded DRPs on a postcard sized data collection form

for half a day on alternate days, rotating between morning and afternoon, and included the following information:

1. Type of problem (14 options; see Table 1-10)
2. Type of intervention (10 options; see Table 1-10)
3. Problem drug (open-ended)
4. Whether the problem was detected by the participant or the patient
5. Patient's age, gender and number of concurrently prescribed drugs
6. Time taken to resolve the problem

From the 128 pharmacies, 144 staff members were recruited and included 34 pharmacists, 71 "prescriptionists" (University-trained dispensing technicians), and 39 pharmacy technicians. Staff also tallied the number of patients they served during the data collection period and information was collected for both prescription and non-prescription medicines.

A broad definition of DRPs was used in order to maximise the scope of the problems detected, with the authors noting that most previous studies had only examined prescription errors, without collecting data on other areas, such as compliance and education. Therefore, any problem that occurred because of "a circumstance of drug therapy that may interfere with a desired therapeutic objective" was considered recordable. Consequently, the information collected contained DRPs that related to prescription errors, adverse events and adherence issues. Definitions were provided for each of 14 categories of DRP and the participants were also requested to document the interventions made in order to resolve the problem (Table 1-10).

<i>Types of problems</i>	<i>Types of interventions</i>
Uncertain aim of drug	Patient medication counselling
Underuse of medication	Practical instruction to patient
Overuse of medication	Patient referred to prescriber
Other dosage problem	Prescriber informed only
Drug duplication	Prescriber asked for information
Drug-drug interaction	Intervention approved by prescriber
Therapy failure	Intervention disapproved by prescriber
Side effect	Switch of drug
Difficulty swallowing tablet	Referral to colleague
Difficulty opening container	Other intervention
Other practical problem	
Language deficiency	
Prescribing error	
Other drug-related problem	

Table 1-10: Types of problems and interventions identified by Westerlund et al.⁶⁸

A total of 1098 DRPs were recorded from an estimated 82,200 prescriptions dispensed, resulting in a rate of 1.34%. However, the authors noted that 134 DRPs were related to OTC medications, but no estimate was made of the number of OTC sales made during the data collection period. Therefore, only 964 DRPs could be included in the calculation, resulting in a prescription-related intervention rate of 1.17%.

Unfortunately, the article reported most results as percentages and graphs, resulting in the actual number of problems and interventions being estimates. The most common type of DRP identified from prescription medications was uncertainty of the purpose of the medication (14.5%), which could be deemed an adherence issue. Other common adherence issues included practical difficulty using devices (11.8%), opening containers (3.0%), and swallowing the medication (2.25%), as well as language deficiency (3.0%). Dosage problems accounted for 25.5% of all DRPs, including overuse (7.0%), underuse (5.2%) and other dosage problem (such as frequency and timing; 13.3%). The study also reported 1469 interventions were required to resolve the DRPs. Due to the large number of adherence issues detected, the most common intervention was patient medication counselling (749 or 51.0%) followed by practical instruction to the patient (280 or 19.1%). Participants reported the interventions took from 1 to 60 minutes to resolve, with the median time being 3 minutes for pharmacists, 4 minutes for prescriptionists and 5 minutes for pharmacy technicians.

The 923 drugs involved were classified by their ATC class⁸⁷, with the most common drugs involved being respiratory drugs (192 or 20.8%), nervous system (164 or 17.8%) and cardiovascular drugs (110 or 11.9%). The top 10 drugs and their associated problems can be seen in Table 1-11.

Rank	Compound	Most common problem(s)
1	Budesonide nasal turbuhaler	Practical problems
2	Timolol eye drops	Difficulty opening container; Other practical problems
3	Salmeterol diskhaler	Practical problems; Uncertainty of aim or function of drug
4	Budesonide turbuhaler	Practical problems; Uncertainty of aim or function of drug
5	Dextropropoxyphene	Uncertainty of aim or function of drug; Dosage problems
6	Terbutaline turbuhaler	Practical problems; Uncertainty of aim or function of drug
7	Dextropropoxyphene + paracetamol in combination	Dosage problems; Overuse; Drug duplication
8	Codeine + paracetamol in combination	Side effects; Drug duplication; Difficulty swallowing tablets
9	Frusemide slow release	Underuse; Prescribing errors
10	Citalopram	Dosage problems

Table 1-11: Top 10 problem-related drugs identified by Westerlund et al.⁶⁸

The study also identified a difference between the number of problems detected by the three different types of staff. The median number of problems detected per 100 prescriptions was higher for pharmacists (6.1) compared to prescriptionists (2.6) and pharmacy technicians (1.1), possibly indicating that a higher level of training corresponds to a higher intervention rate.

Interestingly, the authors found more problems occurring in children and young adults, compared to the elderly. The authors felt this was due to the elderly having chronic conditions and therefore being more closely monitored by their physician, leading to DRPs being resolved earlier in their therapy. The authors also found that 75% of patients were taking two or less medications, which is most likely due to the larger number of younger patients with drug-related problems identified within this study. Additionally, the authors noted that Swedish pharmacies did not have access to patient medication profiles at the

time of the study and therefore, poor access to the patient's medical history may have contributed to the lower number of interventions.

1.3.14 Hawksworth et al. (United Kingdom)⁶⁹

In 1999, Hawksworth et al. published the results of a study where 14 community pharmacies in England recorded clinical interventions for one randomly selected week of each month for a 12 month period. Pharmacists were specifically requested to not record reactive interventions (where the prescribed item could not be dispensed without contacting the prescriber), or non-clinical interventions relating to administrative or legal issues. Thus, all the interventions recorded in this study appeared to be clinical in nature and could be included as a clinical intervention under the definition in section 1.2.

During the study, participating pharmacists recorded 1503 clinical interventions from 201,000 prescription items, resulting in a clinical intervention rate of 0.75%. The options for classifying the interventions were:

1. Missing drug
2. Drug not required
3. Discuss information about a drug
4. Change a drug
5. Alter the formulation
6. Enquiry about the dose
7. Enquiry about the dosage interval
8. Recommend the monitoring of plasma parameters to check efficacy and safety of a drug regimen
9. Discuss a complete drug review of the patient's therapy with prescriber
10. Other

The most common intervention reported was to query the dose (23.8%), however the authors did not report the number of interventions within the other groups. Most commonly, interventions involved medications acting on the cardiovascular or central nervous systems. The average time taken to perform an intervention was 8.11 ± 3.70 minutes and the pharmacists who dispensed less prescriptions spent more time per intervention, however this trend was not statistically significant.

A clinical panel assessed all 1503 interventions to determine the likelihood that it improved the management of the patient's therapy or prevented harm to the patient (such as hospital admission). The panel found that 755 (50.2%) only provided information to the prescriber, and therefore did not directly affect patient outcomes. This resulted in

748 interventions that improved efficacy or prevented harm, resulting in an estimated 'cost-saving' intervention rate of 0.37%. Of these 748 interventions, 242 (32.4%) were rated as possibly preventing a hospital admission, with the panel estimating that 19 of the 242 (7.9%; or 1.3% of all 1503 interventions) definitely prevented a hospital admission.

The authors noted a significant correlation; as the number of prescriptions dispensed by the pharmacy increased, the number of interventions recorded decreased ($p = 0.013$). It was surmised that this could be due to several factors, such as dispensing overload or pharmacist experience, however no further comparisons were made.

1.3.15 van Mil et al. (The Netherlands)⁷⁰

In 2001, van Mil et al. published the results of a study conducted in 17 community pharmacies in the Netherlands. One of the main objectives of their study was to determine the pharmaceutical services (or interventions) that resulted from the use of a computer generated alert (CGA) program that had been used in the Netherlands since 1985. All dispensing software in the pharmacies involved in the study had the capacity to generate these alerts and the alerts were based on a database provided by the Royal Dutch Association for the Advancement of Pharmacy. The dispensing system also allowed for the recording of care activity codes (CACs) in each patient's medication history. The available CACs were:

- IA: Interaction
- CI: Contraindication
- OV: Allergy
- DB: Possible duplicate medication
- NM: Unclear prescription
- ST: Questionable strength
- DS: Dosage different from previous prescription
- EU: Drug dispensed for the first time
- PT: Possibly incorrect patient data
- HV: Unusual quantity

For each of the CACs documented in the dispensing system, an outcome was also documented. Fundamentally, this consisted of an active change (e.g. change made, advice provided, information provided), or effectively no change (e.g. problem previously solved or not relevant, no change made, no information provided).

During the course of the study, a CGA was activated on 45,404 occasions. This resulted in 12,487 active changes documented from 134,132 prescriptions (9.31%). However, as can be seen by the CACs listed above, not all of these interventions could be considered clinical. When the non-clinical interventions were removed (relating to codes NM, EU, PT and HV), 3606 CACs remained, resulting in an estimated clinical intervention rate of 2.69%. This clinical intervention rate was considerably higher than that reported in other studies. One possible reason for this is the method of identification of potential DRPs and the way these were brought to the attention of the dispensing pharmacist. In this study, 45,404 CGAs were raised, representing 33.9% of all prescriptions. These alerts prompted the pharmacist to examine *potential* DRPs, such as drug interactions, contraindications, and inappropriate dosages, and thus may have initiated more *proactive* interventions in the process. Although pharmacists were able to continue dispensing without intervening by overriding the CGA, many may have chosen to intervene simply because they were prompted. Although the majority of these alerts did not result in an active change (usually because the problem had been addressed previously or was not relevant), 12,487 CACs with active changes were documented; therefore, 27.5% of CGAs resulted in a change or advice being provided. A second possible reason for the high frequency of interventions is the nature of the documentation. Most of the other studies use a paper based recording system, whereas this study used a computerised system. Overall, 33.8% of prescriptions had a CGA raised and 24.6% of all prescriptions had a CAC documented, therefore given this high frequency of documentation, entering the CACs is presumably a relatively routine task that does not interrupt workflow, which is an important consideration for any documentation system.

1.3.16 Buurma et al. (The Netherlands)^{71,72}

In 2001, Buurma et al. examined the nature, frequency and determinants of prescription modifications undertaken by Dutch community pharmacists. Pharmacists in 141 pharmacies (9% of all Dutch pharmacies) were asked to record all modifications to prescriptions that were performed on a single pre-determined day, and also to collect a random control prescription to match the modified prescription.

Pharmacists modified 2014 of the 47,374 prescriptions dispensed during the trial, resulting in an intervention rate of 4.25%. The total number of modifications varied between pharmacies, ranging from 0 to 100 recorded modifications. Of these, 1802

modifications and 36,625 prescriptions were for medications (as opposed to non-medicine prescription items such as needles, dressings and incontinence aids), resulting in an intervention rate of 4.92% for prescription medications. As defined by ATC groupings⁸⁷, modifications were most commonly required on medications acting on the nervous system (311 or 17.3%), respiratory system (252 or 14.0%), alimentary tract and metabolism (227 or 12.6%), and cardiovascular system (216 or 12.0%). In 219 of the 1802 cases (12.2%), the modification was triggered by a computer generated alert (such as a change in the therapeutic regimen, drug interactions, contraindications or drug duplication). Handwritten prescriptions were three times more likely to require modification compared to computer-generated prescriptions (OR = 3.30; 95% CI = 2.90 – 3.75), but no significant differences were detected between the number of modifications in original versus repeat prescriptions. Interestingly, in the Netherlands, some GP practices can directly access their patient's pharmacy records online and the study showed the prescriptions from GPs with no online access needed modifying significantly more often than GPs with access (OR = 1.61; 95% CI = 1.33 – 1.94). The benefits of this information flow was previously predicted by Rupp et al.⁵⁷ in 1988, who states that improving pharmacist access would help to identify and resolve errors within the community pharmacy environment (section 1.3.1), and therefore, the reverse flow of information from the pharmacy to the prescriber is also likely to help decrease errors.

Data was also compared between the patients with modified prescriptions and the control patients. There was no significant difference in the gender of the two groups, however patients in the 40-65 years age group were less likely to require a prescription modification compared to the young and elderly patients (OR = 0.74; 95% CI = 0.64 – 0.86), with the authors reasoning that this may be due to a difference in the level of care or vulnerability between the age groups. A higher number of respiratory medication prescriptions required modifications compared to the controls (OR = 1.48; 95% CI = 1.23 – 1.79), whereas a decreased number of nervous system medications required modifications (OR = 0.71; 95% CI = 0.61 – 0.83).

The majority of modifications (1294 or 71.8%) involved clarification of the prescription or were related to non-specification of dose, insufficient patient data, non-specified strength or wrong dosage form, and therefore, would not be considered a clinical intervention according to the definition in section 1.2. Only 400 modifications (22.2%) on prescription medications were classified as corrections of prescription errors which could have led to

clinical consequences (such as wrong dose, wrong medication, contraindication, allergy or drug duplication), resulting in an estimated clinical intervention rate of 1.09%. The study did not allow for interventions due to adherence issues or adverse effects, and due to the recruitment process, the authors noted that possibly only the more proactive and enthusiastic pharmacies had participated in the study.

Workload statistics were also recorded for each pharmacy. On average, the number of prescriptions dispensed per day was 259.8 ± 99.8 (range = 34 – 609) and the number of personnel (including pharmacists and trained dispensary technicians) was 6.0 ± 1.9 (range = 2.0 – 13.5). This resulted in an average workload of 55.9 ± 15.4 (range = 19.6 – 105.2) prescriptions per staff member per day. Despite collecting this data, the authors did not compare it to the intervention rate of each pharmacy, but instead used the data to compare to the national Dutch averages to ensure a representative sample.

An additional paper by Buurma et al. published in 2004 looked at the clinical value of the pharmacist's prescription modifications using five panels (each with 4 health professionals).⁷² The panels found that 77.0% of interventions were positively modified, likely to result in a better outcome for the patient. The panel did not feel that 11.8% had any effect on the patient ("neutral"), whereas 8.2% of modifications may have had a negative impact on the patient (3.0% remained unknown). Of the positive outcomes, 758 (49.8%) were judged to have prevented an ADR and 444 (29.2%) improved the effectiveness of the therapy, with 120 (8.6%) preventing an ADR and improving therapy effectiveness.

1.3.17 Westein et al. (The Netherlands)⁷³

In 2001, Westein et al. published the results of a study of intervention reports collected from pharmacies in the Zeeland region of the Netherlands during one week in May 1998. Pharmacists were asked to record details of interventions on a standardised intervention log form and also to collect details of a control prescription from the same day for a patient of the same gender and age. Interventions were defined as "any action taken by a pharmacist that led to a clarification or change of a prescription".

The 23 pharmacies reported 337 interventions from 39,357 prescriptions dispensed during the week long study, resulting in an average intervention rate of $0.86\% \pm 0.49\%$ (range = 0.13 – 1.94). Through comparison of the intervention and control patients, the authors

determined that original prescriptions had a significantly higher intervention rate than repeat prescriptions (OR = 1.75, 95% CI = 1.18 – 2.33). Other patient determinants such as a prescription from a specialist physician, more than three prescribers, more than 15 prescriptions in the preceding 3 months and more than 3 different medications, also had a higher odds ratio than the controls, however the differences were not significant. The patients with a prescription resulting in an intervention were predominantly female (66.2%) and also tended to be older than 65 years (41.8%). The medications that were more likely to require an intervention were antibiotics (usually due to an interaction), respiratory drugs (usually due to a deviation from an earlier prescription) and cardiovascular drugs.

The authors classified the reasons for the interventions in the same manner as Rupp et al.^{57,58}, with errors of omission resulting in 82 (24.1%) interventions. These problems were usually associated with incomplete prescriptions where the prescription could not be dispensed without further clarification, and therefore would not be considered clinical in nature according to the definition in section 1.2. After these were removed, the remaining 255 interventions resulted in an estimated clinical intervention rate of 0.65%.

The authors also noted that individual pharmacies encountered between 303 and 1673 computer generated alerts (approximately 41% of all prescriptions), however only 2% of these signals lead to an intervention, which is similar to the rate of intervention from CGAs seen by van Mil et al.⁷⁰ They also highlighted the fact that pharmacists probably increased their intervention activities during the week of the trial and that there was no feasible way to determine the number of potential interventions that were missed by the pharmacists.

1.3.18 Whitehead et al. (Australia)⁴⁸

A study of prescription interventions recorded in 18 community pharmacies in Western Australia was published in 2002 by Whitehead et al. The information was collected over a four week period in 2001 using a paper-based intervention recording form. Pharmacists recorded any actions taken that resulted in a change in the patient's therapy and/or the written prescription and the researchers further classified the interventions as clinical or administrative in nature.

A total of 222 interventions were recorded from 34,491 prescriptions, resulting in an intervention rate of 0.64%. Interventions were more common in original (1.14%)

compared to repeat (0.16%) prescriptions and interestingly, clinical interventions appeared to occur more frequently than expected in computer generated compared to handwritten prescriptions. Of these 222 interventions, 75 were deemed clinical in nature, resulting in an estimated clinical intervention rate of 0.22%. As with other studies, the focus was on prescription related problems with few problems being related to patient issues, such as adverse reactions and adherence issues.

1.3.19 Quinlan et al. (United Kingdom)⁷⁴

In 2002, Quinlan et al. published a short article concerning a study aimed at assessing the frequency and types of intervention in community pharmacies. Information was collected using the Royal Pharmaceutical Society's Intervention Audit Form from 34 pharmacies over a two week period in October 2001. No clear definition of an intervention was given in the paper, but a list of intervention types indicated that they collected information on prescription anomalies and administrative errors, as well as clinical interventions such as possible adverse effects.

Pharmacies recorded 419 prescription interventions from 60,525 prescription items, resulting in an intervention rate of 0.69% (range = 0.13 – 2.77). Of these interventions, 171 (40.8%) related to prescription administrative problems (such as no GP signature, illegible, not conforming with legal requirements, not remunerated in drug tariff, or a supply/availability problem), and therefore, would not be considered a clinical intervention under the definition in section 1.2. The remaining 248 interventions appeared to be clinical in nature, resulting in an estimated clinical intervention rate of 0.41%.

1.3.20 Leemans et al. (Belgium)⁷⁵

In 2003, Leemans et al. published the results of a study involving 124 community pharmacists in Belgium that was conducted over 2 weeks during October 2000. The authors used a data collection form that had been previously tested in a group of 30 pharmacists and this form was used to differentiate between technical and clinical interventions. No definition of the events to be documented was given in the paper, but a list of technical and clinical interventions was provided (Table 1-12).

Technical interventions	Clinical interventions
<ul style="list-style-type: none"> • Insufficient or excessive number of drugs (e.g. number of tablets) 	<ul style="list-style-type: none"> • Interactions
<ul style="list-style-type: none"> • Number of packages incompatible with reimbursement guidelines 	<ul style="list-style-type: none"> • Contraindications
<ul style="list-style-type: none"> • Incorrect name of the drug 	<ul style="list-style-type: none"> • Missing or incorrect advice
<ul style="list-style-type: none"> • Way of administration incorrect or missing 	<ul style="list-style-type: none"> • Missing or incorrect dose regimen
<ul style="list-style-type: none"> • Supply problems (e.g. running out of stock) 	<ul style="list-style-type: none"> • Duplication of therapy
<ul style="list-style-type: none"> • Illegible 	<ul style="list-style-type: none"> • Non compliance
<ul style="list-style-type: none"> • Product does not exist 	<ul style="list-style-type: none"> • Follow up necessary
<ul style="list-style-type: none"> • Wrong drug prescribed (due to similar packages) 	<ul style="list-style-type: none"> • Abuse

Table 1-12: Types of interventions documented by Leemans et al.⁷⁵

Overall, 3552 interventions were reported from 87,647 prescriptions during the two week study, resulting in an intervention rate of 4.05% (mean number of interventions = 8.4 ± 13.4 ; range = 0 – 127). Of the 3552 interventions, only 1044 interventions were considered clinical according to the classifications shown in Table 1-12, resulting in a clinical intervention rate of 1.19%.

When the categories of clinical interventions were further examined, categories such as missing advice (342 interventions) and missing dose (114 interventions) were considered clinical by the authors, however would not be considered clinical in nature according to the definition in section 1.2. Therefore, once these interventions were removed, the estimated clinical intervention rate was 0.67% (588 clinical interventions from 87,647 prescriptions). The most common clinical intervention was an interaction (148 or 25.2%), of which 124 (83.8%) were listed as ‘serious’ or ‘very serious’. The authors also reported no differences between the number of interventions recorded and the location of the pharmacy, type of dispensing software used in the pharmacy, or the age of the pharmacist.

1.3.21 Andersson et al. (Sweden)⁷⁶

In 2003, Andersson et al. published the results of a study of pharmacist interventions collected in 20 randomly selected pharmacies in Sweden over two weeks in 1998. The study used the methods and definitions employed by their Swedish colleagues (Westerlund et al.⁶⁸, see section 1.3.13). Pharmacists documented their interventions on a postcard-sized form which were then collated by the research team.

A total of 1465 DRPs associated with the 63,929 prescriptions and approximately 40,000 OTC sales were recorded during the period, resulting in an overall DRP detection rate of 1.41%. Pharmacies returned an average of 86 documentation forms each (range = 26 – 171), with the average time needed to solve each problem being less than 10 minutes in 96% of cases. When only considering prescription items, the resulting clinical intervention rate was 1.00% (637 interventions from 63,929 prescriptions; Table 1-13).

Problem	Prescription medications		OTC and other medications		Total	
	#	%	#	%	#	%
<i>Patient uncertain about purpose or use of the medicine</i>	167	26.2	520	62.8	687	46.9
• Uncertain of purpose of the medicine	117	18.4	415	50.1	532	36.3
• Incorrect use or handling	50	7.8	39	4.7	89	6.1
• Self-care not appropriate	0	0.0	66	8.0	66	4.5
<i>Interactions, side-effects or lack of effect</i>	102	16.0	156	18.8	258	17.6
• Drug-drug interactions	34	5.3	29	3.5	63	4.3
• Side effects	62	9.7	99	12.0	161	11.0
• Lack of effect	6	0.9	28	3.4	34	2.3
<i>Problems caused by prescribers</i>	124	19.5	6	0.7	130	8.9
• Drug duplication	16	2.5	1	0.1	17	1.2
• Prescribing error	108	17.0	5	0.6	113	7.7
<i>Practical handling problems</i>	80	12.6	24	2.9	104	7.1
• Difficulty swallowing tablets	12	1.9	6	0.7	18	1.2
• Difficulty opening container	9	1.4	1	0.1	10	0.7
• Other practical problem	59	9.3	17	2.1	76	5.2
<i>Dosage problems</i>	68	10.7	23	2.8	91	6.2
• Under-dosage	25	3.9	8	1.0	33	2.3
• Over-dosage	43	6.8	15	1.8	58	4.0
<i>Other problems</i>	96	15.1	99	12.0	195	13.3
• Language problems	6	0.9	2	0.2	8	0.5
• Problems caused by the pharmacy	11	1.7	3	0.4	14	1.0
• Other practical problem	79	12.4	94	11.4	173	11.8
Total	637	100.0	828	100.0	1465	100.0

Table 1-13: Classification system for DRPs and number and type of problems detected (from Andersson et al.⁷⁶)

As shown in Table 1-13, the authors used 16 categories to identify the problems, with the most common problems with prescription medications being the patient was uncertain about the purpose or use of the medicine (26.2%) or problems caused by prescribers

(19.5%). The authors also noted in their discussion that a large number of pharmacists reported that they had identified more problems and made more interventions than they documented, a problem which had previously been noted in the study by Dobie and Rascati⁶⁰.

1.3.22 Benrimoj et al. (Australia)³⁴

In 2003, Benrimoj et al. published the results of a comprehensive study of clinical interventions in community pharmacies in Sydney, Australia. The study was designed with multiple arms and aimed to examine the effect of remuneration and two different educational programs on clinical intervention rates within the pharmacies.

Pharmacists recorded intervention details on a purpose-designed intervention reporting form. Thirty of the pharmacies were randomly selected and ten were conveniently sampled, comprising pharmacists who had previously attended additional educational sessions. Baseline data was collected from all participating pharmacies, and the educational programs and remuneration were provided to the pharmacists after this baseline data collection period (Figure 1-4).

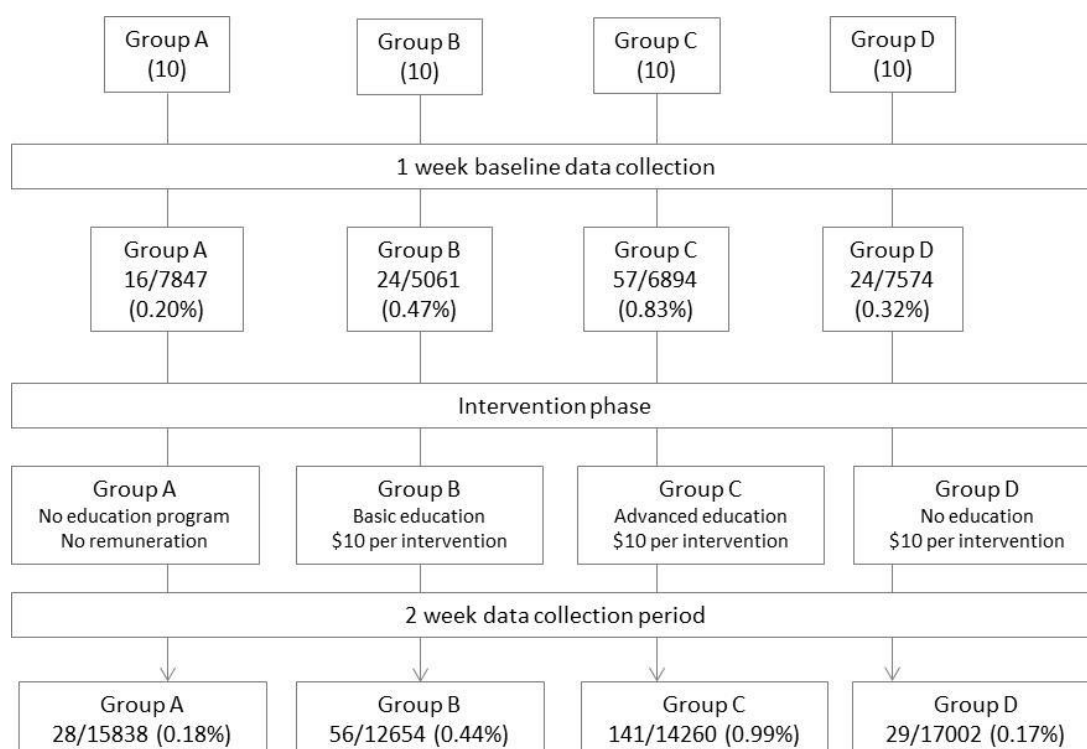


Figure 1-4: Study design and results for proactive interventions found by Benrimoj et al.³⁴

Definitions for 19 different clinical interventions were provided and interventions were then further categorised as proactive (which could be dispensed without further contact with the prescriber or patient) or reactive (which could not be dispensed without further contact). The definitions covered a range of situations relating to errors in prescriptions and potential adverse effects, however there were no problems that directly addressed issues of patient education resulting in adherence issues. The 19 different intervention types and their presumed category of reactive or proactive can be seen in Table 1-14.

Proactive interventions	Reactive interventions
Incorrect strength	Illegible handwriting
Incorrect or inappropriate dose	Omission of dose or directions
Incorrect drug	Omission of dosage form
Incorrect or inappropriate dosage form	Omission of strength
Incorrect quantity	Omission of quantity
Adverse effects	Not on PBS
Drug/drug interaction	Item unavailable
Drug allergy	Organising prescription for a patient
Dose or strength query	Prescribing information
Drug query	

Table 1-14: Intervention types recorded in the Benrimoj et al. study³⁴

The study reported a total of 762 interventions resulting from 87,130 prescriptions during the course of the three weeks, resulting in an intervention rate of 0.87%. Of these, 387 (50.8%) were reactive interventions that were predominantly related to errors or omissions in required information on the prescription, and would not be regarded as clinical in nature under the definition in section 1.2. The remaining 375 were proactive interventions, therefore resulting in an estimated clinical intervention rate of 0.43%.

There were significant differences amongst the pharmacies in terms of proactive intervention frequency at baseline and differences in the effects of the educational program and remuneration. Groups B and C (the groups that had educational programs provided) had a short lived increase in intervention rates during week 1, but rates for both groups fell below their baseline levels during week 2. Groups A and D showed a gradual decline in intervention rates. All pharmacies showed a rate of interventions below baseline levels at 2 weeks. The authors concluded that payment of a fee for service alone did not increase clinical intervention rates and that a specific educational program together with a fee for service remuneration lead to a short term increase in intervention rates.

The variation between the groups' intervention rates at baseline indicates that there may be characteristics of particular pharmacists and pharmacies that either influence intervention rates or rates of documentation of interventions. Group C, whose pharmacists had a higher level of previous continuing education participation, had the highest proactive intervention rate at baseline, which may imply that clinical knowledge is a factor in intervention rate. However, the study did not collect information about pharmacy and pharmacist characteristics, therefore the authors were unable to determine any additional reasons for the differences in intervention rates.

1.3.23 Chen et al. (United Kingdom)⁷⁷

In 2005, Chen et al. published the results of a study of interventions recorded by community pharmacists which was undertaken during 2000 and 2001. Pharmacists in nine community pharmacies in England were asked to record situations where problems were detected in the dispensing process that either:

- interfered with the dispensing of prescriptions (e.g. incomplete prescriptions, prescriptions with incorrect information) or
- were potentially harmful to the patient (e.g. potentially hazardous drug interactions, inappropriate doses or directions, contraindications, adverse drug reactions, allergies or drug duplications)

Information was recorded on a data collection form that had been previously piloted in several pharmacies. The information gathered included the age and gender of the patient, the time spent by the pharmacist dealing with the problem, the type of problem, the possible cause of the problem and the total number of prescriptions dispensed at each pharmacy.

There were 196 problems identified from 32,403 items dispensed, resulting in an intervention rate of 0.60% (range = 0.2 – 1.9). The majority of problems reported were related to incomplete, illegible or incorrect prescriptions (131 or 67%) and were therefore considered non-clinical in nature according to the definition in section 1.2. Analysis of the results revealed that 93 would be considered clinical interventions, therefore resulting in an estimated clinical intervention rate of 0.29%. The pharmacists reported that they spent an average of 5.7 minutes per problem (median = 5 minutes; range = 0.2 – 48).

The authors reported a negative correlation between dispensing volume and problem reporting rate (*Pearson coefficient* = -0.69, *p* = 0.041), with the two pharmacies with the

lowest dispensing volume having the highest reporting rate. The nearly ten-fold variation between the intervention rates of the individual pharmacies was thought to be due to a combination of factors, such as the experience of the pharmacist, incentives, dispensing volume and workload, different dispensing systems and pharmacy location, however none of these factors (except prescription volume) was measured during the data collection.

Pharmacists were also asked to record why they thought the prescribing problem had occurred in the first place. Pharmacists did not record this for every problem, however the most common reasons reported were transcribing/typing errors (30 or 15.3%), prescriber's lack of knowledge about a drug or product (29 or 14.8%), and poor communication between GPs, pharmacists and/or patients (25 or 12.8%).

1.3.24 Hämmerlein (Germany)⁷⁸

In 2007, Hämmerlein et al. published the results of a study documenting DRPs in 1146 German pharmacies for one week during 2005. Pharmacists were asked to record any event or circumstance that actually or potentially interfered with desired health outcomes. The authors designed a standardised form for the pharmacists to document the DRP including patient age and gender, drug involved, whether the prescription was an original or repeat, time needed for resolution of the DRP, free-text description of the DRP and its management. After the trial, two members of the research team classified each of the DRPs into the PI-Doc System⁸⁸ which had been modified to include a total of 72 categories.

The study reported that on average each pharmacy served 900 patients and dispensed 1600 prescriptions and OTC drugs during the week, however actual numbers were not reported. Overall, 10,427 DRPs were recorded from approximately 1,833,600 prescriptions, resulting in an approximate intervention rate of 0.57% and was equivalent to 9.1 DRPs per pharmacy per week. The most common DRPs identified were wrong data on the prescription (such as wrong dose or drug) with 1889 (28.5%), safety or effectiveness issues (such as interactions or contraindications) with 1872 (28.2%) and patient knowledge issues (such as patient ignorant of correct dose or insufficient knowledge about their condition or medication) with 1468 (22.2%). The most common medications involved included NSAIDs, cardiovascular drugs (such as beta-blockers and ACE-inhibitors), insulin, inhaled beta₂ agonists and antidepressants. The median time for DRP resolution was 5 minutes (range = 1 – 210). The PI-Doc System recorded all types of

DRPs, including technical problems, therefore from the 10,427 DRPs, only 6628 were considered a clinical intervention under the definition in section 1.2, resulting in an estimated clinical intervention rate of 0.36%.

The main limitations of this study were the short time frame of only one week and the pharmacies were able to choose which week they wished to record their DRPs, which may have increased the actual intervention rate.

1.3.25 Krähenbühl (Switzerland)⁷⁹

In 2008, Krähenbühl et al. published the results of a study documenting DRPs in 20 Swiss pharmacies over four consecutive weeks in 2005. Pharmacists were asked to record any event or circumstance that actually or potentially interfered with desired health outcomes. The authors designed an electronic intervention recording system that was integrated with the dispensing software, which was similar to the PROMISe design described within section 1.3.26. Pharmacists were asked to electronically categorise the DRPs based on the Pharmaceutical Care Network Europe (PCNE) classifications⁸⁹ which included the type of DRP, its potential negative outcome, its management and the individuals involved. This four-step plan allowed documentation of 17 different DRP types, of which 10 were considered clinical interventions by the authors and also met the conditions according to the definition in section 1.2.

From the 38,663 prescriptions dispensed over the four weeks, pharmacists documented 287 clinical DRPs corresponding to an average clinical intervention rate of 0.74%. The most common DRPs identified were wrong dosage (91 or 31.7%), drug-drug interactions (45 or 15.7%), wrong drug regimens (33 or 11.5%) and adherence problems (27 or 9.4%). The study also had 736 technical problems recorded against the prescriptions, resulting in an average technical intervention rate of 1.90%. The most common technical problem was a discrepancy between the prescription and the medication record (208 or 28.3%), with 63% of these problems occurring due to a physician error.

Over the four week study, the authors noted that the mean overall clinical intervention rate decreased from 1.04% in the first week to 0.45% in the fourth week, with 15 of the 20 pharmacies recording a decline. Pharmacies did not receive any incentives for participation in the trial and the authors believed that this may have contributed to the declining intervention rate. The authors also noted that the clinical intervention rate

varied between the individual pharmacies (range = 0.0 – 2.6%), however no contributing factors to this difference were discussed.

This study closely resembles the main methodological points of the previous PROMISE study⁸¹ as it was one of the only studies that used an integrated electronic system to document the DRPs. Like PROMISE, the participating pharmacies also volunteered and they received no incentives for participation, plus the authors separated clinical DRPs and technical problems.

1.3.26 Previous PROMISE trial (Australia)^{80,81}

In 2005, the Pharmacy Recording Of Medication Incidents and Services electronic documentation system (PROMISE) study examined clinical interventions recorded in community pharmacies in Australia and was conducted in 52 pharmacies in Melbourne. Pharmacists used a computerised intervention documentation system that was integrated within their dispensing software to record ‘any professional activity by the pharmacist directed towards improving the quality use of medicines and resulting in a recommendation for a change in the patient’s medication therapy, means of administration or medication-taking behaviour’. This definition encompassed all prescription errors, adverse events and adherence issues, and pharmacists used the DOCUMENT classification system^{90,91} to classify each intervention (see Chapter 2 for details on the development of the DOCUMENT system).

Over the eight week trial, participating pharmacists recorded 2385 clinical interventions from 435,520 prescriptions, resulting in a clinical intervention rate of 0.55%. The majority of interventions were due to drug selection problems (22.7%), dosage problems (19.4%) or education or information problems (17.4%). Drug groups associated with the most clinical interventions according to ATC groupings⁸⁷ were drugs for diabetes (261 or 10.9%), drugs for respiratory disorders (120 or 5.0%) and antibiotics (119 or 5.0%). However, due to all prescriptions being collected during the trial period, intervention rates could also be calculated on each drug group. When the number of prescriptions was also considered, the drug groups with the highest intervention rates were drugs for diabetes (1.87%), anti-diarrhoeals (1.46%), anti-anaemic preparations (1.23%) and systemic corticosteroids (0.93%). Further evaluation of the types of problems within specific drug groups of interest established that common interventions included:

- Compliance problems with anti-diabetic medications
- Drug selection and dosage problems with antibiotics
- Provision of information with respiratory agents (most often relating to demonstration of a device)
- Dose problems with corticosteroids
- Dose and drug selection problems with cardiovascular agents
- Drug selection problems with anti-inflammatory agents
- Untreated indications with antithrombotic agents

Remuneration had a small, short term effect on intervention rate in some pharmacies, but did not appear to have a significant effect overall. Increased prescription workload caused a marked decrease in intervention frequency in the majority of pharmacies. An intervention prompt promoting the use of aspirin in diabetic patients was effective in prompting 201 specific interventions in the pharmacies where it was installed and also contributed to the large number of interventions on drugs used in diabetes. The prompt also increased the overall intervention rate by almost two-fold in pharmacies where the prompt was installed. Participating pharmacists were also asked to complete an assessment of their clinical problem solving skills, however no correlation was seen between the clinical problem solving score of the pharmacists and their intervention rate.

1.3.27 Warholak and Rupp (USA)⁸²

In 2009, Warholak and Rupp published a study examining the number of errors detected on electronic prescriptions that were resolved by community pharmacist interventions. Seven chain pharmacy organisations were approached to participate, resulting in 68 participating pharmacies in five States of the USA (Massachusetts, New York, Pennsylvania, Maryland and Nevada). Despite the study being performed on e-prescriptions, the pharmacist still recorded their interventions on a paper form, which was then faxed or mailed to the researchers. The data collection period was over three months in 2006, with each pharmacy recording their interventions for a period of 14 consecutive days.

Pharmacists recorded 113 interventions on 2690 e-prescription items, resulting in an intervention rate of 4.20%. The most common reason for intervention was omitted information (37 or 32.7%), however these interventions would not be considered clinical in nature according to the definition in section 1.2. Another 25 interventions were also not clinical in nature (illegal prescriptions, non-formulary drugs etc.), resulting in 51 clinical interventions and an estimated clinical intervention rate of 1.90%. The clinical

interventions included insufficient dose (11 or 21.6%), excessive dose (9 or 17.6%) and excessive quantity/duration (7 or 13.7%). From the 113 recorded interventions, the most common drug groups involved were central nervous system agents (19 or 16.8%), cardiovascular agents (18 or 15.9%), anti-infective agents (15 or 13.3%), and hormones and synthetic substitutes (13 or 11.5%). Each intervention took an average of 6 minutes to resolve. The authors also reported that the intervention rate was much higher on new e-prescriptions compared to repeat prescriptions, however it was not reported if this difference was significant.

This study showed a higher intervention rate than other studies, however the authors point out that this may have been due to the focus on e-prescriptions which was relatively new technology for many prescribers at the time. They felt that the number of errors would decrease as the prescribing became more familiar with the technology and the software vendors improved their systems. It was also interesting to note that the pharmacists recorded their intervention on paper forms, despite the intervention being conducted on e-prescriptions. By incorporating the reporting system into the e-prescription technology, the number of interventions documented is likely to be increased.

1.3.28 Braund et al. (New Zealand)⁸³

In 2010, Braund et al. published a study conducted in Dunedin, New Zealand in 2008. The study enrolled 24 pharmacies, however only 20 pharmacies completed any data entry during the trial. The study was conducted for four weeks, however only 6 pharmacies completed data collection for the full four weeks, therefore only the first week of data (when all pharmacies completed all data forms) was used for analysis. Participating pharmacists were asked to record information about performed interventions on a paper-based tally form and the data was collated by the researchers at the end of the trial. Pharmacists were asked to record the 'grade' of the intervention as according to the Pharmaceutical Society of New Zealand's recommendations. The grades were:

- Grade 1: Bureaucratic (such as non-compliance with subsidy or legislative requirements)
- Grade 2: Saved patient money by generic substitution or similar intervention
- Grade 3: Clarified or interpreted prescriber's instructions
- Grade 4: Optimised drug therapy such as by improving compliance or patient lifestyle

- Grade 5: Prevented a moderate to serious threat to health
- Grade 6: Prevented a potentially life threatening incident

Grade 4 was not used during the study as the researchers wished to only record reactive interventions and Grade 4 interventions were considered proactive, therefore compliance issues were not documented. Other information that was collected on the form included the time spent on the intervention and the prescription count for each day.

Over the first week of data collection, 1551 interventions were recorded from 24,059 prescriptions, resulting in an average intervention rate of 6.45% (range = 2.3 – 32.3). The time spent on the 1551 interventions was 1684 minutes, resulting in an average time of 1.09 minutes per intervention. The study also found a negative correlation between intervention rates and the number of prescriptions dispensed; as the dispensing volume increased, the intervention rate decreased (*Pearson coefficient* = -0.46, *p* = 0.042).

The grading system used in this study did not allow the pharmacist to note what the DRP was (such as drug selection errors or dosing errors) that required an intervention, and therefore the nature of the interventions remains unknown. However it appears that only Grade 5 and 6 would be considered a clinical intervention under the definition in section 1.2, and with only 134 interventions coded as Grade 5/6, the estimated clinical intervention rate was 0.56%. Although Grade 5/6 was only coded in 8.6% of interventions, they took 50% of the total time to resolve, indicating that it took the pharmacist more time to perform these interventions.

A significant decrease in participation was seen during this study, where 20 pharmacies recorded data in the first week but only 6 pharmacies completed data collection for the full four weeks. The authors did not give any reasons for this finding and it is likely that the intervention rate during the first week was inflated, given that other studies have also reported a significant decline over the weeks of their trial.^{34,79}

1.3.29 Haavik et al. (Norway)⁸⁴

In 2011, Haavik et al. published an article describing two clinical intervention studies conducted in Norway. Nine community pharmacies documented their interventions for a five week period in 2004, with two hospital outpatient pharmacies and one community pharmacy documenting their interventions for a ten week period in 2006. Participating pharmacists were trained in the use of the system and asked to document any prescription errors requiring intervention.

Pharmacists recorded 2385 interventions on 85,475 prescriptions, resulting in an intervention rate of 2.79%. Of the four identified categories of interventions (formal errors, formal omissions, errors with potential clinical effects, omissions with potential clinical effects), only 'errors with potential clinical effects' would be considered clinical in nature. Approximately 405 interventions were due to errors with potential clinical effects, resulting in an estimated clinical intervention rate of 0.47%.

The authors reported that most of the interventions were on new prescriptions (82.0%) that were computer-generated (65.5%), however it was not stated if these differences were significant. An expert panel consisting of 8 pharmacists and 8 physicians examined a sample of 124 of the interventions and determined that 106 (85.5%) were potentially clinically significant. Within these 124 examined interventions, the most common drug groups involved (according to ATC groupings⁸⁷) were anti-bacterials for systemic use (24 or 19.4%), analgesics (12 or 9.7%) and anti-asthma agents (12 or 9.7%).

The authors note that the use of computer-generated prescribing based on electronic patient records can reduce the error rate of prescriptions, however it can also introduce different kinds of errors such as choosing the wrong drug or wrong patient, as seen in this study.

1.3.30 Sanchez and Campos (Spain)⁸⁵

A Spanish study was completed in one community pharmacy in Madrid, where prescribing error data was recorded in a computerised system for a 6-month period in 2009. All of the available 'prescription error' categories were not detailed within the article, however pharmacists were encouraged to record 'any problems identified in the process of dispensing that might interfere with the dispensing of prescriptions (such as incomplete or incorrect prescriptions), or be potentially harmful to patients (such as drug interactions, inappropriate doses or directions, contraindications, ADRs, allergies and drug duplications)'.

The study reported 355 recorded interventions and 23,995 prescriptions dispensed, resulting in an intervention rate of 1.48%. Removing the 117 interventions that were recorded due to 'incorrect prescription, size, quantity, illegality', this left an estimated clinical intervention rate of 0.99% (238 interventions from 23,995 prescriptions).

The information was recorded by a pharmacist at the end of each day using the hard-copy prescriptions. This eliminated the need for the pharmacist to document the intervention at the time, which may have led to an increased intervention rate compared to other studies. However, this system would not be practical long-term within a community pharmacy setting as it required information to be entered separate from the dispensing system.

1.3.31 Summary of the literature concerning community pharmacy interventions

As can be seen in Table 1-1 and the summary of each of the studies, there is a wide range of reported rates of clinical interventions in community pharmacies ranging from 0.09% to 2.69%.^{27,32-34,48,57-75,77-80,82-85} Direct comparison of the studies is difficult due to the differences in the definition of a clinical intervention, as many studies focused only on prescription errors.^{32,33,48,64} The studies also showed differences in data collection methods, where observational studies tended to detect a higher number of interventions than self-reporting studies.^{57,58,60,61,67} This may have occurred due to the participating pharmacists not recognising their intervention or not having enough time to record it. One study found that pharmacists admitted post-trial that they had performed many interventions that they did not document⁷⁶, which is likely to have occurred in many of the studies.

New prescriptions were commonly identified as requiring more interventions than repeat prescriptions.^{48,57,58,73,84} Most studies found that the use of computerised prescriptions decreased the number of interventions (often due to a decrease in the number of illegible prescriptions^{27,59,71,72,84}), whereas another study found an increased rate of intervention required in e-prescriptions.⁸²

The most common type of error detected by pharmacists was dosing issues^{32,33,57,58,60,61,68,69,75,78,79}, followed by drug-drug interactions.^{32,33,58,65,78,79} Other common problems included lack of patient understanding or a compliance issue^{57,60,68,78,79}, incorrect drug^{58,61}, incorrect strength^{32,33,60} or allergies⁶⁵. When reported within the literature, the majority of studies showed that most interventions improved patient outcomes.^{58,60,69,71,72,84}

The most common drug groups involved in interventions were cardiovascular agents^{59,62,63,68,69,71-73,78}, central nervous system agents^{59,62,63,68,69,71,72}, respiratory system agents^{59,68,71-73,84} and anti-infectives^{58-60,62,63,73,84}. Other problematic drug groups identified included dermatological agents⁵⁸, narcotic analgesics⁵⁸, hormones and substitutes⁵⁸, alimentary tract agents^{71,72}, NSAIDs⁷⁸ and other analgesics⁸⁴.

Many of the studies reported pharmacies where little or no documentation occurred, resulting in a large range of individual intervention rates. Most commonly, prescription volumes or pharmacist workloads were identified as a major contributor, with a higher prescription volume usually leading to a decreased intervention rate.^{27,32,33,58,61,69,71,72,77,83} Other factors examined for their influence included location of pharmacy^{32,33}, independent versus chain pharmacies⁶⁵, number of nursing homes^{32,33}, reimbursements^{27,34}, use of electronic prompts^{70,73}, type of dispensing software⁷⁵, pharmacist willingness/motivation⁵⁸, training/educational sessions^{27,34}, level of education⁶⁸ and the age of the pharmacist⁷⁵. Some studies also found overall decreases in intervention rates over the course of the trial.^{32-34,66,79,83}

Some studies also reported average times to perform the interventions, with values ranging from an average of 1 to 8 minutes.^{61-64,67-69,77,78,83} Very few studies used computerised documentation systems^{66,70,79}, with paper-based recording likely to have contributed to lower intervention rates.

1.4 Factors influencing the delivery of pharmacy services

Despite identifying a large range in intervention rates between pharmacies, the previous articles published on clinical intervention studies often omit comparisons between the intervention rates and influencing factors. As seen in the previous section, clinical intervention studies in community pharmacy have reported high prescription volumes and high pharmacist workloads as a common contributor to low intervention rates^{32,33,61,69,71,72,77,83}, however there are many other possible contributing factors that are not routinely reported. Clinical interventions are considered a cognitive pharmaceutical service, along with five other pharmacy services: provision of drug information; provision of pharmacy and pharmacist-only medications; medication management services; preventative care services for patients with chronic conditions; and, participating in therapeutic decisions.⁹² It was therefore necessary to examine a broader range of

pharmacy services to determine additional influencing factors that may contribute to these individual differences between pharmacies and pharmacists.

1.4.1 Implementation and continuing provision of pharmacy services

There are a multitude of factors that can influence the implementation or continuing delivery of a pharmacy service. As early as 1979, a short article was published detailing the three key barriers that needed to be overcome to increase the pharmacist's ability to provide pharmacy services: pharmacist knowledge/competency; interaction with other health professionals; and, reimbursement.⁹³ An overview of pharmaceutical care published in 2004 identified several areas that must be satisfied for effective implementation of a pharmacy service: specific practice standards; adequate documentation mechanisms; appropriate inter-professional relationships between pharmacists and physicians; and, overcoming the barriers identified by the pharmacist themselves.⁹⁴ An overview of the implementation issues arising within the field of health promotion within Canada published in 2006 found that the main barriers to implementation were the lack of interest of the participants, lack of funds/resources and lack of skilled staff.⁹⁵ A Danish study in 1999 surveyed pharmacists regarding the barriers to implementing pharmaceutical care in their practice, with pharmacists citing staff shortages, lack of computer support and lack of engagement with patients as the main barriers to pharmaceutical care implementation.⁹⁶ A literature review conducted in Australia identified two main components with four areas that influence the implementation of cognitive services in community pharmacy, where both individual and organisational level factors need to be considered in order to successfully implement cognitive services (Table 1-15).⁹⁷

Individual		Training in clinical and other skills
		Identification of motivators
		Identification of learning resources
		Motivational strategies
Organisational	<i>Internal pharmacy environment</i>	
		Pharmacy design/layout
		Planning and goal setting
		Documentation of service provision
		Utilisation of support staff and task delegation
		Quality assurance and improvement
		Evaluation of performance and outcomes
		Description/definition of service
		Use of technology
		Policies and procedures manual
		Appointment cards
		Software reminders
	<i>External pharmacy environment</i>	
		Relationships with patients, prescribers and payers
		Target population identification
		Support from a researcher or other pharmacists
		Feedback from pseudo-patrons
	<i>Business and financial</i>	
		Reimbursement for service provision
		Merchandising plan
		Business plan
		Marketing strategies
		Resource assessment - financial and human
		Management of resources
		Packaging services together

Table 1-15: Components of the process for the implementation of cognitive services⁹⁷

A further review identified specific individual and organisational facilitators that contributed to successful practice change (Table 1-16).⁹⁸

Individual facilitators	
Pharmacist competence	Professional satisfaction
Education and training for pharmacy assistants	Pharmacists' knowledge of cognitive services
Education and training for pharmacists	Pharmacists' attitudes towards cognitive services
Communication skills	Pharmacists' confidence in ability to provide cognitive services
Motivation	Autonomy
Leadership skills	Attitude of pharmacy staff
Organisational facilitators	
Physical environment (such as adequate space/privacy and workflow)	Interaction with other pharmacists
Culture of the pharmacy	Support of management
Remuneration/incentives	Access to reference literature
Sufficient and qualified staff/manpower	Pharmacist-patient relationship
Use of pharmacy technicians	Marketing
Delegation of tasks	Support from professional organisations and/or government
Innovative practice orientation	Low prescription volume
Patient demand/expectations	Rural location
Relationship with doctors	Legislation requiring or supporting provision of services
Equipment and technology (such as computers)	Attitude/perception of doctors
Access to patient information/records	Attitude/perception of patients
Documentation system	Examples from leading practitioners
Profile within the local community	External advisors or mentors
Attention for special patient groups	Evidence of benefits of services
Use of protocols	

Table 1-16: Facilitators that can improve the implementation of cognitive services⁹⁸

Numerous studies have been published and reported on the difficulties on implementing and maintaining delivery of services within the pharmacy environment, with many reporting on the initiatives required to overcome these difficulties. The following section reviews the barriers and facilitators to implementation and maintaining service delivery within these studies on a variety of different pharmacy services.

1.4.1.1 *Raisch 1993*⁹⁹

An early study examining perceived barriers to providing cognitive services was undertaken in 1993 in the USA. Cognitive services were defined as counselling patients

and evaluating prescription orders before dispensing them (presumably detecting prescription errors), which were not a mandatory part of a pharmacist's duties at the time. Barriers were divided into four types:

- Situational barriers (such as working conditions and economic factors)
- Cognitive barriers (such as lack of knowledge or ability to perform the service)
- Legal barriers (such as the influence of regulations for pharmacy practice)
- Attitudinal barriers (such as the pharmacist's beliefs about themselves, other health professionals and patients)

Pharmacists were given a list of barriers and required to rate them on a 5-point Likert scale, where 1 = least important and 5 = most important. A score of 0 indicated that the pharmacist did not feel the barrier was applicable. A total of 64 pharmacists returned the questionnaires, with excessive workload identified as the most common barrier (score = 2.9 ± 1.7), indicating that the pharmacists perceived that they did not have enough time to perform cognitive services. Other important barriers were lack of privacy (score = 1.9 ± 1.2), patients being uninterested in counselling (score = 1.9 ± 1.3) and poor store layout (such as a physical barrier between the pharmacist and the patient; score = 1.8 ± 1.6).

An arbitrary 'rate' of providing cognitive services was also calculated by the number of patient counselling events or number of prescriber interactions divided by the number of prescriptions dispensed. Two barriers were found to be directly linked with the rates of provision of cognitive services, workload ($p = 0.02$) and peer pressure ($p = 0.02$), with pharmacists who perceived they had an excessive workload or perceived peer pressure (presumably the pressure to dispense rather than provide cognitive services) having a lower rate of providing cognitive services.

The authors noted that pharmacists were currently only reimbursed for dispensing medications, rather than for cognitive services, which therefore affected the amount of time that a pharmacist could spend on cognitive services. It was therefore an interesting finding that pharmacists did not feel lack of financial payment was an important barrier to providing cognitive services (score = 1.0 ± 1.0). A limitation of the study was that pharmacists were not asked to identify or measure any internal barriers, such as lack of education, which may have also influenced the provision of cognitive services.

1.4.1.2 *Latif 1998*¹⁰⁰

In 1998, a survey was administered to pharmacists in the USA to examine the effects of workload pressure and beliefs of their employers or patients on their clinical decision making behaviour. Statements with 7-point Likert scale answers were used to determine the perceived beliefs of employers and patients, whereas the workload was measured by taking the number of prescriptions dispensed and accounting for the number of support staff at the time.

One hundred and thirty-one pharmacists completed the survey. The study found that workload pressures did not influence the provision of pharmaceutical care ($p = 0.686$), but that the perceived beliefs of the employers and patients accounted for 7.6% of the variance ($p = 0.003$). This was in contrast to other studies that found that workload did affect the provision of services and could be explained by several possibilities. The authors noted that the measure of workload was not sensitive enough to capture the true relationship. However, it also appears that the reporting procedure was not very robust, with pharmacists self-reporting any clinical decision making they made on the last five patients with chronic conditions, which did not capture the longer timeframe over which additional clinical decisions were most likely made.

1.4.1.3 *Christensen and Hansen 1999*¹⁰¹

A 1999 study aimed to determine the characteristics of pharmacies and pharmacists that were associated with the provision of cognitive services. Surveys were administered to the pharmacy owner/manager (to complete on behalf of the pharmacy) and each employee pharmacist enrolled in a larger trial that was examining reimbursement of cognitive services in community pharmacies in Washington, USA. The authors provided two sets of results: a model which predicted whether a pharmacy/pharmacist would perform any cognitive services, as well as a model to predict the rate of cognitive services provided. The performance rate of cognitive services was defined as the number of services performed per 1000 prescriptions dispensed, which was similar to intervention studies in section 1.3.

The participants were split into two groups based on remuneration; Group One received reimbursement for the documentation of cognitive services, whereas Group Two did not. The authors received 76 pharmacy questionnaires and 162 pharmacist questionnaires from Group One, and 62 pharmacy and 126 pharmacist questionnaires from Group Two.

Overall, the authors noted that the documentation of cognitive services was strongly linked to reimbursement.

Pharmacy characteristics

A logistic regression analysis was used to determine a model to predict whether a pharmacy would perform any cognitive services (performer vs non-performer). The variables that were significant and consequently included in the pharmacy model were perceptions of the pharmacist-in-charge about the usefulness of documenting cognitive services and the number of full-time pharmacists in the pharmacy. Together, these two factors had an overall prediction rate of 66.7%, with more 'performers' being correctly identified (88.1%) compared to 'non-performers' (31.4%). This shows the effect that attitude can have on the implementation of pharmacy programs, as the likelihood of the pharmacy performing cognitive services increased with a motivated pharmacist-in-charge. The number of full-time pharmacists was significantly correlated with several other factors, such as pharmacy size and prescription volume, indicating that workload was also a significant factor in the ability to provide cognitive services.

A multiple regression analysis was also performed to determine the factors that influence the rate of cognitive services performed by the pharmacy. The model explained approximately 24% of the variance between the pharmacies, with three significant factors contributing to the model: reimbursement; monthly prescription volume; and, percentage of prescriptions dispensed to Medicaid recipients (government assistance for low income families). Pharmacies that were reimbursed, that dispensed less prescriptions per month, but a higher percentage of Medicaid prescriptions, had a higher rate of documenting cognitive services.

Pharmacist characteristics

A logistic regression analysis was also used to determine a model to predict whether a pharmacist would perform any cognitive services (performer vs non-performer). The variables that were included in the pharmacist model were pharmacist position, perceptions of how burdensome the task of documentation was, and percentage of sales from prescriptions. The model had an overall prediction rate of 61%, with more 'performers' being correctly identified (79%) compared to 'non-performers' (33%). Pharmacist owner-managers who did not find the documentation of cognitive services to be burdensome were more inclined to document cognitive services. Interestingly, there

were no significant associations with reimbursement, training, first year of practice, or attitudes and beliefs in the pharmacist model.

A multiple regression analysis was also performed on the pharmacist data to determine the factors that influence the rate of cognitive services performed, therefore all pharmacists that recorded no cognitive services during the trial were excluded prior to the analysis. The model explained approximately 32% of the variance between the pharmacists, with five significant factors contributing to the model: monthly prescription volume; reimbursement; percentage of prescriptions dispensed to Medicaid recipients; medical centre location; and, rural location. The only differences between the pharmacy and pharmacist model was the addition of the medical centre and rural location factors. The authors showed that the medical centre pharmacies had a higher percentage of sales relating to prescriptions, which may explain its influence, and surmised that rural pharmacies may have a higher documentation rate of cognitive services due to an increased rapport with patients.

One limitation of this study is the way that prescription volume and pharmacist workloads were measured. Pharmacists were asked to record a “typical” prescription volume, rather than record the actual number of prescriptions dispensed, which may have affected the accuracy of the workload calculations.

1.4.1.4 *Dunlop and Shaw 2002*¹⁶

A survey administered to 348 New Zealand pharmacists aimed to determine their understanding of pharmaceutical care and barriers that prevent implementation of professional services to improve pharmaceutical care.¹⁶ The factors that were identified as barriers to the provision of pharmaceutical care included lack of time (87.0%), lack of reimbursement (81.9%) and lack of patient demand (64.1%). The pharmacists also felt that adequate knowledge and an adequate documentation process was necessary to implement pharmaceutical care.

1.4.1.5 *Westerlund et al. 2003*¹⁰²

Westerlund et al. published the results of a survey administered to pharmacists participating in a study that electronically documented DRPs relating to OTC products. The questions aimed to determine the ease of use of the system and identify some of the factors that the pharmacists believed impacted on their use of the system.

Of the 447 pharmacists that had participated in the OTC study, 376 (84%) responded to the survey. Interestingly, 139 (37%) of the respondents had not recorded any interventions during the 10-week documentation period, allowing the researchers to attempt to quantify the differences between the 'performers' and 'non-performers'. Most of the respondent pharmacists seemed highly motivated to document DRPs and the resulting interventions, with the authors noting that even the non-performers felt the documentation system was important to pharmacy practice. A significant relationship was found between the perceived interest in the project and the DRP documentation rate ($p = 0.004$). Almost 40% of participants did not perceive any time constraints to documenting the DRPs, with no significant difference detected between the perceived time constraints and the documentation rate, which is in contrast to results found by other studies. In general, the authors concluded that there was a need to change the attitudes among pharmacists and convert practice orientation towards professional service in order to improve patient care.

1.4.1.6 *Svarstad et al. 2004*¹⁰³

A study published in 2004 used mystery shoppers to determine factors that influenced patient counselling in community pharmacies. The shoppers presented three new prescriptions to the 306 pharmacies in eight States of the USA and recorded the level of interaction with the pharmacist, as well as estimated pharmacist and pharmacy demographics.

The shoppers found that an increased level of pharmacist interaction occurred with younger pharmacists (less than 35 years) who were working in less busy pharmacies. Pharmacists working in States with an increased intensity of regulations mandating counselling also had an increased level of pharmacist interaction, suggesting that legal requirements can have a significant impact on pharmacy practice. No interaction was found between the pharmacy type (chain vs independent) and the level of patient counselling, with the authors concluding that the busyness of the pharmacy was a better predictor of patient interaction compared to pharmacy type.

1.4.1.7 *Becker et al. 2005*¹⁰⁴ and *2007*¹⁰⁵

Two studies by Becker et al. identified specific factors that contribute to the likelihood that a pharmacist will dispense a drug that interacts with another drug the patient is taking concurrently. Firstly, a literature review was undertaken that identified seven

papers that discussed contributing factors. From the papers, three different groups of factors were identified:

- Relationship between the pharmacist and prescriber, where patients with a single primary-care physician and a single dispensing pharmacy were less likely to receive interacting medications
- Quality of the medication surveillance software, where the number of dispensed interacting medications can be decreased by the software, but too many or too few alerts can also contribute to an increased number of dispensed interacting medications
- Pharmacy organisation and the knowledge of the pharmacist, both of which affect how the pharmacist manages the alerts provided within the software

Taking this knowledge, the authors then designed a study to examine the factors influencing the dispensing of 10 common drug-drug interactions (such as macrolides and digoxin, or beta-blockers and beta₂ agonists). The only drug-drug interaction where commonalities were found was between macrolides and digoxin, where pharmacies that dispensed this combination regularly were medical centre pharmacies and pharmacies using one specific software system. This may indicate the effect that software alerts can have on the dispensing of drug-drug interactions, with the authors noting that this software system was not as advanced in their alert systems as some of the other programs on the market. However, the authors also noted that the pharmacist's attitude in using any of the software systems may have contributed to the effectiveness of the alerts, therefore the software systems themselves cannot be held fully accountable.

1.4.1.8 Irujo et al. 2007¹⁰⁶

A Spanish study in 2005 examined the factors that influenced the under-reporting of ADRs within community pharmacies by comparing pharmacists that had reported an ADR within the last year compared to pharmacists that had not. Using a case-control method, 18 pharmacists who had reported an ADR were compared to 60 control pharmacists. The authors found that the factors positively associated with ADR reporting were older pharmacists with more years of experience, increased participation in educational activities related to the detection and resolution of DRPs, and a higher score on a knowledge survey delivered as part of the study.

1.4.1.9 Roberts et al. 2008¹⁰⁷

A large amount of research has also been completed within Australia which aimed to identify the factors that influence practice change overall within the pharmacy

environment, including factors that influence the introduction of new cognitive services. A 43-item quantitative survey using statements answered with a 5-point Likert scale was designed using organisational theory framework and mailed to 2000 community pharmacies within Australia.

Out of 2000 pharmacies, 735 responded with a yield of 1303 individual questionnaires (each pharmacy could provide a completed survey from the pharmacy owner, a pharmacist employee and a pharmacy assistant). Factor analysis revealed 7 factors that explained 48.8% of the total variance: relationships with physician; remuneration; pharmacy layout; patient expectation; manpower and staff; communication and teamwork; and, external support and assistance. The authors suggested requirements for successful practice change for each factor (Table 1-17).

Factor	Requirements for successful practice change
Relationship with physicians	Build rapport with local physicians
Remuneration	Provide incentive payments or a fee-for-service
Pharmacy layout	Provide a private or designated area for service delivery
Patient expectation	React to the patient's needs
Manpower/staff	Decrease workforce shortages and provide additional staff for implementation
Communication and teamwork	Involve the whole pharmacy team in the implementation process, not just the pharmacy owner
External support and assistance	Provide support for planning and implementing change, as well as clinical support for the service

Table 1-17: The seven key areas in implementing practice change identified by Roberts et al.¹⁰⁷

1.4.1.10 Uema et al. 2008¹⁰⁸

A 2005 study into the perceived barriers to pharmaceutical care in Argentina examined the responses from 90 pharmacist questionnaires. The options were not pre-defined as seen in a similar study⁹⁹, therefore the pharmacists were required to formulate five barriers to the implementation of pharmaceutical care in their own words and also rank their importance.

Some pharmacists reported less than 5 barriers in their questionnaire, resulting in 90 responses that detailed 323 situations that were considered barriers. Researchers analysed the questionnaires and manually grouped similar responses together, with the

results showing that the three most important barriers were lack of time, lack of specific training and lack of communication skills with patients (Table 1-18). Interestingly, lack of reimbursement was only stated as a barrier in 3 (3.3%) questionnaires, which is in contrast to other reported studies.^{16,109}

Barrier	#	%
Lack of time	82	25.4
Lack of specific training	56	17.3
Lack of communication skills with patients	37	11.5
Lack of space	25	7.7
Lack of acceptance of a need for a pharmacist by the health system	17	5.3
Lack of human resources or personnel	16	5.0
Lack of communication skills with health team	15	4.6
Lack of motivation/compromise	14	4.3
Disorganisation in the use of resources	14	4.3
Lack of specific software/technological resources	10	3.1
Lack of funds or financial resources	5	1.5
Occasional patients	5	1.5
Lack of documentation skills	4	1.2
Difficulties to access drug information	4	1.2
Lack of reimbursement	3	0.9
Others	7	2.2
Not a barrier	9	2.8
Total	323	100.0

Table 1-18: Barriers to the implementation of pharmaceutical care reported by Argentinian pharmacists¹⁰⁸

When the importance rankings were analysed, lack of time was indicated as the major barrier in 53 (58.9%) of the questionnaires. Interestingly, when these barriers were then compared to the pharmacist's year of graduation, lack of time appeared more frequently in the pharmacists that had graduated a longer time ago. This may indicate a higher level of efficiency in the more recently graduated pharmacists, who may perceive that they require less time to implement new services. The newly graduated pharmacists may also be more willing to change, and therefore do not see the implementation of a new pharmacy service as an inconvenience. The ranking of lack of time as the most important barrier was affected by the number of pharmacists working within the pharmacy. When only one pharmacist was present, 66% believed lack of time was a major barrier, but this decreased to 54% when two pharmacists were present and 40% when three pharmacists were present. This may be therefore linked to pharmacist workload, as a higher number of

available pharmacists will most likely decrease the overall workload, therefore allowing more time to provide professional services. Also, the authors classified 90% of the barriers as being 'internal' to the pharmacy and pharmacist, highlighting that simple alterations to these factors could increase the implementation of pharmaceutical care.

The authors noted that the sample could not be considered representative, as the survey was distributed at continuing professional development (CPD) events and it is possible that participating pharmacists were already more motivated to implement pharmaceutical care. The majority of the respondents were female (81%), which may have also caused a bias in the results. The authors did not define what 'pharmaceutical care' was on the survey form and stated that it was a fairly new concept in Argentina, therefore it is also possible that the participating pharmacists did not fully understand the purpose of the survey.

1.4.1.11 Latif and Boardman 2008⁵³

A 2006 study aimed to investigate the factors that influenced the number of medication use reviews (MURs) performed by community pharmacists in the UK. Questionnaires were distributed to 280 pharmacists with 167 respondents (59.6%). The factors that were found to significantly affect the number of reviews performed were:

- Current position (employee and managing pharmacists performed more MURs than locums)
- Weekly hours (pharmacists working more than 20 hours per week performed more MURs)
- Access to a practical consultation area (pharmacists with access performed more MURs)

Gender, years since qualification, additional post-graduate qualifications and pharmacy size did not appear to influence the number of MURs performed.

Pharmacists were also asked to answer 16 attitudinal statements on a 5-point Likert scale, of which 6 statements assessed their beliefs on barriers to performing MURs. The pharmacists felt lack of time (74%), lack of support staff (74%) and lack of a suitable consultation area (64%) were barriers to the performance of MURs. Pharmacist opinions regarding remuneration were varied, with 50% believing that an adequate financial incentive would increase the number of MURs performed but 38% disagreeing with this statement.

1.4.1.12 Zardain et al. 2009¹¹⁰

A survey was undertaken in Spain in 2005 to identify the psychosocial determinants that influence the implementation of pharmaceutical care. Using a survey that was validated prior to the study, the authors identified that a community pharmacist would be more likely to implement pharmaceutical care if the pharmacist had a positive attitude, believed they were capable of performing the services, and observed colleagues performing the service with the perception that they were supported to also perform the service themselves. Information regarding demographics and professional experience was collected, as well as a range of statements to gauge the participants' attitudes, social influence, self-efficacy, motivations and needs.

The survey was completed by 1925 pharmacy owners in the five different stages of implementation: pre-contemplation (have not considered adopting pharmaceutical care, n = 1255); contemplation (considering adopting pharmaceutical care in the next 6 months, n = 322); preparation (willing to implement pharmaceutical care within the next month, n = 120); action (have been implementing pharmaceutical care for up to six months, n = 33); and, maintenance (have been implementing pharmaceutical care for over six months, n = 195). The survey found that as the respondents moved from the pre-contemplation to the implementation stage, their attitude and self-efficacy scores increased, indicating that the pharmacists who were already implementing pharmaceutical care had a more positive attitude towards the service and felt more competent to provide the service.

A logistic regression analysis was performed to create a prediction model for whether a pharmacist would perform pharmaceutical care (where the pharmacists were in the 'action' or 'maintenance' stage). The final model explained 50% of the change of behaviour from 'not performing' to 'performing', with the following covariates being significant:

- Training in pharmaceutical care (OR = 13.92; 95% CI = 5.37 – 36.08)
- High self-efficacy score (OR = 3.19; 95% CI = 2.38 – 4.28)
- Presence of assistant pharmacists (OR = 1.70; 95% CI = 1.02 – 2.80)
- High attitude score (OR = 1.03; 95% CI = 1.01 – 1.04)

This indicates that training was the most influential factor in this study, with pharmacists who were trained being 14 times more likely to perform pharmaceutical care. As predicted by the authors, a pharmacist's positive attitude and belief in their ability to perform the service were also influential. Interestingly, the presence of additional

pharmacists also had an influence on the performance of pharmaceutical care, which may indicate that the additional pharmacists contributed to a more efficient workload distribution.

The identified barriers also differed between pharmacists in the five different stages. Pharmacists in the pre-contemplation or contemplation stages identified the need for more training courses, practice guidelines and specific software. Pharmacists in the maintenance stage identified the need for better communication between pharmacists and other members of the healthcare team (such as doctors and hospital physicians). This indicates that the barriers that need to be overcome to allow implementation of pharmaceutical services often differ to the barriers identified whilst maintaining the provision of the service.

1.4.1.13 Lounsbury et al. 2009¹⁰⁹

A 2007 survey of outpatient-based pharmacists within the USA aimed to determine the barriers that affected the implementation of a medication management service and the continued provision of the service.¹⁰⁹ The study found that for the 194 pharmacists not currently offering the service, implementation was affected by the lack of additional staffing (89.6%), poor access to the patient's medical information (84.0%), lack of physical space to perform the services (80.3%), lack of ability to obtain compensation (79.8%) and lack of an efficient documentation system (77.7%). Many pharmacists also felt that they did not understand the components of the service, which also affected their motivation to implement it.

For the 776 pharmacists currently offering the service, continued provision of the service was affected by lack of adequate compensation (70.8%), inability to obtain adequate compensation (67.3%), and lack of recognition as a healthcare provider (62.2%).

Interestingly, once the service had been introduced, significantly less pharmacists identified with staffing levels and physical space being a barrier to offering the service.¹⁰⁹

Many factors identified surrounded the ability to change the pharmacist's practice, and once this had been achieved, continued remuneration was required to maintain offering the service. Again, it also highlighted the difference between the perceived barriers to implement services compared to the perceived barriers to maintaining the provision of the service.

1.4.1.14 *Gastelurrutia et al. 2009*¹¹¹

A qualitative study was undertaken in Spain to determine the facilitators for practice change within Spanish community pharmacies. Thirty-three semi-structured interviews were undertaken, with 15 practitioners (pharmacists currently working in a pharmacy providing cognitive services) and 18 'strategists' (pharmacists currently involved with the design and implementation of cognitive services). From the interviews, 12 facilitators for practice change were identified, which were grouped into four domains:

- Pharmacists – the need for more clinical education; the need for clearer messages from professional leaders about the future of pharmacy; and, the need for a change in pharmacist attitude in regards to practice change
- Pharmacies – the need for a change in reimbursement (by reducing income for dispensing and increasing income for cognitive services); and, the need to change the structure of pharmacies (increasing their size, increasing the number of pharmacists and providing private areas for patient care)
- Pharmaceutical profession – the need for the governing bodies to take leadership in the implementation of professional programs; the need for a decrease in administrative workload; the need to reduce the gap between research and the practice environment; and, the need for more practical research on effectiveness and efficiency
- Miscellaneous – the need to increase patient demand for cognitive services; the need to improve relationships between pharmacists and physicians; the need for greater support from healthcare authorities; and, the need for marketing of cognitive services and their benefits to the public and other healthcare professionals.

Interestingly, the practitioners and the strategists ranked the importance of the facilitators differently. Practitioners felt that remuneration was the most important facilitator, followed by increasing clinical education, legal support, and marketing of cognitive services. Strategists felt that clinical education was the most important facilitator, followed by the attitude of the pharmacist, communication with the primary healthcare team, and the provision of adequate tools for implementation. This highlights the disconnect that pharmacists often feel when trying to implement research projects, as the views of the researchers that design the services are often very different to the views of the pharmacists implementing the service.

1.4.1.15 *Gadkari et al. 2009*¹¹²

A study conducted in non-metropolitan pharmacies in the USA examined the pharmacy characteristics associated with the provision of drug therapy services (including

medication management services and disease state management programs). Pharmacy owner/managers were approached to complete a survey that collected data about the pharmacy's demographics, as well as staffing, services offered, prescription workload and service orientation (assessed by 3 statements answered by a 5-point Likert scale).

The study received 115 completed responses from pharmacists in non-metropolitan areas and a logistic regression analysis was run on eight factors to create a model to predict whether a pharmacy would provide any drug therapy services. The following four factors contributed significantly to the model:

- Pharmacy provides immunisation ($p = 0.01$)
- Service orientation measure where pharmacy owners were supportive of their staff if they wished to increase service provision ($p = 0.01$)
- Prescription workload per pharmacist ($p = 0.03$)
- Pharmacy located in a rural area as opposed to a regional centre ($p = 0.04$)

The factors that were not significant to the model were staffing levels (additional pharmacists and presence of technicians/interns), number of dispensing-aiding technologies (including barcode scanners, electronic ordering system etc.), and whether the pharmacy was independent or part of a chain. The limitation of this study was that it was self-reported, and therefore, the actual workloads and staffing levels may have been different in practice.

1.4.1.16 Garrett and Reeves 2009¹¹³

An analysis of the attitudes of Australian pharmacists that influenced the reporting of interventions within a public hospital environment was published in 2009. All public hospitals across New South Wales were using an incident reporting system, and survey responses were received from 79 pharmacists representing 78% of all pharmacists using the system. Despite most pharmacists believing that performing clinical interventions were part of their role and that the interventions improved patient outcomes, pharmacists generally did not perceive the recording of the interventions as important. The most commonly reported barriers to recording interventions were lack of time (34%), difficulties with the computer system (17%) and lack of feedback (14%). This study highlighted the need for a change in attitude in the pharmacists, where education on the importance of recording interventions to create a more complete patient record may improve the use of a documentation system.

1.4.1.17 Mandt et al. 2010¹¹⁴

A Norwegian study examined prescription intervention practices in community pharmacy through the use of focus groups. The 14 participants discussed their working procedures and professional judgements related to prescription interventions during two focus groups. From the participants, the authors identified two main dispensing processes: *active dispensing* where information was extracted through communication with the patient and through decision support, and *fast dispensing* where information was only extracted from the current prescription. All pharmacists identified that *active dispensing* was the ideal procedure, but that *fast dispensing* was the process used when time was limited. The pharmacists identified that both the detection and documentation of interventions suffered when *fast dispensing* was practiced. Facilitators that increased prescription interventions were proactive patients, adequate information technology (many Norwegian pharmacies have electronic links to the patient's prescription history), and a pharmacy layout that allowed interaction with the patients during the dispensing process.

1.4.1.18 Blake and Madhavan 2010¹¹⁵

In 2010, a study was published that aimed to provide a model to predict a community pharmacist's likelihood to provide a medication management service. Pharmacists were asked to answer statements on a 7-point Likert scale to determine the barriers to providing services. Out of the 256 survey responses, only 174 were included, as the remaining surveys were answered by pharmacists not currently practicing in community pharmacy. The pharmacists indicated that the major barriers to providing a medication management service were lack of time and attitude of the physician. The major facilitators were the willingness of the patient to participate and the educational background of the pharmacist. This can be seen in Table 1-19 where low mean scores indicate barriers and high mean scores indicate facilitators.

Barriers/facilitators	Mean	SD
Lack of time	3.08	1.88
Physician attitudes	4.23	1.47
Lack of reimbursement	4.34	1.92
Legal liability	4.56	1.68
Lack of patient counselling area	4.57	2.06
Adequate support staff	4.58	1.97
Lack of confidence	4.98	1.69
Employer	5.10	1.65
Lack of customer loyalty	5.23	1.70
Educational background	5.24	1.50
Patients' willingness to participate	5.69	1.18

Table 1-19: Barriers and facilitators to the provision of a medication management service found by Blake and Madhavan¹¹⁵

A principal components analysis was conducted to determine what factors significantly contributed to the provision of a medication management service. It showed that a three-factor solution could explain 53.3% of the variance, with the three factors being perceived ability to respond to patient interest (grouping confidence, educational background, patients' willingness and legal liability together), pharmacy-related factors (grouping counselling area, time, customer loyalty and reimbursement together), and enabling factors (grouping physician attitudes, employer and adequate support staff together). Practice setting and demographic variables (such as gender, job status and highest degree earned) were not significant predictors of the provision of a medication management service.

The authors also noted that the majority of pharmacists (73.8%) indicated that, if given the choice, they were likely or very likely to work in a pharmacy that provides medication management services compared to a pharmacy that does not. This indicated that there is considerable interest to provide these services from an employee point of view.

1.4.2 Analysis of specific influencing factors

Studies consistently report barriers both for the individual (the pharmacist) and the organisation (the pharmacy) in the implementation and continuing provision of professional services within the pharmacy. The following section explores studies that specifically aimed to measure the effects of commonly reported barriers, such as workflow design, workload, education, reimbursement, technology and practice change.

1.4.2.1 Workflow design and pharmacy layout

A 1999 study of Irish pharmacists aimed to quantify the actual percentage of time a community pharmacist spent on professional services, rather than rely on self-reporting post-activity or direct observation.¹¹⁶ The study estimated that 49% of a pharmacist's time was spent engaged in professional activities (such as assessing prescription appropriateness, checking accuracy, counselling, training staff), 29% on semi-professional activities (such as labelling the products and administration tasks) and 22% on non-professional tasks (such as inventory, housework and non-professional conversations). This study was repeated 10 years later¹¹⁷, and found that 49% of a pharmacist's time was spent engaged in professional activities, 31% on semi-professional activities and 20% on non-professional tasks, demonstrating that the composition of pharmacist workloads had not changed in the previous 10 years. The authors identified that the 20% of time spent on non-professional tasks (including 8% of time on inventory activities which could easily be delegated to a non-pharmacist) was underutilising a pharmacist's professional skills, indicating that redistribution of the pharmacist's responsibilities would likely increase the amount of time spent on professional activities.

Another study examined an interesting alteration of workflow within a community pharmacy employing two pharmacists.¹¹⁸ One pharmacist was nominated as a 'clinical community pharmacist' whose sole role was to analyse drug therapy, educate patients, field therapeutic questions from patients and document interventions. The second pharmacist completed all the administrative tasks and fielded all phonecalls to the pharmacy, thus removing the non-clinical distractions from the clinical pharmacist. Several dispensary technicians were also utilised, each with specific tasks to complete within the dispensing process, with all positions aimed to eliminate distractions from the clinical pharmacist. During a 6-month period, 221 clinical interventions were made and the authors noted several cases where patient outcome was significantly improved. Most importantly, the same number of staff members were utilised, but in a different capacity, therefore little or no extra cost was incurred to redesign the pharmacy workflow in this way.¹¹⁸ Improving the workflow design within a community pharmacy could therefore significantly improve the amount of time a pharmacist spends on professional services.

A different study also made alterations within the dispensing area to improve the level of patient counselling¹¹⁹, which would increase the amount of interaction with the patient and therefore, most likely increase the number of interventions detected by the

pharmacist. In this study, the use of space within the dispensary was improved and the responsibility of technicians was increased, ensuring that the pharmacist's time for patient interaction was at a maximum level. The study found that with the redesign, the pharmacist involvement with data entry was significantly decreased (61% to 10%; $p < 0.001$) and the number of offers of oral counselling to the patient was significantly increased (5% to 85%; $p < 0.001$). Unfortunately, the number of actual counselling sessions did not increase, with the authors reporting that this was due to the patients often declining a counselling session with the pharmacist.¹¹⁹ Again, this simple redesign of existing infrastructure achieved better interactions between the pharmacist and patient, therefore allowing an increase in the level of pharmaceutical care provided. The study also highlighted a barrier that could have an extensive impact on the provision of cognitive services, as patients may also require education to ensure they understand the expertise of the pharmacist.

1.4.2.2 Workload

In previous sections, several studies have been identified where workload and prescription volume have significantly affected the number of professional services provided by pharmacists, including the documentation of clinical interventions.^{27,33,61,69,71,77,83}

Similarly, another study examined the effect of pharmacist workload on the dispensing of drug-drug interactions (DDI).¹²⁰ The study found that the factors which significantly contributed to an increased risk of dispensing a potential DDI included pharmacist workload (OR = 1.03; 95% CI = 1.03 – 1.05) and pharmacy staffing (OR = 1.10; 95% CI = 1.09 – 1.11). Other factors included various technologies, such as sophisticated telephone systems, electronic receipt of orders, and the ability to modify DDI alert-screening sensitivity. These findings suggest that as pharmacies process more prescriptions per hour, they are likely to dispense more potential DDIs. This most likely occurs due to the pharmacists becoming busier, and therefore less likely to detect DDIs, evaluate DDI warnings within the software, or act on those warnings. The mean number of prescriptions processed per pharmacist hour was 14.1 ± 4.9 and the relative risk of dispensing a potential DDI increased by 3% for each additional prescription processed per pharmacist hour (OR = 1.03; 95% CI = 1.028 – 1.034). The authors noted that the patient outcomes were not measured, therefore the rate of adverse effects experienced by the patients in this study as a result of the dispensed drug-drug interaction was not known¹²⁰, however one clinical intervention study found that 83.8% of interventions involving drug-

drug interactions would have resulted in serious or very serious consequences if the pharmacist had not intervened⁷⁵, implying that the resolution of drug-drug interactions is extremely important.

Despite this apparent overwhelming other evidence, some studies have found no correlation between the pharmacist workload and the rate of delivering pharmacy services.¹⁰⁰ For example, one study found there was not a significant correlation between the pharmacist workload (measured as prescription volume per hour) and the rate of counselling within the pharmacy.¹¹⁹ The actual workload of the pharmacist can be difficult to measure, which ultimately could contribute to the variations seen between the studies.

1.4.2.3 Education

Poor clinical knowledge and lack of continuing education of the pharmacist have also been identified as factors that affect the provision of services. One study examined the effect of an intensive training program on the ability of pharmacists to identify DRPs and required pharmacists to commit to 40 hours of face-to-face training sessions, 10 weeks of structure and process changes, then 14 months of case-based assignments.¹²¹ The study found a significant improvement in the pharmacist's ability to manage DRPs from the middle of the education period and the end of the education period ($p = 0.008$), indicating the benefit that education can have on the detection of DRPs.¹²¹ Unfortunately, this level of commitment to continuing education would not be achievable by the majority of community pharmacists, either due to lack of time or lack of motivation.

As described in section 1.3.22, the Benrimoj study³⁴ examined the difference in intervention rate between pharmacists with different levels of education. Of the four study groups within the trial, the two groups that received education had a higher intervention rate, however this difference was not statistically significant.³⁴ The interventions by the more highly trained pharmacists also appeared to provide increased cost savings compared to the basic education group and the control group.¹²²

A Swedish study examined the effectiveness of providing a counselling model to pharmacists to detect DRPs in specific drug groups.¹²³ The study found that pharmacists using the counselling model had a documented intervention rate of 10.9%, with nearly 25% of patients using NSAIDs experiencing a drug-related problem. Therefore, providing pharmacists with a more structured and consistent way to detect DRPs may increase their ability to provide pharmaceutical care and intervention rate.

A recent study in the USA compared traditional CE (such as didactic lectures) to CPD (more targeted workshops and self-directed learning) to determine which form of continuing education was better. The 91 pharmacists self-reported that the targeted CPD increased their clinical knowledge, skills and attitudes as well as improved the level of patient care they provide¹²⁴, which may lead to an increased provision of professional services. These pharmacists also reported better interactions with other health-care providers and initiated new practice changes as a result of their education activities.¹²⁴ Unfortunately, pharmacists within this study also reported that lack of time was a barrier to completing the additional activities within the CPD model¹²⁴, making the level of commitment needed for the basic CE model more appealing to the majority of community pharmacists.

A Belgian study examined the differences between pharmacists who undertook CE training (attendees) and the pharmacists that did not (absentees).¹²⁵ The authors found that more women attended CE activities compared to men ($p = 0.021$), and that more owners attended compared to employees ($p < 0.001$). The pharmacists were also asked to list the factors influencing their attendance with gathering practical knowledge and keeping knowledge up to the standard listed as the most motivating factors, with the authors noting that maintaining this level of knowledge would be extremely beneficial for their patients. Older pharmacists tended to feel more duty-driven than their younger counterparts which increased their attendance at CE events. Interestingly, women were more driven to attend CE events if there was a reward ($p < 0.001$), whereas men were more likely to attend based on the learning activity itself ($p = 0.006$). Barriers to attendance were also reported, where females were more influenced by the distance to classes ($p < 0.001$), reluctance to make the trip ($p < 0.001$), and family commitments ($p < 0.001$), whereas their male counterparts were more influenced by concurrent activities such as sport ($p = 0.038$) and the belief that they do not have to continue to learn ($p = 0.013$).¹²⁵ Some of the differences in the provision of professional services may therefore be linked to demographics, as the levels of commitment to continuing education, and therefore the level of clinical knowledge, may differ between genders and employment position.

A study regarding the benefits of continuing education was also conducted in India, where CE was not mandatory and often not available to the pharmacists.¹²⁶ The authors found that in the 48 participant pharmacists, CE improved their patient counselling skills and professional skills (such as BP and BSL monitoring), and more importantly, they began to

implement this knowledge and skills into their everyday practice which would be likely to improve patient outcomes. The authors also identified that self-motivation was an important strategy in overcoming the barrier of implementing new services.¹²⁶

Amongst other health professionals, trends have also been noted between continuing medical education (CME) and physician performance. Several studies have concluded that CME improved physician performance¹²⁷⁻¹³⁰ and, in some cases, health outcomes for patients¹²⁸, demonstrating that continuing education can improve the level of service provision amongst several different health professionals.

1.4.2.4 Reimbursement

Several studies have indicated that adequate remuneration could provide an increase in the provision of cognitive services. The Benrimoj study³⁴ examined the effect of a fee-for-service remuneration for the documentation of clinical interventions. The remuneration only group did not have a significantly different intervention rate to the control group, therefore it was concluded that payment of a fee-for-service alone did not increase clinical intervention rates.³⁴ Despite this, many pharmacists and pharmacies continually report that a lack of adequate (or any) remuneration is a significant barrier to the implementation and continuing provision of professional services.

1.4.2.5 Computerisation

Several studies have noted that the computerisation of the prescribing process has decreased the number of prescription errors overall, as the errors occurring from illegible handwritten prescriptions have been decreased dramatically.^{27,48,71} However, two studies have also noted that computerisation can increase the number of prescription errors relating to drug selection, where the physician can accidentally select an incorrect drug from the drop-down boxes.^{84,131} Also, a study in the USA showed that the average workload per hour within an automated pharmacy was double that of a non-automated pharmacy (59 ± 7.26 compared to 24 ± 16.28)¹³², showing that as computerisation increases the efficiency of the pharmacy, it also increases the pharmacy's workload. As seen in previous sections, higher workloads have frequently been associated with a lower provision rate of professional services.

A study was conducted in a large hospital pharmacy department in 1993 to determine the effect of a switch from manual to electronic documentation of clinical interventions.¹³³

The manual documentation of interventions was seen as cumbersome and time-consuming, and required a large amount of manpower to process the manual forms and provide summaries. An electronic documentation system was designed to alleviate this, and was successfully implemented. The electronic system also provided a dramatic increase in the number of interventions recorded in a 3-month period from the previous year, which the authors attributed to the system's ease of use and decreased time required to record. The system also allowed pharmacists to benchmark themselves against their peers, by calculating a cumulative cost saving that their interventions caused.¹³³ This study highlights the need for electronic documentation to be seamlessly linked with the pharmacist's daily tasks and the effect that motivation can have on the recording.

1.4.2.6 Use of CDSS and prompts

CDSS have been used within the literature to increase the accuracy of prescribing and dispensing medications, such as through the use of pop-up warnings indicating a potential problem should the physician or pharmacist continue with the process.⁶ Unfortunately, some studies have also shown that pharmacists override the prompts on a regular basis. A Swiss study published in 2007 showed that 56.7% of drug-drug interaction alerts were overridden by the community pharmacists.¹³⁴ Pharmacies were able to choose the level of interaction severity that the computer system should detect, and the pharmacies that selected to only report severe interactions had a much lower override level of 35.2%.¹³⁴ This implies that pharmacists can become immune to the alerts (known as prompt fatigue), especially when the prompts are trivial, therefore decreasing their ability to detect and act on serious interactions when they are displayed. Another study examining the pharmacy predictors of the dispensing of DDIs found that the pharmacies with higher rates of dispensing DDIs were more likely to have computer systems that provided detailed information on the DDI.¹²⁰ Again, this could be attributed to prompt fatigue or desensitisation, as the pharmacists may have less time to evaluate the wealth of information they are provided and therefore are more likely to ignore or override the alert. A Swedish study examined the effect of an electronic barrier to prevent dispensing errors in community pharmacies.¹³⁵ The barrier could not be overridden by the pharmacist, resulting in a significant decrease in dispensing errors during the trial.¹³⁵ However, this system may not be seen as practical in reality, as there may be situations where the dispensing error has been corrected and needs to be overridden. Another study

in the USA published in 2007 reported a significant decrease in the number of eight critical drug-drug interactions dispensed once an alert system was activated ($p = 0.013$), however the authors again noted that the alert produced 'excess noise' which would contribute to prompt fatigue.³⁸ Another study examining the habits of prescribing physicians found that physicians accepted only 9.2% of drug interaction alerts and 23.0% of allergy alerts.³⁹ The physicians accepted high-severity alerts only slightly more often than the moderate- or low-severity alerts (10.4%, 7.3% and 7.1% respectively; $p < 0.001$). The authors surmised that the high override rate of all alerts indicated that most active physicians felt that the alerts were more of a nuisance than an asset.³⁹

The use of CDSS has wider ranging capabilities than just detecting drug interactions, for example, alerts can be used to improve the quality use of medications. The previous PROMISE study in 2005 incorporated a prompt into the dispensing system that encouraged pharmacists to assess the suitability of commencing aspirin in diabetic patients.¹³⁶ A decision support prompt appeared with each dispensing of an oral antidiabetic agent, provided the patient was not already taking aspirin. During the study, the pharmacies in the prompted arm recorded 201 interventions regarding the use of aspirin in diabetic patients, with none of these interventions recorded in the non-prompt arm. The prompt also improved the overall intervention rate, indicating that the prompt may have triggered pharmacists to record other interventions as well. The authors also noted a decline in the intervention rate over the six week trial, attributing this decline to the pharmacists experiencing 'prompt fatigue'.¹³⁶

A review of the use of prompts within prescribing software that aimed to highlight interactions as well as improve quality use of medications also determined some of the facilitators and barriers to the appropriate use of the system.¹³⁷ Fundamental issues included the availability and accessibility of the hardware, sufficient technical support and training in the use of the system, the level of system integration into clinical workflow, and the relevance and timeliness of the prompts. The authors again noted that the effect of alert fatigue was present, with some physician participants noting that they felt they may become desensitised to the alerts and therefore miss important information.¹³⁷

1.4.2.7 Practice change

Several studies have also identified the need for the pharmacy and pharmacist to be flexible and willing to adapt their practice to incorporate changes, as increasing the level

of training, number of staff and reimbursements will not always be sufficient to implement services. An exploratory study conducted in the USA found that there were a variety of factors that supported practice change within pharmacy, including improving resources (such as upskilling staff), involvement in demonstration projects (such as actively promoting pharmacy services within the pharmacy), regular environmental scanning (such as providing services requested by the customers or benchmarking themselves against other local pharmacies) and regular interaction with advocates for pharmacy practice change (such as pharmacy associations or innovative practitioners).¹³⁸ As expected, this implies that the more motivated pharmacists are the ones who are more likely to change and adapt as new practices and programs become available.

A qualitative study also performed in Australia found four pharmacy business models that affected the pharmacy's ability to implement cognitive services; classic community pharmacy, retail destination pharmacy, health care solution pharmacy and networked pharmacy.¹³⁹ The classic community pharmacy did not feel any immediate threat from the external environment and service provision was not the focus at these pharmacies, with many services being out-sourced. They were generally smaller in size, had a limited ability to implement new services, and were generally owner-operated with the owners fairly reluctant to change. Retail destination pharmacies were generally manager-operated, part of a corporate banner groups and much larger in physical size, and they often used technology to improve their efficiency. They tended to not be service-orientated, and regarded supermarkets and department stores as their competitors. Health care solution pharmacies had made a conscious decision to promote themselves as professional, health care providers, often in response to external stimulus (such as a discount pharmacy opening within the local area). These pharmacies were predominantly independent and owner-operated, with the delegation of specific tasks to other staff that were trained in that area. These pharmacies also used technology to improve their efficiency and improve their provision of the services. The networked pharmacies were connected via a shared ownership structure, which improved the abilities to provide services and often shared the responsibilities amongst the pharmacies.¹³⁹ Different types of pharmacies will have different capabilities of implementing services, with some types requiring more assistance to implement services. In addition, there are several characteristics that can be used to identify an innovative pharmacy which may be more likely to implement new services. Characteristics such as liking to work in a team environment, placing a high value on the

professional aspects of practice, and a large team of staff that have a strong desire to be helpful to people, tend to be common characteristics to innovative pharmacies.⁹² It is therefore important to consider the type of pharmacy as a factor when considering their ability to implement and maintain the provision of cognitive services.

A Canadian study examined the culture of pharmacy by asking pharmacists to answer the simple question “what does a pharmacist do?”.¹⁴⁰ The study found that the responses could be grouped into three categories: product focused (such as dispensing medications, counselling on medications, procuring the correct medications), patient focused (such as addressing patients’ medication needs, interacting with health professionals, managing and monitoring drug therapy, providing pharmaceutical care), or ambiguous (such as vague statements about ‘helping patients’ or ‘providing services’, which could not be easily grouped). The study found that 57% of pharmacists used dispensing or product focused terms in their first response, indicating that the pharmacists’ self-perception is that they are simply a ‘dispenser’. Successful pharmacy practice change, and a consequential increase in the provision of professional services, will therefore only be attained if the pharmacists begin to believe that they are patient-centred practitioners. Pharmacists need to become comfortable with the transition towards patient-centred care before a pharmaceutical care model could be fully embraced. The authors noted that attempts to address the commonly identified barriers of lack of time, training, remuneration and support from other health professionals did not always increase the adoption rate of cognitive services, surmising that the pharmacists’ underlying attitudes and beliefs are impeding the desired changes in pharmacy practice.¹⁴⁰

Another study aimed to quantify the factors that influenced a pharmacist’s behaviour.¹⁴¹ The resulting regression model explained 57% of the variance with the most important predictor being past behaviour. Other significant factors were perceived behavioural control (defined as the perceived ease or difficulty of performing the task) and behavioural intention (the intention to perform a task). Current attitude and social norm (beliefs about other people’s opinions of the participant’s behaviour) did not appear to be significantly associated with a pharmacist’s behaviour.¹⁴¹ These findings indicate the importance of practice change, as past behaviour has a significant influence on future behaviour.

A study in the USA aimed to determine the factors influencing pharmacists' enrolment in an electronic prescription monitoring program.¹⁴² The factors that influenced the non-enrolled pharmacists were time available to access the system once enrolled, availability of internet access and time available to enrol. On the contrary, the factors that influenced the enrolled pharmacists were being able to assist with decreasing doctor shopping, being able to assist with decreasing drug diversion and the usefulness of the system at their practice site.¹⁴² Again, this may highlight the need for practice change, as the responses from the enrolled pharmacists appear to demonstrate more motivated individuals that are keen to make a difference within their profession.

Another review of the implementation of pharmaceutical care⁹⁴ found that barriers differ depending on where the pharmacist was in the implementation process:

- Those already offering pharmaceutical care were concerned with educational issues and communication with physicians
- Those who were intending to start offering pharmaceutical care were concerned with lack of time, skills and reimbursement
- Those who were previously providing pharmaceutical care, but had since abandoned it, stated it was due to lack of time, lack of space within the pharmacy, lack of reimbursement, lack of cooperation of staff, patients and physicians, and they also claimed that the practice was incompatible with working hours
- Those who considered the implementation of pharmaceutical care as unviable stated that structural problems (such as lack of personnel, education, money and space) and the lack of acknowledgment by governing bodies were the main barriers⁹⁴

This was similar to the results seen in studies by Lounsbery et al.¹⁰⁹ and Zardain et al.¹¹⁰, where the reported barriers to implementation were different to the reported barriers to the maintenance of the professional service.

1.4.3 Summary of the factors influencing the provision of pharmacy services

Studies on the implementation and continuing provision of pharmacy services consistently report lack of time as a major barrier in community pharmacy.^{16,53,108,115} This lack of time may be actual or perceived, but affects the pharmacy's ability to implement new services and to continue to provide these services. Pharmacist workload is also closely linked to lack of time, with many studies identifying a direct relationship between the workload of the pharmacist and their ability to deliver additional services.^{99,101,103,112}

In many countries (including Australia), the remuneration model for pharmacies is based largely on the prescription volume dispensed by the pharmacy. Therefore, increasing professional services requires alternative remuneration models in order to make it cost-effective for the pharmacy. Despite this, the effect of reimbursement on implementation and continued provision of the services was varied, with some studies reporting lack of reimbursement as a barrier^{16,101,109}, whereas other studies reporting no effect.^{99,108} Other organisational factors that were reported to influence the provision of services included pharmacy layout^{53,109,114}, and the availability of adequately trained support staff.¹⁰⁹ Some pharmacy demographics, such as chain versus independent pharmacies, also did not appear to affect implementation^{103,112}, despite these pharmacies often having a larger prescription volume and therefore a higher pharmacist workload.

Several studies identified that often the pharmacists themselves are a barrier, either through lack of motivation^{101,102,111}, or the belief that their abilities are not appreciated by the employer, the patients or the physicians.^{16,101,105,108,109} A positive attitude towards the task and motivation to provide better care can influence the pharmacist to attain a higher level of service provision¹¹⁰, however practice change can be hard to achieve in pharmacists who lack these traits. Some studies also reported links with pharmacist demographics (such as gender, graduation year, current position)^{53,106}, as well as the need for adequate knowledge (and training) and an adequate documentation process to improve the level of service provision.^{16,106,108,110,111,115}

It is also important to note that three studies identified that the barriers to implementing a professional service differed to the barriers to maintaining provision of that service, both within the pharmacy and the individual pharmacist^{94,109,110}, therefore the support required to implement the service may differ greatly from the support required to maintain it.

1.5 *Documentation systems within Australian community pharmacies*

While pharmacists seem to undertake clinical interventions despite the perceived barriers, the current practice is not to document these interventions unless there is some imperative. The imperative for documentation may be to facilitate communication to other pharmacists involved in the patient's care, or to adequately record details of a potentially litigious situation. The appropriateness and functionality of currently available

electronic systems were examined to determine the requirements for the documentation system for this study.

1.5.1 Existing documentation systems

Documentation systems for interventions require the capacity to enter information and produce reports regarding intervention occurrences. Identifying and “tagging” patient records that have been the subject of an intervention is important, as it allows for information sharing and continuity of care amongst pharmacists within a pharmacy. The increased scope for awareness amongst pharmacy staff that a particular patient has been the subject of an intervention provides opportunities to follow up care with the patient to determine what outcomes have occurred, and to determine whether the patient requires further assistance. Reporting is considered important as common factors could be identified for improving patient health care, such as a prescriber consistently prescribing an inappropriate medication, or interventions occurring more frequently in a group of patients, such as a particular nursing home, therefore reporting may allow the pharmacist to educate other professionals regarding the interventions.

The majority of community pharmacists in Australia use one of the following dispensing systems: Amfac[®] windows; Simple Retail’s Aquarius[®] Dispense; CDC[®]; FRED[®]; Pharmasol LOTS[®]; MINFOS[®]; Phoenix Rex[®]; or, PharmacyPro Dispense[®].¹⁴³ Obtaining information about existing intervention documentation capabilities of community pharmacy dispensing software was difficult, requiring a visit to a pharmacy that had the particular system installed, and asking the pharmacist to demonstrate how the documentation aspect of the system worked. It was not possible to view CDC[®] or PharmacyPro Dispense[®] within Tasmania so the information regarding these was obtained via email from the vendors. A summary of the features can be seen in Table 1-20.

Amfac[®] Windows and Aquarius[®] Dispense dispensing systems both had the capability to document intervention information in the patient notes. This method was easy to use but did not prompt the pharmacist to provide categorising information, such as when the event occurred or what recommendations were made. Since the information was contained in the notes field in an inconsistent free text format, identifying and producing reports about intervention occurrences was not possible.

CDC[®] had the capability to document interventions, and several intervention classifications were provided, such as drug allergy or drug-drug interactions. Intervention notes could be made by the pharmacist and the intervention severity classifications could be set up by the pharmacist. CDC[®] provided the option to document patient outcomes and was able to produce intervention reports. Unfortunately, the time of an intervention was determined by the opening and closing of the intervention screen, which is a poor and unreliable indicator of the true time of an intervention.

FRED[®] had the capability to document interventions, however this functionality was not made obvious to the user, as it was accessed via a somewhat obscure keyboard shortcut, 'Alt + I'. FRED[®] provided a list of intervention reasons, a numerical severity rating, and intervention notes. Reports could be generated for time periods, patient groups, and intervention types. This dispense vendor was involved with the previous PROMiSe study⁸¹ (see section 1.3.26), therefore many of these features had been redesigned from the trial and incorporated into the current software.

Pharmasol LOTS[®] had the capability to document interventions, activated using a button on the dispensing screen. Several intervention classification options were available, such as change of dose, and correcting prescriber error. Intervention notes could be made by the pharmacist and the time taken for the intervention could be documented. In addition, the intervention could be viewed and printed from the patient history. There was no option to produce reports or group interventions by type, patient group or time period.

The MINFOS[®] system was capable of documenting basic information about an intervention. It had several options for the type of intervention, including change of dose, and doctor contacted. Once completed, an intervention symbol was shown in the patient history next to the intervened prescription. This system had several limitations though, including not having an option to provide intervention notes, produce reports, or group interventions by type, patient group or time period. In addition, the option to create an intervention was not obvious to the pharmacist. Consequently, an intervention documented in this system would be of limited value.

Rex[®] also had the capability to document interventions, made accessible to the pharmacist via an intervention button located on the dispensing screen. It provided a good range of categories for intervention types, severity levels and time taken. Intervention notes could be entered and reports could be generated for time periods, patient groups and

intervention types. This vendor was involved with the original PROMISE pilot study¹⁴⁴ and again, some of the current features had been adapted from their previous involvement.

PharmacyPro[®] Dispense had the capability to document interventions. This could occur whilst dispensing a prescription or in the patient history. It provided a list of intervention options and a numeric severity level classification. Highlighting and right-clicking a prescription provided the option of adding an intervention. Intervention notes, and the time taken could be entered, and a range of reports could be produced.

Dispensary software	Able to document interventions?	List of CI reasons	Severity of CI	Time taken for CI	Notes	Outcomes of CI	Reports
Amfac [®]	✓						
Aquarius [®]	✓						
CDC [®]	✓	✓	✓	✓	✓	✓	✓
FRED [®]	✓	✓	✓	✓	✓		✓
LOTS [®]	✓	✓		✓	✓		✓
MINFOS [®]	✓	✓					
Rex [®]	✓	✓	✓	✓	✓	✓	✓
PharmacyPro [®]	✓	✓	✓	✓	✓		✓

Table 1-20: Summary of intervention documentation features present in the current dispensing systems

Among the dispensing systems there were a variety of intervention documentation options; Amfac[®] and Aquarius[®] had no formal documenting option, whereas CDC[®], FRED[®], Pharmasol LOTS[®], MINFOS[®], Rex[®] and Pharmacy Pro[®] Dispense had a number of options. Of those systems that could document interventions, there were no consistent approaches regarding classifying intervention types, recommendations made, intervention severity, time taken, or reporting options. In addition, several systems had extensive (but not standardised) options for classifying interventions, notes provision and reporting that would be useful for investigating intervention-related issues and for the transfer of information amongst staff. These systems included CDC[®], FRED[®], Rex[®] and Pharmacy Pro[®]. However, despite having the intervention documentation features, Pharmacy Pro[®] and FRED[®] did not make the feature obvious to the user. Thus, although systems for documenting clinical interventions existed within some of the pharmacy software systems, there was no consistency of definitions or accepted methodology in place, which required a more uniform and useful system to be developed for the PROMISE trial.

1.6 *Aims and objectives of the project*

While pharmacists undertake clinical interventions as part of their duty of care, the current practice is not to routinely document these interventions unless there is some imperative, such as to facilitate communication to others involved in the patient's care or to adequately document details of a potentially litigious situation. International community pharmacy studies have estimated that pharmacists perform clinical interventions at varying rates, ranging between 0.09% and 2.69% of prescriptions.^{61,68,70,75,79} However, there is currently no standardised documentation system in Australia that allows pharmacists to document these interventions. It is therefore difficult to determine the frequency and type of DRPs that are occurring and being resolved within the community pharmacy environment.

The aim of the third PROMISe (Pharmacy Recording Of Medication Incidents and Services electronic documentation system) trial was to estimate the number and nature of DRPs detected and clinical interventions performed within community pharmacy in Australia. In addition to this, it was vital to establish the viability of, and requirements for, national implementation of an electronic documentation system for the recording of these interventions identified in community pharmacy, in order to both improve the quality of life for patients, as well as provide an overall cost saving to the government via a reduction in healthcare resource utilisation.

To determine which software features would improve intervention rates, several versions of documentation software, including one which incorporated electronic decision support, were trialled. In addition, many participant surveys and focus groups were also utilised to determine influential factors that would affect documentation rates, thereby aiming to improve documentation rates by controlling these factors. Using these influencing factors to determine the effect on the intervention rates of the pharmacy and the pharmacist is a key component of this thesis.

This thesis has been separated into distinct sections: Chapter 3 examines the frequency and type of interventions and the medications involved; Chapter 4 examines the participating pharmacies, their intervention rates and the factors that may have influenced the variation in the rates; Chapter 5 examines the participating pharmacists, their individual intervention rates and the individual factors that may have influenced the variation in the rates; Chapter 6 qualitatively analyses the observations of pharmacists

during the trial; and Chapter 7 discusses how the reported results could be used to further improve the intervention rate.

As mentioned in section 1.2, this study defined a clinical intervention as;

Any professional activity by the pharmacist directed towards improving the quality use of medicines and resulting in a recommendation for a change in the patient's medication therapy, means of administration or medication-taking behaviour.

2 Chapter 2: Methods

The three Pharmacy Recording of Medication Incidents and Services electronic documentation system (PROMISe) trials were conducted over a period of ten years and aimed to determine the frequency and type of clinical interventions occurring within Australian community pharmacies. This thesis focuses on using the data from PROMISe II (conducted in 2007) to implement the PROMISe III trial and then the analysis of the data collected during the PROMISe III trial. The PROMISe I and PROMISe II trials⁸¹ were considered the pilot studies for the PROMISe III trial, with the project design and classification system being adapted from the previous iterations. Many surveys were included in PROMISe III due to their previous inclusion in PROMISe II or because PROMISe II showed results that prompted the inclusion of a survey or survey question to determine additional influencing factors.

Prior to the data collection during the PROMISe III trial, documentation software needed to be designed to allow pharmacists to document clinical interventions, including the modification of the DOCUMENT DRP Classification System to allow pharmacists to classify their interventions. Numerous surveys were also designed to allow data to be collected with the intention that this data would be compared to the resulting intervention rates to determine any influencing factors.

2.1 Focus groups

Before the trial commenced, focus groups were used to identify actual and potential factors that could influence the documentation of the clinical interventions within community pharmacy. It was thought that integrating the users into the design phase of the system would increase the usability of the documentation system and therefore ultimately improve the number of clinical interventions documented within the system.

Feedback from participants at the conclusion of the previous PROMISe project identified a range of implementation and documentation barriers and facilitators to the specific tasks of performing and documenting clinical interventions.⁸¹ As seen in Chapter 1, barriers and facilitators to the wider implementation of professional services were also investigated, and these results were incorporated into the study design.

For the PROMISe III project, Ian DeBoos of DeBoos Associates was contracted to facilitate in-depth focus groups and semi-structured interviews with key stakeholders of the

PROMISe project. DeBoos is a qualified pharmacist and qualified social statistician and market researcher. He works part time in community pharmacy and has a unique combination of social researching skills and an understanding of community pharmacy issues. The research objectives of these focus groups and interviews were to determine the stakeholder's views of pharmacy clinical interventions, the barriers and facilitators to the identification of DRPs and the subsequent performance and documentation of clinical interventions, and the information required for a documentation system to be successful. These sessions were recorded with permission from the participants.

The 36 participants in the five focus groups were comprised of nominated pharmacy owners including representatives of the Pharmaceutical Society of Australia and the Pharmacy Guild of Australia, employee and accredited pharmacists, previous participating pharmacists from PROMISe II, consumers and representatives of Quality Use of Medicine (QUM) organisations including the Australian Commission on Quality and Safety in Healthcare, the National Prescribing Service and the Veterans' Medicines Advisory and Therapeutic Education Services (MATES).

The focus groups were conducted using an exploratory interview approach based on grounded theory, without any pre-defined hypotheses. The outcomes of the focus groups and interviews revealed that consumers and pharmacists regarded performing clinical interventions as an important aspect of community pharmacy. Pharmacists saw interventions as their ethical responsibility and something they performed as second nature. They stated they would always investigate and act on anything regarded to be a serious DRP, irrespective of their work demands. Consumers said they were reassured knowing pharmacists could identify potential DRPs and could also represent consumers' best interests within the health system, in this case to prescribers.

The focus group participants identified a number of factors that influence the appropriate identification of DRPs. The barriers and facilitators to identifying DRPs are detailed in Table 2-1, and as expected, these factors are almost identical to those already reported in the literature.^{16,108,115}

Barriers	Facilitators
Lack of clinical knowledge	Reimbursement of interventions
Pharmacists have too many roles and there is not enough time to investigate some minor drug problems	Existing community pharmacy protocols could be adapted to allow pharmacists to better understand patient's health status
Pharmacists that focus on the business rather than the clinical aspect of their role	Greater community interaction with patients and other health professionals
Low interaction with patients, especially by pharmacists who remain at their dispensing stations	More complete patient histories would enable pharmacists to have the full picture
Low confidence to contact prescribers	Improved clinical education

Table 2-1: Focus group findings: Barriers and facilitators to identification of DRPs

Participants of the focus groups also identified their requirements for an electronic documentation system. The functionality for this documentation system was divided into *must have features*, *nice to have features* and *if possible features*. A summary of these findings can be seen in Table 2-2.

Must have features
Simple operation (quick and easy)
Dispensing aids or reminders such as flags or prompts
Reporting for incomplete and complete documented interventions
Nice to have features
Auto save function
Printing summary of interventions
Pop up window link to previous interventions for that patient
Transmission of intervention documentation to external party
Incomplete documentation reminder
Colour coded pop ups
Inclusion of diagnostic data (such as space for INR recording)
Inclusion of diagnosis space
Ability to turn off selected pop ups to a dispenser's initials
If possible features
Allergic reaction notification when the problem drug is dispensed for the patient

Table 2-2: Focus groups findings: Suggested features for PROMISe software

The results of the focus groups and interviews conducted before the PROMISe III data collection period indicated several aspects that would be implemented into the design of the trial. The documentation software was designed using these specifications and was subsequently used in the PROMISe III trial.

2.2 DOCUMENT DRP Classification System

As detailed in Chapter 1, the comparison between previous clinical intervention studies is difficult due to the number of different DRP classification systems available. The DOCUMENT DRP Classification System was designed for the previous PROMISe I and II trials, and underwent refinement prior to the PROMISe III trial, with this process the subject of a published article.¹⁴⁵ The DOCUMENT system was incorporated into the documentation software used in PROMISe III to allow pharmacists to record clinical interventions more consistently.

2.2.1 Initial DOCUMENT system

It was felt that previous classification systems did not provide enough detail for reconstruction of a clinical scenario. For example, the Hepler and Strand system¹ did not provide coding for activities to resolve the DRP (such as actions undertaken and recommendations by the pharmacist to resolve the DRP), whereas the PCNE system⁸⁹ required the assessment of the cause of the DRP, which is not always possible, and did not allow for sufficient economic analysis of the outcomes of the DRP.⁸⁶ For these reasons, an open, hierarchal classification system was developed, based on the types of problems identified by Hepler and Strand¹ and the PCNE classification system.⁸⁹ The system facilitated the classification of five aspects of the DRP and the clinical intervention undertaken to resolve it. These were:

1. the type of DRP;
2. the actions undertaken to investigate the DRP;
3. the recommendations made to resolve the DRP;
4. the outcomes of the actions undertaken to resolve the DRP; and
5. the perceived clinical significance of the DRP.

2.2.1.1 Type of DRP

The system consisted of eight categories (types) of DRP, with each category including between one and five subcategories (Appendix 1). This version of the system was used during the PROMISe I and PROMISe II studies, and was refined for the PROMISe III study. The types of DRP classified in the DOCUMENT system were defined as follows:

- *Drug selection* – DRPs related to the choice of drug prescribed or taken (such as drug duplication, drug interaction and wrong drug)
- *Over or underdose prescribed* – DRPs related to the prescribed dose or schedule of the drug (such as dose too high, dose too low and incorrect schedule)

- *Compliance* – DRPs related to the patient's medication-related behaviour (such as taking too little, taking too much, intentional drug misuse and difficulty in using a dosage form)
- *Untreated indications* – DRPs related to actual or potential conditions that require management (for example, a diagnosed condition not adequately treated or preventative therapy required)
- *Monitoring* – DRPs related to inadequate monitoring of the efficacy or adverse effects of a drug (such as laboratory and non-laboratory monitoring)
- *Education or information* – DRPs related to patient's knowledge of the disease or its management (such as requests for drug information, confusion about therapy or disease states and demonstration of devices)
- *Non-clinical* – DRPs related to administrative aspects of the prescription
- *Toxicity or adverse reaction* – DRPs related to the presence of signs or symptoms which are suspected to be related to an adverse effect of the drug (such as toxicity caused by dose, drug interaction or unknown causes)

2.2.1.2 *Actions to investigate the DRP*

The types of actions undertaken to investigate the DRP were derived from a previous study of community pharmacists' interventions.¹⁴⁴ It was identified that these activities would be associated with a substantial component of the total time involved with an intervention, and therefore may be used as a predictor for length of time taken to complete an intervention. In addition, some knowledge of the actions taken by the pharmacist was thought to complete the intervention record, and demonstrate the pharmacist's ability to make decisions about the DRP. Actions classifiable in the DOCUMENT system are shown in Appendix 1. As seen in section 2.2.3, this option was removed prior to the PROMISE III trial.

2.2.1.3 *Recommendations to resolve the problem*

The codes and categories for recommendations to resolve the DRPs were also determined following evaluation of clinical interventions from a previous study.¹⁴⁴ Given that a clinical intervention, by definition in the PROMISE trials, must involve the pharmacist making a recommendation to the patient or prescriber, it was vital that the details of the recommendations made were included in the documentation process. The documenting of the pharmacist's recommendations also allowed for a complete intervention record which researchers or other pharmacists within the pharmacy could use to interpret the situation. Codes for recommendations which were thought likely to occur were also added. These are shown in Appendix 1.

2.2.1.4 Outcome/Acceptance of the recommendation

A simple acceptance code for the recommendation was developed for the system. As multiple recommendations were possible for a single DRP, a category for partial acceptance was created to allow for the situation where only some of the recommendations made by the pharmacist were accepted. As seen in section 2.2.3, this option was removed prior to the PROMISe III trial.

2.2.1.5 Clinical significance

Five levels of clinical significance for the DRP were chosen. This measure was included as it was expected to be a good indicator of typical economic value of an intervention. A brief description of the clinical significance codes is shown in Appendix 1. As seen in section 2.2.3, the levels of clinical significance were changed prior to the PROMISe III trial.

2.2.2 Validation of the DOCUMENT system

The DOCUMENT system was validated for reliability and internal consistency. Twenty scenarios were selected from the pilot dataset where each scenario described a DRP situation that had occurred in community pharmacy.¹⁴⁴ The aim of the validation was to determine if pharmacists could appropriately classify the category and sub-category of DRP from a description. Of the 241 pharmacists that expressed interest, 156 assessed at least one scenario and 92 pharmacists assessed all 20 scenarios. The pharmacists did not receive any initial training on the classification system, but did have access to explanatory notes during the validation process. The number of correct assessments of the category and sub-category are shown in Table 2-3, where the majority of participants (70.2%) were able to identify the correct category of DRP for most of the scenarios. The level of agreement between the pharmacists was assessed using Fleiss' kappa.¹⁴⁶ The test returned a value of $\kappa = 0.53$, which is considered indicative of moderate agreement between the raters. Given that the pharmacists involved in the validation exercise had no previous experience with the DOCUMENT system and received no training before undertaking the validation process, and that the majority of them completed the exercise in a short period of time, the level of agreement with the correct DRP category was considered reasonable.

To confirm consistency of classification, a random selected sample of 40 of the pharmacists who originally completed the scenarios were approached to re-attempt the classification as an internal consistency test. Of these, 18 completed the 20 scenarios

again approximately one month after initial classification (see Number (%) Concordant in Table 2-3). There was good concordance (69.2%) between the first and second attempts in the selection of categories, indicating that the same pharmacist would use the same DOCUMENT category to code the same scenario on two separate occasions.

Correct Type	Scenario #	Number (%) Correct Responses	Number (%) Concordant (n=18)
Drug selection	1	91 (64.1%)	11 (61.1%)
	2	89 (78.1%)	16 (88.9%)
	3	89 (84.8%)	18 (100.0%)
	4	61 (57.5%)	12 (66.7%)
	5	55 (52.4%)	12 (66.7%)
	Total	385 (67.3%)	69 (76.7%)
Over or underdose	1	131 (96.3%)	17 (94.4%)
	2	95 (89.6%)	13 (72.2%)
	3	94 (89.5%)	14 (77.8%)
	Total	320 (92.2%)	44 (81.5%)
Compliance	1	95 (62.1%)	11 (61.1%)
	2	100 (89.3%)	12 (66.7%)
	3	74 (66.7%)	11 (61.1%)
	Total	269 (71.5%)	34 (63.0%)
Untreated indications	1	76 (63.3%)	11 (61.1%)
	2	32 (29.6%)	13 (72.2%)
	3	76 (73.1%)	12 (66.7%)
	Total	184 (55.4%)	36 (66.7%)
Monitoring		82 (76.6%)	10 (55.6%)
Education		64 (57.7%)	10 (55.6%)
Non-clinical		101 (99.0%)	16 (88.9%)
Toxicity or adverse reaction	1	80 (63.5%)	8 (44.4%)
	2	71 (64.5%)	13 (72.2%)
	3	53 (48.2%)	9 (50.0%)
	Total	204 (59.0%)	30 (55.6%)
Total		1609 (70.2%)	249 (69.2%)

Table 2-3: Results of the validation exercise for the DOCUMENT DRP Classification System

2.2.3 Modifications to the DOCUMENT system prior to PROMISe III

Experiences gained from the PROMISe II trial⁸¹ indicated a need to improve the DOCUMENT classification system so as to refine and simplify the documentation process. To inform this revision, a detailed examination of the interventions documented in the

PROMISe II trial was undertaken, including an analysis of the frequency of intervention types. An additional review of articles detailing clinical intervention studies was also performed to determine if any additional classification systems had been discussed in the broader international literature since 2007.^{78,79,84,85} The main purpose of the revision was to refine and simplify the documentation process to make it easier and quicker to use.

2.2.3.1 *DRP category changes*

A number of additional sub-categories were added to the 'Drug selection' category.

- *Incorrect strength* was added to accommodate when an error has been made when selecting a drug strength not intended for that patient.
- *Inappropriate dosage form* was reworded from 'wrong dosage form'.
- *Contraindications apparent* was added for situations where the pharmacist has determined that the patient has been prescribed drug therapy which is contraindicated with their medical condition.
- *No indication apparent* was included for when there is no clear reason why the drug should be used in the patient.

In the 'Over or underdose' category, *Incorrect or unclear dosing instructions* was included to accommodate situations where the specified dosage time was not optimal, or there was insufficient dosing instructions or an inappropriate dosage schedule.

Erratic use of medication was added to the 'Compliance' category to encompass when the patient has been inconsistent with taking their medication, possibly due to poor memory or lack of care or knowledge.

The category 'Untreated indications' was renamed to 'Undertreated', as some indications may be treated, but not adequately. The additional sub-categories *Condition undertreated* and *Condition untreated* allowed the pharmacist to distinguish between the two different interventions.

The 'Education or information' category was condensed to three sub-categories from the five sub-categories in PROMISe II. Within community pharmacy, a patient request for information would be either in relation to their drug therapy or their disease, therefore the two main sub-categories *Patient requests drug information* and *Patient requests disease management advice* were felt to encompass the majority of problems relating to education or information.

The 'Non-clinical' category was renamed to 'Not classifiable'. In PROMISE II, participants were asked to document administrative interventions, however, in PROMISE III pharmacists were specifically asked to not document non-clinical interventions such as those relating to administration of the Pharmaceutical Benefits Scheme. Therefore, this category was renamed to target situations where a pharmacist felt that a clinical intervention could not be classified under other categories.

The 'Toxicity' category was condensed to one option in PROMISE III, down from four in PROMISE II. This was to simplify classification of any problem relating to the presence of signs or symptoms of toxicity that may be attributed to a medication.

The incorporated changes and therefore the final version of DOCUMENT used in PROMISE III and this study can be seen in Table 2-4.

2.2.3.2 Recommendation changes

The recommendation classifications remained very similar to those used in PROMISE II. One change was made by dividing *Dose change* into *Dose increase* and *Dose decrease* in order to assist researchers with interpretation of the intervention. The incorporated changes to the recommendation lists can be seen in Table 2-5.

2.2.3.3 Clinical significance category changes

The significance codes of the intervention as allocated by the pharmacist were simplified in PROMISE III, by renaming the categories and by including more detailed descriptions to enable easier allocation. *Nil significance* was removed as PROMISE III pharmacists were asked to document only clinical interventions, not administrative tasks, and therefore, there should be no clinical intervention which has zero clinical significance. These changes can be seen in Table 2-6.

2.2.3.4 Other changes

The other major change to the DOCUMENT DRP Classification System was the removal of the Action and Outcomes components. During analysis of the PROMISE II trial, it was determined that knowing the actions of the pharmacist did not provide any measurable benefit, so it was removed to lighten the pharmacists' workload. The Outcomes component was removed because PROMISE II pharmacists commented that they were often unable to determine the outcome of the intervention, yet were flagging the recommendation as 'Accepted' in 82.1% of cases. This suggested that the pharmacists

were not reporting the outcome accurately, thus this option was removed. A simple decision-tree was also developed to assist pharmacists in identifying the main DRP category (Appendix 2).

2.2.4 Final version of the DOCUMENT system

The final version of the DOCUMENT DRP Classification System can be seen in Table 2-4, Table 2-5 and Table 2-6, and more detailed explanations of the categories can be found in Appendix 3. The DOCUMENT classification system has been published in two separate, peer-reviewed articles.^{145,147}

Drug-related problem	Code	Description	Code	Description
	D	Drug selection (Problems relating to the choice of drug prescribed or taken)	D1	Duplication
			D2	Drug interaction
			D3	Wrong drug
			D4	Incorrect strength
			D5	Inappropriate dosage form
			D6	Contraindications apparent
			D7	No indication apparent
			D0	Other drug selection problem
	O	Over or underdose (Problems relating to the prescribed dose or schedule of a drug)	O1	Prescribed dose too high
			O2	Prescribed dose too low
			O3	Incorrect or unclear dosing instructions
			O0	Other dose problem
	C	Compliance (Problems relating to the way the patient takes the medication)	C1	Taking too little
			C2	Taking too much
			C3	Erratic use of medication
			C4	Intentional drug misuse (incl. OTCs)
			C5	Difficulty using dosage form
			C0	Other compliance problem
	U	Undertreated (Problems relating to actual or potential conditions that require management or prevention)	U1	Condition undertreated
			U2	Condition untreated
			U3	Preventative therapy required
			U0	Other untreated indication problem
	M	Monitoring (Problems relating to monitoring the efficacy or adverse effects of a drug)	M1	Laboratory monitoring
			M2	Non-laboratory monitoring
			M0	Other monitoring problem
	E	Education or information (Where a patient requests further information about a drug or disease state)	E1	Patient requests drug information
			E2	Patient requests disease management advice
			E0	Other education or information problem
	N	Not classifiable (Problems that cannot be classified under another category)	N0	Clinical interventions that cannot be classified under another category
	T	Toxicity or adverse reaction (Problems relating to the presence of signs or symptoms that may be attributed to a drug)	T1	Toxicity, allergic reaction or adverse effect present

Table 2-4: Final DOCUMENT DRP categories and sub-categories used in PROMISe III

Recommendations	A change in therapy	R1	Dose increase
		R2	Dose decrease
		R3	Drug change
		R4	Drug formulation change
		R5	Drug brand change
		R6	Dose frequency/schedule change
		R7	Prescription not dispensed
		R8	Other changes to therapy
	A referral required	R9	Refer to prescriber
		R10	Refer to hospital
		R11	Refer for medication review
		R12	Other referral required
	Provision of information	R13	Education or counselling session
		R14	Written summary of medications
		R15	Recommend dose administration aid
		R16	Other written information
	Monitoring	R17	Monitoring: Non-laboratory
		R18	Monitoring: Laboratory test
	Other	R19	No recommendation necessary

Table 2-5: Final DOCUMENT recommendation codes used in PROMISe III

Significance	S1	Consequences related to information
	S2	Prevented mild symptom or improved compliance
	S3	Prevented or required a GP visit
	S4	Prevented or required a hospital admission

Table 2-6: Final DOCUMENT significance codes used in PROMISe III

2.3 Clinical knowledge survey

Several previous studies that were identified during the literature review found important correlations between the pharmacist's level of clinical knowledge or education, and their ability to provide professional services.^{106,108,110,115,121} Therefore, using clinical intervention data that was collected during the PROMISe II trial⁸¹, a survey-based clinical knowledge measurement tool was developed. Three clinical pharmacy researchers (including this author) constructed nine clinical cases with seven multiple-choice questions (63 questions in total) based on scenarios that were found to occur frequently in Australian community pharmacies.

The questions aimed to assess a pharmacist's ability to identify, gather relevant information about, and make appropriate recommendations to resolve, a DRP.

Pharmacists were required to read a descriptive paragraph and select how relevant or

appropriate they felt each of several proposed actions was to the specific scenario using a 7-point Likert scale. A 7-point scale was chosen as it was thought that more options would provide a more accurate representation of the pharmacist’s abilities. The pharmacist was required to answer each statement before they could move on to the next question (see Appendix 4 for all questions).

2.3.1 Administration of the survey

The survey was administered through the online survey builder LimeSurvey v1.8 (<http://www.limesurvey.org/>) and an example screen layout can be seen in Figure 2-1. An online survey system was chosen to administer the tool, as it would substantially increase the number of pharmacists who could participate compared to a simulated patient study.

*
A slightly overweight, 51yo female patient who regularly visits your pharmacy presents a prescription for perindopril 5mg. The dispensing records indicate that the last antihypertensive agent prescribed for this patient was the perindopril/indapamide combination and it was last dispensed 3 months ago.

Please indicate how relevant each piece of additional information would be in this case.

	Very Relevant	Moderately Relevant	Only Slightly Relevant	Neutral	Only Slightly Irrelevant	Moderately Irrelevant	Totally Irrelevant
Discuss with the patient whether the medication change was intentional.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discuss with the patient's doctor whether the medication change was intentional.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Obtain the patient's blood pressure to determine current efficacy of her antihypertensive treatment.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determine the patient's smoking history.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discuss with the patient their compliance with the antihypertensive agent.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Determine if the patient has had a cholesterol level done recently.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Discuss a weight management program with the patient.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

[\[Exit and clear survey\]](#)

Resume later

<< PreviousNext >>

Figure 2-1: The appearance of the clinical knowledge survey questions in LimeSurvey

2.3.2 Refining the questions

Eighteen clinical research pharmacists and academics within three Schools of Pharmacy in Australia (University of Tasmania, Monash University and Curtin University of Technology) were asked to validate the questionnaire to determine its suitability. Questions were to be removed if the validators’ answers created standard deviations that were greater than two units above the mean, and this process eliminated 11 questions. For the remaining questions, the answers were analysed to determine if the validators gave similar answers to the writers’ intentions. Any questions with responses that were too dissimilar to the writers’ intentions were also removed (for example, the question was written with the

intention of an ‘irrelevant’ response but the validators said it was ‘relevant’). A further 12 questions were removed using this method, leaving 9 clinical cases, each with between three and six multiple-choice statements, resulting in a total of 40 questions for analysis.

2.3.3 *Developing a scoring system*

From the 40 questions, scores were calculated where the correct answer was defined as the mode of the 18 validators’ answers. Each question received a score of 2, 1 or 0 depending on how far away the answer was from the mode. For example, if the validators agreed the answer was ‘Relevant’, the participant would receive a score of 2 for answering ‘Relevant’, 1 for ‘Very Relevant’ or ‘Slightly Relevant’ and 0 for any other answer. For this survey, the lowest possible total score was 0 and the highest was 80, with the intention that a higher score would signify a higher level of clinical knowledge.

2.3.4 *Validation of the survey*

The survey was administered to Bachelor of Pharmacy undergraduate students at the University of Tasmania to validate the survey and consisted of 28 fourth-year, 41 third-year, and 42 first-year students. Overall, students’ level of clinical knowledge is expected to increase as they proceed through each year of the pharmacy degree. That is, as seen in previous student knowledge questionnaires¹⁴⁸, it was expected that the fourth-year students would have a higher mean score than the third-year students, who in turn would have a higher score than the first-year students. The scoring system derived from the validators’ answers was used to conduct an analysis of variance, which showed significant differences between the three groups of students ($F(2,108) = 82.14, p < 0.001$). Post-hoc analysis was undertaken using the Gabriel method, as the population variance proved normal with Levene’s test of equality but the sample sizes were unequal.¹⁴⁹ The Gabriel post-hoc results showed significant differences between the first-years and the third- and fourth-years ($p < 0.001$ for both tests), but the difference between the third- and fourth-years was only approaching significance ($p = 0.054$).

	Count	Mean	Std. Dev.	Min.	Max.
4th years	28	52.36	6.62	42.00	68.00
3rd years	41	48.20	6.59	33.00	58.00
1st years	42	32.43	7.81	15.00	54.00
Total	111	43.28	11.14	15.00	68.00

Table 2-7: Descriptive statistics of the survey scores for the three groups of students

2.3.5 Measurement of inter-rater reliability

Reliability of the survey was assessed using the Cronbach's alpha and Fleiss' kappa methods. Cronbach's alpha is a measure of the internal reliability of a scale¹⁴⁹ and Fleiss' kappa is a statistical measure for assessing the reliability of agreement between a fixed number of raters when assigning categorical ratings to a set number of items.¹⁴⁶ Fleiss' kappa was considered more relevant than Cronbach's alpha for this particular survey due to the use of the Likert scale categories; however, both methods were utilised.

2.3.5.1 Cronbach's alpha

To ensure an accurate Cronbach's alpha value, negatively worded questions must first be reversed.¹⁴⁹ This required reversal of the scores in questions 4.2, 4.5, 5.4, 5.6, 6.6, 7.1, 7.5, 7.6, 7.7, 8.1, 8.2, 8.5, 8.6 and 9.7.

A Cronbach's alpha value of 0.7 or higher is considered to show good correlation between the subjects.¹⁴⁹ Analysis using SPSS (versions 17 and 18) showed that the survey had moderate correlation between the validators on the final 40 questions ($\alpha = 0.62$) with 'α with the deletion of one item' ranging from 0.46 to 0.61, indicating that the questions had similar influence in the total score. When the analysis was performed on answers from additional groups (validators and fourth-year students, with and without third-year students), $\alpha = 0.63$ and $\alpha = 0.70$ respectively. Table 2-8 shows the reliability coefficients of various Cronbach's alpha tests using different parameters.

	Number of participants	Cronbach's alpha
Validators	18	0.620
Validators plus 4 th years	46	0.630
Validators plus 4 th and 3 rd years	87	0.704
Validators plus 4 th , 3 rd and 1 st years	129	0.843
4 th , 3 rd and 1 st years	111	0.828

Table 2-8: Results of Cronbach's alpha statistical tests using various parameters

2.3.5.2 Fleiss' kappa

In addition to the Cronbach's alpha analysis, a Fleiss' kappa statistical test was also run in Microsoft Excel® on the 40 answers given by the validators. The statistical test returned a value of $\kappa = 0.33$, which is considered a fair agreement.¹⁴⁶

2.3.6 Use in PROMISe

The final evaluation of the pharmacist's clinical knowledge measurement tool was performed by administering it to Australian community pharmacists who were participating in the PROMISe trial. The pharmacists' survey scores were used to determine whether there was a correlation between the pharmacist's ability to detect and resolve DRPs and their actual rate of documenting clinical interventions during the trial.

2.4 Development of the intervention documentation software

In order to accurately collect the intervention data, software was designed and integrated into the pharmacy dispensing systems. This software communicated with a remote repository, which allowed easy collation of all pharmacy data for analysis.

2.4.1 PROMISe user interface

The two dispensing software vendors that were involved in the PROMISe project were FRED® (FRED Health, Melbourne, Australia) and Aquarius® (Simple Retail, Sydney, Australia). The FRED® dispense system had over 50% of the market share in Australian pharmacies¹⁵⁰, allowing a large number of pharmacies to take part in the trial. Aquarius® was established in over 500 pharmacies¹⁵¹ (approximately 10% of the market) and had substantial penetration in the NSW, Victorian and Tasmanian markets. The PROMISe software was integrated into the dispensing systems to ensure that the PROMISe interface had the same “look and feel” as the dispensing system that the participating pharmacists were accustomed to.

The user interface was activated by clicking on the PROMISe icon or by pressing ‘Alt + i’ on the keyboard. Additionally, FRED® users could also access the interface by selecting ‘New Intervention Note’ from the ‘Activities’ menu. Activation of the interface could be made at any stage of dispensing a prescription and fields would appear pre-populated where possible. The user interface can be seen in Figure 2-2.

Figure 2-2: PROMISE intervention documentation interface (FRED®)

The DOCUMENT classifications and extra notes sections were available in the tabbed sections of the screen as shown in Figure 2-2. The intervention classification tabs were listed in order from left to right to reflect workflow in both dispensing systems – category, recommendations, significance, and extra information. The category tab detailed the DOCUMENT DRP category, the recommendation tab listed the options for the pharmacist’s recommendations to the patient, and the significance tab contained the four possible significance categories for the intervention. The pharmacist was required to select the most appropriate sub-category from each of these tabs. The notes or extra information section provided a free text box for the pharmacist to write a short description of the intervention.

The time taken to perform the intervention and the pharmacist initials were both mandatory fields. As requested by the focus groups, a pharmacist was able to save the intervention as a draft and complete it at a later time to help to improve the workflow surrounding the documentation process.

By clicking the 'Display Help Panel' checkbox, information about the selected sub-categories could be seen at the bottom of the intervention screen. Information displayed here included details of when and when not to use, and examples of use of each classification selection within the DOCUMENT system, as can be seen in Figure 2-3.

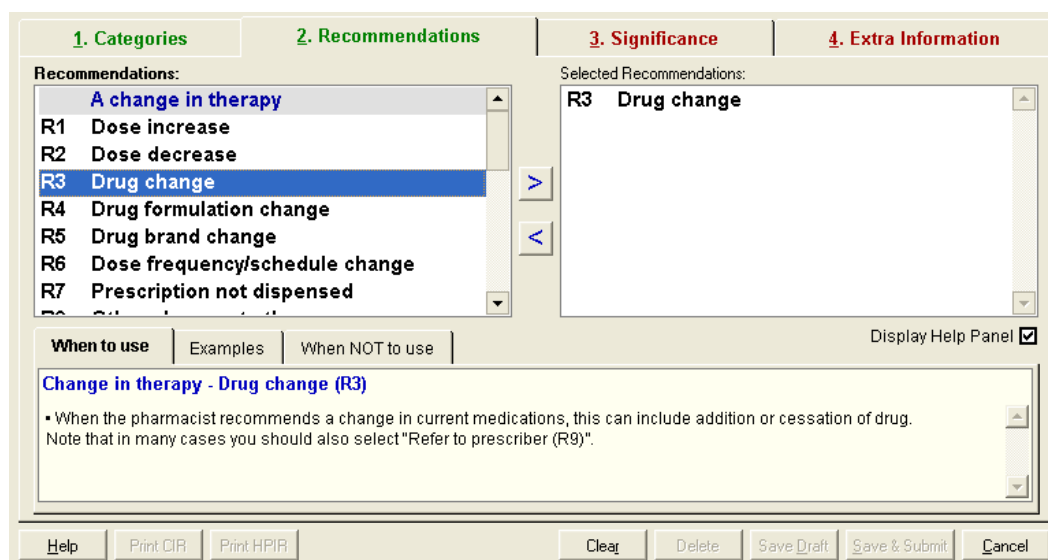


Figure 2-3: Help function within the PROMISE interface

Once an intervention was documented against a patient, the PROMISE logo appeared in the patient's dispensing history indicating that the patient had been subject to an intervention, which allowed a pharmacist to access the information regarding the intervention in the future. The information about each completed intervention was transmitted to a secure repository.

2.4.2 Feedback mechanisms

Feedback from pharmacists in the initial focus groups indicated that encouragements and reminders may prompt more interventions than would otherwise have occurred. Therefore, several electronic feedback mechanisms, including web-based reports, a statistic display, non-specific reminders and specific prompts, were built into the PROMISE software.

All participants were able to access the web-based reports through the PROMISE website that displayed individual pharmacy and pharmacist intervention details. The reports also provided the intervention rates for each state and a breakdown of intervention types, recommendations, and drug groups, which were aimed to motivate the participants.

A real time statistic display was incorporated into the intervention screen to provide accessible motivational feedback to all pharmacists, an example of which can be seen in Figure 2-4. The PROMISe repository was polled several times daily to update the current overall trial intervention rate. The display showed the entire trial intervention rate as shown by *All* in the FRED® figure and *Global* in the Aquarius® figure. The individual pharmacy intervention rate was entitled *Site* in the FRED® figure and *Local* in the Aquarius® figure. These screenshots were taken prior to the trial going live, therefore the percentages are inaccurate.



Figure 2-4: Statistics display for FRED® (left) and Aquarius® (right)

Feedback and support was also provided through pharmacy visits. The visits ranged in duration from fifteen to ninety minutes depending on the needs of the pharmacists. During the visits, the pharmacists were shown how to access the online reports and they were also given the opportunity to ask any questions and relay any problems back to the project team. The other aim of the visits was to obtain additional pharmacy data. Pharmacies also received reminder phonecalls at various times throughout the trial.

2.4.2.1 Reminder

For selected pharmacies only, a non-specific reminder was timed to appear at 11am and 3pm. It aimed to remind pharmacists to document their interventions or to complete their draft interventions (Figure 2-5).



Figure 2-5: The reminder built into the software

The timing of the reminder targeted periods of the day where the pharmacist may have enough time to document the interventions (morning tea and afternoon tea time). These times were similar to the peaks in number of interventions documented by Rupp et al., whose article reported that the most interventions were documented during 10-11am and 4-5pm.⁵⁷

2.4.2.2 Prompt

The use of a prompt for one specific intervention (the prophylactic use of aspirin in patients with diabetes) was trialled in the PROMISe II project to test the function of influencing a specific type of intervention.⁸¹ The presence of the prompt resulted in an increased frequency of the targeted intervention, as well as an increase in the overall intervention rate.¹³⁶

In PROMISe III, prescriptions of high-dose proton pump inhibitors (PPIs), specifically pantoprazole (Somac®) and esomeprazole (Nexium®), were targeted with a specific intervention prompt. This particular intervention was chosen on the basis of high publicity from a National Prescribing Service (NPS) media release in May 2009.¹⁵² The prompt, shown in Figure 2-6, was activated in selected pharmacies when pantoprazole 40mg or esomeprazole 40mg were chosen for dispensing. It encouraged pharmacists to discuss with eligible patients the possibility of reducing their medication dosage on consultation with their GP. The pharmacists had the choice to continue dispensing, print the patient information leaflet or print the pharmacist/GP information leaflet. These leaflets can be found in Appendices 5 and 6.

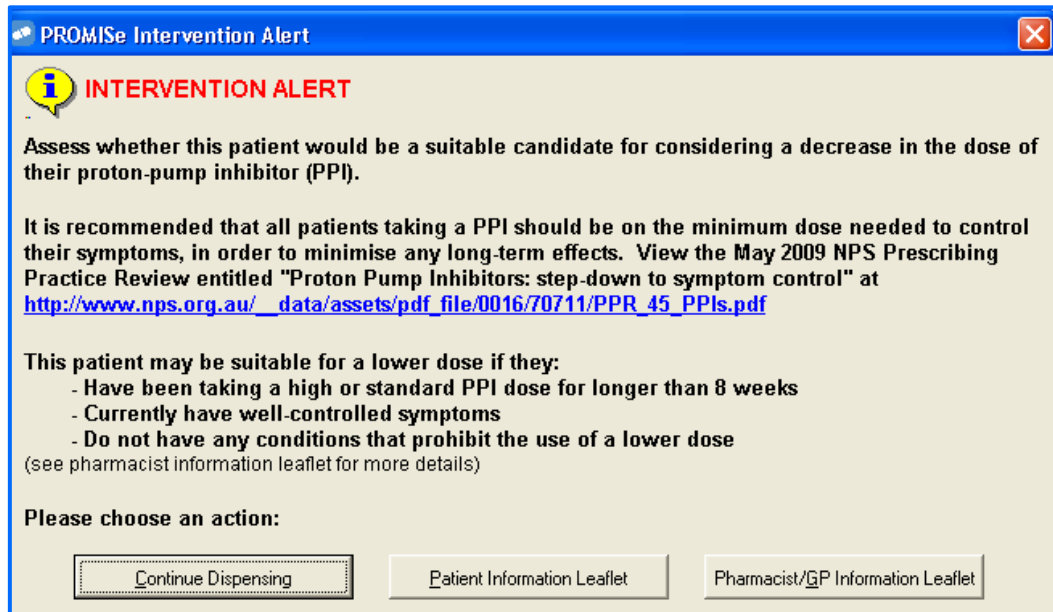


Figure 2-6: Specific prompt built into the PROMISe software

2.5 *PROMISe III trial*

To examine the nature and frequency of clinical interventions documented in community pharmacy in Australia and to determine any factors that influenced the documentation of these interventions, the PROMISe III trial was conducted throughout 210 Australian pharmacies in 2009.

2.5.1 *Ethics approvals*

All aspects of the PROMISe III project trial methodology were approved by the Tasmanian Health and Medical Research Ethics Committee as outlined in Table 2-9.

Study	Approved by	Reference No.
Documenting Clinical Interventions in Community Pharmacy - PROMISE III	Tasmanian Health and Medical Human Research Ethics Committee	H0010393
Documenting Clinical Interventions in Community Pharmacy - PROMISE III: Sub-study of consumers subject to a clinical pharmacy intervention	Tasmanian Social Science Human Research Ethics Committee	H0010388
Documenting Clinical Interventions in Community Pharmacy - PROMISE III: Sub-study of random pharmacy consumers	Tasmanian Social Science Human Research Ethics Committee	H0010388
An observational sub-study of pharmacists and the rate of interventions in the sales of non-prescription medicines	Tasmanian Social Science Human Research Ethics Committee	H0010623

Table 2-9: Ethics approvals for PROMISE III

2.5.2 Project outline

The PROMISE III trial was conducted over a twelve week period and involved 210 Australian pharmacies from across three states; Tasmania, Victoria and New South Wales. During the trial, an observational sub-study was conducted that involved observing participating pharmacists performing their usual activities in the pharmacy. These and the other aspects of the trial are outline in the flowchart in Figure 2-7.

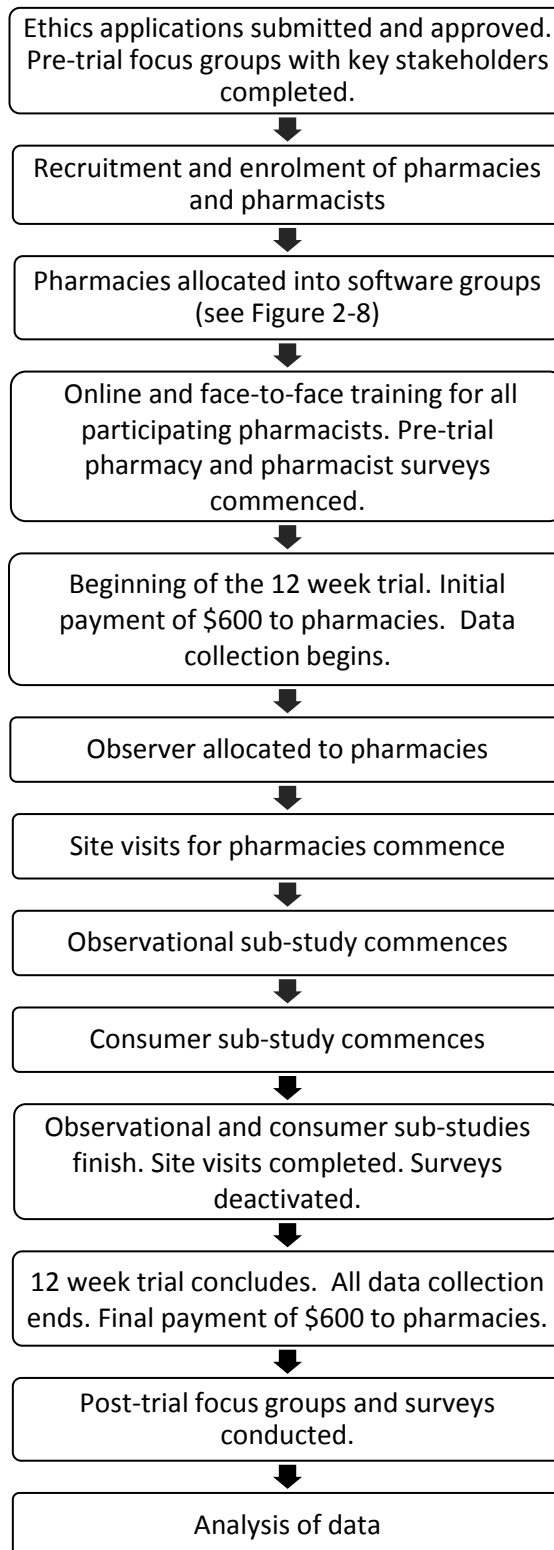


Figure 2-7: PROMISE III trial outline

The aspects of the consumer sub-study were not considered relevant to this thesis and therefore will not be discussed in detail.

2.5.3 Study arms

In order to determine what influence each of the major features of the documentation software had on the intervention rates, a number of different trial arms were used throughout the study.

2.5.3.1 No software pharmacies

In order to collect a true representation of intervention and documentation behaviour in the absence of the PROMISe software, the no software pharmacies received only minimal information about the PROMISe project and did not have the PROMISe software installed. The no software pharmacy data was collected by pharmacy observers over a five-day period (see section 2.5.7.4 for more information). The observers recorded the pharmacist's current method of documenting interventions and obtained a *performed* clinical intervention rate, as well as a *documented* clinical intervention rate, by noting the number of prescriptions dispensed and the number of interventions both performed and documented. The performed intervention rates recorded in the no software group were compared to the performed rates in the PROMISe software pharmacies to determine if the presence of the PROMISe software increased the rate of performing interventions, as well as the rate of documenting interventions.

2.5.3.2 Software pharmacies

Three groups of software pharmacies were established to determine the optimum combination of feedback and support mechanisms to facilitate a high level of uptake of documentation using the recording system. As described in section 2.4.2, all groups had access to the online repository providing electronic feedback and reports of interventions specific to both the pharmacy and pharmacist. In addition, they could all view a live intervention documentation rate on the PROMISe interface, including the rate for the pharmacy and the overall trial rate. The groups were therefore defined by their software functions:

- Group One had the PROMISe documentation software installed with no additional features and was also referred to as the 'software only' group.
- Group Two had the software installed with a reminder built into the system. The reminder, as mentioned in section 2.4.2.1, was activated at 11am and 3pm to encourage pharmacists to document interventions. This group was also referred to as the 'software with reminders' group.

- Group Three had the software installed with the reminder and the additional intervention prompt feature. As discussed in section 2.4.2.2, this prompt was activated when dispensing pantoprazole 40mg or esomeprazole 40mg. This group was also referred to as the ‘software with prompts and reminders’ group.

2.5.4 Sample size calculation

The sample size selected was limited by the resources available and logistics. In order to obtain a representative sample, a decision was made to examine approximately 5% of the pharmacies in Australia. As there were 5006 pharmacies in Australia at the time of the trial, a sample size of 210 (4.2%) pharmacies was selected.

Table 2-10 shows the statistical power of three scenarios, based on the 24 no software pharmacies and the remaining 186 in the software pharmacy groups. All calculations were performed by an outside statistical consultant with the *sampsi* command in Stata 11 (StataCorp LP, College Station, Texas), using a standard first-type error of $\alpha = 0.05$. The sample size of 210 pharmacies would be able to detect a difference in intervention rate of at least 0.001 (1 in 1000 prescriptions) with 100% power, provided the level of data loss was within tolerances. A difference of 0.0005 would be detected in all cases with a power of approximately 90%.

Assumption	N* in treatment group	N in control group	Intervention rate in treatment group	Intervention rate in control group	Power
Full cohort – 1000 Rx/week	2,232,000	288,000	0.0053	0.005	56%
			0.0055		94%
			0.0060		100%
Full cohort – 900 Rx/week	2,008,800	259,200	0.0053	0.005	52%
			0.0055		91%
			0.0060		100%
90% of cohort – 900 Rx/week	1,803,600	237,600	0.0053	0.005	49%
			0.0055		89%
			0.0060		100%

*N refers to the number of prescriptions

Table 2-10: Power calculation for 186 software pharmacies and 24 no software pharmacies

2.5.4.1 Stratification

The group allocation is detailed in Figure 2-8. The software pharmacies were stratified based on the national average of PhARIA (Pharmacy Access/Remoteness Index of

Australia; a measure of the remoteness of the pharmacy¹⁵³) and estimated annual prescription volume categories, as outlined in the 2008 Guild Digest.¹⁵⁴ Once stratified accordingly, pharmacies were then randomly allocated across the three software groups. The pharmacies in the no software group were recruited and stratified separately to the 186 software pharmacies as discussed in section 2.5.6.2. Chapter 4 will further detail group allocation and stratification.

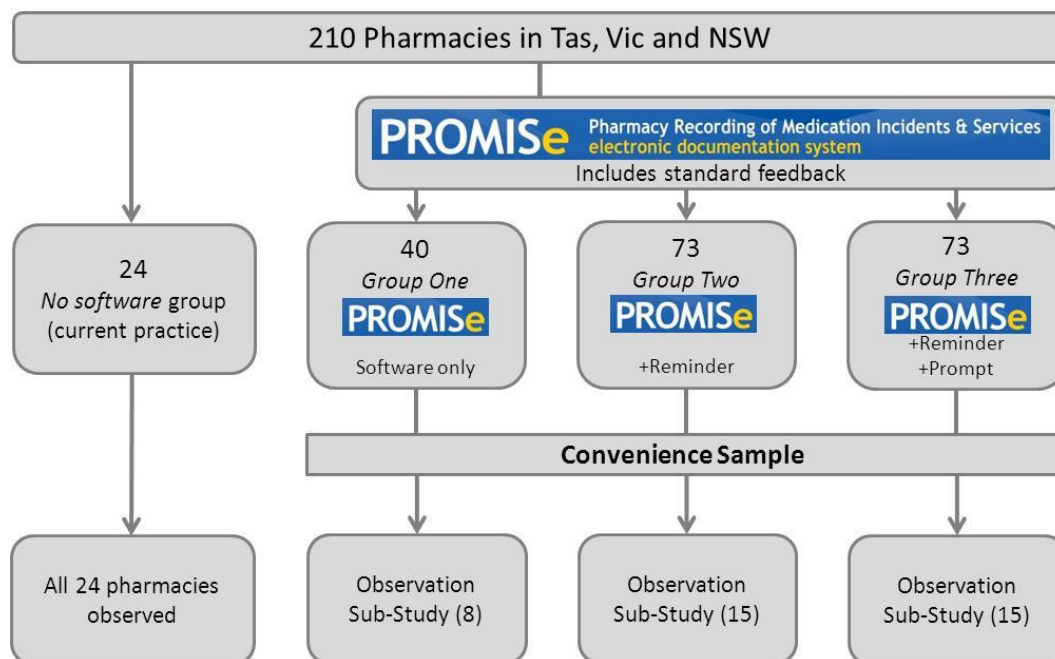


Figure 2-8: Allocation plan for PROMISE III project

The no software group and the three software groups were of different sizes for two reasons. The no software group required an observer in the pharmacy, therefore budget constraints meant that only 24 no software pharmacies could be recruited. In addition, the software groups were deliberately weighted to have more pharmacies in the reminder and prompt groups, as PROMISE II had shown these groups should have a higher intervention rate.

2.5.5 Observational sub-study

The observational sub-study had two arms:

- *No software pharmacies* were observed to collect information on current pharmacy practice
- *Software pharmacies* were observed on current practice as well as the documentation of interventions on the installed software

As can be seen in Figure 2-8, a sample of pharmacies from each group were invited to participate on the basis of location and size, and participation was voluntary.

2.5.5.1 *Observational study design*

The observational sub study was designed to assist in determining which factors actually influence a pharmacist's performance and documentation of interventions. Previous studies have frequently used self-reporting which only detects the perceived influencing factors, while an observational study has the benefit of being able to more accurately measure real factors. Selected pharmacists were observed performing their usual activities in the pharmacy by a trained pharmacist observer who collected data on paper-based forms. Collected data included the pharmacists' current methods of documenting DRPs and interventions, the performed clinical intervention rate, and the documented clinical intervention rate. Sixty two pharmacies participated in the observation sub-study; 24 from the no software pharmacies and 38 from the software pharmacies (Figure 2-8).

Twelve registered pharmacists across Tasmania, Victoria and New South Wales were recruited as observers for the sub-study. One Tasmanian-based observer was individually trained and undertook one week of pilot observation to detect any methodological issues with the study. This was undertaken prior to the training of the observers, as shown in the schedule in Table 2-11. The results of the pilot observation meant the data collection record forms could be improved prior to the commencement of the main study.

The observers "shadowed" one participating pharmacist over five days (Monday to Friday from 9am until 5pm). On some occasions, due to rostering and staff hours, this meant different pharmacists were observed during the observation week. Most observers were employed for seven weeks: they undertook observer training for one week and observed for the remaining six weeks. Some observers visited fewer pharmacies than others and therefore were employed for less time. They also uploaded their real-time data collection reports to the online storage site within the six week observation period.

Observer	July 13-17	July 27-29	Aug 3-7	Aug 10-14	Aug 17-21	Aug 24-28	Aug 31-Sept 4	Sept 7-11
1	Tas*	Observer training (Tas)		Tas		Tas		
2			Tas	Tas	Tas	Tas	Tas	
3			NSW	Vic	Tas	Tas	Tas	Tas
4			NSW	NSW	NSW	NSW	NSW	NSW
5				NSW	NSW	NSW	NSW	
6				NSW	NSW	NSW		
7			Vic	Vic	Vic	Vic	Vic	NSW
8			Vic	Vic	Vic	Vic	Vic	Vic
9			Vic	Vic	Vic	Vic	Vic	Vic
10			Vic	Vic	Vic	Vic	Vic	Vic
11			Vic	Vic	Vic	Vic	Vic	Vic
12				Vic	Vic	Vic	Vic	Vic

*Pilot observation

Table 2-11: Schedule for observers in the observational sub-study

2.5.6 Recruitment and training

Recruitment for the project was extensive, with both pharmacies and observers required for the study.

2.5.6.1 Recruitment of software pharmacies

Participating pharmacies were recruited in several ways. Advertisements were run in *Pharmacy News* and *The Australian Pharmacist* in March and April 2009, targeting users of the FRED® and Aquarius® dispensing software. The advertisements directed interested parties to view the PROMISE website, which was located at <http://www.promise.org.au> during the trial. However, the advertising did not produce the required number of participants. The Pharmacy Guild of Australia assisted by sending out faxes to approximately 3000 pharmacies within the three targeted states, asking interested parties to view the website, phone the project team or return the fax with their contact details. This resulted in an improved response, with 334 pharmacies expressing interest. The researchers used the details on the expression of interest form to group these pharmacies according to their PhARIA and estimated annual prescription volume. Pharmacies were selected using the inclusion and exclusion criteria as shown in Table 2-12, resulting in 186 pharmacies invited to participate.

Inclusion criteria	Exclusion criteria
Fred® or Aquarius® dispensing software	Dispensing software other than Fred® or Aquarius®
Ability to be stratified according to the desired category of prescription turnover and PhARIA	The appropriate prescription turnover/PhARIA category being at capacity
All employee pharmacists committed to the twelve weeks of the trial	Inability of the employee pharmacists to commit to the trial
Timely expression of interest	Application after the cut-off date

Table 2-12: Inclusion and exclusion criteria of trial pharmacies

2.5.6.2 *Recruitment of no software pharmacies*

A further 24 pharmacies were recruited to make up the no software group. As these pharmacies did not receive the PROMISe intervention software, the pharmacy could be using any dispensing software and therefore the exclusion criteria were less strict (Table 2-13). The pharmacies recruited for the no software group were mostly pharmacies ineligible for inclusion in the software group, due to the pharmacy using another dispensing system or their stratification group already at maximum capacity.

Inclusion criteria	Exclusion criteria
Ability to be stratified according to the desired category of prescription turnover and PhARIA	The appropriate prescription turnover/PhARIA category being at capacity
Any dispensing software	Remote location (impractical to be visited by an observer)
Timely expression of interest	Application after the cut-off date

Table 2-13: Inclusion and exclusion criteria for no software pharmacies

2.5.6.3 *Training of the pharmacists*

Pharmacists participating in the PROMISe project were trained in the use of both the DOCUMENT system and the PROMISe intervention software. The training was presented in two ways; online and face-to-face. The online option provided practice for using the DOCUMENT system and short videos showing the use of the PROMISe software. It was necessary to provide online training, as many participants in remote areas were unable to attend one of the six face-to-face training sessions. The training was incentivised by awarding 1.5 CPD points and a \$50 Coles/Myer gift voucher for completion of the 15 training scenarios, plus an additional \$50 Coles/Myer gift voucher for attending the face-to-face training.

Online training

Thirty-one online training scenarios were prepared, based on a range of pharmacy specific situations. Scenario wording and classification codes were assigned and peer reviewed. Pharmacists were required to complete at least fifteen scenarios to receive their incentives, but were encouraged to undertake a further sixteen intervention scenarios. Pharmacists had to evaluate each scenario using the DOCUMENT system, and assign a DRP category, recommendations and significance category to the case-based scenario. At the completion of each scenario, the pharmacist was provided with immediate feedback which contained the peer-reviewed classification codes and an explanation as to why these codes were chosen. In addition, two videos demonstrating documentation of an intervention on both FRED® and Aquarius® PROMISe software were available online. The demonstrations were approximately fifteen minutes in length. All pharmacists were encouraged to complete the online training and view the demonstrations.

Face-to-face training

Face-to-face training sessions were held in Tasmania, Victoria and New South Wales, with two training sessions being run per state. The attendees assigned DOCUMENT categories, recommendations and significance categories to intervention scenarios that were similar to those seen in the online training. Each pharmacy received a training package that contained a welcome letter, information about their allocated group, a timeline of the trial, information about the sub-studies, a software “cheat sheet” guide, the DOCUMENT DRP Classification System booklet and a sticker to place on their computer monitor. Pharmacies that did not have a representative at any of the face-to-face training sessions were sent their training package in the mail. The aforementioned demonstration videos were presented at the face-to-face training, and computers were set up with the PROMISe software for participants to access.

2.5.6.4 Observer recruitment and training

The observer positions were advertised in the Australian Association of Consultant Pharmacy (AACP) and Pharmaceutical Society of Australia (PSA) news bulletins. A total of 19 pharmacists expressed interest from which 12 observers were recruited. The final 12 were selected based on their experience and location, and the selection criteria were as follows:

- At least five years of community pharmacy experience
- Ability to observe in one of the three trial states (TAS, VIC or NSW)
- Preference was given to candidates who had experience in similar roles for other studies

Of the selected group of 12 observers, 10 (83.3%) were female with a mean age of 39 ± 10.7 years. They had an average of 12.4 ± 8.5 years of community pharmacy experience, with two observers having previous experience with research projects. There were no particular conflicts of interest known to the project team.

The observers underwent a two and a half day training course in Tasmania. The course involved intensive training in the DOCUMENT DRP Classification System and in their observation tasks, as shown in Table 2-14. The observers all received two folders, one with their training information and another with all of their forms for data recording. They also received pre-paid A4-sized envelopes to post their data collection forms back to the PROMISE team.

Task	Description	Form
Explain study	Discuss the project and sub-study with each observed pharmacist: build rapport with the observed pharmacists, ensuring all observed pharmacists place a consumer notice in the pharmacy.	Consumer Notice
Determine performed intervention rate and the documented intervention rate	Record each and every intervention you witness in the pharmacy regardless of whether the pharmacist documented it. Record daily workload details of each observed pharmacist for each day.	Intervention Record; Hourly Log
Determine the pharmacist intervention level for OTC medication	Observe and record details of any intervention regarding OTC medications. Record the total number of OTC requests dealt with by the pharmacist to provide a denominator statistic for the interventions.	OTC Intervention Record Form; Hourly Log
Recruit consumers for the consumer sub-study	Assist the enrolled pharmacists with the recruitment of consumers for the consumer sub-study.	Consumer Envelopes
Undertake a 'Time and Motion' analysis of the pharmacy	Record the workflow of the pharmacy, the nature of the pharmacist's workload and staffing levels	Daily Log
Determine the practical barriers and facilitators to documenting clinical interventions	Record the observed barriers and facilitators for each pharmacist. For no software pharmacies, also record the details of the current methods of documenting interventions.	Barriers and Facilitators Record Form
Complete data entry	Enter all collected data online for ready access by the project team. Hard copies of the data collection forms to be mailed back to the project team.	Online Survey

Table 2-14: Outline of observer tasks

2.5.7 Data collection

In order to reduce implementation issues, the software pharmacies had a “rolling start” to the trial with the software being activated progressively over the course of two weeks. Each pharmacy was phoned by a member of the project team who provided them with an activation code, which also enabled the additional software features if allocated. Once activated, the pharmacy computers automatically sent data to the repository and the data collection period began once all pharmacies had been activated.

Information collected during this project needed to be sufficiently detailed for a reasonable “reconstruction” of the intervention, while still being relatively straightforward for pharmacists to record. Information relating to the intervention, the patient, the pharmacy, and the pharmacist were obtained. As shown in Table 2-15, information was collected from the repository, surveys, site visits and from the sub-studies.

Source	Data collected
Intervention data repository	Intervention information
	Patient information
	Prescription information
Pharmacist information	Background survey
	Intervention survey
	Empathy survey
	Professionalism survey
	Clinical knowledge survey
	Software survey
Pharmacy information	Owner/Manager survey
	Site visits
Observation sub-study	Intervention record
	Hourly log
	OTC intervention record
	Daily log
	Barriers and facilitators
Consumer sub-study information (*not discussed)	PROMiSe consumers
	Non-PROMiSe consumers

Table 2-15: Sources of data collected during the PROMiSe trial

2.5.7.1 *Intervention data repository*

The main source of data from the trial was collected through the PROMiSe interface which was linked to the data repository.

Intervention information

The type of intervention, according to the DOCUMENT DRP Classification System, was documented by the pharmacist with each individual intervention record. Up to four recommendation(s) made by the pharmacist could be documented, as well as a clinical significance as assigned by the pharmacist. Extra information could also be entered by the pharmacist as free text. The drug involved and the nature of the prescription (whether it was an original or repeat) was automatically assigned by the dispensing system if the intervention was directly linked to a prescription. Otherwise, the pharmacist nominated

the drug involved. The time taken to conduct the intervention was also provided by the pharmacist. The intervention information collected from the interface was sent to the central repository (see Figure 2-2 for the interface appearance).

Patient information

The dispensing history of the patient for the past six months was automatically collated and sent to the repository upon transmission of each individual recorded intervention. This allowed for a list of other medications to be constructed for each patient that was subject to an intervention, allowing a patient background to be created. The documenting pharmacist also identified the gender and provided an estimate of the patient's age bracket.

Prescription information

Details of all prescriptions dispensed in the pharmacy during the trial period were sent to the repository, so as to facilitate analysis based on the number of interventions documented versus the number of prescriptions dispensed, or the number of interventions performed within a particular group of drugs.

2.5.7.2 *Pharmacy information*

Pharmacy information was gathered in two ways. Firstly, an online survey was completed by owners or managers of the pharmacy, and secondly, site visits were undertaken by the project team.

Owner/Manager survey

This survey gathered information about the following areas:

- Demographics
 - Dispensing system
 - Pharmacy location
 - Area of the pharmacy (in m²)
 - Estimated financial turnover
 - Average weekly/annual prescription turnover
- Current practice
 - Number of trading days and hours per week
 - % of business attributable to the dispensary
 - Number of pharmacists responsible for making business decisions
 - Owner or manager operated
 - Banner group or independent

- Whether the pharmacy caters for an aged care facility
- Proportion of prescriptions assembled by dispensary technicians
- Presence of pre-registration pharmacist within the last two years
- Services
 - PGA-funded professional services currently provided
 - DMAS (Diabetes Management Assistance Service – a trial to assess the feasibility of offering diabetes management services through community pharmacies¹⁵⁵)
 - DAA (Dose Administration Aid trial – a trial assessing the provision of a medication packing service for war veterans⁵⁶)
 - PMP (Patient Medication Profile program – a trial to assess the provision of medication lists to consumers¹⁵⁶)
 - PAMS (Pharmacy Asthma Management Service – a trial to assess the feasibility of offering asthma management services through community pharmacies¹⁵⁷)
 - Mirixa – an electronic program used as a platform to deliver professional services within the community pharmacy¹⁵⁸
- Other professional services
 - Blood pressure monitoring
 - HMR (Home Medication Review) services
 - DAA (Dose Administration Aid) packing
 - Opioid dependency program
 - Diabetes screening
 - Wound care
 - Weight management program
 - MedsIndex

This information was used to determine the ‘type’ of pharmacy and aimed to determine any impact that these factors had on the pharmacy’s ability to participate effectively within the PROMISe III trial. See Appendix 7 for the complete survey.

Site visits

Site visits by the project team were carried out on the software pharmacies. Information was gathered in the following areas:

- Visibility and accessibility of the pharmacist and dispensary
- Presence and type of counselling area
- Number and type of health promotion posters or professional services advertised
- Workflow roles/responsibilities
- Number of dispensing terminals
- Number of FTE staff per week

The site visitor was also asked to make notes on the general pace and feel of the pharmacy from a patient's perspective. The site visit data collection sheet and staff roster template can be found in Appendices 8 and 9.

2.5.7.3 *Pharmacist information*

Information was gathered from the enrolled pharmacists before and after the trial period using the following surveys.

Background survey

The background survey gathered information about the following areas:

- Demographics
 - Gender
 - Age range
 - Year of graduation
 - Additional pharmacy qualifications
 - Professional memberships
- Background and current practice
 - Number of full-time years worked in community/hospital/ consultant pharmacy practice
 - Average number of hours of CPD completed annually
 - Current area of practice for the majority of the working week
 - Current role in community pharmacy
 - How many years in current position
 - How many hours a week in community pharmacy
 - Proportion of time spent on dispensing tasks
 - Number of other pharmacists working concurrent shifts
 - Approximate number of prescriptions dispensed per 9-hour day

This information was used to characterise a typical pharmacist and aimed to determine any impact that these factors had on the pharmacist's ability to participate effectively within the PROMISe III trial. See Appendix 10 for the complete survey.

Intervention survey

This survey collected the views of pharmacists concerning their current practice of performing clinical interventions in a community pharmacy setting by asking the pharmacists to assign their level of agreement on a 5-point Likert scale (Strongly Agree to Strongly Disagree) to the following statements:

- I believe that pharmacists are already too busy within the workplace which prevents them from taking on any new tasks.
- I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment.
- I would be willing to change my current practice if a new, better way was available.
- I believe the future of pharmacy remuneration will consist of more than just dispensing prescriptions.
- I always counsel patients with regards to their medications.
- I believe I have a good level of clinical knowledge to perform clinical interventions.
- I am confident in my ability to perform clinical interventions.
- I already perform clinical interventions on a daily basis.
- I believe the recording of interventions will increase my level of job satisfaction.
- I am concerned it will take too long to document interventions through the recording system.
- I am concerned the recording system will be hard to use
- I believe that a 'pop up' prompt would be useful to remind pharmacists to record clinical interventions.
- I believe customers should receive a printout if they are subject to an intervention.
- I believe participation in research projects is an important part of pharmacy practice.

This information was used to determine a pharmacist's views on interventions and determine any impact that these attitudinal factors had on the pharmacist's ability to participate effectively within the PROMISE III trial. The pharmacist's pre-trial answers were also compared to their post-trial answers to determine if the trial had altered their views. See Appendix 11 for the complete survey.

Empathy survey

This survey was derived from the 'Toronto Empathy Questionnaire' developed by Spreng et al.¹⁵⁹ which was a 16-item survey that enabled an empathy score to be allocated to each pharmacist. The marking scheme was detailed in the original article where the least empathetic response possible was 0 and the most empathetic response was 64.¹⁵⁹

Pharmacists were asked how often they agreed on a 5-point Likert scale (Always to Never) to the following statements:

1. When someone else is feeling excited, I tend to get excited too
2. Other peoples' misfortunes do not disturb me a great deal
3. It upsets me to see someone being treated disrespectfully
4. I remain unaffected when someone close to me is happy

5. I enjoy making other people feel better
6. I have tender, concerned feelings for people less fortunate than me
7. When a friend starts to talk about his/her problems, I try to steer the conversation towards something else
8. I can tell when others are sad even when they do not say anything
9. I find that I am 'in tune' with other people's moods
10. I do not feel sympathy for people who cause their own serious illnesses
11. I become irritated when someone cries
12. I am not really interested in how other people feel
13. I get a strong urge to help when I see someone who is upset
14. When I see someone being treated unfairly, I do not feel very much pity for them
15. I find it silly for people to cry out of happiness
16. When I see someone being taken advantage of, I feel kind of protective towards him/her

During the PROMiSe II trial, female pharmacists were shown to document a higher number of interventions compared to males, and it was thought that this may be due to differences in empathy. A measure of empathy was therefore included within the surveys to analyse any differences empathy made on a pharmacist's intervention rate. The complete survey is shown in Appendix 12.

Professionalism survey

This survey was derived from one designed by Chisholm et al.¹⁶⁰, which used 18 statements to look at six factors of professionalism within the pharmacy profession and provide a professionalism score. The original article was lacking in detail and did not provide a marking scheme or state which questions belonged in each of the six sub-scales. Correspondence with the author did not further clarify this as she had moved several times since the article was written and did not have the information available. Six pharmacists/researchers within the University of Tasmania were therefore given the sub-scale definitions from the article and asked to assign each question to a sub-scale. Consensus between these researchers was achieved and the sub-scale consensus appeared to match the scoring system provided in the original article. The professionalism questions were divided into the sub-scales of:

- Altruism (3 questions)
- Duty (2 questions)
- Honour and integrity (2 questions)
- Accountability (2 questions)
- Excellence (5 questions)
- Respect for others (4 questions)

This allowed a valid score to be assigned to all participants where the least professional response was 18 and the most professional response was 90. To calculate the score, pharmacists were asked to assign their level of agreement on a 5-point Likert scale (Strongly Agree to Strongly Disagree) to the following statements:

1. I do not expect anything in return when I help someone.
2. I attend work daily.
3. If I realise that I will be late, I contact the appropriate individual at the earliest possible time to inform them.
4. If I do not follow through with my responsibilities, I readily accept the consequences.
5. I want to exceed the expectation of others.
6. It is important to produce quality work.
7. I complete my tasks independently and without supervision.
8. I follow through with my responsibilities.
9. I am committed to helping others.
10. I would take a job where I felt I was needed and could make a difference, even if it paid less than other positions.
11. It is wrong to cheat to achieve higher rewards.
12. I would report a medication error even if no-one else was aware of the mistake.
13. I am able to accept constructive criticism.
14. I treat all patients with the same respect, regardless of perceived social standing or ability to pay.
15. I address others using appropriate names and titles.
16. I am diplomatic when expressing ideas and opinions.
17. I accept decisions from those in authority.
18. I am respectful to individuals who have different backgrounds than mine.

It was thought a higher level of professionalism may cause a pharmacist to perform more effectively in the PROMISe III trial, due to CIs being considered a professional service. A professionalism measure was therefore included to determine if this was correct and the survey is shown in Appendix 13.

Clinical knowledge survey

As discussed in section 2.3, a survey to assess the pharmacist's ability to identify, gather relevant information about and make relevant recommendations to resolve a DRP was administered. Pharmacists were asked to select how relevant they felt each action was to the specific scenario using a 7-point Likert scale (Very relevant to Not relevant at all). For this survey, the lowest possible score was 0 and the highest was 80, with a higher score indicating a higher level of clinical knowledge. The survey and the correct answer assigned to each statement can be seen in Appendix 4.

Software survey

In order to gain feedback after the trial period, participating pharmacists were asked to complete a software survey. This survey provided enrolled pharmacists the opportunity to offer feedback about the software and make suggestions. Some of the statements used in the initial intervention survey (Appendix 11) were repeated to determine if participation in the trial altered their responses. The survey is shown in Appendix 14.

2.5.7.4 Observational sub-study

Observers collected additional information for 38 software pharmacies and 24 no software pharmacies. The data collection forms used by the observers and their content were as follows:

Intervention record

This form was used to collect data about each actual intervention the pharmacist made, including patient demographics, drug involved and classification according to the DOCUMENT system. Also collected was the time taken by the pharmacist to perform and document the intervention, the resources used, and whether the pharmacist had documented it. Details of any prompts involved were also recorded. Collation of these forms provided details on the performed intervention frequency, as well as the documentation frequency by the pharmacist. The form is shown in Appendix 15.

Hourly log

This form recorded the date, approval number, pharmacist initials and opening hours. Also collected was the hourly data on the pharmacist's workload, including prescription count and other procedures, such as dispensing daily pick-ups, providing CMIs, dealing with OTC requests and completing administrative paperwork such as issuing safety net cards. This form also collected details of staffing levels for each hour and whether the interventions recorded by the observer were performed and/or documented by the pharmacist. The number of consumer packs sent out was also noted. The form is shown in Appendix 16.

Daily log

Completed daily, this log provided data concerning the approximate amount of time that the pharmacist spent on particular tasks during the course of the day. These tasks included dispensing, serving consumers, administrative tasks, and ordering. Data on the workflow in the pharmacy was also recorded, allocating approximate levels of dispensing

task distribution between non-dispensary staff, dispensary assistants and pharmacists. The form is shown in Appendix 17.

Barriers and facilitators

Observers collected data on potential barriers and facilitators which may have influenced the observed pharmacist in the documentation of clinical interventions. For the baseline pharmacies, information was also collected on the current level of documenting interventions. The forms are shown in Appendices 18 and 19.

Halls professionalism survey

Each of the observed pharmacists were asked to complete the modified Halls professionalism survey.¹⁶¹ As the online professionalism survey (see section 2.5.7.3) was previously only validated in pharmacy students, the results of the longer, validated Halls professionalism survey were compared to ensure a correlation between the two scores. The survey is shown in Appendix 20.

2.6 Analysis method

In order to analyse the factors that may have contributed to the differences seen in intervention rates between pharmacies and between pharmacists, many methods of analysis were employed.

2.6.1 Intervention rates

Intervention rates for the pharmacies were calculated from the intervention database by the number of documented interventions divided by the number of prescriptions dispensed for the whole period. The calculation was performed once the data was thoroughly cleansed in the following ways:

1. Removal of all interventions documented by pharmacists that were not enrolled in the trial (such as locum pharmacists, recent staff additions etc.)
2. Removal of all prescriptions dispensed by pharmacists that were not enrolled in the trial
3. Removal of all interventions documented for an OTC item or a symptom-based request (see section 2.6.1.1)
4. Removal of all interventions linked to the prompt in Group Three pharmacies (see section 2.6.1.2)

Intervention rates for the pharmacists were calculated by the number of interventions documented by that pharmacist divided by the number of prescriptions dispensed by that

pharmacist during the trial period. Again, all OTC, symptom-based and prompted interventions were removed from the dataset prior to performing the calculation. This calculation provided the documented intervention rates and are the intervention rates referred to in Chapter 4 and 5, unless otherwise specified.

2.6.1.1 OTC interventions

OTC product sales were not recorded through the dispensing system, therefore it was impossible to collect data to determine the 'denominator' for such interventions, such as the number of OTC products sold within that day by that pharmacy. It was therefore deemed necessary to remove all interventions documented for an OTC product. OTC products were identified by ATC groups⁸⁷ and subsequently removed.

2.6.1.2 Prompted interventions

As mentioned in section 2.6.1, interventions that were deemed to be associated with the prompt in Group Three were removed prior to analysis. The criteria for removal of these interventions were as follows:

1. Interventions associated with ATC groups⁸⁷ A02BC02 (pantoprazole) and A02BC05 (esomeprazole)
2. At least one of the following DOCUMENT recommendation categories: R2, R3, R7, R13
3. If available, reviewing the intervention notes made by pharmacists for these interventions to identify any anomalies.

2.6.1.3 Performed versus documented intervention rates

As mentioned in section 2.5.5, observers were placed in a sample of pharmacies for a period of five consecutive days to determine what percentage of performed clinical interventions were documented. Observers were present in the pharmacy for the day observing one pharmacist at a time, and using paper-based forms, they documented:

- Number of prescriptions dispensed by the pharmacist
- Number of interventions performed
- Number of interventions documented

This allowed two intervention rates to be calculated for each observed pharmacist:

1. Performed intervention rate (number of performed interventions divided by number of observed prescriptions dispensed)
2. Documented intervention rate (number of documented interventions divided by number of observed prescriptions dispensed)

The performance and documentation of interventions within observed pharmacies was then examined to quantify the effect that the documentation system had by comparing the software pharmacies with the no software pharmacies.

2.6.2 Analysis of the frequency and types of interventions

The intervention data was broken down into DOCUMENT categories, recommendations and significance to determine any differences in the frequency between each of the categories. The drugs involved were analysed according to their ATC grouping⁸⁷ to identify the most commonly intervened drugs. Drugs were also analysed according to their dispensing volume to determine if those with higher intervention rates were actually due to a higher frequency of prescriptions being dispensed. The time taken to perform and document interventions was also analysed to ensure the documentation system was not majorly impacting on the pharmacist's workload.

2.6.3 Analysis of demographics

Using chi-square tests, demographics of pharmacies, pharmacists and patients were analysed against the national averages where possible to ensure adequate sample representation.

2.6.3.1 Pharmacy demographics

Data was collected from the pharmacies participating in the trial through selected surveys, as detailed in section 2.5.7. Where possible, this information was then compared to national figures to ensure the PROMISe sample was representative. The allocation of the PROMISe groups was also analysed to ensure there was ample representation within each software group and within the no software group.

2.6.3.2 Pharmacist demographics

Data about each participating pharmacist was collected through the online surveys (see section 2.5.7) and their demographics were also analysed against national figures where possible. The results of the professionalism, empathy and clinical knowledge surveys were also compared to participating pharmacist demographics to identify any trends within the pharmacist group.

2.6.3.3 Patient demographics

The age and gender of each patient who was subjected to an intervention during the trial was collected and compared to the national figures to determine if there were demographic trends within the group of intervened patients.

2.6.4 Analysis of factors affecting intervention rate

Analysis between one factor and the relevant intervention rate was used to determine any relationships. Due to the intervention rate being non-normally distributed, non-parametric statistical tests were utilised.

2.6.4.1 Prescription factors

Original prescriptions were compared to repeat prescriptions to determine any relationship with the documented intervention rate.

2.6.4.2 Software groups

The difference in the intervention rates between each of the three software groups was also analysed. This determined the effect of the general reminder and specific prompt that were built into the documentation system.

General reminder

The time of day data was analysed from each of the software groups to determine the effect of the general reminder.

Prompt

A simple definition of a prompted intervention was defined, such that it was possible to determine how many of these interventions occurred through inspection of the intervention and prescription data, and by comparing groups, estimate how many of these interventions occurred as a result of the prompt. An estimation of the rate of uptake of the prompted interventions was also determined using subsequent prescription data that was available for patients who were the target of a prompted intervention during the first 4 weeks of the trial to determine if the effect of the prompt was evident in the following 8 weeks of prescription data. Having an idea of the efficacy and uptake of the prompted interventions, as well as an understanding of the cost of the drugs involved before and after the intervention, some economic analysis was also undertaken by an Honours student, Colin Curtain.¹⁶² This was done by extrapolating forward through a 12-month

period, under the assumptions that the intervention continued for that 12-month period, that is, the patient continued to take the lower (cheaper) dose of medication, and that the patient would not have lowered their dosage through other means.

2.6.4.3 *Pharmacy factors*

Many pharmacy factors were analysed to determine if any affected the overall intervention rate of the pharmacy. Factors that were compared to the intervention rate included PhARIA, pharmacy type, prescription volume, pharmacist workload, size of the pharmacy, estimated annual financial turnover, dispensary attribution to total turnover, trading hours, operational structure of the pharmacy, banner affiliation, dispensing system, presence of graduate pharmacists, staffing levels, workflow roles/responsibilities, number and types of professional services offered/promoted, type of counselling area and pharmacist accessibility. The effect of the observation week on the pharmacy, as well as the impact of site visits, was also analysed.

2.6.4.4 *Pharmacist factors*

Many pharmacist factors were analysed to determine if any affected the individual intervention rate of the pharmacist. Factors that were compared to their intervention rate included age, gender, graduation year, additional qualifications, professional memberships, previous pharmacy experience, current practice, pharmacist's workload, level of annual CPD activity, survey scores, beliefs about the intervention system and level of PROMISe training.

2.6.4.5 *Pharmacist workload*

An average pharmacist workload during a 38-hour week was calculated for each pharmacy using the number of prescriptions dispensed by the pharmacy during the trial and the number of full-time equivalent (FTE) pharmacists working each week. The number of FTE pharmacists was determined by obtaining a roster for each pharmacy during the site visits and calculating the number of pharmacists present during each hour the pharmacy was open, then dividing the number of hours by 38. For example, if the pharmacy was open for 70 hours a week, the total number of pharmacist hours might be 100 due to two pharmacists being present during busy periods. This results in 2.63 FTE pharmacists (calculated by $100 / 38$). Therefore, if the pharmacy dispensed 17,000 prescriptions during the trial, this would result in an average of 1416.67 prescriptions per week and an average pharmacist weekly workload of 538.66 prescriptions ($1416.67 / 2.63$). Once the average

pharmacist weekly workload for the pharmacy was calculated, the data was transferred into the pharmacy and pharmacist dataset. This meant that if there were five pharmacists working within the same pharmacy, they would all have the same average pharmacist workload.

An average pharmacist workload during a 38-hour week was also calculated for each pharmacy taking into account the number of FTE dispensary technicians as well. Again, the number of FTE dispensary technicians was determined by obtaining a roster for each pharmacy and calculating the number of technicians present during each hour the pharmacy was open, then dividing the number of hours by 38. The FTE dispensary technicians were then added to the FTE pharmacists to make a 'FTE dispensary staff'. Again, the total number of prescriptions dispensed during the trial was divided by 12, then by the FTE dispensary staff to give an average weekly workload within the pharmacy.

2.6.5 Statistical analysis

Statistical analysis was undertaken in SPSS® versions 17 and 18, as well as Microsoft Excel®. Where a chi-square analysis was required on summarised data, the StatView® program was used as it was felt that it handled summarised data better than SPSS®.

2.6.5.1 Analysis of demographics

The analysis comparing the demographics of the PROMISE pharmacies, pharmacists and patients compared to national averages were completed using Pearson chi-square tests. To meet the requirements of chi-square tests, it was always ensured that all cells had expected counts greater than 5. If cells had expected counts of less than 5, categories were merged to increase the population count within the cell.

To ensure consistency within each software groups, chi-square tests were also conducted between the software groups and other categorical variables. This aimed to ensure that the effects seen were independent of the software group that the pharmacy and pharmacist were in.

2.6.5.2 Analysis between two factors

The intervention rate was non-parametric in nature, therefore non-parametric tests were used to determine relationships between independent variables and the intervention rate. The following tests were conducted using the intervention rate as the dependent variable:

- Mann-Whitney chi-square
 - Used when the independent variable was categorical with two groups
- Kruskal-Wallis chi-square
 - Used when the independent variable was categorical with three or more groups
 - The Jonckheere-Terpstra statistic test was used to determine if there was a significant trend between the groups
 - If needed, individual Mann-Whitney tests were used to determine where the differences between the groups occurred. Type I error was minimised by calculating a new critical p -value by dividing 0.05 by the number of Mann-Whitney tests conducted (for example, critical p -value with 3 categorical groups and therefore 3 Mann-Whitney tests = $0.05/3 = 0.0167$)
- Spearman's correlation
 - Used when the independent variable was also continuous
 - Also used when comparing Likert scale questions
 - Likert scale questions are ordinal data (where 1 is better than 2) therefore a non-parametric correlation can be used and is usually better than grouped analysis. For these analyses, 'Unknown' was tagged as '0' and was therefore the lowest point on the scale.

Other factors such as prescription volumes, pharmacist workloads and survey scores were normally distributed, therefore some parametric data analysis was also performed.

- Pearson's correlation
 - Used when dependent and independent variables were both continuous
- Paired t-tests
 - Used to analyse relationships between estimated and actual data, such as estimated and actual prescription volumes
- Independent t-test
 - Used when dependent variable was continuous and independent variable was categorical with two groups, such as pharmacist gender compared to their prescription volume
- Analysis of variance (ANOVA)
 - Used when dependent variable was continuous and independent variable was categorical with three or more groups, such as pharmacy size and prescription volume
 - Post-hoc analysis¹⁴⁹ for ANOVA
 - Population variances were determined using Levene's test, where a non-significant result shows equal variances of the populations
 - Tukey method was used if sample sizes were equal and population variances were equal
 - Gabriel method was used if sample sizes were slightly different and population variances were equal

- Hochberg's GT2 method was used if sample sizes were very different and population variances were equal
- Games-Howell method was used if population variances were unequal

2.6.5.3 *Designing a statistical model to predict the intervention rate of the pharmacy*

The intervention rate was not normally distributed (*Kolmogorov-Smirnov* $D(185) = 0.187$, $p < 0.001$; *Shapiro-Wilk* $F(185) = 0.710$, $p < 0.001$; where the Shapiro-Wilk statistic is usually considered a more accurate measure of distribution).

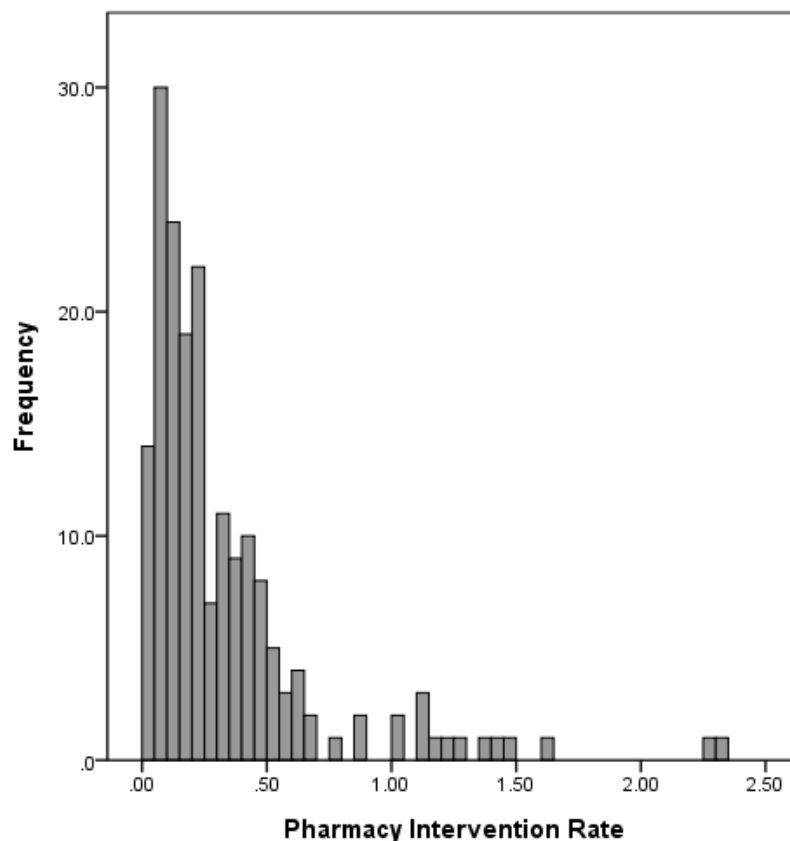


Figure 2-9: Frequency histogram for pharmacy intervention rate

Due to the skew of the histogram (Figure 2-9), it was thought that a log transformation would provide a more normal distribution. There were three 'zero' performers in the data (one documented no interventions and the other two documented only prompted interventions which were subsequently removed, resulting in three pharmacies with an intervention rate of zero), therefore a constant was added before transformation as zero cannot be logarithmically transformed. It was thought to be important to include the 'zero' performers to determine any factors that may contribute to a 'zero' intervention

rate. Given that the values of the intervention rate were so small (range = 0.00 – 2.34), a very small constant of 0.01 was chosen. The value of 0.01 was added to each intervention rate, therefore increasing the range to 0.01 – 2.35.

Logarithmic transformation

A logarithmic transformation was performed on the CI rate plus constant, resulting in the following data:

Mean		-0.667
95% CI	Lower	-0.730
	Upper	-0.604
5% Trimmed Mean		-0.659
Median		-0.652
Variance		0.188
Std. Dev.		0.434
Min.		-2.000
Max.		0.370
Range		2.370
IQR		0.580
Skewness		-0.313
Kurtosis		0.541

Table 2-16: Descriptive statistics for the log-transformed intervention rate

The intervention rate now appeared to be normally distributed (*Kolmogorov-Smirnov* $D(185) = 0.034$, $p < 0.20$; *Shapiro-Wilk* $F(185) = 0.987$, $p = 0.087$), which was also evident from the histogram (Figure 2-10).

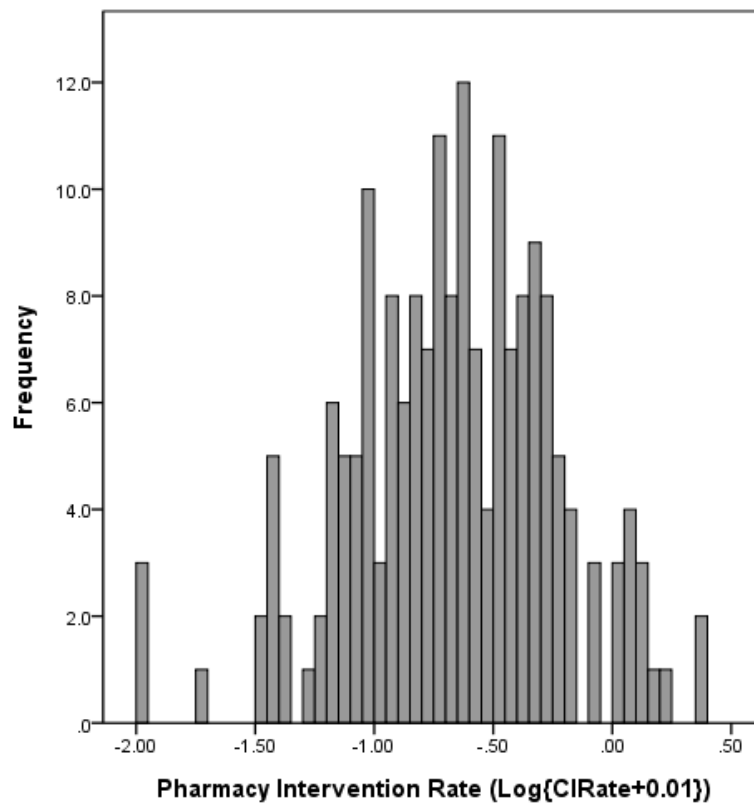


Figure 2-10: Frequency histogram for the log-transformed pharmacy intervention rate

Multiple regression was considered to be a suitable modelling procedure since the dependent variable is a continuous, normally distributed variable.¹⁴⁹ This method allows independent variables to be continuous or binary categorical, but cannot accommodate categorical variables with three or more groups. Therefore, some categorical variables had to be converted to 'dummy' variables, where '1' denoted 'membership' within that group whereas '0' denoted 'no membership'. Continuous independent variables were also logarithmically transformed, however this still did not normalise the distribution of several variables, resulting in some continuous variables being transformed to categorical.

Multiple regression

The multiple regression model can be written as¹⁴⁹:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k$$

This results in a prediction for Y based on the value for each X coefficient.

Logistic regression

A logistic regression was also performed to determine whether a pharmacy would have a 'high' intervention rate or a 'low' intervention rate. After pharmacies were divided into a dichotomous variable (high vs low), stepwise regressions were performed to determine a model.

2.6.5.4 Designing a statistical model to predict the intervention rate of the pharmacist

Regression models were researched to determine which type would be suitable to model the factors that influenced a pharmacist's documentation rate during the PROMISe trial.

The modelling techniques that were considered were:

1. Linear regression
 - Requires continuous independent and dependent variables.
 - Assumes normality, linearity, homoscedasticity and independence of residuals, and no multicollinearity.
 - Discrete (grouped) variables can be included using dummy variable coding, where group membership is denoted as 1 compared to 0.
2. Logistic regression
 - Allows grouped variables to be incorporated into the model easily, but requires the dependent variable to be binary or grouped.
 - Does not assume normal distribution.
 - Calculates the odds (or probability) of membership in one group based on a combination of predictor variables.

Determining which statistical model to use

Eighty-four out of 509 pharmacists (16.5%) did not document any interventions during the trial, therefore they had an intervention rate of 0%. This contributed to the pharmacist intervention rate having a non-normal distribution. Transformation was attempted, however due to the excessive number of zeros, no transformation (including addition of a constant to each intervention rate) could normalise the large number of zero intervention rates (Figure 2-11). This meant that a linear regression model was not suitable, as the dependent variable did not meet the assumptions of linear regression.

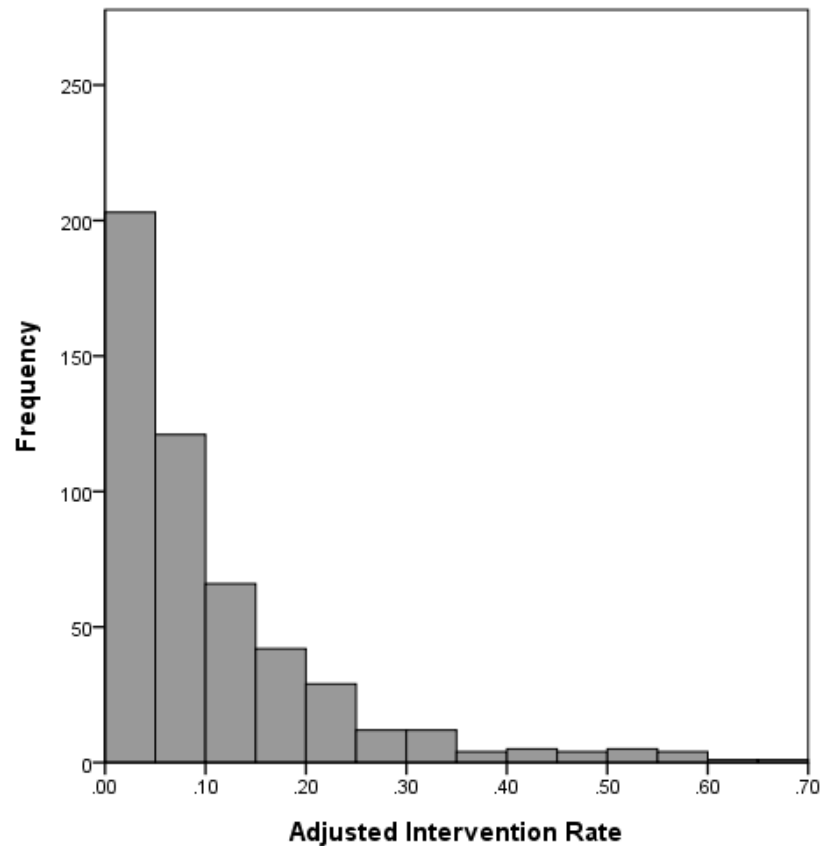


Figure 2-11: Intervention rate histogram where adjusted intervention rate = $\log_{10}(\text{intervention rate}+1)$

The logistic regression model was therefore chosen, which required the clinical intervention rate to be converted into a grouped variable. Using the BINNED function in SPSS®, the intervention rate was split into three equivalent groups, which were then named 'Low CI rate', 'Moderate CI rate' and High CI rate'. As the dependent variable resulted in three groups, a multinomial logistic regression model was used.

Multinomial logistic regression

The logistic regression model can be written in terms of log of the odds^{149,163}:

$$\log_e(\pi/1-\pi) = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_kX_k$$

This results in a likelihood estimation which predicts the likelihood (odds ratio) changes with each increase/decrease in the X coefficients.

Logistic regression

A logistic regression was also performed to determine a whether a pharmacist would document interventions. Pharmacists were divided into a dichotomous variable

(‘performer’ vs ‘non-performer’), stepwise regressions were performed to determine a model.

2.6.6 Analysis of user satisfaction

A survey seeking to determine the pharmacist user’s opinions regarding the PROMISE documentation software was also undertaken, particularly with regards to its limitations and ways it might be improved. These results have been summarised in Chapter 6.

2.6.7 Cost saving analysis

An expert assessment panel was recruited to determine the cost savings of a random sample of interventions. Twenty-four experts (consisting of 5 specialists, 11 GPs and 8 pharmacists) assessed a random sample of 200 interventions to determine the consequences of the intervention occurring. Costs and savings were then applied to these consequences to provide a costing for each intervention, resulting in an overall value of an average intervention. This was done as a separate analysis by a different researcher and thus, was not included within this thesis. More detail on the calculation methods can be found in the PROMISE III final report¹⁶⁴ and the article written by Stafford et al.¹⁶⁵

3 Chapter 3: DRPs and prescription factors

During the PROMISe III trial, data was collected on each DRP and resulting intervention documented by the pharmacist, as well as prescription data. This allowed analysis to be conducted to determine intervention frequencies amongst certain prescription types, DOCUMENT classification groups and each drug group.

For the purposes of reporting results, clinical interventions (CIs) documented in the PROMISe system will be referred to as documented CIs, as opposed to those CIs observed (whether documented or not) which will be referred to as performed CIs. Analysis of the observational sub-study data determined that only 49% of performed interventions were actually documented (see Chapter 5 for more detail), as such it is unknown exactly how many CIs were performed in all pharmacies. Analyses have been completed only on documented CIs with consideration that the actual rate of performed CIs was likely to be much higher.

An outline of the interventions documented and prescriptions dispensed during the study is shown in Figure 3-1. During the course of the study, 776 pharmacists dispensed 2,396,451 prescriptions for 546,717 patients and documented 7000 interventions. Of these, 245 pharmacists were not enrolled in the study (most likely locums or new employees within the pharmacy), thus having insufficient access to training for the PROMISe system. These pharmacists dispensed 292,528 prescriptions for 63,570 patients and documented 245 interventions. As these pharmacists were not enrolled, these instances have been excluded from the analysis (see Exclusion Box 1 in Figure 3-1).

The remaining 531 enrolled pharmacists dispensed 2,013,923 prescriptions for 483,147 patients and documented 6755 interventions. Of these interventions, 525 were related to either OTC medications or symptom-based requests to the pharmacist, and these were also excluded from the analysis (see Exclusion Box 2 in Figure 3-1). These interventions were examined separately and more detail can be found in the PROMISe III report.¹⁶⁴

The remaining 6230 interventions involved prescription medications. Group Three pharmacies undertook 282 interventions that were linked to the prompt (see Chapter 2), which were also removed prior to analysis. Once this data was removed, an overall average of 3 interventions were documented for every 1000 prescriptions dispensed or 12 interventions per 1000 patients (Figure 3-1).

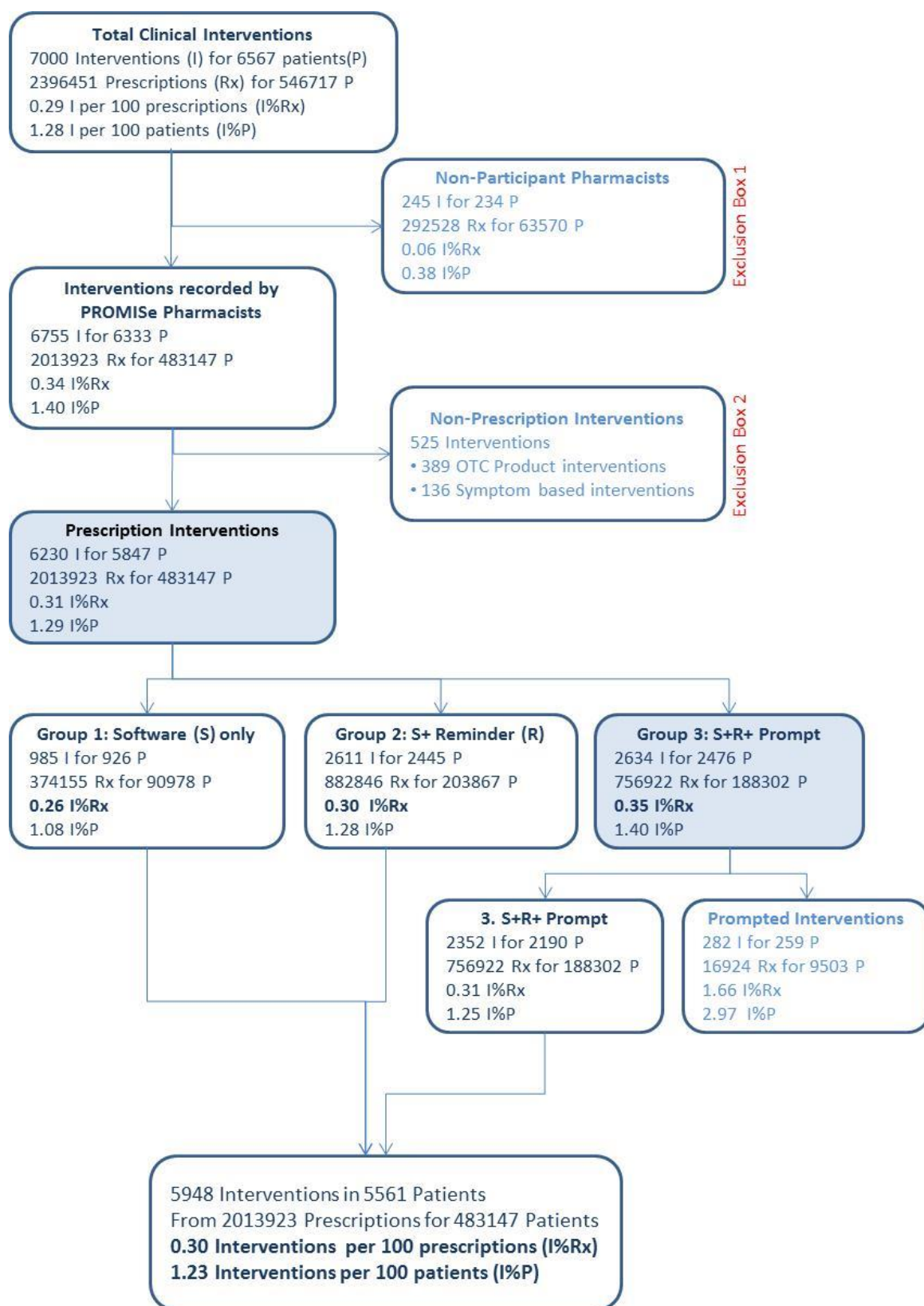


Figure 3-1: Breakdown of clinical interventions documented during the PROMISE trial

3.1 Overall number and rate of documented CIs

The 5948 interventions resulted in an overall average of 3 interventions documented for every 1000 prescriptions. There was a decline in the documentation of interventions with time as shown in Figure 3-2, and this decline was significant (*Kruskal-Wallis* $\chi^2 = 184.57$, *df* = 11, $p < 0.001$; *Jonckheere-Terpstra* = -13.29, $p < 0.001$).

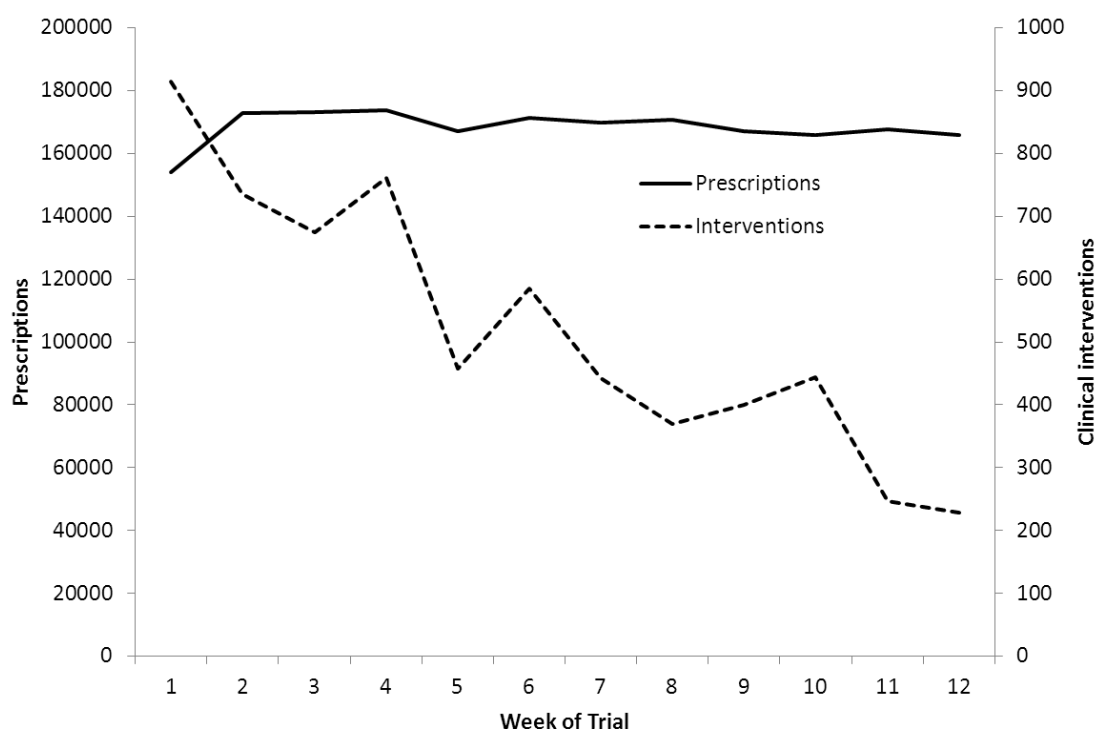


Figure 3-2: Number of CIs documented and number of prescriptions dispensed

3.2 Categories and subcategories of interventions

The majority of documented CIs were related to either drug selection problems (1829 or 30.7%) or educational issues prompted by patient requests (1412 or 23.7%; Table 3-1). Examples of the different types of documented CIs are included in Appendix 21.

Code	Category	Subcategory		# (%) of category	#	%
D	Drug selection	D1	Duplication	232 (12.7%)	1829	30.7
	(Problems relating to the choice of drug prescribed or taken)	D2	Drug interaction	265 (14.5%)		
		D3	Wrong drug	223 (12.2%)		
		D4	Incorrect strength	347 (19%)		
		D5	Inappropriate dosage form	211 (11.5%)		
		D6	Contraindications apparent	141 (7.7%)		
		D7	No indication apparent	42 (2.3%)		
		D0	Other drug selection problem	368 (20.1%)		
O	Over or underdose	O1	Prescribed dose too high	384 (32.5%)	1183	19.9
	(Problems relating to the prescribed dose or schedule of a drug)	O2	Prescribed dose too low	316 (26.7%)		
		O3	Incorrect/unclear dosing instructions	392 (33.1%)		
		O0	Other dose problem	91 (7.7%)		
C	Compliance	C1	Taking too little	116 (20.8%)	557	9.4
	(Problems relating to the way the patient takes the medication)	C2	Taking too much	101 (18.1%)		
		C3	Erratic use of medication	100 (18%)		
		C4	Intentional drug misuse (including OTC medications)	34 (6.1%)		
		C5	Difficulty using dosage form	56 (10.1%)		
		C0	Other compliance problem	150 (26.9%)		
U	Undertreated	U1	Condition undertreated	164 (60.3%)	272	4.6
	(Problems relating to actual or potential conditions that require management or prevention)	U2	Condition untreated	42 (15.4%)		
		U3	Preventative therapy required	58 (21.3%)		
		U0	Other undertreated problem	8 (2.9%)		
M	Monitoring	M1	Laboratory monitoring	42 (30%)	140	2.4
	(Problems relating to monitoring the efficacy or adverse effects of a drug)	M2	Non-laboratory monitoring	81 (57.9%)		
		M0	Other monitoring problem	17 (12.1%)		
E	Education or information	E1	Patient requests drug info	668 (47.3%)	1412	23.7
	(Where a patient requests further information about a drug or disease state)	E2	Patient requests disease management advice	278 (19.7%)		
		E0	Other education or information problem	466 (33%)		
N	Not classifiable	N0	Clinical interventions that cannot be classified under another category	110 (100%)	110	1.8
	(Problems that cannot be classified under another category)					
T	Toxicity or ADR	T1	Toxicity, allergic reaction or adverse effect present	445 (100%)	445	7.5
	(Problems relating to the presence of signs or symptoms that may be attributed to a drug)					
Total				5948 (100%)	5948	100.0

Table 3-1: Categories and sub-categories of documented CIs

3.3 Intervention recommendations

An average of 1.6 recommendations were made for each intervention, indicating that multiple recommendations were common. The most common type of recommendation related to a change in therapy, with 40.1% (3833 occasions) of interventions receiving these types of recommendations. These changes were commonly a change of drug (846 occasions), or a dose change (642 dose increases, 652 dose decreases; Table 3-2).

Provision of information was the next most common type of recommendation, with 34.7% (3312) of interventions receiving recommendations of this type. Within this type, 73.6% (2437 occasions) of recommendations related to, presumably, verbal provision of information in the form of a counselling or education session. When a referral recommendation was made, this was almost uniformly to the prescriber (91.3% or 1786 occasions; Table 3-2). These two recommendations (an education or counselling session and referral to the prescriber) accounted for 44.2% (4223 of the 9551) of all recommendations made by pharmacists to resolve the identified DRP.

Category	Subcategory		Number (%) of Category	Number (%) of Total
A change in therapy	R1	Dose increase	642 (16.7%)	3833 (40.1%)
	R2	Dose decrease	652 (17.0%)	
	R3	Drug change	846 (22.1%)	
	R4	Drug formulation change	383 (10.0%)	
	R5	Drug brand change	96 (2.5%)	
	R6	Dose frequency/schedule change	527 (13.7%)	
	R7	Prescription not dispensed	307 (8.0%)	
	R8	Other changes to therapy	380 (9.9%)	
A referral required	R9	Refer to prescriber	1786 (91.3%)	1956 (20.5%)
	R10	Refer to hospital	36 (1.8%)	
	R11	Refer for medication review	76 (3.9%)	
	R12	Other referral required	58 (3.0%)	
Provision of information	R13	Education or counselling session	2437 (73.6%)	3312 (34.7%)
	R14	Written summary of medications	260 (7.9%)	
	R15	Recommend dose administration aid	75 (2.3%)	
	R16	Other written information	540 (16.3%)	
Monitoring	R17	Monitoring: Non-laboratory	277 (61.6%)	450 (4.7%)
	R18	Monitoring: Laboratory test	173 (38.4%)	
Other	R19	No Recommendation Necessary	111*	
Total			9551	9551 (100.0%)

Table 3-2: Recommendations made to address identified DRPs (*R19 recommendations have been excluded from analysis)

When the types of recommendations were compared to the initial categories of interventions, a number of relationships were identified (Table 3-3). Interventions where the recommendation was for a change in therapy were more likely to be either drug selection problems or dosage problems ($\chi^2 = 2165.2$, $df = 7$, $p < 0.001$). Interventions where a referral was required were more likely to involve a DRP associated with toxicity or an untreated indication requiring addition of therapy ($\chi^2 = 659.2$, $df = 7$, $p < 0.001$). Recommendations where information was provided were more likely to be associated with education or compliance issues ($\chi^2 = 1691.3$, $df = 7$, $p < 0.001$).

Category	Number (%) of DRPs and Recommendation Type				
	A change in therapy	Referral required	Information provision	Monitoring	Total
Drug selection	1620 (56.3%)	599 (20.8%)	534 (18.6%)	123 (4.3%)	2876 (100.0%)
Over/underdose	1110 (62.9%)	348 (19.7%)	269 (15.2%)	37 (2.1%)	1764 (100.0%)
Compliance	307 (32.6%)	221 (23.5%)	382 (40.6%)	32 (3.4%)	942 (100.0%)
Undertreated	193 (35.8%)	193 (35.8%)	126 (23.4%)	27 (5.0%)	539 (100.0%)
Monitoring	20 (7.3%)	63 (22.9%)	94 (34.2%)	98 (35.6%)	275 (100.0%)
Education/information	207 (9.6%)	176 (8.2%)	1695 (78.8%)	74 (3.4%)	2152 (100.0%)
Not classifiable	51 (36.2%)	56 (39.7%)	30 (21.3%)	4 (2.8%)	141 (100.0%)
Toxicity/ADR	325 (37.7%)	300 (34.8%)	182 (21.1%)	55 (6.4%)	862 (100.0%)
Total	3833	1956	3312	450	9551 (100.0%)

Table 3-3: Recommendations made by category of intervention

3.4 Clinical significance

During the documentation process, pharmacists were asked to assign a clinical significance to the intervention. S3 interventions were those that were likely to require medical intervention to resolve and S4 were those that were likely to require hospitalisation to resolve (see Table 2-6 and Appendix 3). Almost half of the interventions (42.6% or 2535 occasions) were classified as either of moderate (S3) or severe (S4) level of clinical significance by the documenting pharmacist (Table 3-4).

	#	%
S1	908	15.3
S2	2505	42.1
S3	2119	35.6
S4	416	7.0
Total	5948	100.0

Table 3-4: Clinical significance of the interventions as assigned by the documenting pharmacist

When compared to the recommendations made by the pharmacist, more significant interventions (S3 or S4) were associated with a drug change, contact with the prescriber or referral to a hospital, or a monitoring recommendation. Less significant interventions (S1 or S2) were more commonly associated with information or educational recommendations (Table 3-5).

Category	Subcategory		Low Clinical Significance	High Clinical Significance	Total
A change in therapy	R1	Dose increase	326 (50.8%)	316 (49.2%)	642
	R2	Dose decrease	295 (45.2%)	357 (54.8%)	652
	R3	Drug change	273 (32.3%)	573 (67.7%)	846
	R4	Drug formulation change	240 (62.7%)	143 (37.3%)	383
	R5	Drug brand change	62 (64.6%)	34 (35.4%)	96
	R6	Dose frequency/schedule change	328 (62.2%)	199 (37.8%)	527
	R7	Prescription not dispensed	115 (37.5%)	192 (62.5%)	307
	R8	Other changes to therapy	184 (48.4%)	196 (51.6%)	380
A referral required	R9	Refer to prescriber	636 (35.6%)	1150 (64.4%)	1786
	R10	Refer to hospital	5 (13.9%)	31 (86.1%)	36
	R11	Refer for medication review	36 (47.4%)	40 (52.6%)	76
	R12	Other referral required	23 (39.7%)	35 (60.3%)	58
Provision of information	R13	Education or counselling session	1645 (67.5%)	792 (32.5%)	2437
	R14	Written summary of medications	181 (69.6%)	79 (30.4%)	260
	R15	Recommend dose administration aid	44 (58.7%)	31 (41.3%)	75
	R16	Other written information	443 (82.0%)	97 (18.0%)	540
Monitoring	R17	Monitoring: Non-laboratory	131 (47.3%)	146 (52.7%)	277
	R18	Monitoring: Laboratory test	56 (32.4%)	117 (67.6%)	173
Total			5023 (52.6%)	4528 (47.4%)	9551

Table 3-5: Recommendations made and their clinical significance

The interventions of higher clinical significance were more likely to be undertreatment or toxicity problems ($\chi^2 = 751.8$, $df = 7$, $p < 0.001$), whilst educational interventions were usually graded as less significant by the documenting pharmacists (Table 3-6).

Category	Low clinical significance	High clinical significance	Total
Drug selection	847 (46.3%)	982 (53.7%)	1829
Over/underdose	610 (51.6%)	573 (48.4%)	1183
Compliance	357 (64.1%)	200 (35.9%)	557
Undertreated	87 (32.0%)	185 (68.0%)	272
Monitoring	66 (47.1%)	74 (52.9%)	140
Education/information	1216 (86.1%)	196 (13.9%)	1412
Not classifiable	67 (60.9%)	43 (39.1%)	110
Toxicity/ADR	163 (36.6%)	282 (63.4%)	445
Total	3413 (57.4%)	2535 (42.6%)	5948

Table 3-6: Clinical significance of different intervention types

The clinical significance reported by the pharmacists appeared to correlate well with the economic value determined by the independent expert panel (see Chapter 2 and section 3.9). As the significance code increased, the average cost saving to the Australian healthcare system (as determined by the panel) also increased (*Kruskal-Wallis* $\chi^2 = 17.9$, $df = 3$, $p < 0.001$; *Jonckheere-Terpstra statistic* = 4.2, $p < 0.001$).

3.5 ‘Other’ interventions

Despite the refinement that the DOCUMENT DRP Classification System underwent before being used in the PROMISE III trial (see Chapter 2), 1210 (20.3%) interventions were still documented under the ‘Other’ categories. Upon analysis of a random selection of ‘Other’ interventions, it appeared that in most cases the pharmacist chose the correct DOCUMENT category, but then chose ‘Other’ as the sub-category, despite a more appropriate sub-category being available. Only 353 out of 2535 (13.9%) interventions of higher clinical significance were documented in an ‘Other’ category, compared to 857 out of 3413 (25.1%) interventions of lower clinical significance ($\chi^2 = 75.53$, $df = 1$, $p < 0.001$).

3.6 Drugs involved

For 5642 of the 5948 interventions, a specific drug was identified by the documenting pharmacist. A wide range of drugs (447 different generic entities) were involved, indicating that a range of different interventions are performed within community pharmacy. However, it should be noted that each intervention was listed in the database as being associated with the dispensed drug, although other drugs may have also been associated with the intervention. This design issue has some ramifications, as

interventions in which a drug change was made may appear to suggest that a particular drug was the problem, when in fact it was the solution.

3.6.1 Number of clinical interventions

The vast majority of medications involved in documented CIs can be grouped using a multilevel anatomical therapeutic category (ATC) classification code. The groupings of the drugs involved are shown in Table 3-7 to Table 3-10. Codes are included in the tables to enable determination of members of particular therapeutic classification groups.

When the drugs involved in the interventions were considered by generic drug name (Table 3-7), the most common drug involved was the widely used antibiotic, amoxycillin (associated with 204 or 3.4% of interventions). Nearly one third of all the interventions were related to the top 20 generic medications shown in Table 3-7.

Despite the removal of 282 prompted PPI interventions from the analysis, this class of medications was still responsible for 233 (3.9%) of the overall interventions (Table 3-8). It should be noted that 143 interventions were in Group One and Group Two pharmacies (who did not have the prompt, nor were they aware of the details of the prompt), as such these interventions were known to be unrelated to the prompt. The remaining 90 interventions were in Group Three pharmacies who did have the prompt, and may have been related to the prompt, but not excluded under the method detailed in Chapter 2. It is likely that the high number of interventions in this drug group was therefore related to the high frequency of dispensing of this class of agents (Table 3-12).

ATC Code Level 5	Drug	Number	% of interventions
J01CA04	Amoxycillin	204	3.43
H02AB06	Prednisolone	113	1.90
A10BA02	Metformin	107	1.80
J01DB01	Cephalexin	104	1.75
A02BC05	Esomeprazole	102	1.71
J01CR02	Amoxycillin and enzyme inhibitor	98	1.65
N02AA05	Oxycodone	95	1.60
C10AA05	Atorvastatin	94	1.58
N02AA59	Codeine (combinations excluding psycholeptics)	92	1.55
R03AK06	Salmeterol and other drugs for obstructive airways	92	1.55
R03AC02	Salbutamol	89	1.50
C09AA04	Perindopril	83	1.40
J01FA06	Roxithromycin	82	1.38
N02BE01	Paracetamol	78	1.31
N02AX02	Tramadol	75	1.26
J01FA01	Erythromycin	68	1.14
B01AA03	Warfarin	67	1.13
M01AC06	Meloxicam	61	1.03
C09DA04	Irbesartan and diuretics	60	1.01
J01AA02	Doxycycline	57	0.96
	Others (< 1% of all interventions)	4127	69.38
Total		5948	100.0

Table 3-7: Top 20 ATC level 5 coded drugs involved in interventions

ATC Code Level 4	Drug	Number	% of interventions
A02BC	Proton pump inhibitors	233	3.92
C10AA	HMG CoA reductase inhibitors	210	3.53
J01CA	Penicillins with extended spectrum	204	3.43
J01FA	Macrolides	199	3.35
N02AA	Natural opium alkaloids	199	3.35
C09AA	ACE inhibitors; plain	171	2.87
H02AB	Glucocorticoids	140	2.35
N06AB	Selective serotonin reuptake inhibitors	132	2.22
N06AX	Other antidepressants	130	2.19
C09CA	Angiotensin II antagonists; plain	116	1.95
C08CA	Dihydropyridine derivatives	111	1.87
A10BA	Biguanides	107	1.80
J01DB	First-generation cephalosporins	105	1.77
R03AC	Selective beta-2-adrenoreceptor agonists	104	1.75
C09DA	Angiotensin II antagonists and diuretics	102	1.71
J01CR	Combinations of penicillins; including beta-lactamase inhibitors	98	1.65
R03AK	Adrenergics and other drugs for obstructive airways disease	92	1.55
C07AB	Beta-blocking agents; selective	90	1.51
N05BA	Benzodiazepine derivatives	86	1.45
N02BE	Anilides	85	1.43
	Others	3234	54.37
Total		5948	100.0

Table 3-8: Top 20 ATC level 4 coded drug groups involved in interventions

ATC Code Level 3	Drug	Number	% of interventions
J01C	Beta-lactam antibacterials; penicillins	388	6.52
N02A	Opioids	320	5.38
N06A	Antidepressants	311	5.23
A02B	Drugs for peptic ulcer and gastro-oesophageal disease (GORD)	268	4.51
C10A	Lipid modifying agents; plain	242	4.07
M01A	Anti-inflammatory and anti-rheumatic products; non-steroids	216	3.63
J01F	Macrolides; lincosamides and streptogramins	212	3.56
R03A	Adrenergics; inhalants	196	3.30
C09A	ACE inhibitors; plain	171	2.87
A10B	Blood glucose lowering drugs; excl. insulins	166	2.79
J01D	Other beta-lactam antibacterials	144	2.42
H02A	Corticosteroids for systemic use; plain	141	2.37
B01A	Anti-thrombotic agents	140	2.35
C07A	Beta-blocking agents	130	2.19
C09C	Angiotensin II antagonists; plain	116	1.95
C08C	Selective calcium channel blockers with mainly vascular effects	111	1.87
R03B	Other drugs for obstructive airway disease; inhalants	104	1.75
C09D	Angiotensin II antagonists; combinations	103	1.73
N02B	Other analgesics and antipyretics	93	1.56
N05A	Antipsychotics	93	1.56
	Others	2283	38.38
Total		5948	100.0

Table 3-9: Top 20 ATC level 3 coded drug groups involved in interventions

ATC Code Level 2	Drug	Number	% of interventions
J01	Antibacterials for systemic use	866	14.56
C09	Agents acting on the renin-angiotensin system	428	7.20
N02	Analgesics	428	7.20
N06	Psychoanaleptics	318	5.35
R03	Drugs for obstructive airway diseases	302	5.08
A02	Drugs for acid related disorders	271	4.56
C10	Lipid modifying agents	264	4.44
N05	Psycholeptics	236	3.97
M01	Anti-inflammatory and anti-rheumatic products	216	3.63
A10	Drugs used in diabetes	193	3.24
S01	Ophthalmologicals	155	2.61
C08	Calcium channel blockers	150	2.52
H02	Corticosteroids for systemic use	141	2.37
B01	Anti-thrombotic agents	140	2.35
C07	Beta-blocking agents	130	2.19
G03	Sex hormones and modulators of the genital system	111	1.87
D07	Corticosteroids; dermatological preparations	106	1.78
M05	Drugs for treatment of bone diseases	88	1.48
C03	Diuretics	81	1.36
C01	Cardiac therapy	79	1.33
	Others	1245	20.93
Total		5948	100.0

Table 3-10: Top 20 ATC level 2 coded drug groups involved in interventions

As can be seen from the above tables, a wide range of drugs were associated with documented CIs, such as antibiotics, analgesics, psychoactive agents, cardiovascular drugs and drugs for respiratory disorders.

3.6.2 Frequency of CIs for particular drug groups

Although some conclusions can be drawn from the frequency of interventions with different generic drugs and drug groups, it is more appropriate to consider the frequency of interventions in relation to the frequency of prescriptions for those drugs. Many uncommon drugs were associated with an intervention, resulting in a high intervention frequency. Therefore, only the medications that were associated with 55 or more of the total interventions (approximately 1%) were included in Table 3-11.

ATC Level 5 Code	Drug	# CIs	# Rx's	Intervention frequency
J01CE02	Phenoxymethylpenicillin	55	4748	1.16
J01FA01	Erythromycin	68	6963	0.98
H02AB06	Prednisolone	113	17788	0.64
N02AX02	Tramadol	75	16067	0.47
N02AA05	Oxycodone	95	20748	0.46
R03AK06	Salmeterol and other drugs for obstructive airways disease	92	21446	0.43
J01CA04	Amoxycillin	204	48469	0.42
J01AA02	Doxycycline	57	13615	0.42
J01FA06	Roxithromycin	82	20953	0.39
J01CR02	Amoxycillin and enzyme inhibitor	98	27050	0.36
M01AC06	Meloxicam	61	17569	0.35
A10BA02	Metformin	107	31381	0.34
N02AA59	Codeine (combinations excluding psycholeptics)	92	28386	0.32
R03AC02	Salbutamol	89	28414	0.31
J01DB01	Cephalexin	104	33870	0.31
B01AA03	Warfarin	67	23310	0.29
N02BE01	Paracetamol	78	33520	0.23
C09DA04	Irbesartan and diuretics	60	27329	0.22
C09AA05	Ramipril	56	26163	0.21
C09AA04	Perindopril	83	40387	0.21
A02BC05	Esomeprazole	102	50079	0.20
C10AA07	Rosuvastatin	55	31087	0.18
C10AA05	Atorvastatin	94	75424	0.12
Unknown		83	49407	0.17
Others		3878	1319750	0.29
Total		5948	2013923	0.30

Table 3-11: Intervention rate for ATC Level 5 medications

The medications with the highest proportions of interventions were the antibiotics, phenoxymethylpenicillin and erythromycin. Typical concerns with penicillins included allergies and correct paediatric dosing. Erythromycin had similar concerns to penicillin, but also had a large number of drug interactions which may have increased the number of interventions required.

ATC Level 4 Code	Drug	# CIs	# Rx's	Intervention frequency
J01CE	Beta-lactamase sensitive penicillins	56	5162	1.08
M01AB	Acetic acid derivatives and related substances	66	11528	0.57
J01FA	Macrolides	199	35371	0.56
H02AB	Glucocorticoids, systemic	140	25264	0.55
N02AX	Other opioids	75	16067	0.47
R03BA	Glucocorticoids, inhaled	76	16988	0.45
R03AK	Adrenergics and other drugs for obstructive airway diseases	92	21446	0.43
J01CA	Penicillins with extended spectrum	204	48490	0.42
S01AA	Antibiotics, ophthalmic	62	15977	0.39
J01AA	Tetracyclines	62	16208	0.38
N06AX	Other antidepressants	130	35056	0.37
J01CR	Combinations of penicillins; including beta-lactamase inhibitors	98	27146	0.36
N02AA	Natural opium alkaloids	199	56519	0.35
M05BA	Bisphosphonates	58	16828	0.34
A10BA	Biguanides	107	31381	0.34
M01AC	Oxycams	65	19087	0.34
R03AC	Selective beta-2-adrenoreceptor agonists	104	31695	0.33
J01DB	First-generation cephalosporins	105	34256	0.31
D07AC	Corticosteroids; potent (group III) dermatologicals	64	21095	0.30
B01AA	Vitamin K antagonists	67	23310	0.29
N05BA	Benzodiazepine derivatives	86	35251	0.24
N06AB	Selective serotonin reuptake inhibitors	132	54757	0.24
N02BE	Anilides	85	36063	0.24
C09DA	Angiotensin II antagonists and diuretics	102	49299	0.21
C09AA	ACE inhibitors; plain	171	85587	0.20
C08CA	Dihydropyridine derivatives	111	57275	0.19
C07AB	Beta-blocking agents; selective	90	46614	0.19
A02BC	Proton pump inhibitors	233	122911	0.19
B01AC	Platelet aggregation inhibitors; excluding heparin	61	37743	0.16
C09CA	Angiotensin II antagonists; plain	116	72812	0.16
C10AA	HMG CoA reductase inhibitors	210	160129	0.13
Unknown		83	49407	0.17
Others		2439	697201	0.35
Total		5948	2013923	0.30

Table 3-12: Intervention rate for ATC Level 4 medication groups

ATC Level 3 Code	Drug	# CIs	# Rx's	Intervention frequency
N07B	Drugs used in addictive disorders	56	5649	0.99
J05A	Direct acting antivirals	57	6701	0.85
J01F	Macrolides; lincosamides and streptogramins	212	36364	0.58
H02A	Corticosteroids for systemic use; plain	141	25443	0.55
J01C	Beta-lactam antibacterials; penicillins	388	85703	0.45
M01A	Anti-inflammatory and anti-rheumatic products; non-steroids	216	49956	0.43
J01A	Tetracyclines	62	16208	0.38
S01A	Anti-infectives	62	16226	0.38
R03A	Adrenergics; inhalants	196	53141	0.37
N02A	Opioids	320	87490	0.37
N03A	Antiepileptics	68	18732	0.36
M05B	Drugs affecting bone structure and mineralisation	88	24382	0.36
N05A	Antipsychotics	93	27889	0.33
J01D	Other beta-lactam antibacterials	144	44419	0.32
R03B	Other drugs for obstructive airway disease; inhalants	104	33077	0.31
A10B	Blood glucose lowering drugs; excl. insulins	166	56766	0.29
N06A	Antidepressants	311	109020	0.29
D07A	Corticosteroids for dermatological use; plain	78	29158	0.27
N02B	Other analgesics and antipyretics	93	37176	0.25
N05B	Anxiolytics	86	35288	0.24
C07A	Beta-blocking agents	130	58996	0.22
B01A	Anti-thrombotic agents	140	63572	0.22
C09D	Angiotensin II antagonists; combinations	103	49907	0.21
A02B	Drugs for peptic ulcer and gastro-oesophageal disease (GORD)	268	132910	0.20
C09A	ACE inhibitors; plain	171	85587	0.20
C08C	Selective calcium channel blockers with mainly vascular effects	111	57275	0.19
N05C	Hypnotics and sedatives	57	30607	0.19
C09C	Angiotensin II antagonists; plain	116	72812	0.16
C10A	Lipid modifying agents; plain	242	173169	0.14
Unknown		87	52260	0.17
Others		1582	438040	0.36
Total		5948	2013923	0.30

Table 3-13: Intervention rate for ATC Level 3 medication groups

ATC Level 2 Code	Drug	# CIs	# Rx's	Intervention frequency
J05	Antivirals for systemic use	57	6701	0.85
S02	Otologicals	69	8120	0.85
N07	Other nervous system drugs	61	7229	0.84
H02	Corticosteroids for systemic use	141	25443	0.55
J01	Antibacterials for systemic use	866	196806	0.44
M01	Anti-inflammatory and anti-rheumatic products	216	50028	0.43
N03	Antiepileptics	68	18732	0.36
M05	Drugs for treatment of bone diseases	88	24382	0.36
C03	Diuretics	81	23446	0.35
R03	Drugs for obstructive airway diseases	302	88009	0.34
N02	Analgesics	428	130181	0.33
D07	Corticosteroids; dermatological preparations	106	32333	0.33
C01	Cardiac therapy	79	25077	0.32
A10	Drugs used in diabetes	193	62499	0.31
N06	Psychoanaleptics	318	115374	0.28
N05	Psycholeptics	236	93784	0.25
G03	Sex hormones and modulators of the genital system	111	49119	0.23
C07	Beta-blocking agents	130	58996	0.22
B01	Anti-thrombotic agents	140	63572	0.22
A02	Drugs for acid related disorders	271	134696	0.20
S01	Ophthalmologicals	155	77343	0.20
C08	Calcium channel blockers	150	76654	0.20
C09	Agents acting on the renin-angiotensin system	428	230415	0.19
C10	Lipid modifying agents	264	183423	0.14
Unknown		87	52260	0.17
Others		903	179301	0.50
Total		5948	2013923	0.30

Table 3-14: Intervention rate for ATC Level 2 medication groups

3.7 Prescription factors

Two previous studies found that original prescriptions were subject to more interventions than repeat prescriptions^{48,73}, therefore for all interventions documented within the PROMISE software, the type of prescription (original or repeat) was recorded within the database. An original prescription identified prescription items that were dispensed from

a new prescription; however, the item may not have been a new item for the patient (for example, the patient may have taken the item before but was presenting a prescription on original paperwork to the pharmacy that day). A repeat prescription identified items that had already been dispensed using that particular prescription including deferred prescriptions.

3.7.1 *Original versus repeat prescriptions*

Out of the 5948 interventions, there were 1777 interventions where the database did not have adequate information recorded for analysis (Table 3-15). This was due to incorrect coding by the pharmacist (for example, searching for the drug name within the software rather than linking the intervention to the dispensed prescription) or due to a technical data transfer problem. Within the remaining 4171 interventions, there was a much higher intervention rate on original prescription items, with 79.5% of all interventions occurring on originals despite them only contributing to 45.4% of all dispensed prescriptions (Table 3-15). This was equivalent to an intervention rate of 0.36%, whereas the intervention rate on repeat prescriptions was much lower at only 0.08%. A chi-square test showed a significant difference between the two groups ($p < 0.001$; Table 3-15).

	# CIs	%	Valid Percent	# Rx's	%	CI Rate per 100 Rx's
Repeat	855	14.4	20.5	1098864	54.6	0.08
Original	3316	55.7	79.5	915059	45.4	0.36
Total	4171	70.1	100.0	2013923	100.0	
Missing	1777	29.9	Statistics: $\chi^2 = 1947.74$, $df = 1$, $p < 0.001$ (StatView®)			
Total	5948	100.0				

Table 3-15: Number of interventions within each prescription category

3.8 *Patient demographics*

For all patients subject to an intervention, the pharmacist was asked to enter their age group and gender. The number of medications that were dispensed to each patient was also determined from the patient's dispensing history and recorded within the PROMISE database. Out of the 5948 interventions, 362 were "duplicates" which meant the patient had more than one intervention documented against their unique identification number. Due to a technical problem early in the trial, 7 interventions did not have a patient identification number assigned, resulting in 5580 unique identification numbers.

3.8.1 Age range and gender

Of the 5580 unique patients, 105 interventions did not have an age range or gender selected, with an additional 2 interventions with no age range and an additional intervention with no gender (Table 3-16). This occurred due to a data transfer problem from Aquarius® pharmacies in the first week of the trial.

Of the 5474 patients where gender was known, 3086 (56.3%) were female, which was slightly higher than the Australian Bureau of Statistics 2009 report of 50.2% females in the Australian population.¹⁶⁶

		Gender			Total
		Female	Male	Unknown	
Age Range	0-3 years	77	116	0	193
	4-12 years	131	116	0	247
	13-20 years	89	67	0	156
	21-64 years	1488	1263	1	2752
	65-80 years	1021	703	0	1724
	81+ years	278	123	0	401
	Unknown	2	0	105	107
Total		3086	2388	106	5580

Table 3-16: Age and gender of patients involved in an intervention

Of the 5473 patients where age was known, 2752 (50.3%) were in the adult age range of 21-64 years old and 2125 (38.8%) were aged 65 or over. These results were significantly different from the Australian Bureau of Statistics 2009¹⁶⁶ projected population demographics in 2010 (Table 3-17; $\chi^2 = 913.11$, $df = 2$, $p < 0.001$ [Statview®]), with interventions occurring much more commonly in the older population.

		PROMISe N	%	ABS 2010 Projected N	%
Age Range	0-20 years	596	10.9	1040	19.0
	21-64	2751	50.3	3683	67.3
	65+ years	2125	38.8	750	13.7
Total		5472	100.0	5472	100.0

Table 3-17: PROMISe patient demographics compared to expected population (taken from the Australian Bureau of Statistics 2010 projections¹⁶⁶)

3.8.2 Average number of medications

Of the 5580 patients with interventions, only 5219 could be matched to one or more prescriptions in the dataset. This was due to the fact that a number of the prescription

interventions were documented without linking the intervention with a dispensed prescription or patient history, resulting in the intervention being given a unique patient identifier, even though the patient may have visited the pharmacy regularly. Since it was known that these patients must have received at least one prescription – despite the fact that none could be found – it was elected to treat these values as missing for the purpose of calculating the average number of medications per patient, instead of treating them as zeros. For those 5219 patients who had medications which could be reliably counted, a count of unique medications, as defined by ATC⁸⁷ level 5, was determined for the three month trial period. The median number of unique medications per patient was 4 (range = 1 – 25; Figure 3-3).

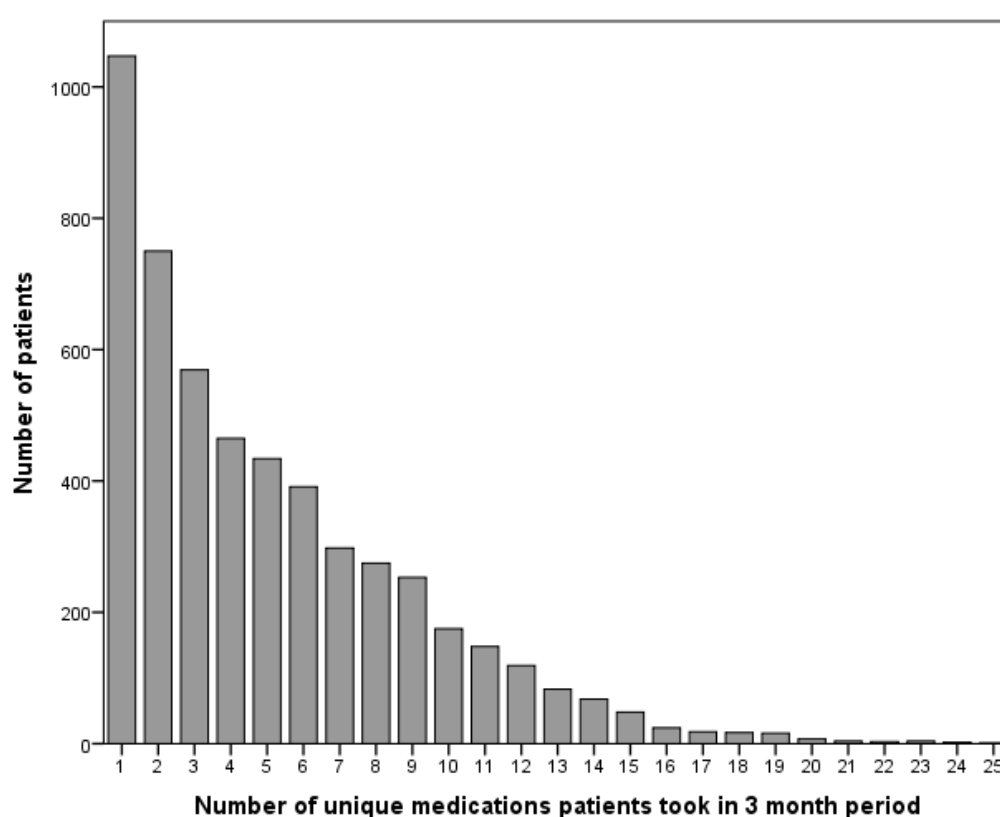


Figure 3-3: Number of patients with the number of unique medications over the trial period

3.9 *Cost saving analysis*

An independent expert panel was utilised to determine the average costs and cost savings associated with a sample of 200 interventions. This was done by assigning multiple factors to each intervention, such as number of GP/specialist visits or the cost of hospital admission, if the pharmacist had not intervened. Depending on the clinical significance of

the intervention, between \$231 and \$731 was saved (Table 3-18), with the average intervention resulting in a saving of approximately \$360. More detail about the calculation of the cost saving analysis can be found in the PROMISE III final report¹⁶⁴ and the methodology article by Stafford et al.¹⁶⁵

Parameter	S1	S2	S3	S4
Quality Adjusted Life Years	0.009	0.0077	0.0113	0.0200
Quality Adjusted Life 'Days'	3.28	2.80	4.12	7.29
Number of GP visits	1.3103	1.1554	1.7468	2.4479
Cost of GP visits	-\$43.96	-\$38.76	-\$58.60	-\$82.13
Number of specialist visits	0.2987	0.3278	0.4590	0.9390
Cost of specialist visits	-\$16.71	-\$18.61	-\$26.26	-\$50.21
Cost of investigations	-\$23.91	-\$38.67	-\$36.99	-\$68.21
Duration of hospital admission	0.1382	0.2412	0.2683	0.6060
Cost of hospital admissions	-\$137.57	-\$224.35	-\$274.17	-\$555.00
Cost of medications	-\$9.04	\$15.93	-\$58.95	\$24.46
Total Health Resource Utilisation	-\$231.19	-\$304.47	-\$454.97	-\$731.09

Table 3-18: Average change in health resource utilisation due to a clinical intervention

3.10 Discussion of types of clinical interventions

The overall intervention rate of 0.3% was comparable to other community pharmacy intervention studies, both in Australia and overseas^{61,64,66,77,78,81,84}, however it was lower than the previous PROMISE II study where the intervention rate was 0.55%.⁸¹ This may have been due in part to the longer running time, as PROMISE III ran for 12 weeks as opposed to the 6 week PROMISE II trial. The PROMISE III trial also saw a significant decline in the intervention rate over the trial period, which has been noted in several previous studies.^{34,59,66,79,136} It is possible that a degree of 'trial fatigue' occurred, where the participants become complacent in their duties, leading to a tapering level of participation during the trial. This phenomenon has often been discussed in relation to trials with computer-generated alerts, where pharmacists become 'fatigued' with the prompt, resulting in a declining effect over time.^{38,120,136} The participating pharmacies only received financial incentives before and after the trial, therefore it is possible that the lack of a 'fee-for-service' reimbursement scheme also contributed to the decline. Previous studies have noted that some pharmacists believe that increasing the level of remuneration will improve their provision of services^{53,109}, therefore it is possible that a fee-for-service model may lead to an improved intervention rate and help to combat the declining rate over time. It is unknown whether it was only the documented intervention rate that

declined over time, or whether the pharmacists also decreased the number of interventions performed. Again, a fee-for-service model may help maintain the documented intervention rate as the pharmacies would need to sustain adequate records to facilitate their payments. However, the effect on the performed intervention rate would continue to remain unknown.

Pharmacists in the PROMISe III study were required to categorise the nature of the problem that they identified and resolved using the DOCUMENT DRP Classification System. This is in contrast with other studies, where researchers were used to categorise the problem from information provided by the documenting pharmacist.^{27,62,63,73,76,78,83}

Asking the documenting pharmacist to classify the problem may have led to more inconsistency within this study, however, the range of categories and subcategories were similar to those documented within the previous PROMISe II study,⁸¹ and were also in keeping with our understanding of the types of DRPs identified in routine community pharmacy practice. Over 50% of the DRPs identified related to either the selection or dose of the medication, with a further 24% related to education or information. The nature of the problems also appeared to be consistent with those typically detected by community pharmacists in other published studies.^{60,61,68,69,75,78,79,167,168} Although many studies have not recorded adherence issues as a clinical intervention, one study did find 9.4% of interventions were due to an adherence problem⁷⁹, which was the same as the 9.4% identified in the PROMISe III study. Howard et al. identified that over 30% of preventable drug-related hospital admissions were due to adherence problems¹⁰, highlighting the importance of this type of intervention which can improve patient compliance within the community environment before hospitalisation is necessary.

Patients often received more than one recommendation to resolve the DRP, with the most common type of recommendation related to a change in therapy, such as a change of drug or a dose change. Provision of information was also common, as was a referral to the prescriber. These two recommendations (an education or counselling session and referral to the prescriber) accounted for 44.2% of all recommendations made by pharmacists to resolve the DRP. Again, this is consistent with our understanding of community pharmacy practice, where potential problems are often resolved by discussion with the patient, their prescriber or both.

Almost half of the clinical interventions (42.6%) were classified as being at either a moderate or high level of clinical significance by the documenting pharmacist. It is a limitation of the study that pharmacists may overstate the clinical significance of an intervention. However, the clinical significance reported by the pharmacists did appear to correlate well with the economic value determined by the expert panel; as the significance code increased, the average cost saving to the Australian healthcare system (as determined by the panel) also increased.

There are several possible explanations for the finding that around 20% of interventions were documented in the 'Other' categories. In most cases, it appeared that the pharmacist chose the correct DOCUMENT category, but then incorrectly chose 'Other' as the sub-category. This may have been caused by a lack of time or lack of motivation causing the pharmacists to select 'Other' rather than refer to the help files to classify a difficult case. This was supported by the finding that there were a significantly lower proportion of highly significant interventions documented within the 'Other' category, possibly indicating that pharmacists spent more time and effort classifying an intervention they felt was important. Within focus groups conducted post-trial, participating pharmacists also admitted to using the 'Other' sub-categories or not documenting the intervention at all if they found the intervention hard to classify.

Pharmacists were asked to identify a single drug involved with the intervention, which was recorded in the database using the ATC classification system.⁸⁷ The generic drugs associated with the largest total number of interventions were amoxycillin, prednisolone, metformin, cephalexin and esomeprazole. Common drug groups involved included proton pump inhibitors, HMG CoA reductase inhibitors, antibiotics, analgesics and agents acting on the renin-angiotensin system. This differs from the previous PROMISe II trial that reported drugs for diabetes, drugs for respiratory disorders and antibiotics as the most common drug groups. Only one other study reported interventions at the drug group level, where NSAIDs, beta-blockers, agents acting on the renin-angiotensin system, insulin, inhaled beta₂-agonists and antidepressants were found to be the drugs most commonly associated with an intervention.⁷⁸ The majority of the other studies have only reported the frequency of drugs within the system they work on. In these studies, drugs acting on the cardiovascular system, central nervous system, respiratory system and infections were most commonly reported.^{59,60,62,63,68,71,73,82,84} The type of drug involved in these international studies differs from those seen in the PROMISe III trial and this difference is

most likely due to diverse prescribing habits between countries, resulting in different drugs that the pharmacists intervene on. A difference was also seen between the previous PROMISe II study and this study, which may be due to the prompt used in PROMISe II which activated with each dispensing of an oral antidiabetic agent¹³⁶, thus increasing the number of interventions on antidiabetic drugs.

When the number of prescriptions for each group of medications was taken into account, medications with the highest proportions of interventions were phenoxymethylpenicillin and erythromycin. As mentioned previously, typical concerns with these antibiotics include allergies and correct paediatric dosing, as well as erythromycin having a large number of drug interactions which may increase the number of interventions required. In addition, all of these interventions were tagged as original prescriptions by the documentation system, not a repeat issue. This may have contributed to a high intervention rate for these antibiotics, due to original prescriptions being associated with a significantly higher number of interventions overall. It was also interesting to note the high number of interventions for drugs such as prednisolone, tramadol, and oxycodone, which all have the potential for serious adverse effects should they be used incorrectly. Systemic antibiotics, prednisolone, and analgesics have been identified as some of the most common drugs implicated in DRPs experienced by ambulatory care patients⁷ and requiring hospital admission^{3,10}, which may indicate that pharmacists are resolving many DRPs that may have otherwise resulted in a drug-related hospital admission. By encouraging pharmacists to increase their vigilance with these medications, through the use of targeted education or system prompts, the number of preventable drug-related admissions could be considerably reduced.¹⁰

As seen in previous studies^{48,73}, original prescriptions were again associated with a higher intervention rate. This difference is most likely due to original prescriptions having a higher incidence of drug selection errors, drug interactions and education requirements, compared to repeat prescriptions. These issues are likely to be fixed with the original prescription, therefore subsequent repeat prescriptions do not require further intervention, as the pharmacist has deemed the amended original prescription as safe to dispense. Additionally, professional standards recommend that a pharmacist offer counselling to each patient, especially if the medication is new¹⁶⁹, and this communication with the patient increases the opportunity to intervene. Unfortunately, many interventions did not have 'original vs repeat' information recorded within the system.

This was due to a design flaw within the software that was detected too late, where if the pharmacist recorded an intervention by selecting the drug manually (rather than recording the intervention against a dispensed drug in the history), the 'original vs repeat' field was left blank in the database. Ideally, the selection of 'original vs repeat' would be mandatory before an intervention could be finalised.

The patients that were subject to an intervention were significantly older than the general population according to data from the Australian Bureau of Statistics 2009.¹⁶⁶ This is likely to be due to the older population taking more medications, and therefore having an increased susceptibility to DRPs requiring intervention. There was also a higher percentage of females requiring interventions, which could be due to the aging population (which has a higher proportion of females due to longer life expectancy), and also by the trend of females tending to access healthcare on a more regular basis¹⁷⁰ and tending to discuss their health with their family and friends more often. Due to the intervention database assigning a unique patient identifier to each individual patient at each pharmacy, it is possible that one patient could have more than one 'identity' within the database. For example, if the same patient had visited two different pharmacies with the PROMISE software, their prescriptions and any interventions would have been entered into the database under two different ID numbers. Due to privacy issues, these numbers could not be associated with the patient's Medicare number, therefore this limitation was unavoidable within the trial environment. However, it is most likely not a large issue as most of the software pharmacies were located in different areas, resulting in a decreased likelihood that the same patient would have visited more than one PROMISE software pharmacy during the trial period.

An intervention was determined to save \$360 on average on healthcare expenditure. This shows the importance of performing clinical interventions within the community pharmacy environment, with even interventions of low clinical significance saving an average of \$231. Of course, these figures were calculated through a retrospective analysis of what might have happened without the intervention. Ideally, a future study to determine actual outcomes over a longer term would allow more accurate costs and savings to be calculated.

In summary, interventions tended to occur more frequently in certain drug groups (such as systemic antibiotics, prednisolone and opioids) and certain patient groups (such as

older females), as well as occurring more frequently on original prescriptions. However, these are not the only factors that contribute to whether an intervention is completed and the following two chapters will explore the pharmacy and pharmacist factors that can influence the performance and documentation of interventions.

4 Chapter 4: Pharmacy data and factors influencing pharmacy CI rate

Throughout the PROMISE trial, a large amount of data was collected on each pharmacy and pharmacist through the PROMISE software, online surveys, site visits, and by trained observers during the observation weeks. This data was then used to compare the pharmacies with national averages to ensure the sample was representative, and also to determine any factors that may have influenced the CI rate at the pharmacy level. Both bivariate and multivariate analysis between each pharmacy's intervention rate and any influencing factors will be reported within this chapter.

4.1 Characteristics of the pharmacies

PROMISE pharmacies were selected to ensure they were likely to be a representative sample of all pharmacies within Australia. PhARIA¹⁵³ and estimated annual prescription volume were chosen as the two key measures for selection, since these factors gave some indication of location and workload, but also had easily accessible national data from the Pharmacy Guild of Australia (PGA).¹⁵⁴ The data from the pharmacies was then statistically compared to the national figures from the PGA, where PhARIA data was available for 5006 pharmacies, and prescription volume data for 2395 pharmacies.

The composition of each of the software groups was also examined to ensure there were no statistical differences between the groups. In total, 210 pharmacies were recruited which were then divided into the two groups of 24 no software pharmacies and 186 software pharmacies. The 186 software pharmacies were further divided into the three software groups. The no software pharmacies were not required to complete the same surveys as the software pharmacies, and so could not be compared in all categories. Therefore, the two groups are described separately in the following sections.

4.1.1 No software pharmacies

Twenty-four pharmacies were recruited for the no software group. These pharmacies had no software installed, but instead had an impartial observer present for five working days to collect data. These pharmacies were selected according to their PhARIA and estimated annual prescription volume so as to provide a nationally representative sample.

4.1.1.1 PhARIA

Pharmacies were categorised as metropolitan (PhARIA 1) or regional (PhARIA 2-6). There was no significant difference between the broad PhARIA groupings of the participating no software pharmacies and the national distribution obtained from the PGA ($\chi^2 = 0.00$, $df = 1$, $p = 0.99$), which ensured that the no software group was representative of pharmacies nationwide in terms of rurality (Table 4-1).

	PROMISE		National	
	N	%	N	%
PhARIA 1	20	83.3	4166	83.2
PhARIA 2-6	4	16.7	840	16.8
Total	24	100	5006	100

Table 4-1: PhARIA of no software pharmacies compared to national average¹⁵⁴

4.1.1.2 Estimated annual prescription volume

When grouped, there was no significant difference between the estimated annual prescription volume of the participating pharmacies with no software and the national average from the PGA ($\chi^2 = 1.73$, $df = 3$, $p = 0.63$). Therefore, the no software group was considered representative of pharmacies nationwide (Table 4-2).

	PROMISE		National	
	N	%	N	%
Less than 30,000	7	29.2	1526	30.6
30,000 – 55,000	8	33.3	1792	35.9
55,000 – 90,000	8	33.3	1188	23.8
Over 90,000	1	4.2	486	9.7
Total	24	100	4992	100

Table 4-2: Estimated annual prescription volume of no software pharmacies compared to national average¹⁵⁴

4.1.1.3 Pharmacy location

No software pharmacies were asked to describe the location of their pharmacy, with most pharmacies being located on a shopping strip (Table 4-3). There was no statistical difference between the location of no software pharmacies and the software pharmacies ($\chi^2 = 0.73$, $df = 4$, $p = 0.95$). The location of the pharmacies could not be compared to national averages as the PGA did not report location data.

	No software pharmacies		Software pharmacies	
	N	%	N	%
Local shopping centre (less than 25 shops)	4	16.7	41	22.2
Major shopping centre (more than 25 shops)	3	12.5	17	9.2
Medical centre	2	8.3	17	9.2
Shopping strip	15	62.5	109	58.9
Other	0	0.0	1	0.5
Total	24	100	185	100

Table 4-3: Location of no software pharmacies compared to software pharmacies

4.1.2 Software pharmacies

The remaining 186 pharmacies had the PROMISe software installed into their dispensing system for the 12-week trial. These pharmacies were also selected according to their PhARIA and estimated weekly prescription volume to provide a nationally representative sample. Weekly prescription volume information was collected from the software pharmacies (but not from the no software pharmacies) and was considered more accurate, therefore the weekly prescription volume data was used for the software pharmacy comparisons.

4.1.2.1 PhARIA and estimated weekly prescription volume

Of the 186 participating pharmacies, 185 completed the trial successfully, with one pharmacy withdrawing due to the unforeseen sale of the business. Out of the 185 pharmacies that completed the trial, 184 (99.5%) completed the owner survey and again, pharmacies were categorised as either metropolitan (PhARIA 1) or regional (PhARIA 2-6). There were no statistically significant differences between the 185 pharmacies that completed the trial and the population of pharmacies within Australia with regards to PhARIA group (Table 4-4; $\chi^2 = 0.98$, $df = 1$, $p = 0.32$) and weekly prescription volume (Table 4-5; $\chi^2 = 1.10$, $df = 4$, $p = 0.89$). There were also no significant differences when all groups were compared (Table 4-6; $\chi^2 = 8.02$, $df = 9$, $p = 0.53$).

	PROMISe		National	
	N	%	N	%
PhARIA 1	159	85.9	4166	83.2
PhARIA 2-6	26	14.1	840	16.8
Total	185	100	5006	100

Table 4-4: PhARIA of PROMISe software pharmacies compared to national average¹⁵⁴

	PROMISE		National	
	N	%	N	%
Up to 400	9	4.9	189	7.9
400-800	60	32.6	812	33.9
801-1200	53	28.8	678	28.3
1201-2000	46	25.0	580	24.2
Over 2000	16	8.7	137	5.7
Total	184	100.0	2395	100.0

Table 4-5: Weekly prescription volume of PROMISE software pharmacies compared to national average¹⁵⁴

		PROMISE		National	
		N	%	N	%
PhARIA 1	Up to 400	8	4.3	87	3.6
	400-800	53	28.8	676	28.2
	801-1200	46	25.0	488	20.4
	1201-2000	38	20.7	457	19.1
	Over 2000	14	7.6	193	8.0
PhARIA 2-6	Up to 400	1	0.5	34	1.4
	400-800	7	3.8	174	7.3
	801-1200	7	3.8	141	5.9
	1201-2000	8	4.3	113	4.7
	Over 2000	2	1.1	33	1.4
Total		184	100	2395	100.0

Table 4-6: PhARIA and weekly prescription volume compared to national average¹⁵⁴

The owner/manager of the pharmacy was asked to estimate the weekly prescription volume and this was compared to the actual average weekly prescription volume from the pharmacies during the trial. A paired T-test showed no significant difference between the estimated weekly prescription volume and the actual volume recorded during the trial ($t(183) = 0.63, p = 0.53$), indicating that the owner/manager's estimation was reasonably accurate.

4.1.2.2 Dispensing software

Within Australia, the FRED® dispensing software system had approximately 50% market share¹⁵⁰ and Aquarius® had approximately 10%¹⁵¹; therefore, the PROMISE sample would be expected to be approximately 83% FRED® and 17% Aquarius®. There were 158 FRED® pharmacies and 27 Aquarius® pharmacies in the PROMISE sample, which was not statistically different from the expected numbers (Table 4-7; $\chi^2 = 0.57, df = 1, p = 0.45$).

	PROMISE		Expected
	N	%	%
FRED®	158	85.4	83.4
Aquarius®	27	14.6	16.6
Total	185	100	100

Table 4-7: Dispensing software of PROMISE software pharmacies compared to national average^{150,151}

4.1.2.3 Pharmacy location and identification of pharmacy types

During the enrolment process, pharmacies were asked if they were located in a shopping centre, medical centre or shopping strip, with the majority of PROMISE pharmacies (58.9%) being located in a shopping strip (Table 4-8). The pharmacies were separated into six major groups based on PhARIA and pharmacy location, and no significant differences between the distributions of pharmacies within each of the three principal pharmacy types across the PhARIA groups was seen (Table 4-9; $\chi^2 = 3.91$, $df = 2$, $p = 0.14$).

	N	%
Local shopping centre (less than 25 shops)	41	22.2
Major shopping centre (more than 25 shops)	17	9.2
Medical centre	17	9.2
Shopping strip	109	58.9
Other	1	0.5
Total	185	100

Table 4-8: Frequency of pharmacy locations

		PhARIA		Total
		1	2 - 6	
Shopping centre	PROMISE N	51	7	58
	% of Total	27.6%	3.8%	31.4%
Medical centre	PROMISE N	17	0	17
	% of Total	9.2%	0.0%	9.2%
Shopping strip/other	PROMISE N	91	19	110
	% of Total	49.2%	10.3%	59.5%
Total	PROMISE N	159	26	185
	% of Total	85.9%	14.1%	100.0%

Table 4-9: Frequency of the six pharmacy types sorted by PhARIA and location

4.1.2.4 Group allocation

As mentioned in Chapter 2, the software group pharmacies were allocated into the three groups using their weekly prescription volume and PhARIA as the determinants. From the original 186 pharmacies, the allocation resulted in 40 pharmacies in Group One and 73

pharmacies each in Groups Two and Three. After removing the pharmacy that did not complete the trial, the pharmacies were still distributed between the three groups with 40 in Group One, 72 in Group Two and 73 in Group Three (Table 4-10). Only 71 pharmacies are shown in Group Two in the table, as the pharmacy that did not complete the owner survey was also in this group.

		Group One: Software only		Group Two: Software with reminders		Group Three: Software with prompts and reminders		Total	
		N	%	N	%	N	%	N	%
PhARIA 1	Up to 400	3	7.5	0	0.0	5	6.8	8	4.3
	401 - 800	8	20	20	28.2	25	34.2	53	28.8
	801 - 1200	11	27.5	20	28.2	15	20.5	46	25.0
	1201 - 2000	11	27.5	17	23.9	10	13.7	38	20.7
	Over 2000	1	2.5	5	7.0	8	11.0	14	7.6
PhARIA 2 - 6	Up to 400	0	0	0	0.0	1	1.4	1	0.5
	401 - 800	2	5	2	2.8	3	4.1	7	3.8
	801 - 1200	3	7.5	2	2.8	2	2.7	7	3.8
	1201 - 2000	1	2.5	3	4.2	4	5.5	8	4.3
	Over 2000	0	0	2	2.8	0	0.0	2	1.1
Total		40	100	71	100.0	73	100.0	184	100.0

Table 4-10: Software groups compared by PhARIA and weekly prescription volume

As the groups were quite small in the table above, the prescription volume groups were consolidated to give a larger sample within each cell and therefore a more accurate statistical result. A chi-square test still showed no significant differences between the groups in relation to their PhARIA or weekly prescription volume (Table 4-11; $\chi^2 = 3.28$, $df = 6$, $p = 0.77$).

	Group One		Group Two		Group Three		Total	
	N	%	N	%	N	%	N	%
Metro 0 - 1200	22	55.0	40	56.3	45	61.6	107	58.2
Metro 1200+	12	30.0	22	31.0	18	24.7	52	28.3
Regional 0 - 1200	5	12.5	4	5.6	6	8.2	15	8.2
Regional 1200+	1	2.5	5	7.0	4	5.5	10	5.4
Total	40	100.0	71	100.0	73	100.0	184	100.0

Table 4-11: Software groups compared by PhARIA and weekly prescription volume

A chi-square test also showed no significant differences between the three software groups when compared by the pharmacy types (Table 4-12; $\chi^2 = 6.56$, $df = 8$, $p = 0.59$).

		Group One		Group Two		Group Three		Total	
		N	%	N	%	N	%	N	%
PhARIA 1	Shopping centre	12	30.0	20	27.8	19	26.0	51	27.6
	Medical centre	5	12.5	6	8.3	6	8.2	17	9.2
	Shopping strip/Other	17	42.5	36	50.0	38	52.1	91	49.2
PhARIA 2-6	Shopping centre	0	0.0	5	6.9	2	2.7	7	3.8
	Shopping strip/Other	6	15.0	5	6.9	8	11.0	19	10.3
Total		40	100.0	72	100.0	73	100.0	185	100.0

Table 4-12: Software pharmacy type compared to group allocation

4.1.2.5 Pharmacy area

Each pharmacy owner was asked to categorise their pharmacy into the same sizing groups used within the PGA data. According to the Guild Digest 2008¹⁵⁴, the average pharmacy area was 150m², with pharmacies located in shopping centres being larger at 169m² on average, shopping strip pharmacies 147m² on average, and medical centre pharmacies being a smaller 87m² on average. Of the 184 pharmacies that answered the survey, 62 pharmacies (33.7%) were 101-150m² and 37 pharmacies (20.1%) were 151-250m²; therefore, 54.4% of the participating pharmacies were close to the national average (Table 4-13). A chi-square test showed no statistical difference between pharmacy area and the three software groups ($\chi^2 = 9.06$, $df = 8$, $p = 0.34$), showing an even spread of different pharmacy sizes across the three groups.

	Group One		Group Two		Group Three		Total	
	N	%	N	%	N	%	N	%
Less than 100m ²	7	17.5	16	22.5	16	21.9	39	21.2
101-150m ²	19	47.5	21	29.6	22	30.1	62	33.7
151-250m ²	8	20.0	16	22.5	13	17.8	37	20.1
251-500m ²	6	15.0	16	22.5	16	21.9	38	20.7
Over 500m ²	0	0.0	2	2.8	6	8.2	8	4.3
Total	40	100.0	71	100.0	73	100.0	184	100.0

Table 4-13: Software pharmacy area in m² compared to group allocation

4.1.2.6 Annual financial turnover

The annual financial turnover of the PROMISE pharmacies in 2007/8 was fairly evenly distributed, with the majority of pharmacies stating a turnover of less than \$2 million per

annum (Table 4-14). This was slightly lower than the average turnover of \$2.4M in 2007, as reported in the Guild Digest 2008.¹⁵⁴ A chi-square test showed no significant differences between the pharmacy's annual turnover (combined into four groups for the chi-square test: Less than 1.5M, 1.5-2.5M, 2.5-4.0M, and Over 4.0M) and the three software groups ($\chi^2 = 4.45$, $df = 6$, $p = 0.62$).

	N	%
Less than 1.0M	20	10.9
1.0 - 1.5M	38	20.7
1.5 - 2.0M	37	20.1
2.0 - 2.5M	23	12.5
2.5 - 3.0M	18	9.8
3.0 - 4.0M	22	12.0
4.0 - 5.0M	16	8.7
Over 5.0M	10	5.4
Total	184	100

Table 4-14: Annual financial turnover of software pharmacies (categories expressed in million dollars)

4.1.2.7 Percentage of turnover attributed to the dispensary

As expected, most PROMISe pharmacies attributed the majority of their turnover to their dispensary, with only 19 pharmacies (10.3%) having less than 60% of their turnover attributable to the dispensary (Table 4-15). A chi-square test showed no significant difference between the pharmacy's estimated dispensary attribution and the three software groups ($\chi^2 = 4.56$, $df = 8$, $p = 0.81$).

	N	%
Less than 60%	19	10.3
60 - 69%	21	11.4
70 - 79%	58	31.5
80 - 89%	70	38.0
90 - 99%	16	8.7
Total	184	100

Table 4-15: Percentage of total turnover attributed to the dispensary, in software pharmacies

4.1.2.8 Pharmacy trading hours

On average, pharmacies were open six days per week (mean = 6.4 ± 0.6 ; mode = 6) and traded for an average of 60 hours per week (mean = 59.2 ± 12.5 ; range = 40 – 103), which matched the PGA data, where the average number of opening hours per week was 59.¹⁵⁴

A chi-square test showed no statistical difference between pharmacy weekly trading hours and the three software groups ($\chi^2 = 5.79$, $df = 6$, $p = 0.45$), showing an even spread of pharmacy opening hours across the three groups (Table 4-16).

	Group One		Group Two		Group Three		Total	
	N	%	N	%	N	%	N	%
Up to 50	13	32.5	17	23.9	26	35.6	56	30.4
51 – 60	15	37.5	29	40.8	20	27.4	64	34.8
61 – 70	4	10.0	14	19.7	15	20.5	33	17.9
Over 71	8	20.0	11	15.5	12	16.4	31	16.8
Total	40	100.0	71	100.0	73	100.0	184	100.0

Table 4-16: Software pharmacy trading hours per week compared to group allocation

4.1.2.9 Pharmacy ownership

Of the 184 owner survey respondents, 133 (72.3%) were owner-operated, with the remainder being run by a manager. A chi-square test showed no statistically significant difference between the operation of the pharmacy (owner vs. manager) and the three software groups ($\chi^2 = 2.11$, $df = 2$, $p = 0.36$). Owners were asked how many pharmacists were responsible for business decisions within the pharmacy, with an even split of 92 pharmacies (50.0%) having one responsible pharmacist and the other 92 pharmacies having two or more pharmacists responsible (Table 4-17).

	Owner	Manager	Total
1	69	23	92
2 or more	64	28	92
Total	133	51	184

Table 4-17: Number of pharmacists responsible for business decisions in owner vs manager-operated pharmacies

On average, the pharmacies had had the same owner for 10 years, ranging from 1 year to 47 years.

4.1.2.10 Banner group pharmacies

There was also an even split between independent pharmacies and banner group pharmacies, with 95 pharmacies (51.6%) identifying themselves as independent. Within the 89 banner group pharmacies, the most common groups were Amcal®, Guardian® and Pharmore® (Table 4-18). There was also no significant difference between membership in a banner group and the three software groups ($\chi^2 = 2.96$, $df = 2$, $p = 0.23$), which showed

an even spread of the two pharmacy types (banner vs. independent) across the three groups.

Banner group	Count
Amcal®	18
Guardian®	16
Pharmore®	12
Priceline Pharmacy®	8
Capital®	6
Quality Pharmacy®	5
UFS Dispensary®	5
Health Information Pharmacy®	4
MediAdvice®	4
Healthwise®	2
Nova®	2
Other banner group	7
Independent pharmacy	95
Total	184

Table 4-18: Frequency of each banner group within the software pharmacies

4.1.2.11 Staff mix

On average, a software pharmacy had 6.7 full-time equivalent (FTE) staff (range = 2.1 – 21.4) consisting of 2.3 pharmacists, 1.1 dispensary assistants and 3.3 pharmacy assistants (Table 4-19).

	Mean	Std. Dev.	Minimum	Maximum	Median
FTE all staff	6.72	3.88	2.10	21.41	5.65
FTE pharmacists	2.33	1.12	1.00	6.60	2.00
FTE dispensary assts	1.07	1.19	0.00	6.60	1.05
FTE pharmacy assts	3.31	2.67	0.00	13.10	2.57

Table 4-19: Number of FTE staff in software pharmacies

Number of FTE pharmacists

On average, there were 2.3 full-time pharmacists per pharmacy (range = 1 – 6.6), which was similar to the PGA average of 2.4.¹⁵⁴ A Kruskal-Wallis test showed no significant difference between the number of full-time pharmacists and the three software groups ($\chi^2 = 0.40$, $df = 2$, $p = 0.82$).

Employment of pre-registration pharmacists

During the previous two years, 64 pharmacies (34.8%) had employed a pre-registration pharmacist, with 43 (23.4%) pharmacies currently employing a pre-registration pharmacist. A chi-square test showed no significant differences between those pharmacies employing a pre-registration pharmacist in the last two years and the three software groups ($\chi^2 = 1.12$, $df = 2$, $p = 0.61$).

4.1.2.12 Services provided by the pharmacy

The owner/managers were also asked to indicate which professional services their pharmacy offered.

Aged care

Sixty-two of the PROMISe pharmacies (33.7%) catered for aged care facilities (ACFs) during the PROMISe trial. A chi-square test showed no significant differences between the pharmacies catering for aged care and the three software groups (Table 4-20; $\chi^2 = 3.23$, $df = 2$, $p = 0.20$).

	Group One		Group Two		Group Three		Total	
	N	%	N	%	N	%	N	%
Caters for ACFs	16	8.7	27	14.7	19	10.3	62	33.7
No ACFs	24	13.0	44	23.9	54	29.3	122	66.3
Total	40	21.7	71	38.6	73	39.7	184	100.0

Table 4-20: Caters for ACFs compared to group allocation

Number of professional services offered

The majority of pharmacies offered two to four additional PGA professional programs (Table 4-21) and three to five additional professional services (Table 4-22).

	N	%
0	12	6.5
1	17	9.2
2	45	24.5
3	67	36.4
4	35	19.0
5	8	4.3
Total	184	100

Table 4-21: Number of PGA professional programs offered by software pharmacies

	N	%
0	1	0.5
1	5	2.7
2	16	8.7
3	30	16.3
4	55	29.9
5	44	23.9
6	19	10.3
7	11	6.0
8	3	1.6
Total	184	100

Table 4-22: Number of additional professional services offered by software pharmacies

There was no significant difference between the total number of professional services offered by the pharmacy and the three software groups ($ANOVA F(2,181) = 0.71, p = 0.50$).

Type of PGA professional programs

During the PROMISe trial, 172 pharmacies (93.5%) were participating in other professional programs run by the PGA under the Community Pharmacy Agreement, with the most popular programs being the Dose Administration Aid (DAA) Program (164 or 89.1%) and the Patient Medication Profile (PMP) Program (140 or 76.1%; Figure 4-1).

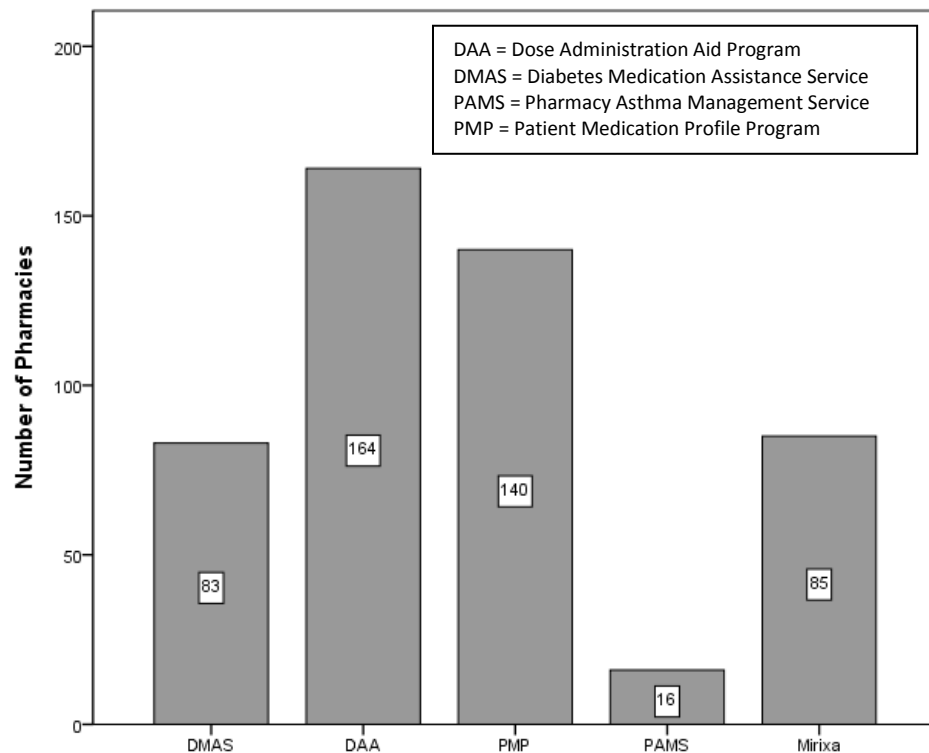


Figure 4-1: Number of pharmacies participating in concurrent Community Pharmacy Agreement professional programs (Note: Mirixa is an industry-sponsored service directed at adherence)

4.1.2.13 *Type of professional services offered*

The most common professional services offered were dose administration aid packing (94.6% of pharmacies), Home Medication Reviews (89.1%) and blood pressure monitoring (83.2%; Figure 4-2). Data was available for 184 pharmacies, with only one pharmacy stating that they did not offer any professional services. However, this pharmacy was actually a compounding pharmacy, which could be considered a specialised professional service. It should also be noted that the MedsIndex service (which used the patient's dispensing history to provide a compliance 'score') was partially funded externally by some drug companies, possibly contributing to a higher level of participation than would otherwise be expected. It was also largely an automated calculation, with little time commitment required by the pharmacist.

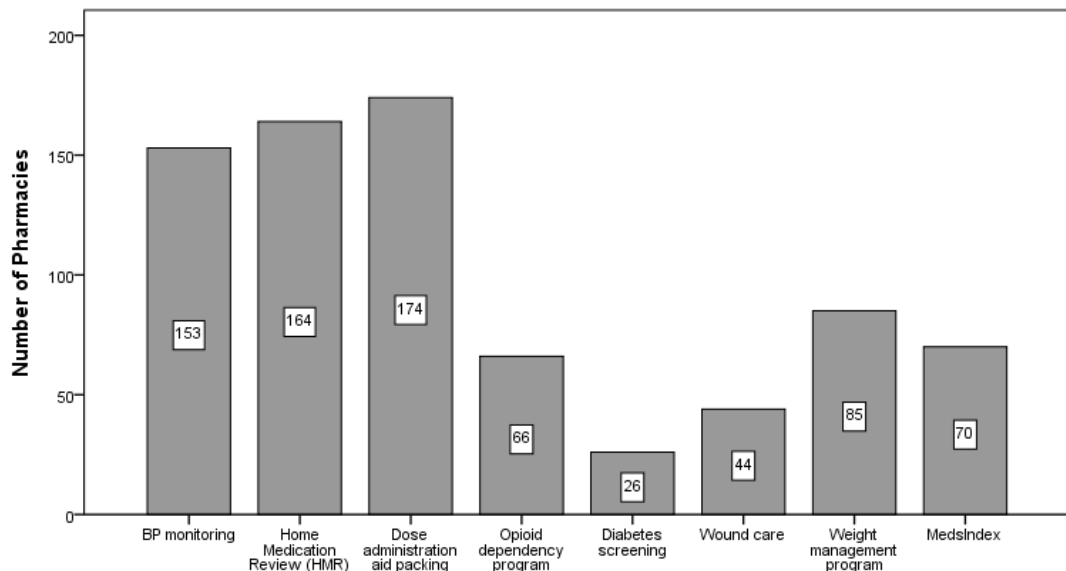


Figure 4-2: Number of pharmacies offering each professional service

4.1.2.14 *Visibility of dispensary and accessibility of the pharmacist*

In total, 184 pharmacies received a site visit from a member of the project team. The site visitors found that the dispensaries of 167 pharmacies (90.3%) and 156 pharmacists (84.3%) were considered to be clearly visible from the front entry. Of the 27 pharmacies (14.6%) that possessed a back entry, the dispensary could be clearly seen in 17 of those pharmacies (63.0%) and the pharmacist could be clearly seen in 15 pharmacies (55.6%). Site visitors believed that the pharmacist was easily accessible to the public in 159 pharmacies (85.9%), with reasons for inaccessibility including elevated dispensary areas, high aisle shelving, pharmacists being behind two counters or the need to ask staff to speak to the pharmacist.

4.1.2.15 *Counselling area*

Of the 184 pharmacies that received a site visit, 78 (42.4%) had a permanent counselling area (such as an office with a locking door), 71 (38.6%) had a temporary counselling area (such as a removable screen) and 35 (19.0%) had no designated counselling area. A chi-square test showed a significant difference between the type of counselling areas in the three software groups (Table 4-23; $\chi^2 = 9.85$, $df = 4$, $p = 0.04$), with Group One (software only) having more pharmacies than expected with no counselling areas, Group Two (software with reminders) having more pharmacies than expected with permanent counselling areas and Group Three (software with prompts and reminders) having more pharmacies than expected with temporary counselling areas.

	Group One		Group Two		Group Three		Total	
	N	%	N	%	N	%	N	%
Permanent	11	6.0	35	19.0	32	17.4	78	42.4
Temporary	17	9.2	22	12.0	32	17.4	71	38.6
No counselling area	12	6.5	15	8.2	8	4.3	35	19.0
Total	40	21.7	72	39.1	72	39.1	184	100.0

Table 4-23: Type of counselling area compared to group allocation

4.1.2.16 Number of dispensing terminals

On average, there were 2.3 ± 1.1 dispensing terminals in each PROMISE pharmacy (mode = 2; range = 1 – 6) with only 23 (12.5%) having four or more terminals (Figure 4-3). A chi-square test showed no significant difference between the number of dispensing terminals and the three software groups ($\chi^2 = 0.90$, $df = 4$, $p = 0.93$).

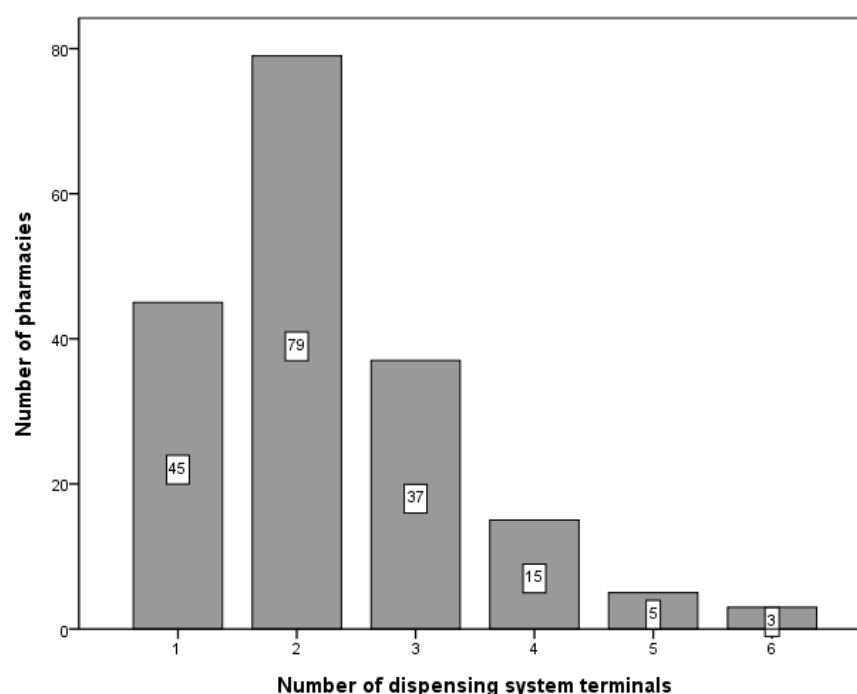


Figure 4-3: Number of dispensing terminals in PROMISE pharmacies

4.1.3 Discussion of pharmacy characteristics

The pharmacies participating in the PROMISE trial appeared to be a representative sample of all pharmacies within Australia, with regards to regionality, location and average prescription volume. Therefore, it could be hoped that the results of the PROMISE trial may represent the results that would be achieved with a national system. The pharmacies were also randomly allocated to the three software groups and no statistical differences were seen between the measured factors and the pharmacies within each group.

One notable difference was that the annual financial turnover of the PROMISE pharmacies in 2007/8 was found to be slightly lower than the average turnover reported by the PGA.¹⁵⁴ Since the pharmacies were asked to select from categories, rather than state their actual turnover, it is possible that the average turnover in PROMISE pharmacies was higher than reported. Pharmacies in the 'over 5.0M' group may have had a much higher turnover than \$5.0M, which would elevate the average turnover in the PGA data. Therefore, it could be presumed that the PROMISE pharmacies would likely compare to the Guild data.

4.2 *Bivariate pharmacy factors analysis*

The pharmacy characteristics reported within the previous section were then assessed to determine which factors may impact on the pharmacy's overall clinical intervention rate.

4.2.1 *Determining the intervention rate of the pharmacy*

As stated in Chapter 2, data was collected over the trial period and cleansed once the trial was finished to determine a valid intervention rate. The 525 OTC interventions and 282 Group Three prompted interventions were removed before the intervention rate was calculated. This cleansing process aimed to provide the most accurate estimate of current clinical intervention rates within community pharmacy, without the influence of non-prescription items or software prompts. The remaining clinical interventions (5948) were divided by the total number of prescriptions dispensed by the pharmacy during the trial, resulting in the pharmacy's overall intervention rate.

The median valid intervention rate during the trial was 0.21% (range = 0.00 – 2.35) or 2.1 CIs in every 1000 prescriptions (Table 4-24). When the prompted CIs were included for comparison, the median intervention rate rose slightly to 2.4 CIs in every 1000 prescriptions (range = 0.00 – 2.38; Table 4-24).

	Count	Mean	Median	25 th %ile	75 th %ile	Min.	Max.
Valid intervention rate	185	0.330	0.213	0.105	0.414	0.000	2.345
Total intervention rate (including prompted CIs)	185	0.355	0.239	0.112	0.441	0.000	2.376

Table 4-24: Intervention rate for pharmacies during the PROMISE trial

4.2.2 *Software group*

The three software groups were compared to the overall pharmacy intervention rates. Although the median and mean intervention rate increased as the group number (and therefore level of software increased), a Kruskal-Wallis chi-square test showed no statistically significant difference between the software group and pharmacy intervention rate (Table 4-25; $\chi^2 = 1.03$, $df = 2$, $p = 0.60$).

	Pharmacy count	Intervention Rate					
		Mean	Median	25 th %ile	75 th %ile	Min.	Max.
Group One: Software only	40	0.305	0.192	0.102	0.421	0.000	1.457
Group Two: Software with reminders	72	0.317	0.197	0.104	0.380	0.000	2.345
Group Three: Software with prompts and reminders	73	0.358	0.235	0.112	0.445	0.000	2.276
Total	185	0.330	0.213	0.105	0.414	0.000	2.345

Table 4-25: Group allocation compared to pharmacy intervention rate

4.2.3 Prescription volume (only participating pharmacists)

The prescription volume dispensed by participating pharmacists within each pharmacy was collected over the 12-week trial period. The prescription volume was then compared to the intervention rate within the pharmacy using a Spearman's correlation. There was a moderately weak, but statistically significant, negative correlation between the two groups (*Spearman's rho* = -0.18, *N* = 185, *p* = 0.02), showing that as the prescription volume increased, the intervention rate tended to decrease (Figure 4-4).

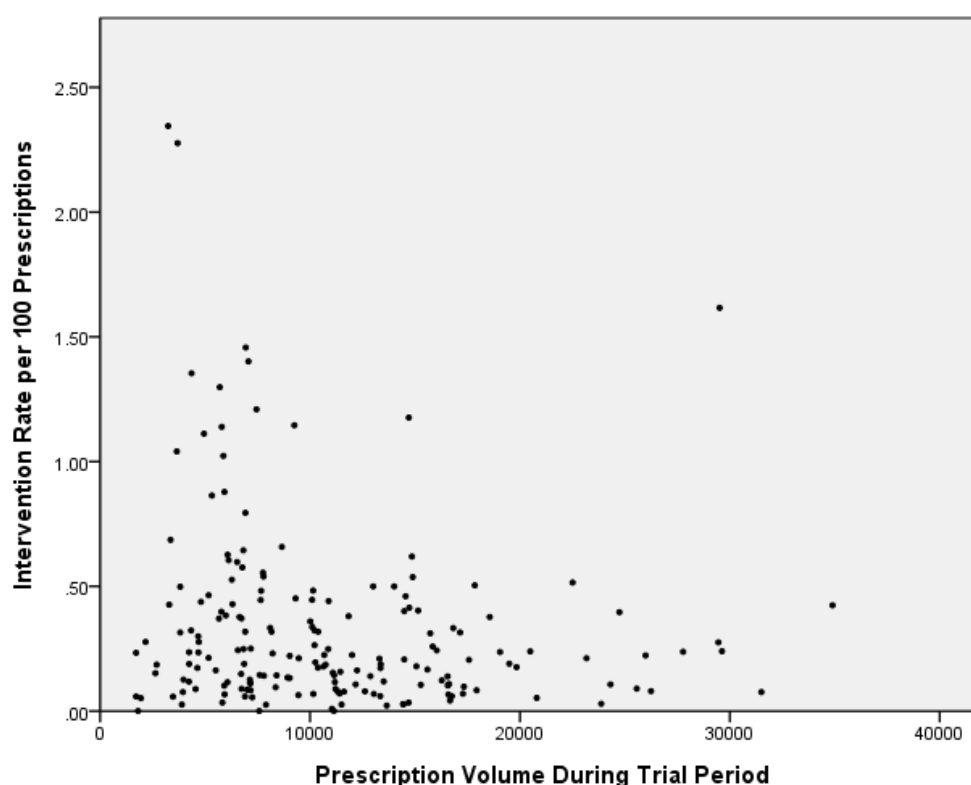


Figure 4-4: Relationship between prescription volume and pharmacy intervention rate

There appeared to be an outlier at the 30000 prescription mark, which is possibly due to participant error, and will be discussed at the end of this section.

4.2.4 *Prescription volume (all pharmacists within the pharmacy)*

The total prescription volume dispensed by all pharmacists within each pharmacy (including non-participant pharmacists, such as locums not enrolled in the trial) was also collected over the 12-week trial period and compared to the intervention rate within the pharmacy using Spearman's correlation. Again, there was a moderately weak, but statistically significant, negative correlation (*Spearman's rho* = -0.23, $N = 185$, $p = 0.002$), showing that as the prescription volume increased, the intervention rate tended to decrease (Figure 4-5).

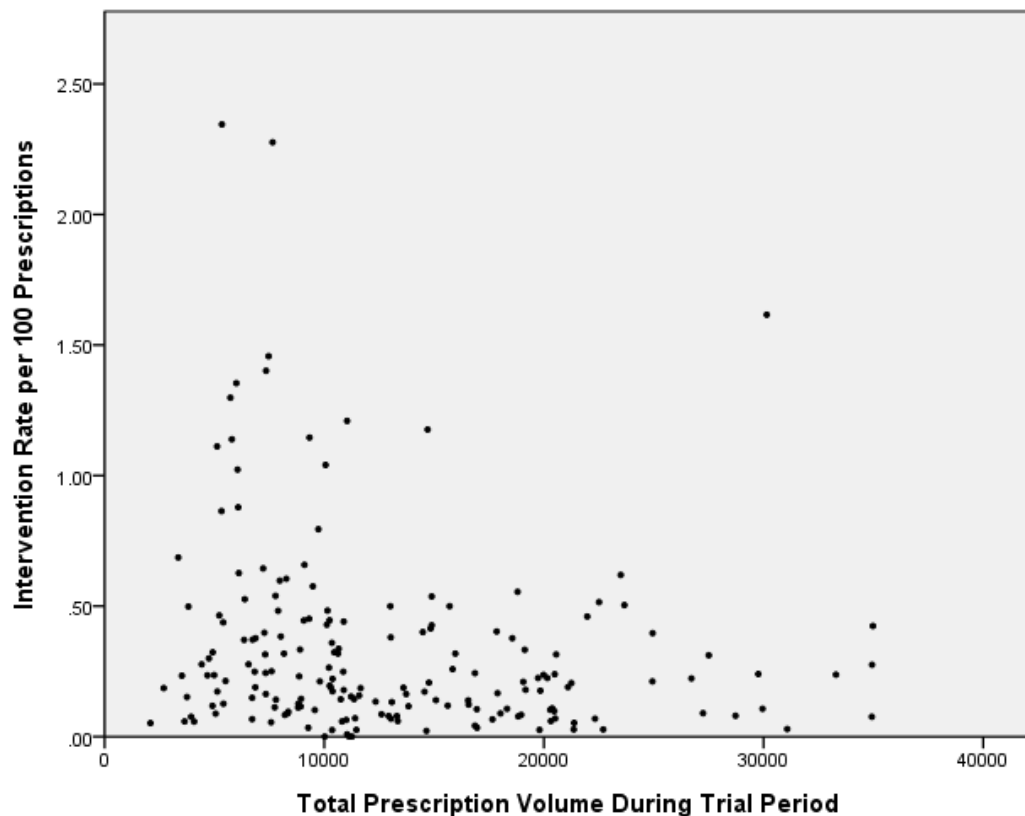


Figure 4-5: Relationship between total prescription volume and pharmacy intervention rate

4.2.5 Pharmacist workload within each pharmacy

The pharmacist workload was calculated by determining the actual number of prescriptions dispensed per week by the pharmacy during the trial and dividing it by the number of FTE pharmacists per week, resulting in the average number of prescriptions dispensed by a pharmacist during a 38-hour week. This figure was then compared to the overall intervention rate of the pharmacy to determine how much impact the workload of the pharmacist had on the pharmacy's intervention rate. A bivariate correlation test showed a moderately weak, but statistically significant, negative correlation between the two factors (*Spearman's rho* = -0.18, $N = 184$, $p = 0.015$), showing that as the workload of the pharmacist increased, the pharmacy's intervention rate tended to decrease (Figure 4-6).

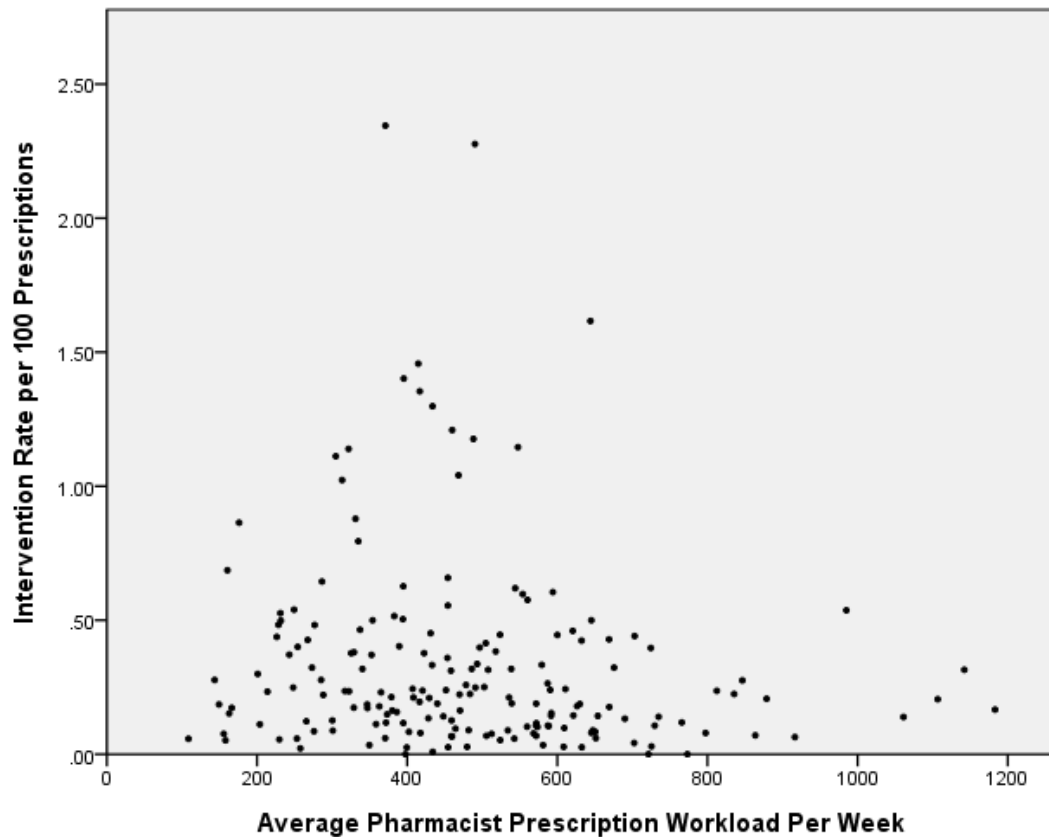


Figure 4-6: Relationship between average pharmacist workload per week and pharmacy intervention rate

A workload incorporating dispensary technicians was also calculated by the actual number of prescriptions dispensed per week by the pharmacy divided by the number of FTE pharmacists and dispensary technicians per week, resulting in the average number of prescriptions dispensed by dispensary staff during a 38-hour week. When technicians were included, the bivariate correlation test was no longer significant (*Spearman's rho* = -0.06, $N = 184$, $p = 0.413$).

4.2.6 Metropolitan or regional (PhARIA)

A Mann-Whitney test showed no significant difference between the intervention rate in metropolitan and regional/rural pharmacies (*Mann-Whitney U* = 1949.00, $z = -0.47$, $p = 0.64$; Table 4-26).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Metro (PhARIA 1)	159	0.221	0.000	2.276	0.103	0.400
Regional (PhARIA 2-6)	26	0.200	0.000	2.345	0.105	0.451
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-26: PhARIA compared to pharmacy intervention rate

4.2.7 Pharmacy location

The three location groups of pharmacies (medical centre, shopping centre, shopping strip/other) were assessed to determine if location was related to intervention rate, with a significant difference seen between the three groups (*Kruskal-Wallis* $\chi^2 = 6.79$, $df = 2$, $p = 0.03$). Post-hoc analysis showed that the difference lay between shopping centre and medical centre pharmacies, with medical centre pharmacies having a significantly higher median intervention rate (*Mann-Whitney U* = 302.00, $z = -2.42$, $p = 0.016$; Table 4-27).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Shopping centre	58	0.189	0.022	2.345	0.078	0.264
Medical centre	17	0.251	0.069	1.401	0.179	0.878
Shopping strip/Other	110	0.234	0.000	2.276	0.108	0.441
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-27: Location compared to pharmacy intervention rate

The pharmacies located within shopping centres had the highest average weekly prescription volume (1341.65 ± 643.11) followed by medical centre pharmacies (1183.00 ± 566.18) and shopping strip pharmacies (925.25 ± 532.87), and these differences were significant (*ANOVA* $F(2,182) = 10.35$, $p < 0.001$). Shopping centre pharmacies also recorded the highest pharmacist prescription workload (529.45 ± 206.01) followed by shopping strip pharmacies (458.87 ± 196.69) and medical centre pharmacies (440.88 ± 118.18), but these differences were only approaching significance (*ANOVA* $F(2,181) = 2.87$, $p = 0.059$). As such, it is possible that medical centre pharmacies may have had a higher intervention rate due to the lighter overall prescription workload within the pharmacy, and this was explored within the multivariate analysis (see section 4.3).

4.2.8 Pharmacy type

The pharmacies were divided into the six pharmacy types that resulted from combining the PhARIA and location of the pharmacy (section 4.1.2.3), although there were no regional medical centre pharmacies, resulting in five pharmacy types being available for

analysis. A Kruskal-Wallis test showed no significant differences between the pharmacy type and the pharmacy's intervention rate ($\chi^2 = 7.79$, $df = 4$, $p = 0.10$; Table 4-28).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Metro shopping centre	51	0.189	0.022	0.687	0.078	0.249
Metro medical centre	17	0.251	0.069	1.401	0.179	0.878
Metro shopping strip/other	91	0.235	0.000	2.276	0.102	0.445
Regional shopping centre	7	0.210	0.029	2.345	0.053	1.617
Regional medical centre	0					
Regional shopping strip/other	19	0.189	0.000	1.298	0.118	0.441
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-28: Pharmacy type compared to pharmacy intervention rate

4.2.9 Dispensing system

The pharmacy's dispensing system (FRED® or Aquarius®) was compared to their intervention rate to determine any differences that may have indicated functional differences between the systems. A Mann-Whitney test showed no significant difference between the dispensing systems and the pharmacy's intervention rate ($U = 2096.00$, $z = -0.14$, $p = 0.89$).

4.2.10 Pharmacy area

The approximate area of each pharmacy in m² was compared to the intervention rate. Data was only available for 184 pharmacies due to an incomplete owner's survey. There was a significant relationship between the area of the pharmacy and the intervention rate (Kruskal-Wallis $\chi^2 = 13.28$, $df = 4$, $p = 0.01$; Table 4-29). Post-hoc analysis showed that smaller pharmacies tended to have a significantly higher intervention rate than larger pharmacies (Jonckheere-Terpstra $t = -2.99$, $p = 0.003$), with additional analysis showing that the critical difference lay between the pharmacies with an area of less than 100m² and pharmacies with an area between 151 – 250m² (Mann-Whitney $U = 476.50$, $Z = -2.52$, $p = 0.01$).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Less than 100m ²	39	0.319	0.000	2.276	0.118	0.605
101-150m ²	62	0.240	0.025	2.345	0.157	0.441
151-250m ²	37	0.134	0.000	1.112	0.069	0.315
251-500m ²	38	0.192	0.028	1.617	0.098	0.396
Over 500m ²	8	0.082	0.058	0.445	0.077	0.188
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-29: Pharmacy area (in m²) compared to intervention rate

As there were only 8 pharmacies with an area greater than 500m², these were combined with the 38 pharmacies with areas between 251 – 500m². Condensing the categories still resulted in significant differences between the groups (*Kruskal-Wallis* $\chi^2 = 11.15$, $df = 3$, $p = 0.010$; *Jonckheere-Terpstra* $t = -2.87$, $p = 0.005$).

As expected, the larger pharmacies had a significantly higher prescription volume and pharmacist workload (*ANOVA* $F(3,180) = 24.32$, $p < 0.001$ and $F(3,179) = 3.30$, $p = 0.022$ respectively), so it is possible that the larger pharmacies had a lower intervention rate due to the workload within the pharmacy. This was explored within the multivariate analysis (see section 4.3).

4.2.11 Annual financial turnover

The pharmacies were divided into four groups according to their annual financial turnover, which was then compared to their intervention rate. A *Kruskal-Wallis* test showed a significant difference between the intervention rates of each turnover group ($\chi^2 = 12.76$, $df = 3$, $p = 0.006$), with a *Jonckheere-Terpstra* post-hoc analysis showing that as the pharmacy's turnover increased, at least between the lower groups, their intervention rate tended to decrease ($t = -2.67$, $p = 0.007$; Table 4-30).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Less than 1.5M	58	0.264	0.052	2.345	0.163	0.605
1.5 - 2.5M	60	0.165	0.000	1.041	0.085	0.390
2.5 - 4.0M	40	0.181	0.022	1.210	0.074	0.317
Over 4.0M	26	0.224	0.025	1.617	0.108	0.414
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-30: Pharmacy financial turnover in 2007/8 compared to pharmacy intervention rate

Post-hoc analysis showed that the differences lay between the 'Less than 1.5M' group and the '1.5 – 2.5M' and '2.5 – 4.0M' groups (*Mann-Whitney* $U = 1169.00$, $Z = -3.07$, $p = 0.002$ and $U = 748.00$, $Z = -2.98$, $p = 0.002$, respectively), but there was no difference between the 'Less than 1.5M' and the 'Over 4.0M' groups (*Mann-Whitney* $U = 583.00$, $Z = -1.66$, $p = 0.102$). This indicates a possible 'J-curve' effect where the pharmacies with the lowest turnover had a higher intervention rate, which sharply decreased with the next turnover category and then increased again, with the highest turnover category showing the second highest intervention rate. These could be pharmacies with sufficient turnover to employ extra pharmacists, facilitating the performance of clinical interventions, which was explored within the multivariate analysis (section 4.3).

As most of a pharmacy's financial turnover is derived from prescription volume, the pharmacies with a higher financial turnover tended to have a significantly higher prescription volume and pharmacist workload (*ANOVA* $F(3,180) = 80.47$, $p < 0.001$ and $F(3,179) = 5.58$, $p = 0.001$ respectively) as would be expected. It is possible that the pharmacies with higher turnovers had a lower intervention rate due to the workload within the pharmacy. Again, this was explored within the multivariate analysis (see section 4.3).

4.2.12 Attribution of dispensary to total pharmacy turnover

A bivariate correlation test showed no significant differences between the pharmacy's estimated dispensary attribution to the total pharmacy turnover and the pharmacy's intervention rate (*Spearman's rho* = -0.04, $N = 184$, $p = 0.573$).

4.2.13 Pharmacy trading hours

A bivariate correlation test showed a moderately weak, but statistically significant, negative correlation between the trading hours and the pharmacy's intervention rate (*Spearman's rho* = -0.18, $N = 184$, $p = 0.015$), illustrating that as the number of trading hours increased, the intervention rate tended to decrease (Figure 4-7).

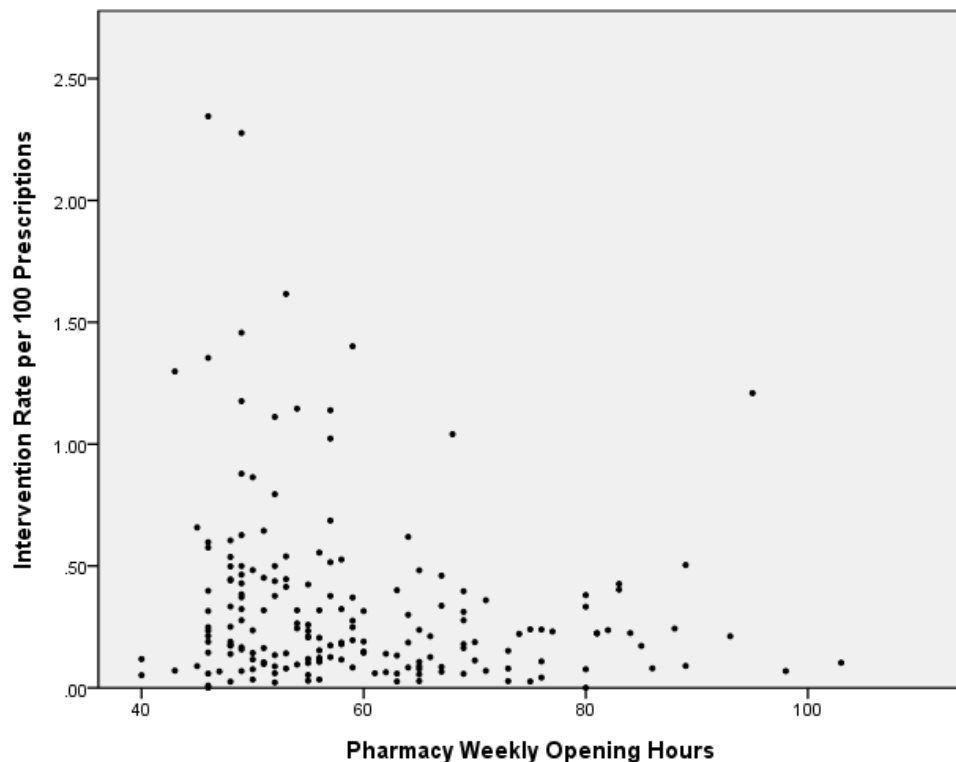


Figure 4-7: Relationship between trading hours and pharmacy intervention rate

The number of weekly trading hours was expected to correspond with the prescription volume and the pharmacist workload within the pharmacy. As expected, there was a correlation between trading hours and prescription volume (*Pearson's correlation* = 0.433, $N = 184$, $p < 0.001$) where pharmacies with longer trading hours had a higher prescription volume; therefore, it is possible that the pharmacies with longer trading hours had a lower intervention rate due to the workload within the pharmacy. This was further explored within the multivariate analysis (see section 4.3). Interestingly, weekly trading hours did not correlate with the average pharmacist workload per week (*Pearson's correlation* = -0.008, $N = 183$, $p = 0.911$), which may be due to varied workloads amongst the pharmacies.

The number of trading days per week was also approaching a significant correlation with the pharmacy's intervention rate (*Spearman's rho* = -0.14, $N = 184$, $p = 0.051$).

4.2.14 Pharmacy ownership

A Mann-Whitney test showed no significant differences between the intervention rates of pharmacies that were owner-operated compared to manager-operated ($U = 3157.00$, $Z = -0.73$, $p = 0.468$). Additionally, a Mann-Whitney test also showed no significant differences

between the intervention rates of pharmacies with a sole pharmacist operator compared to those with two or more ($U = 4099.00$, $Z = -0.37$, $p = 0.718$).

4.2.15 Banner group or independent pharmacy

A Mann-Whitney test showed significant differences between the banner group and independent pharmacies, with independent pharmacies having a higher intervention rate on average ($U = 3452.00$, $Z = -2.15$, $p = 0.029$; Table 4-31).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Independent	95	0.236	0.000	2.345	0.134	0.499
Banner group	89	0.187	0.022	1.617	0.084	0.377
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-31: Pharmacy branding compared to pharmacy intervention rate

Independent T-tests showed that independent pharmacies had a significantly lower average weekly prescription volume and lower average pharmacist workload (Table 4-32), with mean differences of 498.09 (95% CI = 335.90 – 660.28) and 97.28 (95% CI = 41.77 – 152.80), respectively. It is possible that the banner group pharmacies had a lower intervention rate due to the higher workload within the pharmacy. This was explored within the multivariate analysis (see section 4.3).

	Pharmacy Count	Average weekly prescription volume		Average pharmacist weekly workload	
		Mean	Std. Dev.	Mean	Std. Dev.
Banner	89	1337.42	647.47	528.64	177.71
Independent	95	839.33	439.16	431.35	201.01
Total	184	1080.25	602.45	478.14	195.81
Statistics		$t = -6.07$, $df = 153.5$, $p = 0.001$		$t = -3.46$, $df = 181$, $p = 0.001$	

Table 4-32: Differences in prescription volume and pharmacist workload between banner group and independent pharmacies

4.2.16 Pre-registration pharmacists

A Mann-Whitney U test showed significant differences between the intervention rates of the pharmacies that had employed a pre-registration pharmacist compared to those pharmacies that had not ($U = 3150.50$, $Z = -2.00$, $p = 0.049$). The pharmacies that had employed a pre-registration pharmacist tended to have lower intervention rates (Table 4-33).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Pre-reg.	64	0.188	0.000	1.617	0.094	0.295
No pre-reg.	120	0.240	0.000	2.345	0.114	0.462
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-33: The presence of a pre-registration pharmacist within the previous two years compared to pharmacy intervention rate

However, independent T-tests showed that pharmacies that had employed a pre-registration pharmacist within the previous two years had a significantly higher average weekly prescription volume ($t = -4.96$, $df = 106.93$, $p < 0.001$) with a mean difference of 461.67 (95% CI = 277.26 – 646.08). It is possible that pharmacies employing pre-registration pharmacists had a lower intervention rate due to the higher workload within the pharmacy, rather than the presence of a pre-registration pharmacist, which was explored within the multivariate analysis (see section 4.3).

4.2.17 Catered for ACFs

Sixty-two pharmacies indicated that they catered for ACFs during the trial, which was then compared to the pharmacy's intervention rate. A Mann-Whitney test showed significant differences between the groups, with pharmacies that catered for ACFs having a significantly lower intervention rate than pharmacies that did not ($U = 2840.50$, $Z = -2.76$, $p = 0.006$; Table 4-34).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Caters for ACFs	62	0.156	0.000	1.617	0.078	0.315
No ACFs	122	0.237	0.000	2.345	0.126	0.445
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-34: The effect of catering for an aged care facility on the pharmacy intervention rate

Independent T-tests showed pharmacies that catered for ACFs had a significantly higher average weekly prescription volume and higher average pharmacist workload (Table 4-35) with mean differences of 419.88 (95% CI = 244.40 – 595.34) and 80.53 (95% CI = 21.19 – 139.88), respectively. Again, it is possible that pharmacies catering for ACFs had a lower intervention rate due to the higher workload within the pharmacy. This was explored within the multivariate analysis (see section 4.3).

	Pharmacy Count	Average weekly prescription volume		Average pharmacist weekly workload	
		Mean	Std. Dev.	Mean	Std. Dev.
Caters for ACFs	62	1358.65	615.43	531.38	229.78
No ACFs	122	938.77	545.97	450.85	170.58
Total	184	1080.25	602.45	478.14	195.81
Statistics		$t = -4.72, df = 182, p < 0.001$		$t = -2.44, df = 96.41, p = 0.017$	

Table 4-35: Differences in prescription volume and pharmacist workload between pharmacies catering for ACFs

4.2.18 Number of FTE pharmacists

The number of FTE pharmacists working within the pharmacy was compared to the intervention rate with a bivariate correlation showing no relationship between the two factors (*Spearman's rho* = -0.11, $N = 184$, $p = 0.137$).

4.2.19 Proportion of prescriptions assembled by dispensary technicians

The percentage of prescriptions assembled by dispensary technicians within the pharmacy was also compared to the intervention rate. A Kruskal-Wallis test showed no significant differences between the usage of a dispensary technician and the pharmacy's intervention rate ($\chi^2 = 0.33$, $df = 4$, $p = 0.99$).

4.2.20 Number of professional services offered

The total number of professional services and programs offered were compared to the pharmacy's intervention rate. A bivariate correlation test showed a moderately weak, but statistically significant negative correlation between the two factors (*Spearman's rho* = -0.20, $N = 184$, $p = 0.008$), showing that as the number of professional services offered increased, the pharmacy's intervention rate tended to decrease.

When the number of additional services (including Community Pharmacy Agreement professional programs) offered by pharmacies were condensed into four groups, a Kruskal-Wallis test still showed significant differences between the number of services offered and the intervention rate (Table 4-36; $\chi^2 = 8.15$, $df = 3$, $p = 0.043$), with the main difference being seen between pharmacies offering 0-3 services compared to 7-9 (*Mann-Whitney U* = 390.00, $Z = -2.41$, $p = 0.016$). A Jonckheere-Terpstra test showed a generally

negative trend, where the intervention rate decreased as the number of services offered increased ($t = -2.63$, $p = 0.009$).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
0 – 3	14	0.437	0.052	1.354	0.152	0.526
4 – 6	58	0.233	0.026	2.276	0.145	0.483
7 – 9	93	0.189	0.000	2.345	0.089	0.371
10 or more	19	0.210	0.022	1.617	0.064	0.500
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-36: Total number of additional professional services offered compared to pharmacy intervention rate

4.2.21 Participation in other PGA professional programs

Over 90% of participating pharmacies were also participating in other PGA professional programs whilst completing the PROMIS^e trial. A bivariate correlation test showed a moderately weak, but statistically significant negative correlation (*Spearman's rho* = -0.17, $N = 184$, $p = 0.024$), showing that as the number of concurrent PGA programs increased, the pharmacy's intervention rate tended to decrease. Interestingly, the 12 pharmacies that were not participating in any other PGA programs had the highest median intervention rate whereas the 8 pharmacies concurrently providing 5 other programs had the lowest median intervention rate, and this was statistically significant (*Mann-Whitney U* = 18.00, $Z = -2.32$, $p = 0.018$).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
0	12	0.352	0.123	1.354	0.243	0.630
1	17	0.186	0.052	1.139	0.134	0.499
2	45	0.234	0.028	1.401	0.126	0.414
3	67	0.195	0.000	2.345	0.086	0.437
4	35	0.249	0.000	0.645	0.098	0.380
5	8	0.104	0.022	1.457	0.044	0.211
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-37: Number of other PGA programs being concurrently run by each pharmacy compared to pharmacy intervention rate

Comparisons were also made between participation in each individual project and the pharmacy's intervention rate. From the five PGA professional programs, only participation in the DAA and PMP program were associated with a significant difference in intervention

rate (Table 4-38), with the participating pharmacies tending to have lower intervention rates.

Program	<i>U</i>	<i>Z</i>	<i>p</i>
DMAS	3733.50	-1.27	0.206
DAA	986.00	-2.91	0.003
PMP	2439.00	-2.08	0.039
PAMS	1289.00	-0.27	0.788
Mirixa	3835.00	-1.03	0.308

Table 4-38: The effect of participation in other PGA programs compared to pharmacy intervention rate (NB:- Mirixa was not an official professional program)

4.2.22 Other professional services

The number and type of other professional services offered by the pharmacy were also compared to the intervention rate to determine any relationships. A bivariate correlation test showed a moderately weak, but statistically significant negative correlation (*Spearman's rho* = -0.17, *N* = 184, *p* = 0.023), showing that as the number of professional services offered increased, the pharmacy's intervention rate tended to decrease. Individual analysis showed that offering blood pressure monitoring and/or a dose administration packing service was associated with the pharmacy's intervention rate (Table 4-39), with the pharmacies offering these services recording a lower intervention rate.

Service	<i>U</i>	<i>Z</i>	<i>p</i>
BP monitoring	1690.00	-2.52	0.010
HMR	1372.00	-1.19	0.233
DAA packing	537.00	-2.03	0.042
Opioid dependency program	3330.50	-1.63	0.106
Diabetes screening	1875.50	-0.71	0.477
Wound care	2991.00	-0.29	0.768
Weight management program	3641.00	-1.57	0.114
MedsIndex	3953.50	-0.10	0.914

Table 4-39: The effect of offering additional professional services compared to pharmacy intervention rate

4.2.23 Counselling area

There were no significant differences between the three types of counselling area within the pharmacies and the intervention rate (*Kruskal-Wallis* $\chi^2 = 2.81$, *df* = 2, *p* = 0.25). The pharmacies were recoded into two groups where they either had a permanent counselling

area or no counselling area, with those pharmacies with a temporary counselling area being coded as having no counselling area. When compared to the intervention rate, there was still no significant differences between the presence of a permanent counselling area and the pharmacy's intervention rate (*Mann-Whitney* $U = 3538.00$, $Z = -1.67$, $p = 0.097$).

Despite a significant difference in the types of counselling area found between the three software groups (see section 4.1.2.15), there was no correlation between the average number of times per week that the counselling area was used and the pharmacy intervention rate (*Spearman's rho* = 0.09, $N = 184$, $p = 0.241$). This indicated that the previous finding of differences between the software groups may not have been important and may also indicate that the actual use of a counselling area is a more relevant professional factor than simply the presence of a counselling area.

4.2.24 Pharmacist accessibility

A Mann-Whitney test showed no significant differences in the intervention rate between pharmacies where the site visitor considered the pharmacist to be easily accessible compared to those where the pharmacist was not easily accessible ($U = 1480.00$, $Z = -1.48$, $p = 0.147$).

4.2.25 Number of dispensing terminals

The number of dispensing terminals within each pharmacy was also compared to the intervention rate with a bivariate correlation approaching significance (*Spearman's rho* = -0.14, $N = 184$, $p = 0.051$); as the number of dispensing terminals increased, the intervention rate tended to decrease. When the number of terminals were recoded into 3 groups (1 terminal, 2 terminals, and 3 or more terminals), there was a significant difference between the number of terminals and the intervention rate (Table 4-40; *Kruskal-Wallis* $\chi^2 = 7.55$, $df = 2$, $p = 0.02$). However, there was not a significant linear trend (*Jonckheere-Terpstra* $t = -1.81$, $p = 0.07$). Additional post-hoc analysis showed that the only difference lay between those pharmacies with one terminal and those with two terminals (*Mann-Whitney* $U = 1271.00$, $Z = -2.63$, $p = 0.007$).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
1	45	0.315	0.058	2.345	0.163	0.526
2	79	0.179	0.000	2.276	0.086	0.398
3 or more	60	0.211	0.022	1.617	0.106	0.374
Total	184	0.217	0.000	2.345	0.106	0.419

Table 4-40: Number of dispensing terminals compared to pharmacy intervention rate

As expected, ANOVA showed that pharmacies that had more dispensing terminals had a significantly higher average weekly prescription volume and higher average pharmacist workload (Table 4-35).

	Pharmacy Count	Average weekly prescription volume		Average pharmacist weekly workload	
		Mean	Std. Dev.	Mean	Std. Dev.
1	45	559.54	172.71	395.63	159.64
2	79	964.61	383.65	478.19	179.27
3 or more	60	1610.19	626.31	544.00	219.51
Total	184	1076.06	600.73	479.46	196.10
Statistics		$F(2,181) = 75.81, p < 0.001$		$F(2,181) = 7.92, p = 0.001$	

Table 4-41: Differences in prescription volume and pharmacist workload compared to the number of dispensing terminals

Pharmacies were also asked to estimate how often the lack of access to a dispensing terminal affected the dispensary workflow by choosing one of the following categories: Frequently (more than 8 times a day); Occasionally/sometimes (3-8 times a day); or Rarely/never (less than 3 times a day). The frequency of disruption did not appear to be associated with the pharmacy's intervention rate (*Kruskal-Wallis* $\chi^2 = 0.83, df = 2, p = 0.68$).

4.2.26 Health promotion

The site visitors recorded whether the pharmacy displayed any health promotion posters or advertised professional services prominently within their pharmacy. Of the 184 pharmacies that were visited, 102 (55.4%) pharmacies had health promotion or services displayed within their pharmacy. The presence of these promotional materials was not significantly associated with the pharmacy intervention rate (*Mann-Whitney U* = 3783.00, $Z = -1.11, p = 0.265$).

For the 102 pharmacies that were promoting health and services, the site visitors recorded what they were promoting. These comments were grouped into 11 ‘themes’ for analysis:

- Diabetes; including the DMAS trial and BSL testing
- Cardiovascular disease; including BP testing, cholesterol checks, counselling/advice
- Smoking cessation
- Asthma
- Improving compliance; including HMRs, DAAs, PMPs, MedsIndex, MediMate (a program encouraging patients to keep a current list of all their medications)
- Preventative health; including bone mineral density testing, hearing screening, mobility aids, eye checks (glaucoma, macular degeneration), opioid dependency program
- Self-help; including health kiosks, self-care cards
- Weight management programs
- Additional practitioners; including naturopath, herbalist, Chinese medicine, pharmacy nurse
- Child health
- Other (including a head lice clinic, wound care etc.)

The presence of each individual ‘themed’ health promotion did not appear to have any relationship with the pharmacy intervention rate (Table 4-42).

	<i>U</i>	<i>Z</i>	<i>p</i>
Diabetes	3385.00	-0.57	0.566
Cardiovascular	1482.00	-0.10	0.926
Smoking cessation	1373.00	-1.51	0.131
Asthma	524.00	-0.71	0.482
Compliance	2579.00	-0.36	0.722
Preventative health	1752.00	-0.17	0.869
Self-help	1522.00	-1.42	0.157
Weight management	2270.00	-1.61	0.109
Additional practitioners	418.00	-0.27	0.798
Child health	456.00	-1.20	0.233
Other	411.00	-0.33	0.748

Table 4-42: Presence of each health promotion ‘theme’ compared to pharmacy intervention rate

4.2.27 Workflow roles and responsibilities

Pharmacies were asked to estimate the percentage of time that each type of staff member spent on the following tasks:

- Collects prescription and patient details
- Processes prescription through computer
- Collects stock for prescription
- Labels prescription
- Checks prescription
- Hands out prescription
- Counsels patient
- Collects payment for prescription

The pharmacist responsibilities that appeared to correlate with the pharmacy's intervention rate were the percentage of time spent collecting patient details and collecting payments (*Spearman's rho* = 0.17, *N* = 184, *p* = 0.023 and *Spearman's rho* = 0.21, *N* = 184, *p* = 0.005 respectively), where the higher the percentage of time that the pharmacist spent on these tasks, the higher the pharmacy intervention rate. All other factors did not correlate with the intervention rate. There was also no correlation between the pharmacy intervention rate and the percentage of time that dispensary and non-dispensary assistants spent on each task.

4.2.28 General comments about the pharmacy

Site visits were conducted by six different people (five pharmacists and one administration officer), resulting in a non-uniform 'general comments' section. Basic qualitative methods were used to group the information into the following eight themes, which were then used for analysis:

- Gifts/beauty/supermarket style vs dispensary/healthcare orientated
- Modern vs old
- Busy vs steady vs quiet
- Staff friendly vs not friendly
- Small pharmacy vs large pharmacy
- Spacious/tidy vs cramped/messy
- Professional vs unknown
- Distractions vs unknown

There were many unknowns due to site visitors not entering the same information with each visit and, thus, many sample sizes were small.

As can be seen in Table 4-43 and Table 4-44, the only significant differences detected were:

- Pharmacies that the site visitors listed as being healthcare orientated had a higher median intervention rate than those that were listed as having lots of gifts/beauty items or 'supermarket' style (*Mann-Whitney U* = 268.00, *Z* = -2.27, *p* = 0.02)
- Pharmacies that the site visitors listed as being professional-looking or displaying professional services during the site visit had a higher median intervention rate than the 'unknown' group (*Mann-Whitney U* = 2912.00, *Z* = -1.99, *p* = 0.04)

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Healthcare orientated	25	0.259	0.088	2.276	0.195	0.500
Gifts/beauty/supermarket style	33	0.187	0.053	1.457	0.108	0.277
Unknown	127	0.207	0.000	2.345	0.089	0.429
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-43: Healthcare-orientation compared to pharmacy intervention rate

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Professional	55	0.249	0.000	2.345	0.140	0.451
Unknown	130	0.187	0.000	2.276	0.089	0.384
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-44: Professional appearance compared to pharmacy intervention rate

In total, there were 68 pharmacies that the site visitors listed as being 'healthcare orientated' and/or 'professional'. These pharmacies were combined into one group and compared to the remaining 117 pharmacies, which still showed a significant difference in intervention rate (*Mann-Whitney U* = 3020.00, *Z* = -2.73, *p* = 0.006), with the more healthcare-orientated, more professional pharmacies being associated with a higher median intervention rate (Table 4-45).

	Pharmacy Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Healthcare orientated/professional	68	0.250	0.000	2.345	0.155	0.475
Unknown	117	0.174	0.000	1.457	0.084	0.380
Total	185	0.213	0.000	2.345	0.105	0.414

Table 4-45: Healthcare-orientation and/or professional appearance compared to pharmacy intervention rate

This was, at least at face value, in contrast to the results found in sections 4.2.21 and 4.2.22, which showed that the actual provision of more services was found to be associated with a lower intervention rate or no change in the intervention rate. The offering of professional services alone, however, does not necessarily mean that the pharmacy has a professional image.

4.2.29 Summary table of pharmacy bivariate factors

The previous sections have been summarised into the following table.

		Median CI Rate	<i>p</i>
Software Group	Group One	0.192	0.60
	Group Two	0.197	
	Group Three	0.235	
PhARIA	Metropolitan	0.221	0.64
	Regional	0.200	
Pharmacy Location	Shopping centre	0.189	0.03
	Medical centre	0.251	
	Shopping strip/Other	0.234	
Dispensing System	FRED®		0.89
	Aquarius®		
Pharmacy Area	Less than 100m ²	0.319	0.01
	101-150m ²	0.240	
	151-250m ²	0.134	
	251-500m ²	0.192	
	Over 500m ²	0.082	
Annual Financial Turnover	Less than 1.5M	0.264	0.01
	1.5 - 2.5M	0.165	
	2.5 - 4.0M	0.181	
	Over 4.0M	0.224	
Banner Group or Independent	Independent	0.236	0.03
	Banner group	0.187	
Pre-registration Pharmacist	Pre-reg.	0.188	0.05
	No pre-reg.	0.240	
Catered for ACFs	Caters for ACFs	0.156	0.01
	No ACFs	0.237	
Number of additional professional services offered	0 – 3	0.437	0.04
	4 – 6	0.233	
	7 – 9	0.189	
	10 or more	0.210	
Number of dispensing terminals	1	0.315	0.05
	2	0.179	
	3 or more	0.211	

Table 4-46: Summary table of the analysed bivariate factors compared to pharmacy intervention rate

4.2.30 Analysis of software groups

As determined in section 4.2.2, no significant difference in the intervention rates was seen between the three software groups. However, additional analyses were performed to determine any other differences between the three groups.

4.2.30.1 Effect of the general reminder

During the 12-week trial, pharmacies in Group Two and Three received an automatic pop-up reminder everyday at 11am and 3pm which encouraged the pharmacist to document their interventions (see Chapter 2). Although each intervention had a time stamp within its record, there was no equivalent time stamp with each dispensed prescription, unfortunately meaning an intervention rate per hour could not be reliably calculated. Analysis was therefore conducted on the actual number of interventions documented during the hour. Collation of the interventions showed the highest peak at 11am with 850 interventions and the second highest peak at 3pm with 727 interventions (Table 4-47 and Figure 4-8). However, this does not necessarily reflect the time of day that interventions were performed, only the time they were documented and submitted as being complete.

		Group One		Group Two		Group Three		Total	
		N	%	N	%	N	%	N	%
Hour of day	8	5	0.5	36	1.4	19	0.8	60	1.0
	9	83	8.4	183	7.0	156	6.6	422	7.1
	10	102	10.4	229	8.8	257	10.9	588	9.9
	11	122	12.4	379	14.5	349	14.8	850	14.3
	12	94	9.5	322	12.3	254	10.8	670	11.3
	13	91	9.2	238	9.1	215	9.1	544	9.1
	14	113	11.5	187	7.2	244	10.4	544	9.1
	15	102	10.4	352	13.5	273	11.6	727	12.2
	16	103	10.5	297	11.4	280	11.9	680	11.4
	17	107	10.9	226	8.7	183	7.8	516	8.7
	18	29	2.9	86	3.3	80	3.4	195	3.3
	19	18	1.8	48	1.8	24	1.0	90	1.5
	20	15	1.5	22	0.8	14	0.6	51	0.9
	21	1	0.1	5	0.2	4	0.2	10	0.2
	22	0	0.0	1	0.0	0	0.0	1	0.0
Total		985	100.0	2611	100.0	2352	100.0	5948	100.0

Table 4-47: Number of interventions documented each hour within the three software groups

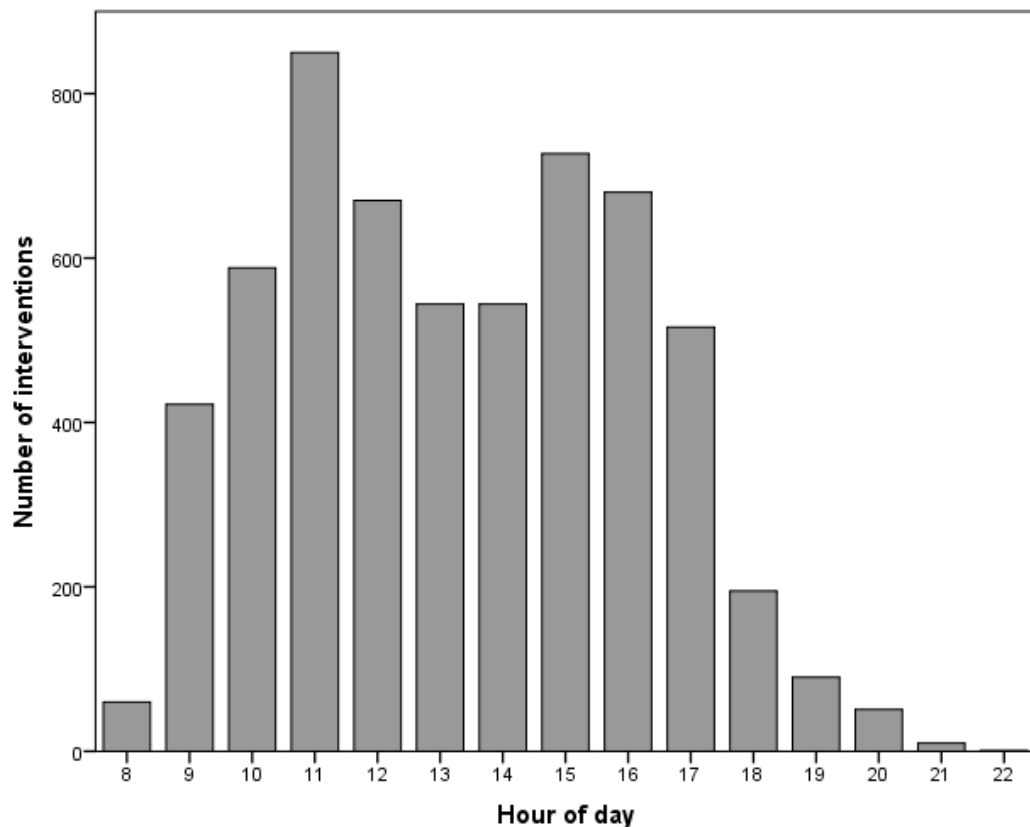


Figure 4-8: Clinical interventions per hour

There appeared to be a significant difference in the times of day that the interventions were recorded between Group One and the other two groups (Figure 4-9). Group One only had the software with neither reminders nor prompts, which resulted in a more consistent documentation rate. Groups Two and Three both had the reminder and displayed a peak of recordings at 11am, with Group Two showing another high peak at 3pm (Figure 4-9). This indicates that the reminder provided a significant increase in the number of interventions in the hour following the reminder ($\chi^2 = 73.4$, $df = 24$, $p < 0.001$). However, as mentioned in section 4.2.2, the reminder did not appear to influence the intervention rate of the pharmacy overall.

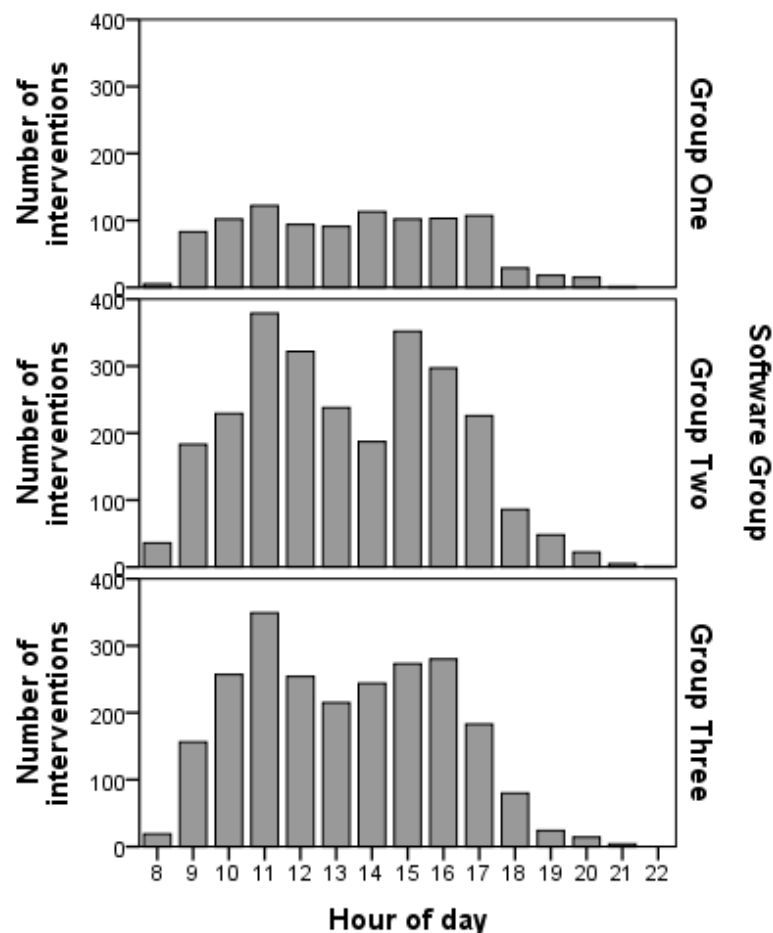


Figure 4-9: Interventions within each software group compared to hour

4.2.30.2 *Effect of the prompt*

As mentioned in section 4.2.2, the prompt in Group Three pharmacies did not appear to influence the overall intervention rate. However, the prompt was expected to affect the intervention rate within the prompted medication groups. Analysis was undertaken to determine any other effects of the electronic prompt.

Identification of clinical interventions relating to the prompt

As discussed in Chapter 2, interventions that were deemed to be associated with the prompt in Group Three were identified as follows:

1. Interventions associated with ATC codes A02BC02 (pantoprazole) and A02BC05 (esomeprazole)
2. At least one of the following DOCUMENT recommendation categories: R2, R3, R7, R13
3. If available, reviewing the intervention notes made by pharmacists for these interventions to identify any anomalies.

These interventions were removed prior to analysis of intervention rates, but were included for the following analysis regarding the prompt.

Opportunities to intervene

Among Group Three pharmacies in the PROMISe III trial, 16,924 prescriptions for esomeprazole 40mg tablets (7,967 prescriptions for 4,647 individual patients) and pantoprazole 40mg tablets (8,957 prescriptions for 4,856 individual patients) were dispensed, thus there were 16,924 opportunities to intervene.

Prompt intervention rate

In total, 282 PPI step-down interventions were identified from the database, consisting of 158 for esomeprazole 40mg and 124 for pantoprazole 40mg (Table 4-48). Although the prompt did not increase intervention rates overall, it significantly increased the number of interventions documented against esomeprazole and pantoprazole ($p < 0.001$; Table 4-48).⁴⁰

	PPI prompt (Group Three)		Control (Groups One and Two)	
	Esomeprazole 40mg	Pantoprazole 40mg	Esomeprazole 40mg	Pantoprazole 40mg
Number of interventions	158	124	32	16
Number of prescriptions	7967	8957	12584	14883
Intervention rate	1.98	1.38	0.25	0.11
Overall intervention rate	1.67		0.17	

Table 4-48: The effect of the prompt

Cost saving analysis^{40,162}

Potential cost savings of the prompted PPI step-down interventions were also investigated. Costing calculations were sub-divided into categories:

1. Reduction of medication strength
2. Use of another medication indicated for the treatment of gastro-oesophageal reflux disease (GORD), and
3. Utilisation of health care resources

All step-down interventions identified within the first four weeks of the trial were examined, as this allowed at least eight weeks of follow-up data post-intervention for each consumer. Using the consumer prescription history, 34 step-down interventions were identified in the first 28 days; 27 consumers decreased their dose, 6 consumers changed to a less expensive PPI and 1 consumer changed to a less expensive H₂-receptor

antagonist. Again, using the patient prescription history post-intervention, it appeared that this change was maintained. The change in cost calculations were based on the 'Schedule of Pharmaceutical Benefits – July 2009' available through the Pharmaceutical Benefits Scheme (PBS) website¹⁷¹ and the average cost saving of the step-down therapy was found to be \$7.98 AUD per pharmacy per month. Extrapolation of the accumulation of cost saving over one year (when the prompt is only used for the first two months of the year) estimated a saving of \$183.60 AUD per pharmacy per year, or approximately \$800 000 per year if the prompt had been active in all Australian pharmacies.⁴⁰ More detail can be found in the article in Appendix 22.

4.2.31 Analysis of trial phases

As determined in section 4.2.2, no significant difference was seen between the three software groups with regards to overall intervention rate. The intervention frequencies for pharmacies based on weeks of activity in each pharmacy were also examined to determine if there were any differences seen between the different trial phases (arbitrary divisions used during post-trial data analysis).

4.2.31.1 Trial weeks

The data was separated into weeks of pharmacy activity, resulting in a total of 2220 weeks of activity to be analysed. After removing the PPI step-down interventions, an intervention frequency was again calculated for each week (Figure 4-10).

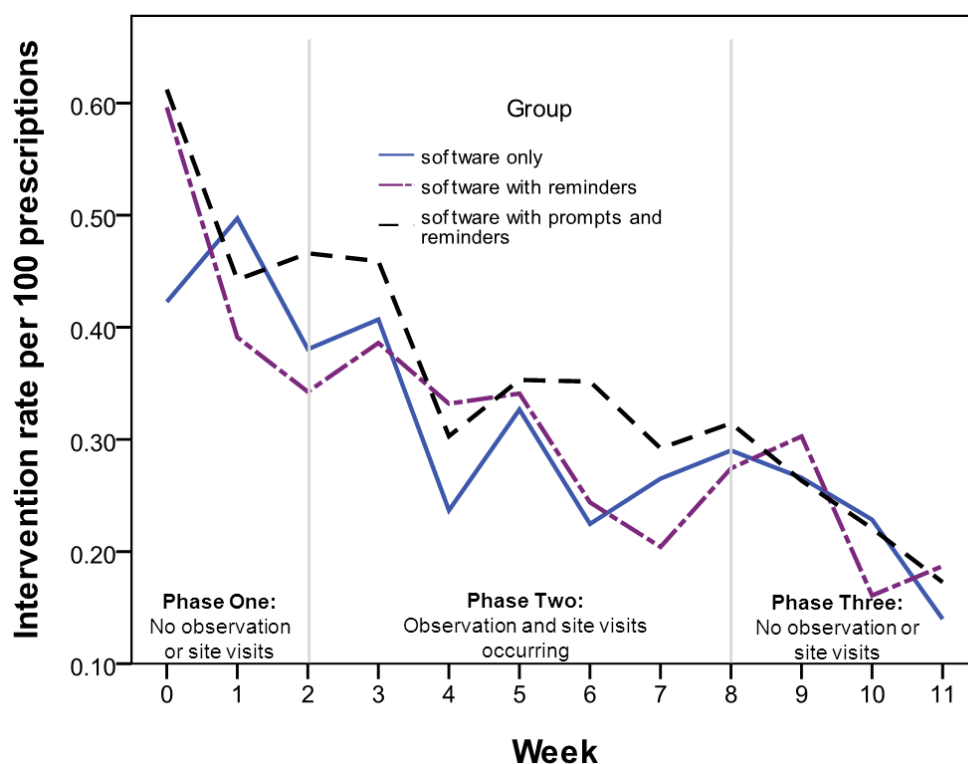


Figure 4-10: Weekly intervention rate for each software group

As shown in Figure 4-10, there was a decline in the intervention rate over the 12 weeks of the trial and a gradual loss of difference between the three groups. When blocks of weeks were examined separately, Kruskal-Wallis tests again showed no significant differences between the three groups; however, the differences were approaching significance. Post-hoc analysis with Jonckheere-Terpstra tests showed that there was a significant positive trend, indicating that the intervention rate was highest in Group Three even with the prompted interventions removed (Table 4-49).

	Difference between software groups	Trend from Group One to Three
First 4 weeks	No ($\chi^2 = 5.83$, $df = 2$, $p = 0.056$)	Yes (J - T statistic = 2.39, $p = 0.016$)
First 6 weeks	No ($\chi^2 = 5.75$, $df = 2$, $p = 0.059$)	Yes (J - T statistic = 2.29, $p = 0.023$)
First 8 weeks	No ($\chi^2 = 5.38$, $df = 2$, $p = 0.069$)	Yes (J - T statistic = 2.21, $p = 0.029$)
12 weeks	No ($\chi^2 = 4.25$, $df = 2$, $p = 0.120$)	Yes (J - T statistic = 2.02, $p = 0.043$)

Table 4-49: Statistical tests between each software group in different blocks of weeks of the trial

4.2.31.2 Trial phases

There were three distinct phases of the trial: 3 weeks of no observational sub-study or site visits; 6 weeks during the observational sub-study and site visits; and, 3 weeks after the observational sub-study and site visits (Figure 4-10). When each phase of the study was considered, Kruskal-Wallis tests showed no significant differences between each software group (Table 4-50 and Figure 4-11).

	Difference between software groups	Trend from Group One to Three
Phase 1	No ($\chi^2 = 2.30$, $df = 2$, $p = 0.318$)	No ($J-T$ statistic = 1.53, $p = 0.126$)
Phase 2	No ($\chi^2 = 2.12$, $df = 2$, $p = 0.344$)	No ($J-T$ statistic = 1.45, $p = 0.141$)
Phase 3	No ($\chi^2 = 4.27$, $df = 2$, $p = 0.115$)	No ($J-T$ statistic = 0.59, $p = 0.549$)

Table 4-50: Statistical tests between each software group in different phases of the trial

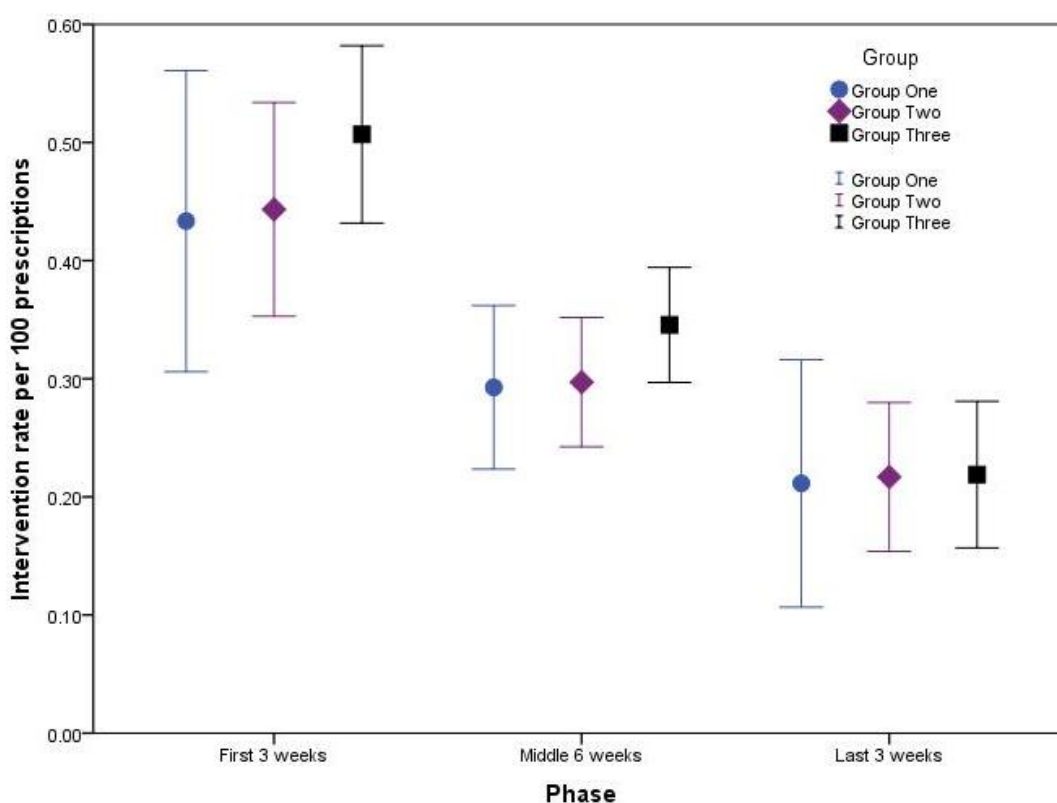


Figure 4-11: Intervention rate for each phase for each software group

4.2.32 Observed pharmacies

During the trial, 38 software pharmacies were observed, allowing analysis of the effect of observation on the pharmacy's intervention rate.

4.2.32.1 Effect of the observation week on pharmacy intervention rate

When the pharmacy intervention rate for the actual observed week was compared to the intervention rate in the remainder of the trial (including the non-observed weeks in pharmacies that were allocated observers), significant differences were seen (*Mann-Whitney U* = 28439.00, *Z* = -9.28, *p* < 0.001; Table 4-51 and Figure 4-12).

	Average intervention rate	
	Observed week	Non-observed weeks
Group One (Software only)	0.898	0.328
Group Two (Software with reminders)	0.824	0.330
Group Three (Software with prompts and reminders)	0.821	0.386
Total	0.834	0.354

Table 4-51: Average intervention rate during the observed week compared to the non-observed weeks

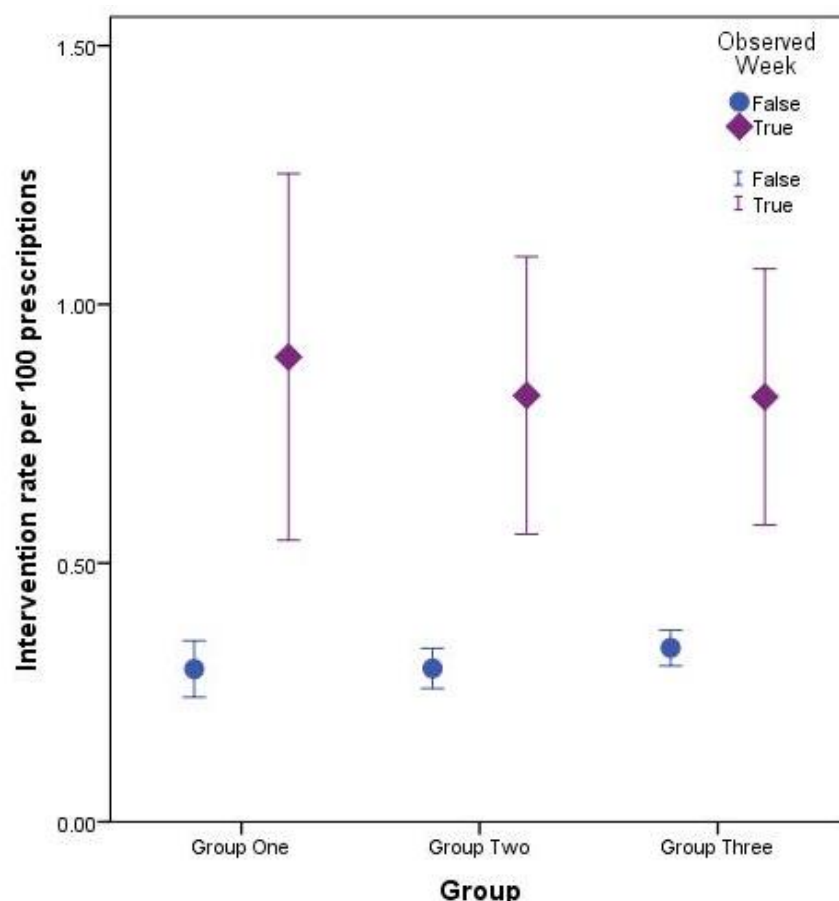


Figure 4-12: Intervention rate during observed weeks compared to non-observed weeks for each software group

4.2.33 Prescription factors

Although the pharmacy environment was likely to have the largest influence on its overall intervention rate, prescription factors were also examined to determine any contribution they may have made to the intervention rate.

4.2.33.1 Original and repeat prescriptions

Despite a significantly higher intervention rate seen with original prescriptions (see Chapter 3), a correlation test did not show a correlation between the overall percentage of original prescriptions dispensed within the pharmacy and the pharmacy intervention rate (*Spearman's rho* = -0.05, *N* = 185, *p* = 0.47).

Analysis was also undertaken to determine if pharmacies dispensed a similar amount of original and repeat prescriptions. There was significant variation between the percentage of original prescriptions dispensed by each pharmacy, ranging from 33.5% to 84.7% (mean = 45.4%). A significant correlation was also detected statistically (*Spearman's rho* = 0.06, *N* = 185, *p* = 0.412), indicating that the proportion of original prescriptions dispensed differed between the participating pharmacies.

4.2.34 Discussion of bivariate analysis

The average frequency of DRPs detected and interventions undertaken was disappointing, at a median rate of 1 intervention every 450 prescriptions. This was much lower than the intervention rates seen in older trials^{57,58,60,68} and it is possible that the length of the trial may have impacted on the intervention rate, as the PROMISE III trial was much longer and included more pharmacies than these previous trials. The more modern trials reported a similar intervention rate to the PROMISE trial.^{77,78,84} This may also be indicative of the added pressures experienced within modern pharmacy, with additional professional services decreasing the pharmacy's ability to adequately complete a professional program. Additionally, as seen in Chapter 1, the definition of a clinical intervention differed significantly between the different trials, which made comparisons between the intervention rates difficult.

There was also an obvious outlier with a much higher than expected intervention rate. It is unlikely that this pharmacist performed and documented such a significantly larger number of interventions, therefore it may have been caused by the pharmacist erroneously documenting routine counselling as a clinical intervention. Unfortunately, the

pharmacist did not regularly record additional information with each intervention and the significantly higher intervention rate was not detected until several months after the trial had finished, making further contact with the pharmacist and further analysis impossible.

4.2.34.1 *Influencing factors*

Several factors were found to be associated with the pharmacy's intervention rate at the bivariate level.

4.2.34.2 *Prescription volume, pharmacist workload and staffing levels*

In an average pharmacy environment, as the pharmacy prescription volume increases, the individual pharmacist workload also increases, unless the staffing levels are also increased to compensate for the additional workload. For this reason, these three factors have been considered together.

Within the bivariate analysis, the prescription volume of the pharmacy appeared to significantly influence the pharmacy's intervention rate; as the prescription volume increased, the intervention rate decreased. The pharmacist workload within the pharmacy also appeared to significantly influence the pharmacy's intervention rate; as the pharmacist workload increased, the intervention rate decreased. Many of the other significant factors were also associated with prescription volume and workload, such as location, catering for ACFs and participation in additional professional services. The effect of prescription volume and pharmacist workload has been examined both quantitatively and qualitatively in a number of pharmacy practice studies. Several previous intervention studies have also shown a significant negative correlation between intervention rate and prescription volume, where the pharmacies with a higher prescription volume had a lower intervention rate. This correlation was seen in the previous PROMISE trial^{80,81}, as well as studies by Irvine-Meek et al.⁶¹ in Canada, Knapp et al.²⁷ in the USA, Hawksworth et al.⁶⁹ and Chen et al.⁷⁷ in England, and Braund et al.⁸³ in New Zealand. A study by Christensen¹⁰¹ on the factors influencing the rate of providing cognitive services within community pharmacy found that pharmacies dispensing less prescriptions had a higher rate of provision. In addition, a study by Rupp⁵⁸ found that pharmacists with a smaller workload had significantly higher intervention rates than those with a larger workload, and Hawksworth et al.⁶⁹ found a trend where pharmacists with a smaller workload tended to spend more time on each intervention. Interestingly, an Australian study published by Caleo et al. in 1996 reported no significant correlation between pharmacy intervention

rate and total prescription volume^{32,33}, and an additional survey study found that workload did not influence the provision of services.¹⁰⁰ Given the large amount of literature documenting a link with prescription volume and workload, it is much more likely that these factors can significantly impact on the pharmacy's intervention rate.

The result that workload affects CI rate is rational and can be explained in several ways. A higher prescription volume generally signifies a busier pharmacy, so the pharmacists may still be performing the interventions but have less time to document them, or the increased prescription volume may inhibit the pharmacist from initially performing the interventions. Although a higher volume of prescriptions may increase the number of opportunities for the pharmacist to intervene, it impacts heavily on the pharmacist's workload and therefore decreases the amount of time that can be spent on clinical activities. Qualitatively, higher prescription volumes and higher pharmacist workloads are often reported as barriers to the provision of cognitive pharmacy services, including clinical interventions.^{99,112} Specific barriers, such as lack of adequate staffing levels, directly affect the pharmacist workload by decreasing the amount of time that the pharmacist can devote to cognitive services. This is inkeeping with a pharmacist survey in the USA which showed that 89.6% of pharmacists felt that inadequate staffing levels prevented their uptake of a medication management service¹⁰⁹, as well as other studies that have identified that adequate staffing levels are required to allow pharmacies to provide a high level of cognitive services.^{53,98,107} Surveyed pharmacists also report that lack of time prevented them from providing an adequate level of cognitive services^{16,53,108,113,115}, and this perceived 'lack of time' is most likely caused by a high workload and inadequate staffing levels. A study that altered the pharmacy workflow and layout to increase the level of patient counselling helped to decrease the amount of time that a pharmacist spent on data entry.¹¹⁹

To improve the provision of cognitive services and therefore increase the documentation rate of interventions, pharmacies need to decrease the workload expected by each pharmacist. As the current business model remunerates pharmacies based on the number of prescriptions dispensed, a decrease in the number of prescriptions dispensed would not be desirable. Instead, it would be more plausible to decrease workloads by increasing the number of pharmacists available to complete the work. Increasing the number of adequately trained support staff, rather than increasing the number of pharmacists, could also decrease the individual pharmacist's dispensing workload and increase the amount of

time a pharmacist could allocate to the provision of cognitive services such as the documentation of interventions.

4.2.34.3 *Financial turnover*

A negative correlation was seen between the pharmacy's annual financial turnover and the intervention rate; as the financial turnover increased, the intervention rate tended to decrease. As seen in section 4.2.11, a type of 'J-curve' was seen, where the pharmacies with the lowest financial turnover had a higher intervention rate, which sharply decreased with the next turnover category and then increased again, with the highest turnover category showing the second highest intervention rate. The J-curve may be explained by workload and staffing levels, where the pharmacies with the lower turnover have a smaller workload and the pharmacies with the higher turnover perhaps have adequate staffing levels, creating more time for both types of pharmacy to perform and document their interventions. The pharmacies with turnovers in the two middle groups may have larger workloads relative to their staffing levels, but also do not have the turnover to warrant employing more staff, which may lead to less time to perform and document their interventions.

4.2.34.4 *Aged care facilities*

The pharmacies that catered for ACFs at the time of the trial tended to have a lower intervention rate than the pharmacies that did not. There are three possible reasons for this explanation. Firstly, the pharmacies that catered for ACFs had a significantly higher prescription volume and higher pharmacist workload, which would impact on their abilities to document interventions. Secondly, catering for ACFs can often be a distraction from the dispensing process, due to an increase in distracting phonecalls, additional paperwork and checking medication packs, which may have contributed to the decrease in the number of interventions. Lastly, the prescription volume within pharmacies catering for ACFs may be disproportionate to the number of consumers they interact with. This is due to the pharmacies dispensing many repeat prescriptions for use in the medication packs using the consumer's medication chart with no interaction with the consumer or ACF staff (known as 'bulk dispensing'). As such, it is likely that less interventions were performed in these pharmacies, since the pharmacist may have already contacted the prescriber to discuss any issues when the item was first prescribed. The annual residential medication management review (RMMR) service provided by consultant pharmacists also

detects other interventions that are then resolved by the GP, and therefore are unlikely to be recorded within the community pharmacy's software. In light of these facts, it is plausible that pharmacies that cater for a large number of aged care patients would have significantly higher prescription volumes with less documented interventions.

Interestingly, and in contrast to this finding, the Australian study published by Caleo et al. in 1996 reported no significant correlations between the pharmacy's intervention rate and the number of aged care facilities they catered for.^{32,33} The articles detailed an intervention study in 29 pharmacies, but did not state how many of these pharmacies catered for aged care. It is possible that the number of pharmacies catering for aged care was low, resulting in a non-significant correlation with the pharmacy's intervention rate, thus differing from the finding in the PROMISE trial where a third of participating pharmacies catered for aged care facilities.

4.2.34.5 Location

Pharmacies that were located in a medical centre had a significantly higher intervention rate, on average, than pharmacies located in shopping centres or shopping strips. This could be due to a closer relationship with the GPs within the medical centre, thereby making the pharmacist more willing to perform interventions due to increased confidence that the prescriber will give their suggestions serious consideration. Also, the medical centre pharmacies were more likely to have a larger base of regular patients, which may also have contributed to a higher intervention rate, as the patients become more comfortable discussing health problems with their regular pharmacist. The medical centre pharmacies also tended to have significantly lower prescription volumes and workloads, which may have contributed to the difference between pharmacies in different locations.

4.2.34.6 Additional services offered

It was thought that pharmacies providing additional services would have a higher intervention rate due to the increased contact with consumers and the additional opportunity to detect DRPs, and pharmacies that were noted to *look* 'healthcare-orientated' or 'professional' by the site visitors did tend to have a higher intervention rate. However, a weak, but statistically significant, negative correlation was seen between the *actual* number of additional services offered by the pharmacy and the intervention rate; as the number of professional services increased, the intervention rate decreased.

This may be in part due to the increase in workload that professional services can produce. Therefore, despite most professional services offering more opportunities to intervene, it also increases the pharmacist's workload and decreases the amount of time available to perform and document clinical interventions. It may also indicate that pharmacists can become 'fatigued' with the provision of many different types of service, which decreases their ability to effectively provide all programs to an optimal level. It is also possible that pharmacies were documenting their findings from these additional pharmacy services elsewhere, such as blood pressure readings in the consumer's dispensing notes, resulting in less interventions resulting from these additional services being documented within the PROMISE software.

4.2.34.7 Pharmacy area

A negative correlation was seen between the area of the pharmacy and the pharmacy's intervention rate, where the intervention rate tended to decrease as the area increased (section 4.2.10). This is in contrast to a pharmacist survey in the USA that found that pharmacists perceived a lack of space as a barrier to the uptake of a professional service program.¹⁰⁹ The results from the PROMISE III trial showed an opposite trend and there are two possible explanations for this. Firstly, smaller pharmacies may be considered more homely and inviting to consumers, resulting in consumers being more comfortable in discussing healthcare issues, increasing the pharmacist's opportunity to intervene. Secondly, analysis showed that larger pharmacies also had a higher prescription volume and higher pharmacist workload, which may impact on the ability of the pharmacy to deliver professional services and consequently decrease their intervention rate.

4.2.34.8 Pharmacy trading hours

A negative correlation was seen between the pharmacy's trading hours and the intervention rate; as the number of trading hours increased, the intervention rate decreased. There are three possible explanations for this finding. Firstly, a pharmacy's trading hours usually reflect their prescription volume, and analysis showed that as the prescription volume increased, the number of trading hours also increased. Secondly, pharmacies with longer opening hours may employ more locum pharmacists who may not have been aware of the PROMISE trial and may have caused an overall decrease in the intervention rate. Lastly, many pharmacists working in a pharmacy with long trading hours are completing longer hours on average, with some reporting 12-hour shifts. It may be

likely that these pharmacists are simply too exhausted by the end of the shift to document their interventions, resulting in a lower overall intervention rate for the pharmacies with longer trading hours.

4.2.34.9 Independent and banner group pharmacies

A significant difference in intervention rate was noted between independent pharmacies and those that were part of a banner group, with the independent pharmacies tending to have a higher intervention rate. This could possibly be explained by two reasons. Firstly, analysis showed that the independent pharmacies tended to have a significantly lower prescription volume and a lower pharmacist workload, so the higher rate of interventions may have been due to the pharmacist being able to focus more on the consumers and the documenting of interventions. Secondly, there was a significant variation in the type of banner groups participating in the trial, with some groups promoting a much more professional environment than others. It is possible that the lower intervention rate in banner group pharmacies was due to these pharmacies being more focused on the commercial side of the pharmacy industry, rather than focusing on professional pharmacy practice, decreasing their level of participation in a trial promoting pharmacy practice.

Two studies within the USA have examined the difference between the independent pharmacies and the chain store pharmacies, with Poston et al.⁶⁵ finding that independent pharmacies had a higher average intervention rate than the chain pharmacies, whereas Rupp et al.⁵⁸ found no difference between the two groups. It is important to note, however, that banner group pharmacies within Australia are still owned by pharmacists, whereas the chain pharmacies in the USA tend to be run by large corporations, making it hard to make definitive comparisons between the two pharmacy systems.

4.2.34.10 Presence of pre-registration pharmacists

It was expected that the presence of a pre-registration pharmacist within the last two years would increase the number of interventions documented, as they would likely be more enthusiastic about their profession due to their recent graduation and also be more likely to have a lower workload, resulting in more time and motivation to document interventions. The finding that these pharmacies tended to have a lower intervention rate was therefore unexpected. Again, the lower intervention rate in pharmacies that employed a pre-registration pharmacist may be explained by the fact that these pharmacies had a significantly higher weekly prescription volume during the trial.

4.2.34.11 Number of dispensing terminals

A significant relationship between the number of dispensing terminals and the pharmacy's intervention rate was found. Pharmacies with only one terminal had the highest intervention rate, pharmacies with two terminals had the lowest rate and pharmacies with three or more terminals had an 'in-between' intervention rate. It may be possible that these differences were similar to those seen in the financial turnover analysis (section 4.2.11), where pharmacies with two terminals were in the 'in-between' group where they are busy, but not busy enough to employ someone else or have an additional terminal. As such, it is possible that the differing rate of interventions in pharmacies was due to different workloads within the pharmacies, rather than the number of dispensing terminals present.

4.2.34.12 Pharmacy workflow

There were positive correlations between the pharmacy's intervention rate and the percentage of time the pharmacist spent collecting prescription/patient details and collecting payment. This can most likely be attributed to the fact that DRPs are often detected during conversations with the patient, so seeing the patient before and/or after the prescription is dispensed will increase the pharmacist's contact time with possible interventions. Poor store layout has previously been noted to influence the provision of cognitive services in several pharmacy studies.^{53,99,109,114} Again, this is likely due to increased interactions between the pharmacist and the consumer, therefore increasing the amount of information exchanged.

4.2.34.13 Non-significant factors

The pharmacy's intervention rate did not appear to be affected by regionality, the attribution of the dispensary to total pharmacy turnover, owner vs manager operation, number of pharmacists responsible for making business decisions, dispensing software system, number of FTE pharmacists per week, proportion of prescriptions assembled by technicians, type of counselling area, pharmacist accessibility to the public and the number of original prescriptions dispensed by the pharmacy.

The Australian study published by Caleo et al. in 1996 also reported no significant differences in the intervention rate of metropolitan pharmacies compared to rural pharmacies^{32,33}, with Leemans et al. finding no difference in intervention rates between urban, suburban and rural pharmacies.⁷⁵ However, a study from the USA found that

pharmacies located in a rural area were more likely to provide cognitive services compared to pharmacies in a regional centre.¹¹² The study by Leemans et al. in Belgium also found that the type of dispensing software in the pharmacy did not appear to affect the pharmacy's intervention rate.⁷⁵

4.2.34.14 Observation

The presence of observers was seen to increase the pharmacy's documented intervention rate, which was most likely due to the Hawthorne effect.¹⁷² The presence of the observer may have increased the pharmacist's awareness of the program, but the pharmacist may also have had a sub-conscious desire to 'please' the observer by documenting their interventions, resulting in a higher intervention rate. The differences in documentation rates between observed and non-observed pharmacists has previously been noted by Dobie and Rascati, where their study used the same methods as an observational study, but asked the pharmacists to self-record, resulting in a 50% decrease in the documented intervention rate.⁶⁰

4.2.34.15 Software groups

The level of software present within the pharmacies did not appear to affect their intervention rate, with the general reminder increasing the number of interventions documented after the reminder appeared, but not significantly increasing the overall intervention rates within these groups. This finding was disappointing, as it was hoped that increased awareness of the trial through the use of reminders and prompts would increase the number of interventions documented within the system, therefore increasing the intervention rate. Although the software did not significantly influence the intervention rate overall, there did appear to be a significant trend from Group One to Group Three, where the intervention rate increased as the group number increased. This effect was also supported by the first four weeks of data, where the differences between the groups were approaching significance. The finding of no significant differences between the groups was unexpected, as Groups Two and Three had reminders and prompts which would increase the pharmacist's awareness of the trial and therefore would be expected to increase the intervention rate within the pharmacy. Also, in the PROMISE II trial, a significant difference in intervention rate was seen between the two groups (prompt and no prompt).^{80,81} Again, this may be due to the fact that the PROMISE III trial involved more pharmacies and went for a longer time, therefore the effect of the

different software groups was harder to maintain. Also, the prompt was only activated with high dose PPIs, which made up 3.8% of the total prescriptions dispensed¹⁶⁴, resulting in another 96.2% of prescriptions that did not activate a prompt. The relatively low rate of activation may also have contributed to no significant differences being found between the software groups.

Before the trial, it was thought that the statistics display within the PROMISe system would be motivating for the pharmacists to document their interventions and try to compete with other pharmacies for a higher intervention rate. However, there is the possibility that the display had the opposite effect, with the pharmacists feeling that they were doing better or on par with the average, resulting in decreased documentation of their interventions. It remains unknown how much influence the statistics display had on the documentation of interventions.

4.2.34.16 Prompt

Although the PPI step-down prompt did not increase the overall intervention rate within the pharmacy, it significantly increased the number of interventions on PPI medications in Group Three pharmacies when compared to either of the other pharmacy groups. This finding was seen as a clearly standout effect of the system and will be discussed further within Chapter 6.

The prompt appeared as a dialog box during the dispensing of esomeprazole 40mg and pantoprazole 40mg, and had to be acknowledged by the dispensing pharmacist by clicking to remove the prompt and continue the dispensing process. In essence, it was interruptive and had to be dealt with before dispensing workflow could continue. The prompt also provided pharmacists with easily accessible additional information, making the process of an intervention easy to complete, which may also have increased the number of prompted interventions performed.

The prompt intervention that was chosen had been brought to the attention of GPs and pharmacists via the NPS during May 2009.^{152,173} This may have assisted pharmacists to be more comfortable with performing this type of proactive intervention. When the prompt was displayed, leaflets for consumers and pharmacists/GPs could be opened and printed, and links to the NPS article were available. This supportive information may also have encouraged pharmacists to perform the prompted intervention.

The number of prompted interventions decreased over the period of the trial, which could indicate pharmacist fatigue with the prompt. Additionally, those regular consumers who were suitable for the intervention would have been expected to receive the intervention within the early weeks of the trial; therefore, the subsequent weeks of the trial would present an increasingly limited number of opportunities to perform the intervention. The intervention did not attract any payment, and therefore did not provide any great incentive for the performing of the intervention. In fact, the prompt actually decreased the financial gain to pharmacy owners, as dispensing high dose PPIs attracts a higher payment for the pharmacy from the PBS. Despite this, many interventions were still performed due to the prompt. Payment for interventions, especially for those actively promoted through the prompt mechanism, may slow the rate of decrease over time. Regularly changing the prompt message would also combat prompt fatigue and may also stop the associated decrease in interventions seen within this trial.

Although the Group Three pharmacies had a higher intervention rate on the PPI medications, it did not significantly increase their intervention rate overall. It is therefore unknown if the Group Three pharmacies decreased the number of interventions performed on other medications in substitution for this, or perhaps just decreased the number of interventions documented on other medications. This could suggest that the prompt helped the pharmacist to remember to document interventions, whilst still maintaining the number of interventions performed. A previous study by van Mil et al.⁷⁰ showed that electronic prompts could significantly increase the number of interventions documented, therefore it is likely that the presence of the prompt was beneficial.

Analysis of the trial prescription data method to detect prompted interventions would have only identified a proportion of intervention recommendation adoptions and would likely to underestimate the true figure. For example, consumers may visit multiple pharmacies which prevents follow-up of prescription evidence via complete medical history; consumers may have not had the time to follow-up the recommendation with their GP during the time period of the trial or may have waited until all prescription repeats were dispensed prior to follow-up (particularly with pantoprazole 40mg where authorisation for five repeats was commonplace); and cessation of therapy would not be immediately obvious through this method of detection. These limitations may have influenced the number of prompted interventions identified in the dataset, most likely resulting in an underestimation of the number of interventions influenced by the prompt.

4.3 Multivariate statistical model for determining the pharmacy's intervention rate

Workload and prescription volume were found to be a significant influence within the bivariate analysis, with many factors that were significantly associated with the pharmacy's intervention rate also associated with the workload and prescription volume of the pharmacy. A multivariate analysis was therefore performed to determine if workload and prescription volume continued to have a significant influence on the pharmacy's intervention rate. As discussed in Chapter 2, the pharmacy intervention rate was not normally distributed and a logarithmic transformation was undertaken to achieve normality, resulting in the variable named logCI_Rate.

4.3.1 Multiple regression modelling

All of the bivariate analyses were re-done, where the intervention rate was substituted for the logCI_Rate and parametric tests were used where indicated. Although the p -values differed slightly in some cases, the same factors remained significant. To ensure that all possible influencing factors were included, a p -value of 0.1 was used as a cut-off point, resulting in the following bivariate factors being considered for inclusion in the multiple regression model:

- Pharmacy location ($p = 0.048$)
- Pharmacy area in m^2 ($p = 0.006$)
- Pharmacy estimated financial turnover in 2007/08 financial year ($p = 0.001$)
- Estimated weekly prescription volume ($p = 0.003$)
- Actual prescription volume of the pharmacy during the trial (participating pharmacists); $p = 0.012$
- Actual prescription volume of the pharmacy during the trial (ALL pharmacists, including non-participants); $p = 0.002$
- Average pharmacist workload (calculated by number of prescriptions divided by FTE pharmacists); $p = 0.019$
- Banner group or independent pharmacy ($p = 0.056$)
- Catered for an aged care facility ($p = 0.006$)
- No. of opening hours ($p = 0.013$) and opening days ($p = 0.051$) per week
- Pharmacy employed a pre-registration pharmacist within the last two years ($p = 0.049$)
- Participation in the DAA trial ($p = 0.003$) and PMP trial ($p = 0.022$)
- Pharmacy provides BP monitoring ($p = 0.012$) and DAA packing ($p = 0.047$)
- Total number of professional services offered (correlation $p = 0.007$)
- Number of dispensing system terminals - 3 groups (1, 2, 3 or more); $p = 0.011$

- % of time the pharmacist collects patient details ($p = 0.025$)
- % of time the pharmacist collects payment from the patient ($p = 0.006$)

4.3.1.1 *Missing value analysis*

A missing value analysis was conducted to determine if there were any patterns to the missing values, resulting in 184 full datasets. For more detail, see Appendix 23.

4.3.1.2 *Creating a list of logical variables*

In order for the multiple regression model to be useful for predictive purposes, the list of variables was reviewed to ensure all included variables were logical. Three measures of prescription volume were included in the list in section 4.3.1: estimated weekly prescription volume; actual prescription volume of the pharmacy during the trial (participating pharmacists); and actual prescription volume of the pharmacy during the trial according to the dispensing records (using data from *all* pharmacists, including non-participants). The ‘actual prescription volume using *all* pharmacists’ was used, as this was considered a more accurate reflection of the actual prescription volume of the pharmacy, rather than estimated volumes or prescription volumes only including participating pharmacists (excluding the locum pharmacists not enrolled).

Pharmacy opening hours per week had a stronger correlation than pharmacy opening days per week, and was considered to be a better reflection of the type of pharmacy. Therefore, it was chosen to represent the ‘availability’ of the pharmacy.

The DAA and PMP trial were unique trials which would be unlikely to be repeated in a future pharmacy setting, so a new binary variable called ‘participation in additional pharmacy trials’ was created to make the model more useful for predictive purposes. All pharmacies that had indicated that they were participating in one of the four concurrent PGA/Community Pharmacy Agreement trials (DAA, PMP, PAMS or DMAS) were assigned as participants, whereas pharmacies that had not indicated they were part of these trials were assigned as non-participants. A Mann-Whitney test still showed a significant difference between the intervention rates of the two groups ($U = 807.00$, $Z = -1.999$, $p = 0.046$), with participating pharmacies having a lower intervention rate than non-participants. In addition, the number of additional professional services (such as BP monitoring and DAA packing) was also recreated into a new binary variable. The pharmacies that offered 3 or more services were grouped together, with the remaining pharmacies that offered 0 to 2 services placed in the other group. A Mann-Whitney test

also showed that there was still a significant difference between the intervention rates of the two groups ($U = 1207.00$, $Z = -2.453$, $p = 0.013$), with the pharmacies offering more services tending to have a lower intervention rate.

4.3.1.3 Proving assumptions

Multiple regression assumes normality, linearity, homoscedasticity, no outliers, no multicollinearity and independence of errors.¹⁴⁹ As such, each variable was analysed to ensure it met these criteria. The binary variables all appeared to be acceptable. The six continuous variables were not normally distributed; therefore, logarithmic transformation was attempted in the same manner in which the CI rate had previously been logarithmically transformed. These transformations were not successful (see Appendix 23 for more details); therefore, the continuous variables were condensed into categorical variables.

Using the BINNED function in SPSS, the actual prescription volume was split into three equal groups: low, moderate and high prescription volume. Within this dataset, the low prescription volume represented pharmacies dispensing 0 – 504 prescriptions per week; moderate = 505 – 1026 prescriptions per week; and high = more than 1027 prescriptions per week. A Kruskal-Wallis test showed significant differences in the intervention rate between the three groups ($\chi^2 = 10.17$, $df = 2$, $p = 0.006$; *Jonckheere-Terpstra* $t = -2.94$, $p = 0.003$). The BINNED function in SPSS was also used to split the average pharmacist workload into three equal groups: low, moderate and high pharmacist workload. Within this dataset, the low pharmacist workload represented pharmacists dispensing 0 – 388 prescriptions per 38-hour week; moderate = 389 – 546 prescriptions per 38-hour week; and, high = more than 547 prescriptions per 38-hour week. A Kruskal-Wallis test again showed significant differences in the intervention rate between the three groups ($\chi^2 = 6.77$, $df = 2$, $p = 0.035$; *Jonckheere-Terpstra* $t = -2.363$, $p = 0.019$).

Pharmacy opening hours were split into a binary variable. The 55 pharmacies with opening hours of 50 hours or less per week were coded as 'conventional', as this number of hours would be achieved with a typical 5 weekdays plus Saturday morning trade. The 129 remaining pharmacies that traded for 51 hours or more per week were coded as 'extended trade', as these pharmacies traded outside the 'conventional' pharmacy hours. A Mann-Whitney test still showed significant differences in the intervention rates of these

groups ($U = 2869.50$, $Z = -2.050$, $p = 0.041$), with the 'conventional' pharmacies having a higher intervention rate than the 'extended trade' pharmacies.

The two variables describing the percentage of time the pharmacist collects patient details and collects payments were combined into one variable. These two responsibilities within the pharmacy increase the amount of interaction time between the pharmacist and the patient; therefore, the variable was recoded into a binary variable that arbitrarily described the level of patient contact. The 23 pharmacies that had a patient contact greater than 50% of the time were coded as 'high patient contact time', whilst the remaining 161 pharmacies were coded as 'low patient contact time'. A Mann-Whitney test still showed significant differences in the intervention rates of these groups ($U = 1369.00$, $Z = -2.019$, $p = 0.043$), with the 'high patient contact time' pharmacies having a higher intervention rate than the 'low patient contact time' pharmacies.

4.3.1.4 *Dummy coding categorical variables*

Multiple regression only allows an independent categorical variable to be binary categorical, so the categorical variables had to be converted to 'dummy' variables (where '1' denoted 'membership' within that group whereas '0' denoted 'no membership'). The following factors needed to be converted before inclusion in the multiple regression model:

- Pharmacy location (3 groups: medical centre, shopping strip, shopping centre)
- Pharmacy area in m² (4 groups used)
- Pharmacy estimated financial turnover in 2007/08 financial year (4 groups used)
- Number of dispensing system terminals (1, 2, 3 or more)
- Actual prescription volume (3 groups; low, moderate and high)
- Average pharmacist workload (3 groups; low, moderate and high)

4.3.1.5 *Included variables*

The following variables were entered into the multiple regression model:

- Pharmacy location (3 groups; medical centre, shopping strip, shopping centre) - dummy coded into 2 binary variables
- Pharmacy area in m² (4 groups) - dummy coded into 3 binary variables
- Pharmacy estimated financial turnover in 2007/08 financial year (4 groups) - dummy coded into 3 binary variables
- Banner group or independent – binary variable
- Catered for an aged care facility – binary variable

- Pharmacy employed a pre-registration pharmacist within the last two years – binary variable
- Participation in other pharmacy trials – binary variable
- Number of professional services offered; '0 to 2 services' vs '3 or more services' – binary variable
- Number of dispensing system terminals (3 groups) - dummy coded into 2 binary variables
- Actual prescription volume of the pharmacy during the trial (ALL pharmacists including non-participants) – 3 groups; dummy coded into 2 binary variables
- Average pharmacist workload (3 groups) – dummy coded into 2 binary variables
- Pharmacy opening hours per week; 'conventional' vs 'extended trade' – binary variable
- % of patient contact time; 'high' vs 'low' – binary variable

There were 21 variables in total. The general rule for multiple regressions is 'number of samples needed $\geq 50 + 8m$ (where m = number of independent variables)',¹⁴⁹; therefore, 218 pharmacies ($50 + 8 \times 21 = 218$) were needed. This was noted, as it may have been necessary to remove some variables.

4.3.1.6 Step 1 (Model 1)

Due to the large number of variables, a stepwise regression was initially run to determine which variables were significant to the overall model. Initially, an inclusion p -value of 0.1 was used to ensure all valid variables were included. The variables that significantly contributed to the overall predictive model were: whether the pharmacy catered for ACFs; pharmacy area of 150-250m²; high pharmacist workload; an annual financial turnover between 1.5M to 2.5M or 2.5M to 4.0M; and, participation in other pharmacy trials. The best adjusted R^2 value achieved through the stepwise regression process was 0.116, indicating that 11.6% of variance could be explained by the model. The Durbin-Watson statistic was close to 2, indicating that the errors appeared to be independent of each other. The ANOVA statistical tests were significant ($p < 0.01$) for the models, indicating that all models were better at predicting logCI_Rate than the constant-only model. Multicollinearity was also not a problem within the model, as no VIF value was greater than 10.

The only outlying case had a logCI_Rate of -2, which indicated that the pharmacy had an intervention rate of zero (as $\log 0.01 = -2.00$). It was expected that pharmacies with an intervention rate of zero would be outliers in any prediction model. Analysis using Cook's distance¹⁴⁹ showed that the outlying case did not significantly influence the overall model;

therefore, this pharmacy was still included in the analysis. The residuals plot showed a fairly uniform distribution, indicating that the assumption of linearity had been met. See Appendix 23 for relevant tables.

4.3.1.7 Step 2 (Model 2)

Two of the three financial turnover dummy variables were included in the model, exerting a negative effect on the intervention rate. These two variables (financial turnover between 1.5M to 2.5M and financial turnover between 2.5M to 4.0M) were then combined, resulting in 3 categories of financial turnover: less than 1.5M; 1.5-4.0M; and, over 4.0M.

The stepwise regression was repeated, resulting in five included variables: an annual financial turnover between 1.5M and 4.0M; whether the pharmacy catered for ACFs; participation in other pharmacy trials; location in a medical centre; and, high pharmacist workload. From the last model, location in a medical centre had appeared and pharmacy area had disappeared. Model 2 achieved a slightly improved adjusted R^2 of 0.125. The Durbin-Watson statistic was 1.811 (indicating independent errors) and the significant ANOVA result ($F(5,177) = 6.20, p < 0.001$) indicated that the model still remained better than the constant-only model. See Appendix 23 for relevant tables.

4.3.1.8 Step 3 (Model 3)

Three of the variables (high workload, location in a medical centre and caters for aged care) had become less significant within model 2. Another stepwise regression was performed with the inclusion p -value decreased to 0.05 (exclusion p -value = 0.1). Three variables remained significant with the altered p -values: high pharmacist workload; annual financial turnover between 1.5M and 4.0M; and whether the pharmacy catered for an aged care facility (Table 4-54). Model 3 achieved a slightly decreased adjusted R^2 of 0.101 (Table 4-52), indicating that 10.1% of variance could be explained by the model. The Durbin-Watson statistic was 1.766 (indicating independent errors) and the significant ANOVA result ($F(3,179) = 7.85, p < 0.001$) indicated that the model still remained better than the constant-only model (Table 4-52 and Table 4-53). Multicollinearity was also not a problem, as no VIF value was greater than 10 (Table 4-54). All the variables remained statistically significant, with high pharmacist workload approaching significance ($p = 0.055$; Table 4-54).

Model Summary ^d										
Model	R	R ²	Adjusted R ²	Std. Error	Change Statistics					Durbin-Watson
					R ² Change	F Change	df1	df2	Sig. F Change	
1	.172 ^a	0.029	0.024	0.418	0.029	5.498	1	181	0.020	
2	.305 ^b	0.093	0.083	0.406	0.064	12.619	1	180	0.000	
3	.341 ^c	0.116	0.101	0.401	0.023	4.695	1	179	0.032	1.766
a. Predictors: (Constant), High Pharmacist Workload										
b. Predictors: (Constant), High Pharmacist Workload, Pharmacy\$Turnover 1.5to4.0M										
c. Predictors: (Constant), High Pharmacist Workload, Pharmacy\$Turnover 1.5to4.0M, Caters for ACFs										
d. Dependent Variable: Log CI Rate										

Table 4-52: Regression model summary for model 3

ANOVA ^d						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.962	1	0.962	5.498	.020 ^a
	Residual	31.684	181	0.175		
	Total	32.646	182			
2	Regression	3.038	2	1.519	9.235	.000 ^b
	Residual	29.608	180	0.164		
	Total	32.646	182			
3	Regression	3.795	3	1.265	7.848	.000 ^c
	Residual	28.851	179	0.161		
	Total	32.646	182			
a. Predictors: (Constant), High Pharmacist Workload						
b. Predictors: (Constant), High Pharmacist Workload, Pharmacy\$Turnover 1.5to4.0M						
c. Predictors: (Constant), High Pharmacist Workload, Pharmacy\$Turnover 1.5to4.0M, Caters for ACFs						
d. Dependent Variable: Log CI Rate						

Table 4-53: ANOVA for model 3

Coefficients ^a													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-0.607	0.038		-16.088	0.000	-0.681	-0.532					
	High Pharmacist Workload	-0.154	0.066	-0.172	-2.345	0.020	-0.284	-0.024	-0.172	-0.172	-0.172	1.000	1.000
2	(Constant)	-0.494	0.048		-10.189	0.000	-0.590	-0.398					
	High Pharmacist Workload	-0.146	0.064	-0.163	-2.289	0.023	-0.272	-0.020	-0.172	-0.168	-0.163	0.999	1.001
	Pharmacy\$Turnover 1.5 to 4.0M	-0.214	0.060	-0.252	-3.552	0.000	-0.333	-0.095	-0.258	-0.256	-0.252	0.999	1.001
3	(Constant)	-0.463	0.050		-9.241	0.000	-0.562	-0.364					
	High Pharmacist Workload	-0.124	0.064	-0.138	-1.934	0.055	-0.250	0.003	-0.172	-0.143	-0.136	0.973	1.028
	Pharmacy\$Turnover 1.5 to 4.0M	-0.198	0.060	-0.234	-3.297	0.001	-0.316	-0.079	-0.258	-0.239	-0.232	0.984	1.017
	Caters for ACFs	-0.139	0.064	-0.156	-2.167	0.032	-0.265	-0.012	-0.208	-0.160	-0.152	0.959	1.043

a. Dependent Variable: Log CI Rate

Table 4-54: Coefficients table for model 3

Only one outlying case was detected and the Cook's distance value was less than 1; therefore, the case did not have a major influence on the overall model. The residuals plot again showed a fairly uniform distribution indicating the assumption of linearity had been met. See Appendix 23 for more details.

4.3.1.9 **Model interpretation – 'Pharmacy workload model'**

Overall, the model fit was relatively poor, as the adjusted R^2 was only 0.101; therefore, only 10.1% of variance was explained by the model. As the dependent variable had been logarithmically transformed, the format for interpretation is that the dependent variable changes by 100*coefficient percent for a one unit increase in the independent variable.¹⁷⁴ Therefore, with 'membership' to that group ('1' rather than '0'), the intervention rate will change by 100*coefficient percent.

Model

$$\text{Log CI Rate} = -0.463 + (-0.138*A) + (-0.234*B) + (-0.156*C) + \text{errors}$$

A = High pharmacist workload (greater than 547 prescriptions per 38-hour week)

B = Pharmacy\$Turnover of 1.5Mto 4.0M

C = Caters for ACFs

[Where 0 = no membership to the group, and 1 = membership to the group]

Factor	Coefficient	Change in DV
High pharmacist workload	-0.138	-13.8
Pharmacy\$Turnover1.5to4.0M	-0.234	-23.4
Caters for aged care	-0.156	-15.6

Table 4-55: Percentage change in the pharmacy's intervention rate according to the model

Therefore, from Table 4-55;

- Pharmacies with a high pharmacist workload had 13.8% lower intervention rates on average (compared to pharmacies with low or moderate pharmacist workloads)
- Pharmacies with a turnover between \$1.5 to 4.0M had 23.4% lower intervention rates on average (compared to pharmacies with turnovers under \$1.5M or over \$4M)
- Pharmacies that catered for ACFs had 15.6% lower intervention rates on average (compared to pharmacies that did not cater for ACFs)

It should be noted that these percentage changes are only accurate when all other independent variables in the model remain unchanged.

4.3.1.10 Prescription volume model

Due to pharmacist workload featuring significantly in the previous model, an additional regression analysis was performed to determine if prescription volume had the same effect. The variables describing pharmacist workload were excluded, resulting in 18 variables to include in the regression. Stepwise regression was used, resulting in a somewhat different set of significant variables: high prescription volume; moderate prescription volume; annual financial turnover \$1.5 to 4.0M; location in a medical centre; and, participation in other pharmacy trials (Table 4-58). The 'caters for ACFs' variable did not feature within this model, indicating that any effect it exerted on the model was similar to the effect exerted by prescription volume. The five variables included within the prescription volume model achieved an adjusted R^2 of 0.118, indicating that 11.8% of variance could be explained by the model (Table 4-56). The Durbin-Watson statistic was 1.987 (indicating independent errors) and the significant ANOVA result ($F(5,177) = 5.866$, $p < 0.001$) indicated that the model still remained better than the constant-only model (Table 4-56 and Table 4-57). Multicollinearity was also not a problem, as no VIF value was greater than 10 (Table 4-58). All the variables remained significant, except moderate prescription volume with a $p = 0.077$ (Table 4-58).

Model Summary ^f										
Model	R	R ²	Adjusted R ²	Std. Error	Change Statistics					Durbin-Watson
					R ² Change	F Change	df1	df2	Sig. F Change	
1	.142 ^a	0.020	0.015	0.420	0.020	3.739	1	181	0.055	
2	.254 ^b	0.065	0.054	0.412	0.044	8.552	1	180	0.004	
3	.312 ^c	0.098	0.082	0.406	0.033	6.513	1	179	0.012	
4	.348 ^d	0.121	0.101	0.402	0.023	4.724	1	178	0.031	
5	.377 ^e	0.142	0.118	0.398	0.021	4.398	1	177	0.037	1.987
a. Predictors: (Constant), High Prescription Volume										
b. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume										
c. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M										
d. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M, Location in a medical centre										
e. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M, Location in a medical centre, Participates in other pharmacy trials										
f. Dependent Variable: Log CI Rate										

Table 4-56: Regression model summary for prescription volume model

ANOVA ^f						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	0.661	1	0.661	3.739	.005 ^a
	Residual	31.985	181	0.177		
	Total	32.646	182			
2	Regression	2.111	2	1.056	6.223	.002 ^b
	Residual	30.535	180	0.170		
	Total	32.646	182			
3	Regression	3.183	3	1.061	6.447	.000 ^c
	Residual	29.463	179	0.165		
	Total	32.646	182			
4	Regression	3.945	4	0.986	6.117	.000 ^d
	Residual	28.701	178	0.161		
	Total	32.646	182			
5	Regression	4.641	5	0.928	5.866	.000 ^e
	Residual	28.005	177	0.158		
	Total	32.646	182			
a. Predictors: (Constant), High Prescription Volume						
b. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume						
c. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M						
d. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M, Location in a medical centre						
e. Predictors: (Constant), High Prescription Volume, Moderate Prescription Volume, Pharmacy\$Turnover 1.5to4.0M, Location in a medical centre, Participates in other pharmacy trials						
f. Dependent Variable: Log CI Rate						

Table 4-57: ANOVA for prescription volume model

Coefficients ^a													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-0.616	0.038		-16.241	0.000	-0.690	-0.541					
	High Prescription Volume	-0.128	0.066	-0.142	-1.934	0.055	-0.259	0.003	-0.142	-0.142	-0.142	1.000	1.000
2	(Constant)	-0.508	0.052		-9.709	0.000	-0.611	-0.405					
	High Prescription Volume	-0.236	0.075	-0.262	-3.160	0.002	-0.383	-0.089	-0.142	-0.229	-0.228	0.756	1.323
	Moderate Prescription Volume	-0.217	0.074	-0.242	-2.924	0.004	-0.364	-0.071	-0.113	-0.213	-0.211	0.756	1.323
3	(Constant)	-0.460	0.055		-8.384	0.000	-0.568	-0.352					
	High Prescription Volume	-0.182	0.076	-0.202	-2.377	0.018	-0.333	-0.031	-0.142	-0.175	-0.169	0.698	1.432
	Moderate Prescription Volume	-0.146	0.078	-0.163	-1.864	0.064	-0.300	0.009	-0.113	-0.138	-0.132	0.660	1.515
	Pharmacy\$Turnover 1.5 to 4.0M	-0.165	0.065	-0.195	-2.552	0.012	-0.293	-0.037	-0.258	-0.187	-0.181	0.863	1.159
4	(Constant)	-0.478	0.055		-8.705	0.000	-0.587	-0.370					
	High Prescription Volume	-0.194	0.076	-0.216	-2.557	0.011	-0.344	-0.044	-0.142	-0.188	-0.180	0.694	1.440
	Moderate Prescription Volume	-0.143	0.078	-0.160	-1.848	0.066	-0.296	0.010	-0.113	-0.137	-0.130	0.660	1.516
	Pharmacy\$Turnover 1.5 to 4.0M	-0.164	0.064	-0.193	-2.554	0.011	-0.290	-0.037	-0.258	-0.188	-0.180	0.863	1.159
	Location in/near a medical centre	0.223	0.103	0.154	2.173	0.031	0.021	0.426	0.145	0.161	0.153	0.990	1.010
5	(Constant)	-0.249	0.122		-2.035	0.043	-0.490	-0.008					
	High Prescription Volume	-0.172	0.076	-0.191	-2.261	0.025	-0.321	-0.022	-0.142	-0.168	-0.157	0.681	1.469
	Moderate Prescription Volume	-0.137	0.077	-0.153	-1.778	0.077	-0.288	0.015	-0.113	-0.132	-0.124	0.659	1.518
	Pharmacy\$Turnover 1.5 to 4.0M	-0.170	0.064	-0.201	-2.680	0.008	-0.296	-0.045	-0.258	-0.197	-0.187	0.861	1.162
	Location in/near a medical centre	0.222	0.102	0.153	2.184	0.030	0.021	0.423	0.145	0.162	0.152	0.990	1.010
	Participates in other pharmacy trials	-0.252	0.120	-0.148	-2.097	0.037	-0.489	-0.015	-0.161	-0.156	-0.146	0.978	1.023
a. Dependent Variable: Log CI Rate													

Table 4-58: Coefficients table for prescription volume model

There were no outlying cases within the model and the residuals plot showed a fairly uniform distribution. See Appendix 23 for the residuals plot.

Model interpretation

The model fit remained relatively poor, as the adjusted R^2 was only 0.118; therefore, only 11.8% of variance was explained by the model.

$$\text{Log CI Rate} = -0.249 + (-0.191*A) + (-0.153*B) + (-0.201*C) + 0.153*D + (-0.148*E) + \text{errors}$$

A = High prescription volume (greater than 1027 prescriptions per week)

B = Moderate prescription volume (between 505 and 1026 prescriptions per week)

C = Pharmacy Turnover of \$1.5M to 4.0M

D = Location in a medical centre

E = Participation in other pharmacy trials

[Where 0 = no membership to the group, and 1 = membership to the group]

Factor	Coefficient	Change in DV
High prescription volume	-0.191	-19.1
Moderate prescription volume	-0.153	-15.3
Pharmacy Turnover \$1.5 to 4.0M	-0.201	-20.1
Location in/near a medical centre	0.153	+15.3
Participates in other pharmacy trials	-0.148	-14.8

Table 4-59: Percentage change in the pharmacy's intervention rate according to the prescription volume model

Therefore, from Table 4-59 ;

- Pharmacies with a high prescription volume had 19.1% lower intervention rates on average (compared to pharmacies with low prescription volumes)
- Pharmacies with a moderate prescription volume had 15.3% lower intervention rates on average (compared to pharmacies with low prescription volumes)
- Pharmacies with a turnover between \$1.5 to 4.0M had 20.1% lower intervention rates on average (compared to pharmacies with turnovers under \$1.5M or over \$4M)
- Pharmacies that were located in or near a medical centre had 15.3% higher intervention rates on average (compared to pharmacies located in a shopping centre or shopping strip)

- Pharmacies that were concurrently participating in other pharmacy trials during the PROMISE trial had 14.8% lower intervention rates on average (compared to pharmacies that were not participating in other trials)

Again, it should be noted that these percentage changes are only accurate when all other independent variables in the model remain unchanged.

4.3.2 Logistic regression

The multiple regression model seen in section 4.3.1.9 was a poor predictor of the pharmacy intervention rate. A logistic regression, based on categorising pharmacies into different groups according to intervention rates, was also performed to determine if a model could predict those pharmacies with a high intervention rate. Cut-off points of intervention rates greater than 1% and greater than 0.6% were chosen for the analysis.

4.3.2.1 Intervention rates greater than 1.0%

All pharmacies with an intervention rate greater than 1.0% were recoded as 'high performers', with 14 pharmacies meeting this criteria. The remaining 169 pharmacies were recoded as 'non-performers' for the purposes of this analysis. Therefore, the resultant model aimed to predict a dichotomous variable; either 'yes' or 'no'.

A forward stepwise regression was performed and identified two pharmacy variables that were significantly associated with a higher intervention rate: location and financial turnover. Pharmacies that were in a medical centre with a financial turnover of less than \$1.5M annually were more likely to have a higher intervention rate (Table 4-60).

- Pharmacies in a medical centre were 560%, and pharmacies in a shopping strip were 47%, more likely to be a high performer than pharmacies in a shopping centre
- Pharmacies with a financial turnover of less than \$1.5M were more likely to be a high performer compared to pharmacies with financial turnovers of \$1.5M to 2.5M (91% more likely), financial turnovers of \$2.5M to 4.0M (75% more likely) and financial turnovers of over \$4.0M (79% more likely)

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Located in a shopping centre			5.264	2	0.072			
Located in a medical centre	1.887	0.959	3.869	1	0.049	6.597	1.007	43.233
Located in a shopping strip	0.384	0.855	0.202	1	0.653	1.468	0.275	7.842
Pharmacy \$ Turnover Less than 1.5M			7.676	3	0.053			
Pharmacy \$ Turnover 1.5M to 2.5M	-2.457	1.078	5.199	1	0.023	0.086	0.010	0.708
Pharmacy \$ Turnover 2.5M to 4.0M	-1.386	0.856	2.620	1	0.106	0.250	0.047	1.339
Pharmacy \$ Turnover Over 4.0M	-1.550	1.114	1.937	1	0.164	0.212	0.024	1.883
Constant	-2.128	0.816	6.793	1	0.009	0.119		

Table 4-60: Variables included in the initial logistic regression analysis

The model provided a correct classification in 92.3% of all cases, however, 0% of the ‘high performers’ were correctly predicted, resulting in a poor Nagelkerke R^2 value of 0.199. This may have occurred due to sample size of ‘high performers’ being very small, therefore a further logistic regression was performed using a different cut-off point.

4.3.2.2 *Intervention rates greater than 0.6%*

In this analysis, pharmacies with an intervention rate greater than 0.6% were recoded as ‘high performers’, with 22 pharmacies meeting this criteria. The remaining 160 pharmacies were recoded as ‘non-performers’ for the purposes of this analysis.

A forward stepwise regression was again performed and identified three pharmacy variables that were significantly associated with a higher intervention rate: location, financial turnover and banner group. Independent pharmacies that were in a medical centre and with a financial turnover of less than \$1.5M annually were more likely to have a higher intervention rate (Table 4-61).

- Pharmacies in a medical centre were 200% more likely to be a high performer than pharmacies in a shopping centre, whereas pharmacies in a shopping centre were 47% more likely to be a high performer than pharmacies in a shopping strip
- Pharmacies with a financial turnover of less than \$1.5M were more likely to be a high performer compared to pharmacies with financial turnovers of \$1.5M to 2.5M (84% more likely), financial turnovers of \$2.5M to 4.0M (76% more likely) and financial turnovers of over \$4.0M (61% more likely)

- Independent pharmacies were 77% more likely to be a high performer than banner group pharmacies.

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI for EXP(B)	
							Lower	Upper
Located in a shopping centre			5.847	2	0.054			
Located in a medical centre	1.092	0.780	1.961	1	0.161	2.981	0.646	13.743
Located in a shopping strip	-0.635	0.664	0.916	1	0.339	0.530	0.144	1.946
Pharmacy \$ Turnover Less than 1.5M			8.994	3	0.029			
Pharmacy \$ Turnover 1.5M to 2.5M	-1.853	0.691	7.201	1	0.007	0.157	0.040	0.607
Pharmacy \$ Turnover 2.5M to 4.0M	-1.426	0.745	3.659	1	0.056	0.240	0.056	1.036
Pharmacy \$ Turnover Over 4.0M	-0.937	0.880	1.135	1	0.287	0.392	0.070	2.197
Member of a banner group	-1.477	0.612	5.829	1	0.016	0.228	0.069	0.757
Constant	-0.408	0.669	0.372	1	0.542	0.665		

Table 4-61: Variables included in the second logistic regression analysis

The model provided a correct classification in 88.5% of all cases, with 99.4% of low performers and 9.1% of high performers correctly identified. This provided a slightly improved R^2 value of 0.220; however, the number of high performers correctly identified overall remained relatively poor.

4.3.2.3 Group of 60 'high performers'

Due to the small number of pharmacies within the 'high performer' group in the previous analysis, the 60 pharmacies with the highest intervention rates were coded as 'high performers' and an additional logistic regression analysis was performed. The model was not improved from the previous analysis with a correct classification provided in 69.4% of all cases (98.4% of low performers and 11.5% of high performers correctly identified) and an R^2 value of 0.115.

4.3.3 Overview of the associated factors

The findings from this section have been summarised into Figure 4-13. The six bolded boxes were the factors significantly associated with the intervention rate of the pharmacy in the multiple regression analyses. The relationships between each of the factors have also been indicated with lines between the boxes.

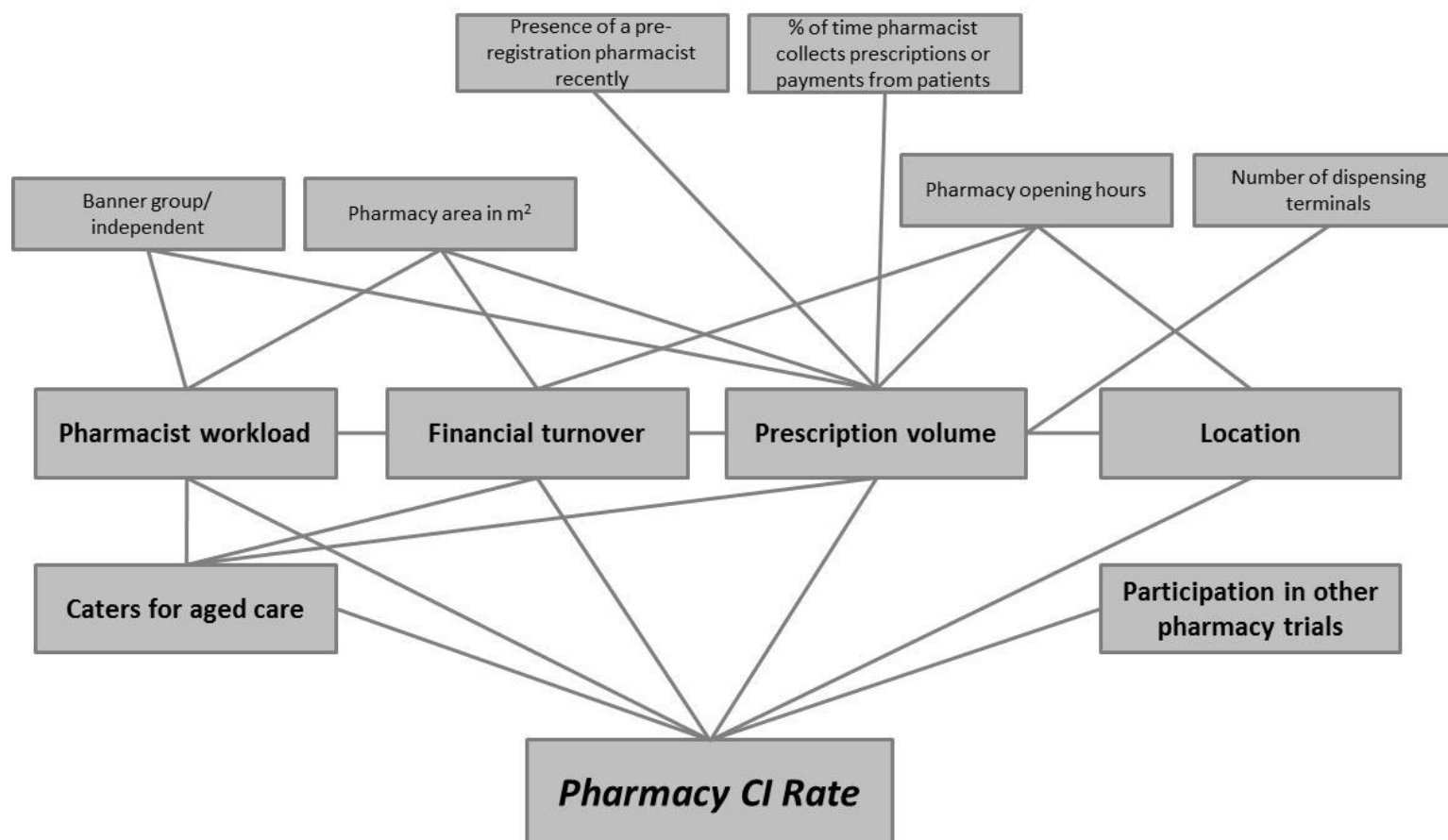


Figure 4-13: Relationships between the factors significantly associated with the pharmacy's intervention rate

4.3.4 Discussion of the multivariate analysis

Two multiple regression models were described that predicted the pharmacy's intervention rate; the 'pharmacist workload' model and the 'prescription volume' model. The 'pharmacist workload' model featured three significant variables: high pharmacist workload; an annual financial turnover of \$1.5 to 4.0M; and, whether the pharmacy catered for an aged care facility. Whereas, the multiple regression 'prescription volume model' featured five significant variables: high prescription volume; moderate prescription volume; an annual financial turnover of \$1.5 to 4.0M; location in or near a medical centre; and, participation in other trials. The variables included within each model are logical and explainable, as seen in the discussion of the bivariate analysis (section 4.2.34), with both models being equally successful in the prediction of the pharmacy's intervention rate. Unfortunately, the prediction success of both models was disappointingly low, with only 10.1% and 11.8%, respectively, of the variance between pharmacies being explained by the model. Although the adjusted R^2 value should not be used as the sole indicator of a model's success¹⁷⁵, all statistical assumptions for multiple regression analysis were met (see section 4.3.1.8 and 4.3.1.10) and further adjustments did not improve the model. It was therefore necessary to examine other reasons why the multiple regression models were not successful.

There are two common problems reported in the literature that can affect the success of a multiple regression analysis; multicollinearity and omitted variables.¹⁷⁶ As seen in sections 4.3.1.8 and 4.3.1.10, multicollinearity was not a problem with the final models, with none of the included independent variables showing correlation with each other. On the other hand, models cannot be checked for omitted variables and this may be the most likely explanation for their poor performance. All measured variables were included in the multiple regression analysis, however, there is the possibility that the differences in the pharmacy intervention rate were due to factors that were not measured during the trial.¹⁷⁵ For example, the majority of pharmacies had several individual pharmacists who contributed to the intervention rate and it was not possible to analyse the effect that differences between these individual pharmacists had on the pharmacy's overall rate. The fact that multiple pharmacists contributed to the pharmacy's intervention rate would have created more 'randomness' and 'noise' within the data, leading to a model with poor predictive capabilities.

In addition, the multiple regression method is not able to assess non-linear relationships within its analysis, so there is also the possibility that the relationships between the independent variables and the intervention rate were not linear.¹⁷⁵ In order for a model to be used for forecasting or prediction purposes, such as predicting factors that affect a pharmacy's intervention rate, a high adjusted R^2 value (for example, greater than 0.7) is necessary.^{175,176} The models found within this study can, therefore, only be used as a guide to significant influencing factors, due to the low R^2 values. It is interesting to note, however, that despite the poor predictive ability of the models, the same influencing factors kept re-occurring: high pharmacist workload; high prescription volume; an annual financial turnover of \$1.5 to 4.0M; whether the pharmacy catered for an aged care facility; location in or near a medical centre; and, participation in other trials. This indicates that these factors do have a significant influence on the pharmacy's intervention rate and altering these factors may allow a pharmacy to improve their intervention rates.

As the multiple regression model failed to achieve a satisfactory R^2 value, a logistic regression was also performed to determine any influential factors that increased the likelihood that a pharmacy would have a high intervention rate. Again, the logistic regression model had a poor R^2 value of 0.22, where the pharmacies with a higher intervention rate tended to be independent pharmacies that were located in a medical centre and had a financial turnover of less than \$1.5M annually.

A similar study used multiple regression techniques to develop a model for predicting whether a pharmacy would provide cognitive services (performer vs non-performer) and a model for predicting the rate of cognitive service provision.¹⁰¹ The authors found that the factors affecting whether the pharmacy was a performer or non-performer was the attitude of the pharmacist-in-charge and the number of FTE pharmacists. No measure of workload was present in the resulting model. However, there were significant correlations between the number of FTE pharmacists and the pharmacy's prescription volume and pharmacy area. The authors found that the rate of cognitive service provision was affected by reimbursement, monthly prescription volume and the number of government assistance prescriptions dispensed. Pharmacies that were reimbursed and that dispensed less prescriptions, but dispensed a higher percentage of government assistance prescriptions, had a higher intervention rate. It is important to note that the pharmacies were asked to record a 'typical' prescription volume, not record their actual volume, which may have decreased the accuracy of the prescription volume measurement.

4.4 Conclusion

The intervention rates were varied between the pharmacies and several factors that were identified may have contributed to this difference. Workload and prescription volume appeared to have a major impact on the pharmacy's intervention rate, with several other significant factors, such as financial turnover, location and catering for ACFs, also associated with altered workloads. Disappointingly, the predictive capabilities of the multiple regression models were poor. This may be due in part to several individual pharmacists contributing to the overall pharmacy intervention rate, as well as the possibility of unknown variables that were not measured. These findings, and how to improve the intervention rate, will be further discussed in Chapter 7.

5 Chapter 5: Pharmacist data and factors influencing pharmacist CI rate

Prior to the PROMISE trial, participating pharmacists were asked to answer a number of surveys whilst completing their online training. This information was then compared to national averages to determine if the pharmacists were representative, and also to subsequently determine any factors that may have been associated with the clinical intervention rate. Both bivariate and multivariate analysis between the pharmacist's intervention rate and any influencing factors will be reported within this chapter.

5.1 Pharmacist demographics

Of the 561 enrolled pharmacists, 30 were 'duplicate' pharmacists as they were also working at another pharmacy enrolled in the trial, resulting in 531 individual pharmacists in total. From these 531 pharmacists, 458 (86.3%) completed the background survey. Of these 458 pharmacists, 258 (56.3%) were female (Table 5-1). This matched the national demographics displayed in the Pharmacy Workforce Planning Study conducted in 2008¹⁷⁷, which showed there were 15337 pharmacists nationwide in 2006 (from ABS population data), of whom 56% were female.

As seen in Table 5-1, the age range with the largest number of pharmacists was 20-30 years old, with 167 (36.5%) of the 458 pharmacists. Unfortunately, the Pharmacy Workforce Planning Study¹⁷⁷, which examined all of Australia, had different age categories (for example, 15-24 years and 25-34 years) compared to the PROMISE survey (for example, 20-29 years and 30-39 years). Due to this, the PROMISE pharmacists were compared to the Victorian Pharmacy Workforce 2007 Study¹⁷⁸. The Victorian data was still considered relevant as the majority of PROMISE pharmacists (58.6%) were based in the State of Victoria. There were significant differences between the demographics of the PROMISE pharmacists and the Victorian averages, where the PROMISE pharmacists generally appeared to be younger (Table 5-1).

		Male			Female			Total		
		Expected	PROMISe		Expected	PROMISe		Expected	PROMISe	
		%	N	%	%	N	%	%	N	%
Age Range	20 – 30	13.73	62	13.54	25.49	105	22.93	19.61	167	36.46
	31 – 40	15.69	52	11.35	22.55	64	13.97	19.12	116	25.33
	41 – 50	20.59	40	8.73	21.57	50	10.92	21.08	90	19.65
	51 – 60	19.61	27	5.90	19.61	30	6.55	19.61	57	12.45
	Over 60	30.39	19	4.15	10.78	9	1.97	20.59	28	6.11
Total		100	200	43.67	100	258	56.33	100	458	100
Statistics		$\chi^2 = 89.57, df = 4, p < 0.01$			$\chi^2 = 45.67, df = 4, p < 0.01$			$\chi^2 = 134.63, df = 4, p < 0.001$		

Table 5-1: Age range of PROMISe pharmacists compared to Victorian pharmacist data from the Victorian Pharmacy Workforce 2007 Study¹⁷⁸

As seen in Figure 5-1, the largest proportion of pharmacists had graduated after the year 2000, accounting for 180 (39.7%) of pharmacists.

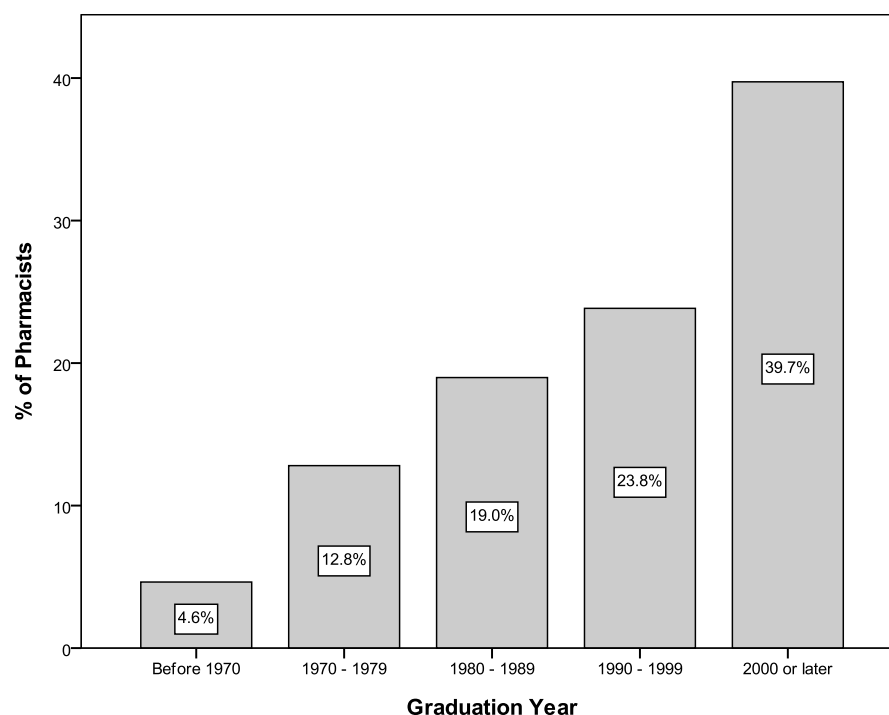


Figure 5-1: Graduation year of the PROMISe pharmacists

A chi-square test showed no statistical difference between the pharmacist's gender, age or graduation year and the software group that their pharmacy was in ($\chi^2 = 0.90, df = 2, p = 0.64$ and $\chi^2 = 14.08, df = 8, p = 0.08$ and $\chi^2 = 11.18, df = 8, p = 0.19$, respectively). Therefore, the distribution of pharmacists throughout the three software groups within the study can be considered fairly representative.

5.1.1 Qualifications

Of the 458 respondents, only 49 (10.7%) indicated they had additional qualifications to their undergraduate pharmacy degree, including graduate certificates, graduate diplomas, and additional postgraduate degrees (Honours, Masters and Doctor of Philosophy). There was substantial variety in the subject of the additional qualifications, including pharmacy-based certificates in wound care, herbal medicine, clinical pharmacy, and geriatrics, as well as additional qualifications outside of pharmacy, including health economics, business administration, and commerce. When the additional qualifications were analysed, 26 pharmacists were considered to have additional *clinical* pharmacy qualifications and were therefore tagged to allow additional analysis later. Eighty-one pharmacists (17.7%) were accredited to conduct HMRs, with 11 pharmacists (2.4%) being accredited as well as holding an additional qualification (Table 5-2).

		Qualification grouping for analysis			
		AACPA	Additional qualifications	'Control' PROMISE participants	Total
Accredited to perform medication reviews	Yes	70	11	0	81
	No	0	15	362	377
	Total	70	26	362	458

Table 5-2: Classification of pharmacists with additional qualifications

5.1.2 Professional memberships

Of the 458 respondents, the most common membership was the Pharmaceutical Society of Australia (PSA), with 75.8% of pharmacists belonging to this society (Table 5-3). There were 233 (50.9%) pharmacists who were members of only one society, 122 (26.0%) pharmacists were members of two societies, and 30 (6.6%) pharmacists were a member of three or more societies. The most common membership combinations were PSA and AACP, PSA and PGA or PSA and PGA and AACP (Table 5-4). Only 76 pharmacists (16.6%) were not a member of any society.

	N	%
PSA	347	75.8
SHPA	12	2.6
AACP	104	22.7
AACPM	14	3.1
APESMA	18	3.9
PGA	70	15.3
Total	458	100.0

Table 5-3: Professional memberships of participating pharmacists

	PSA	SHPA	AACP	ACPPM	APESMA	PGA
PSA	347	7	90	13	15	53
SHPA	7	12	3	0	0	5
AACP	90	3	104	7	3	20
AACPM	13	0	7	14	1	3
APESMA	15	0	3	1	18	1
PGA	53	5	20	3	1	70
Total	347	12	104	14	18	70

Table 5-4: Professional membership combinations of participating pharmacists

5.1.3 Continuing education

The majority of pharmacists (72.7%) stated that they undertook 10-50 hours per year of continuing education or CPD activities (Table 5-5). To ensure the assumptions of a chi-square test were met (where each cell has a count greater than 5), the categories of 'None' and 'Less than 10 hours' were grouped together. The chi-square test showed no statistical difference between the hours of CPD activity that the pharmacist completed per year and the software group their pharmacy was in ($\chi^2 = 3.90$, $df = 6$, $p = 0.69$).

	N	%
None	3	0.66
Less than 10 hours	45	9.83
10 - 25 hours	175	38.21
25 - 50 hours	158	34.50
More than 50	77	16.81
Total	458	100

Table 5-5: Annual CPD activity by PROMiSe pharmacists

5.1.4 Practice background

During their pharmacy careers, 286 (62.4%) of pharmacists had only ever worked in community pharmacy, with 104 (22.7%) having worked in both community and hospital

settings, and 33 (7.2%) having worked in both community and medication review settings. Thirty-three pharmacists (7.2%) had worked in all three areas (community, hospital and medication reviews). Twenty-eight pharmacists had also worked in other areas of pharmacy, such as academia/research, military/government, industry or had practised overseas. The largest proportion of pharmacists (205 or 49.2%) had worked in community pharmacy practice for 10 years or less (Table 5-6).

	Count	%	% (unknown removed)
Less than 5 years	127	27.7	30.5
5 - 10 years	78	17.0	18.7
10 - 15 years	57	12.4	13.7
15 - 20 years	49	10.7	11.8
20 - 25 years	31	6.8	7.4
25 - 30 years	32	7.0	7.7
30 - 35 years	17	3.7	4.1
35 - 40 years	15	3.3	3.6
Over 40 years	11	2.4	2.6
Unknown	41	9.0	
Total	458	100	100

Table 5-6: Number of years spent in community pharmacy practice by PROMISE pharmacists

5.1.5 *Current practice*

As expected, 436 (95.2%) pharmacists currently spent the majority of their working week in community pharmacy practice, with 168 (36.7%) working over 40 hours per week and 213 (46.5%) working between 20 and 40 hours per week (Table 5-7). Of the other pharmacists, 10 (2.2%) worked mainly in hospital, 6 (1.3%) mainly undertook medication reviews and 6 (1.3%) mainly worked in other sectors (such as clinical trials, industry and research). A chi-square test showed a significant relationship between the age of the pharmacist and the number of hours they worked per week. As perhaps expected, a higher proportion of younger pharmacists worked over 20 hours per week, whilst a higher proportion of older pharmacists worked less than 20 hours per week ($\chi^2 = 32.73$, $df = 9$, $p < 0.001$). Pharmacists in the 31-40 year age group also tended to work less hours per week than expected.

	N	%
Less than 10 hours	22	4.80
10 - 20 hours	55	12.01
20 - 40 hours	213	46.51
Over 40 hours	168	36.68
Total	458	100

Table 5-7: Average number of hours worked in community pharmacy each week by PROMISE pharmacists

Employee pharmacists made up the largest majority of participating pharmacists with 211 (46.1%), and 360 pharmacists (78.6%) had worked in their current role for less than 10 years (Table 5-8). A chi-square test also showed a significant relationship between the age of the pharmacist and their current role, with a much higher percentage of older pharmacists being owners and a much higher percentage of younger pharmacists being employees ($\chi^2 = 92.08$, $df = 9$, $p < 0.001$). A chi-square test showed no statistical difference between the current role of the pharmacist and the software group their pharmacy was in during the PROMISE trial ($\chi^2 = 2.56$, $df = 8$, $p = 0.96$).

	Employee	Owner	Manager	Locum/ Other	Total	%
Less than 2 years	62	6	28	8	104	22.71
Between 2 and 5 years	88	32	30	11	161	35.15
Between 5 and 10 years	39	40	11	5	95	20.74
Between 10 and 20 years	18	46	3	1	68	14.85
20 years or more	4	23	1	2	30	6.55
Total N	211	147	73	27	458	100
%	46.07	32.10	15.94	5.89	100	

Table 5-8: Current role of PROMISE pharmacists and years in that role

5.1.6 Workload

Several determinants of workload were collected to determine the typical working conditions and average prescription volume dispensed by a pharmacist.

5.1.6.1 Typical working conditions

Of the 458 respondents, 175 (38.2%) generally worked as the sole pharmacist in their community pharmacy and 178 (38.9%) worked with only one other pharmacist (Table 5-9).

	N	%
None	175	38.2
1	178	38.9
2	72	15.7
3 to 4	31	6.8
5 or more	2	0.4
Total	458	100

Table 5-9: Number of other pharmacists each PROMISE pharmacist worked with during an average shift

5.1.6.2 *Estimated number of prescriptions dispensed per day*

Pharmacists were asked to select from five prescription categories to determine their current daily workload (see Table 5-10 for categories). The majority of pharmacists indicated that they dispensed an average of 100-150 or 150-200 prescriptions per day during a 9-hour shift, with 167 (36.5%) and 118 (25.8%) pharmacists, respectively (Table 5-10). In Australia, an APESMA survey revealed that the average number of prescriptions dispensed ranged from 11 to 33 per hour with an average of 19, which is equivalent to 171 per 9-hour shift.¹⁷⁹ Prior to centralisation of the Pharmacy Boards, the Pharmacy Board of Tasmania recommended dispensing no more than 170 prescriptions per 9-hour shift¹⁸⁰ and the current Australian Board of Pharmacy states that a reasonable workload for one pharmacist is between 150-200 prescriptions per day¹⁶⁹; therefore, the PROMISE participants were dispensing prescriptions at a lower or similar rate to the national standards. The chi-square test showed no statistical relationship between the average number of prescriptions dispensed daily and the software group their pharmacy was in ($\chi^2 = 9.08$, $df = 8$, $p = 0.34$), indicating an even spread of pharmacists with differing workloads over the three groups. To ensure all chi-square cell counts were greater than 5, the 2 'Not appropriate' answers were grouped with 'Less than 100'.

	N	%
Less than 100	95	20.7
100 - 150	167	36.5
150 - 200	118	25.8
200 - 250	39	8.5
Over 250	37	8.1
Not appropriate to my area of practice	2	0.4
Total	458	100

Table 5-10: Estimated number of prescriptions dispensed by each pharmacist during a 9-hour shift

5.1.6.3 Prescriptions dispensed during the trial

During the 12-week trial, each pharmacist dispensed an average of 4061 prescriptions (Table 5-11). This equates to approximately 338 prescriptions per week or approximately 9 prescriptions per hour in a 38-hour week.

Prescriptions	Mean	4060.57
	Std. Error of Mean	141.58
	Std. Deviation	3194.17
	Minimum	16.00
	Maximum	17193.00

Table 5-11: Prescription details during the trial

The pharmacist's estimated number of prescriptions per day was then compared to the actual number of dispensed prescriptions (as recorded in the intervention database) to determine if the pharmacist's estimation correlated with their actual prescriptions. As the estimated number of prescriptions was a grouped variable, a Kruskal-Wallis chi-square test was used. There were significant relationships between the groups ($\chi^2 = 41.77$, $df = 4$, $p < 0.001$), with a significantly positive Jonckheere-Terpstra trend indicating that as the estimated number of prescriptions increased, so did the actual number of prescriptions dispensed ($t = 6.61$, $p < 0.001$). Pharmacists were therefore considered accurate at estimating their prescription volume.

5.1.6.4 Approximate percentage of time spent on dispensing tasks

Pharmacists were asked to indicate the approximate percentage of time they spent on dispensing-related tasks during their shift, such as taking in/dispensing/checking/handing out the prescription. As expected, the majority of pharmacists (401; 87.6%) spent more than 50% of their time on dispensing tasks (Table 5-12).

	Count	%
Less than 10%	6	1.31
10 - 50%	51	11.14
50 - 90%	299	65.28
More than 90%	102	22.27
Total	458	100

Table 5-12: Approximate percentage of time spent on dispensing tasks by PROMISE pharmacists

5.1.6.5 *Average pharmacist workload within the pharmacy*

The pharmacist workload was calculated by determining the actual number of prescriptions dispensed per week by the pharmacy during the trial and dividing it by the number of FTE pharmacists per week, resulting in the average number of prescriptions dispensed by a pharmacist during a 38-hour week (see Chapter 2 for more detail). On average, each pharmacy had the equivalent of 2.67 ± 1.23 FTE pharmacists (range = 1.0 – 6.6), resulting in an average pharmacist workload of 480.83 ± 185.55 prescriptions per 38-hour week (Table 5-13). This was notably higher than the average prescription volume of 338 prescriptions per week seen in section 5.1.6.3, indicating that the average pharmacist workload calculation may not be accurate. This was due to the pharmacist workload being calculated using the pharmacy prescription data, rather than the pharmacist prescription data, which may have led to gross generalisations of the pharmacist workload at an individual pharmacist level. Individual pharmacist workload was unable to be calculated as the pharmacists were not asked to record exactly how many hours they worked at the pharmacy for each week of the trial, so individual workloads could not be calculated using actual hours worked and actual prescriptions dispensed.

FTE Pharmacists	Mean	2.67
	Std. Error of Mean	0.05
	Std. Deviation	1.23
	Minimum	1.00
	Maximum	6.60
Average Pharmacist Workload	Mean	480.83
	Std. Error of Mean	8.06
	Std. Deviation	185.55
	Minimum	109.62
	Maximum	1242.29

Table 5-13: Average pharmacist workload during the trial (including non-participants)

5.1.6.6 *Effect of dispensary technicians*

A workload combining the pharmacist and technicians was also calculated (see Chapter 2 for more detail). On average, each pharmacy had the equivalent of 3.96 ± 2.13 FTE dispensary staff, including pharmacists and dispensary technicians (range = 1.0 – 11.2), resulting in an average workload of 331.69 ± 120.15 prescriptions per 38-hour week (Table 5-14).

FTE Dispensary Staff – Pharmacists plus Technicians	Mean	3.96
	Std. Error of Mean	0.09
	Std. Deviation	2.13
	Minimum	1.00
	Maximum	11.18
Average Weekly Workload Including Technicians	Mean	331.69
	Std. Error of Mean	5.22
	Std. Deviation	120.15
	Minimum	90.05
	Maximum	916.58

Table 5-14: Average pharmacist workload during the trial with technicians included

5.1.7 Training

A total of 215 (40.5%) pharmacists attended the face-to-face PROMISe training and 411 (77.4%) pharmacists completed the online training scenarios, with 196 pharmacists (36.9%) completing both the face-to-face and online training. Although all pharmacists were strongly encouraged to complete the training, there were still 101 (19.0%) enrolled pharmacists who completed neither the face-to-face or online training (Table 5-15). Despite the incentives provided to pharmacists for attending the training, a 100% training rate was not able to be achieved as it was clearly impossible to force participation in the training, apart from perhaps subsequently excluding non-attendees from the trial. It should be noted that results from the untrained pharmacists were still used during the analysis. A chi-square test showed no statistical relationship between the level of training that the pharmacist undertook and the software group their pharmacy was in ($\chi^2 = 6.65$, $df = 6$, $p = 0.35$).

	Pharmacist Count	%
Neither online or face-to-face training	101	19.0
Online training only	215	40.5
Face-to-face training only	19	3.6
Online and face-to-face training	196	36.9
Total	531	100

Table 5-15: Training attendance of the PROMISe participant pharmacists

5.1.8 Survey responses

Before the trial began, pharmacists were asked to complete surveys evaluating empathy, professionalism and clinical knowledge, as well as a survey regarding their opinions about interventions.

5.1.8.1 Empathy score

Of the 531 participating pharmacists, 454 (85.5%) completed the 'Empathy Survey' (see Appendix 12) and the mean score was 46.8 ± 6.1 (range = 25 – 62; Table 5-16). An independent T-test showed that female pharmacists, on average, had a significantly higher empathy score than male pharmacists (Table 5-16; $t = -4.77$, $df = 448$, $p < 0.001$) with a mean difference of 2.7 (95% CI = 1.6 – 3.8). A bivariate correlation showed no statistical relationship between the pharmacist's graduation year and their empathy score (*Spearman's rho* = -0.05, $N = 445$, $p = 0.32$).

	Pharmacist Count	Empathy Score				
		Mean	Std. Error	Std. Dev.	Min.	Max.
Female	253	48.0	0.4	5.8	33.0	62.0
Male	197	45.3	0.4	6.1	25.0	61.0
Unknown	4	43.3	5.0	9.9	30.0	53.0
Total	454	46.8	0.3	6.1	25.0	62.0

Table 5-16: PROMISe pharmacist empathy scores compared to gender

5.1.8.2 Professionalism score

Of the 531 participating pharmacists, 455 (85.7%) completed the 'Professionalism Survey' (see Appendix 13) and the mean score was 80.0 ± 7.7 (range = 19 – 90; Table 5-17). An independent T-test showed that the female pharmacists had a significantly higher professionalism score than male pharmacists (Table 5-17; $t = -2.37$, $df = 449$, $p = 0.02$) with a mean difference of 1.7 (95% CI = 0.3 – 3.2). A bivariate correlation showed no statistical relationship between the pharmacist's graduation year and their professionalism score (*Spearman's rho* = -0.01, $N = 446$, $p = 0.88$).

	Pharmacist Count	Professionalism Score				
		Mean	Std. Error	Std. Dev.	Min.	Max.
Female	254	80.7	0.5	8.3	19.0	90.0
Male	197	79.0	0.5	6.8	32.0	90.0
Unknown	4	78.8	4.8	9.7	65.0	86.0
Total	455	80.0	0.4	7.7	19.0	90.0

Table 5-17: PROMISe pharmacist professionalism scores compared to gender

5.1.8.3 Clinical knowledge

Of the 531 pharmacists participating in the trial, 433 (81.5%) completed the clinical knowledge survey (see Appendix 4) and the mean score was 53.0 ± 7.5 (range = 26 – 67; Table 5-18). An independent T-test showed that females tended to have a higher clinical knowledge score than males ($t = -2.86$, $df = 338$, $p = 0.005$) with a mean difference of 2.1 (95% CI = 0.7 – 3.6). Interestingly, a bivariate correlation showed no statistical relationship between the pharmacist's graduation year and their clinical knowledge scores (*Spearman's rho* = -0.05, $N = 427$, $p = 0.35$), suggesting that the average PROMISE pharmacist's clinical knowledge had apparently not increased or decreased substantially since graduation. An analysis of variance showed no statistical relationship between the pharmacist's clinical knowledge score and the software group their pharmacy was in ($F(2,430) = 0.21$, $p = 0.81$).

	Pharmacist Count	Clinical Knowledge Score				
		Mean	Std. Error	Std. Dev.	Min.	Max.
Female	245	53.9	0.4	6.5	34.0	67.0
Male	187	51.8	0.6	8.5	26.0	67.0
Unknown	1	47.0			47.0	47.0
Total	433	53.0	0.4	7.5	26.0	67.0

Table 5-18: PROMISE pharmacist clinical knowledge scores compared to gender

The dataset was divided into three groups according to the additional qualifications of the pharmacist determined in section 5.1.1; pharmacists with additional qualifications ($n=26$), AACP pharmacists ($n = 66$) and 'control' pharmacists ($n = 341$). Significant differences were seen in the clinical knowledge score between the three groups ($F(2,430) = 5.82$, $p = 0.003$), with post-hoc analysis using the Hochberg method showing a significant difference between the pharmacists with additional qualifications and the control pharmacists ($p = 0.023$; Table 5-19). The difference between AACPA pharmacists and the control pharmacists was approaching significance ($p = 0.051$). There was no significant difference found between the pharmacists with additional qualifications and the AACPA pharmacists (Table 5-20; $p = 0.70$), as such these two groups of pharmacists were combined. An independent samples T-test was performed on the resulting two groups (pharmacists with additional qualifications or AACPA pharmacists versus control pharmacists) and a significant difference was still detected ($t(431) = 3.27$, $p = 0.001$).

	Count	Mean	Std. Dev.	Minimum	Maximum
Other	26	56.4	6.7	40.0	65.0
AACPA	66	54.8	7.5	37.0	67.0
Control	341	52.4	7.5	26.0	67.0
Total	433	53.0	7.5	26.0	67.0

Table 5-19: Descriptive statistics for the three 'qualification' groups within the PROMISe dataset

	Count	Mean	Std. Dev.	Minimum	Maximum
Other & AACPA	92	55.2	7.3	37.0	67.0
Control	341	52.4	7.5	26.0	67.0
Total	433	53.0	7.5	26.0	67.0

Table 5-20: Descriptive statistics for the two 'qualification' groups within the PROMISe dataset

5.1.8.4 Pre-trial survey

The pharmacists were also asked simple Likert scale questions to determine their views regarding pharmacy practice and clinical interventions. A five point scale was available for the pharmacist to assign their view to a range of statements, where Strongly Agree = 1 and Strongly Disagree = 5; as the coded number increased, the level of agreement with the statement decreased. Of the 531 pharmacists, 457 responded to the statements (Table 5-23).

Too busy

Answers to the statement "I believe that pharmacists are already too busy within the workplace which prevents them from taking on any new tasks" were mixed, with 133 pharmacists agreeing, 192 disagreeing and 132 having neutral feelings (Table 5-23; median score = Neutral).

Interestingly, the pharmacists' beliefs about how busy they are were not reflected in the average pharmacy workload (Table 5-21). A bivariate correlation showed no relationship between the pharmacist's perception of busyness and the pharmacy's average pharmacist workload (*Spearman's rho* = -0.04, *N* = 456, *p* = 0.44).

	Pharmacist Count	Average Pharmacist Workload				
		Median	Min.	Max.	25 th %ile	75 th %ile
Strongly Agree	30	500.38	249.42	916.58	391.43	609.14
Agree	103	428.84	158.03	1242.29	337.81	533.39
Neutral	132	491.63	109.62	1106.61	377.65	622.39
Disagree	143	461.46	109.62	1106.61	346.86	585.43
Strongly Disagree	49	459.82	170.93	856.37	286.16	585.43
Unknown	74	503.35	109.62	1142.17	381.39	623.39
Total	531	464.16	109.62	1242.29	352.55	591.61

Table 5-21: The pharmacist's perception of busyness compared to the average pharmacist workload within the pharmacy

Adapting practice

The majority of pharmacists (424 or 92.8%) agreed with the statement “I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment”, with a median score of Strongly Agree (Table 5-23).

Willingness to change

The majority of pharmacists (422 or 92.3%) agreed with the statement “I would be willing to change my current practice if a new, better way was available”, with a median score of Strongly Agree (Table 5-23).

Good clinical knowledge

The majority of pharmacists (328 or 71.8%) agreed with the statement “I believe I have a good level of clinical knowledge to perform clinical interventions”, with a median score of Agree (Table 5-23).

The pharmacist's self-assessment of their clinical knowledge also appeared to moderately correlate with their score on the clinical knowledge survey (section 5.1.8.3), with pharmacists who felt they had a good level of clinical knowledge attaining a higher score on the clinical knowledge survey (*Spearman's rho* = -0.21, *N* = 430, *p* < 0.001; Table 5-22).

	Pharmacist Count	Clinical Knowledge Survey Score				
		Median	Min.	Max.	25 th %ile	75 th %ile
Strongly Agree	94	57.00	26.00	67.00	51.00	61.00
Agree	234	54.00	26.00	67.00	49.00	58.00
Neutral	104	52.00	33.00	66.00	47.00	55.00
Disagree	21	53.00	29.00	62.00	47.00	57.00
Strongly Disagree	4	53.00	50.00	56.00	50.50	55.50
Unknown	74	47.00	43.00	61.00	43.00	61.00
Total	531	54.00	26.00	67.00	48.00	58.00

Table 5-22: The correlation between the pharmacist's self-assessment of their clinical knowledge and their clinical knowledge survey score

Confidence in their ability to perform clinical interventions

The majority of pharmacists (339 or 74.2%) agreed with the statement "I am confident in my ability to perform clinical interventions", with a median score of Agree (Table 5-23). Pharmacists who felt they had good clinical knowledge to perform interventions also had a higher level of confidence in their abilities (*Spearman's rho* = 0.81, *N* = 445, *p* < 0.001).

Already performing clinical interventions

The majority of pharmacists (320 or 70.0%) agreed with the statement "I already perform clinical interventions on a daily basis", with a median score of Agree (Table 5-23).

Job satisfaction

The majority of pharmacists (301 or 65.9%) agreed with the statement "I believe the recording of interventions will increase my level of job satisfaction", with a median score of Agree (Table 5-23).

Belief that the recording system will be hard to use

Answers to the statement "I am concerned the recording system will be hard to use" were mixed, with 102 pharmacists agreeing, 199 disagreeing and 156 having neutral feelings (Table 5-23; median score = Neutral).

Belief that it will take too long to record interventions

Answers to the statement "I am concerned it will take too long to document interventions through the recording system" were also mixed, with 172 pharmacists agreeing, 147 disagreeing and 138 having neutral feelings (Table 5-23; median score = Neutral).

5.1.8.5 Post-trial survey

The post-trial survey aimed to determine the ease of use of the system and also determine if the pharmacists' attitudes towards interventions had changed. Of the 531 pharmacists, only 265 pharmacists answered the post-trial survey (Table 5-24).

Ease of use of the software

The majority of pharmacists (228 or 86.0%) agreed with the statement "I found the software easy to use", with a median score of Agree (Table 5-24).

Sufficiency of training on the software

The majority of pharmacists (223 or 84.2%) agreed with the statement "I received sufficient training to use the software", with a median score of Agree (Table 5-24).

Answers to this statement were also compared to the level of training that the pharmacist received. A chi-square test showed significant differences between the groups ($\chi^2 = 18.89$, $df = 6$, $p = 0.02$), with more pharmacists who had completed both the online and face-to-face training feeling that they had sufficient training, whereas more pharmacists who had completed only the online training felt that they did not have sufficient training.

Unfortunately, due to the low number of respondents, the chi-square test had 5 cells with counts less than 5 and groups were unable to be merged further, so these statistical results may be inaccurate.

Good clinical knowledge

The majority of pharmacists (223 or 84.2%) still agreed with the statement "I have a good level of clinical knowledge to perform clinical interventions", with a median score of Agree (Table 5-24). Pharmacists did not appear to change their views of their clinical knowledge ability, with those who believed they had a good level of clinical knowledge at the start of the trial also believing the same at the end of the trial ($t(255) = 0.73$, $p = 0.47$).

Confidence in their ability to perform clinical interventions

The majority of pharmacists (232 or 87.6%) still agreed with the statement "I am confident in my ability to perform clinical interventions", with a median score of Agree (Table 5-24). Pharmacists did not appear to change their levels of confidence throughout the trial, with those who were confident at the start of the trial remaining so at the end of the trial ($t(255) = 0.85$, $p = 0.40$).

Trial increased awareness of clinical interventions

The majority of pharmacists (211 or 79.6%) agreed with the statement “The trial increased my awareness of how many clinical interventions I perform”, with a median score of Agree (Table 5-24).

Performing clinical interventions increased job satisfaction

The majority of pharmacists (224 or 84.5%) agreed with the statement “The performing of clinical interventions increased my level of job satisfaction”, with a median score of Agree (Table 5-24).

Recording clinical interventions increased job satisfaction

The majority of pharmacists (169 or 63.8%) agreed with the statement “The recording of clinical interventions increased my level of job satisfaction”, with a median score of Agree (Table 5-24).

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Median	Mean	Std. Dev.
Too busy	30	103	132	143	49	3.00	3.17	1.10
Adapting practice	251	173	15	10	8	1.00	1.58	0.81
Willingness to change	263	159	18	6	11	1.00	1.56	0.83
Good clinical knowledge	94	234	104	21	4	2.00	2.14	0.82
Confidence	106	233	90	24	4	2.00	2.10	0.84
Already performing CIs	130	190	106	25	6	2.00	2.10	0.92
Increase job satisfaction	127	174	107	39	10	2.00	2.19	1.01
System will be hard to use	11	91	156	142	57	3.00	3.31	1.01
System will take too long	39	133	138	111	36	3.00	2.94	1.09

Table 5-23: Answers to the pre-trial intervention survey questions

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Median	Mean	Std. Dev.
Software was easy to use	74	154	24	13	0	2.00	1.91	0.75
Received sufficient training	81	142	29	11	2	2.00	1.91	0.80
Good clinical knowledge	34	185	39	6	0	2.00	2.06	0.60
Confidence	41	191	27	5	0	2.00	1.99	0.58
Increased awareness of CIs	68	143	40	9	4	2.00	2.01	0.83
Performing CIs increased job satisfaction	68	156	32	7	1	2.00	1.93	0.72
Recording CIs increased job satisfaction	42	127	67	24	4	2.00	2.32	0.90

Table 5-24: Answers to the post-trial intervention survey questions

5.1.9 Discussion of pharmacist demographics

The pharmacists participating in the PROMISE trial appeared to be fairly representative with regards to gender, but tended to be younger than the average pharmacist, which may indicate that younger pharmacists were more willing to participate in the PROMISE trial. The younger cohort meant that pharmacists may not have been adequately represented within the PROMISE study and this result needs to be considered when assessing the results found in the next section. Despite this, the pharmacists were evenly spread amongst pharmacies within the three software groups and the pharmacies were found to be a representative sample, therefore the sample may still be fairly representative of the pharmacists within Australia.

The average PROMISE pharmacist was an employee, had no additional qualifications, had only ever worked in community pharmacy, was a member of the PSA and undertook 10-50 hours of continuing education each year, which at face value appears to describe a fairly typical Australian pharmacist.

5.2 *Bivariate pharmacist factor analysis*

Using the information gathered in the surveys and the intervention database, pharmacist factors were compared against their intervention rates to determine which factors may impact on their individual intervention rate. As in Chapter 4, the intervention rates discussed are always the ‘documented’ intervention rates, unless otherwise stated.

5.2.1 *Number of pharmacists*

Of the 531 pharmacists enrolled in the trial, 22 pharmacists (4.1%) did not dispense any prescriptions during the trial and were therefore considered ‘inactive’. These pharmacists were presumed to have stopped working at the participating pharmacy before the trial. The remaining 509 (95.9%) were considered ‘active’ as they dispensed at least one prescription during the trial; however, only 425 (83.5%) of those ‘active’ pharmacists documented an intervention using the PROMISe software during the trial period. The data from the non-recording pharmacists was included in the following analyses; however, they were also examined separately in section 0.

5.2.2 *Determining the intervention rate of the pharmacist*

As determined in Chapter 5, data was collected over the trial period and manipulated once the trial was finished to determine a valid intervention rate. The 525 OTC interventions and 282 Group Three prompted interventions were removed before the intervention rate was calculated. The remaining interventions (5948) were divided by the total number of prescriptions dispensed by the pharmacist during the trial, resulting in the pharmacist’s individual intervention rate.

The median valid intervention rate during the trial was 0.17% (range = 0.00 – 3.88) or 1.7 interventions in every 1000 prescriptions (Table 5-25). When the prompted interventions were included for comparison, the median intervention rate rose slightly (Table 5-25).

	Count	Mean	Median	25 th %ile	75 th %ile	Min.	Max.
Valid intervention rate	509	0.325	0.168	0.054	0.375	0.000	3.876
Total intervention rate (including prompted CIs)	509	0.349	0.173	0.055	0.418	0.000	5.128

Table 5-25: Intervention rate for pharmacists during the PROMISe trial

The number of pharmacists with a low intervention rate was very prominent, resulting in a non-parametric distribution (Figure 5-2).

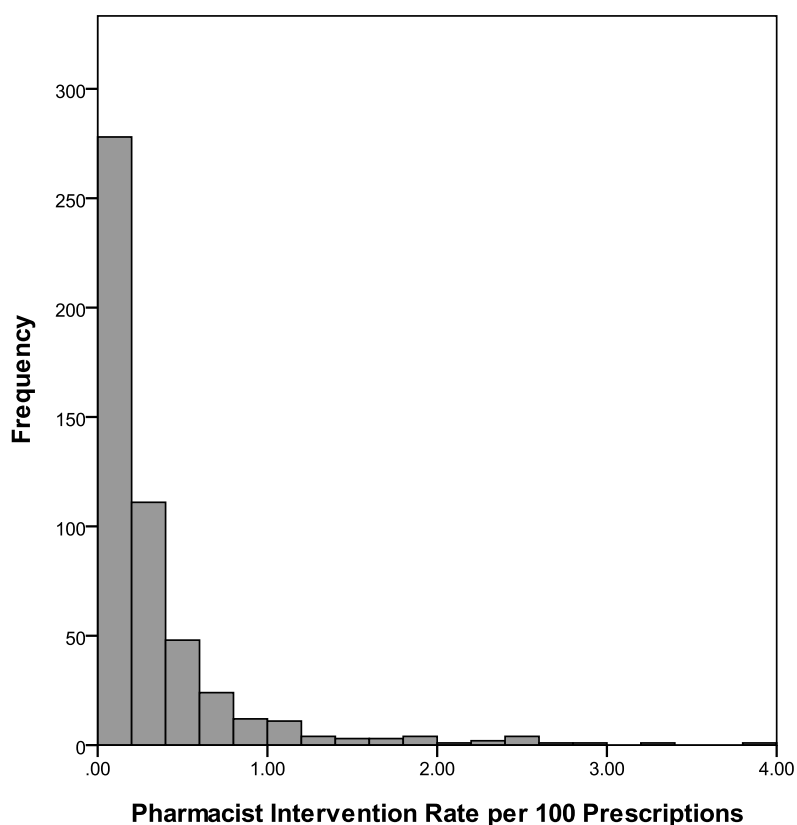


Figure 5-2: PROMISe pharmacist intervention rates per 100 prescriptions

The pharmacists were separated into quartiles according to their valid intervention rate. The first quartile contained 84 pharmacists who did not document a valid intervention during the trial, resulting in a median of zero. The fourth quartile had a much higher median intervention rate of 0.64 CIs in 100 prescriptions (range = 0.38 – 3.88) or 6.4 CIs in 1000 prescriptions (Table 5-26).

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Quartiles	1.00	128	0.000	0.000	0.053	0.000	0.025
	2.00	127	0.109	0.053	0.168	0.079	0.137
	3.00	127	0.246	0.168	0.372	0.213	0.290
	4.00	127	0.641	0.375	3.876	0.502	1.094
Total		509	0.168	0.000	3.876	0.053	0.375

Table 5-26: Median intervention rate for pharmacists within each quartile

As expected, significant differences were seen between the quartiles with a positive trend of increasing intervention rate as the quartiles increased (*Kruskal-Wallis* $\chi^2 = 478.40$, $df = 3$, $p < 0.001$; *Jonckheere-Terpstra* $t = 26.24$, $p < 0.001$). Post-hoc analysis using multiple Mann-Whitney tests showed statistically significant differences between quartile 1 and all other groups ($p < 0.001$ for all pairs; where the critical p -value = 0.0167).

5.2.3 Demographics

Twelve pharmacists completed the background survey but did not dispense any prescriptions during the trial and were therefore 'inactive'. This resulted in 446 'active' pharmacists who completed the background survey.

5.2.3.1 Gender

A Mann-Whitney U test showed no significant relationship between the gender of the pharmacist and their intervention rate ($N = 446$, $\chi^2 = 24235.00$, $Z = -0.196$, $p = 0.84$; Table 5-27).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Male	196	0.174	0.000	2.439	0.079	0.425
Female	250	0.203	0.000	3.876	0.062	0.423
Unknown	63	0.015	0.000	1.096	0.000	0.138
Total	509	0.168	0.000	3.876	0.053	0.375

Table 5-27: Gender compared to the pharmacist's intervention rate

Due to a significant difference being detected between genders during the PROMISe II trial⁸¹, a further analysis was performed to determine if the intervention rate within the first four weeks was different between genders. Again, a Mann-Whitney U test showed no significant relationship between the gender of the pharmacist and their intervention rate during the first four weeks ($\chi^2 = 26543.00$, $Z = -1.72$, $p = 0.09$).

5.2.3.2 Age range

A Kruskal-Wallis test showed no significant differences between the age of the pharmacist and their intervention rate ($N = 446$, $\chi^2 = 6.99$, $df = 4$, $p = 0.14$; Table 5-28).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
20 - 30	160	0.177	0.000	2.857	0.071	0.389
31 - 40	113	0.205	0.000	2.616	0.074	0.428
41 - 50	89	0.239	0.000	3.876	0.116	0.460
51 - 60	56	0.174	0.000	2.408	0.067	0.520
Over 60	28	0.098	0.000	1.219	0.036	0.255
Unknown	63	0.015	0.000	1.096	0.000	0.138
Total	509	0.168	0.000	3.876	0.053	0.375

Table 5-28: Age range compared to the pharmacist's intervention rate

5.2.3.3 Graduation year

The graduation year of the pharmacist was converted into a scale variable 'Years since graduation'. A bivariate correlation test did not show any significant correlation between the years since graduation and the pharmacist's intervention rate (*Spearman's rho* = 0.029, *N* = 443, *p* = 0.55).

Pharmacists were also grouped into 5 'graduation year' groups (Table 5-29) and a Kruskal-Wallis test showed significant differences between the groups ($\chi^2 = 13.40$, *df* = 4, *p* = 0.009). However, the Jonckheere-Terpstra test showed no trends in the data (*t* = -0.76, *p* = 0.44). Post-hoc analysis with the 'Before 1970' group as the control (using Kolmogorov-Smirnov Z tests as there were less than 25 cases in the control group) showed that, according to the critical *p*-value of 0.0125, there were significant differences between 'Before 1970' and '1980-89' and between 'Before 1970' and '1990-1999' (Table 5-29).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Before 1970	21	0.095	0.000	1.219	0.036	0.162
1970 - 1979	57	0.177	0.000	2.439	0.074	0.450
1980 - 1989	85	0.266	0.000	3.876	0.109	0.570
1990 - 1999	105	0.220	0.000	2.616	0.108	0.458
2000 or later	175	0.159	0.000	2.857	0.062	0.348
Unknown	66	0.024	0.000	1.097	0.000	0.138
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-29: Graduation year group compared to the pharmacist's intervention rate

5.2.4 Additional qualifications

Although 26 pharmacists were tagged as having additional qualifications, one of these pharmacists did not dispense any prescriptions during the trial and consequently, their

results were not included in the analysis. A Kruskal-Wallis test showed significant differences between the additional qualifications of the pharmacist and their intervention rate ($\chi^2 = 18.53$, $df = 2$, $p < 0.001$; Table 5-30). Post-hoc analysis using individual Mann-Whitney tests (using pharmacists with no additional qualifications as the control group and a critical p -value of 0.025) still showed significant differences between the control pharmacists and AACPA pharmacists ($N = 484$, $\chi^2 = 11952.00$, $Z = -2.35$, $p = 0.019$) and between the control pharmacists and pharmacists with additional qualifications ($N = 439$, $\chi^2 = 2853.50$, $Z = -3.78$, $p < 0.001$).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Control	414	0.151	0.000	3.876	0.038	0.333
AACPA	70	0.221	0.000	2.616	0.107	0.444
Other quals	25	0.475	0.000	2.358	0.147	1.100
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-30: Additional qualifications compared to the pharmacist's intervention rate (using three groups)

When the two groups of additional qualifications were grouped together, a Mann-Whitney U test showed a significant difference between the additional qualifications of the pharmacist and their intervention rate ($\chi^2 = 14805.00$, $Z = -3.77$, $p < 0.001$; Table 5-31).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Control	414	0.151	0.000	3.876	0.038	0.333
Other & AACPA	95	0.232	0.000	2.616	0.119	0.566
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-31: Additional qualifications compared to the pharmacist's intervention rate (using two groups)

5.2.5 Professional memberships

Out of the six possible memberships that pharmacists could select from, the only significant effect was seen with the 103 AACPA members, where pharmacists who were members had a statistically significantly higher intervention rate (Table 5-32 and Table 5-33). SHPA membership was also associated with a higher intervention rate and the difference was approaching significance.

		Intervention Rate					
		Count	Median	Min.	Max.	25 th %ile	75 th %ile
PSA	Yes	337	0.205	0.000	3.876	0.074	0.423
	No	109	0.169	0.000	3.284	0.068	0.422
SHPA	Yes	12	0.514	0.000	3.876	0.158	1.316
	No	434	0.185	0.000	3.284	0.072	0.422
AACP	Yes	103	0.231	0.000	2.616	0.124	0.475
	No	343	0.171	0.000	3.876	0.062	0.391
ACPPM	Yes	14	0.256	0.000	0.714	0.209	0.448
	No	432	0.181	0.000	3.876	0.069	0.423
APESMA	Yes	17	0.171	0.025	0.714	0.054	0.353
	No	429	0.195	0.000	3.876	0.074	0.423
PGA	Yes	70	0.239	0.000	2.591	0.106	0.567
	No	376	0.176	0.000	3.876	0.070	0.394
Unknown		63	0.015	0.000	1.096	0.000	0.138
Total		509	0.168	0.000	3.876	0.054	0.375

Table 5-32: Professional memberships compared to the pharmacist's intervention rate

	<i>Mann-Whitney χ^2</i>	<i>Z</i>	<i>p</i>
PSA	18049.50	-0.271	0.782
SHPA	1735.50	-1.974	0.050
AACP	15064.50	-2.268	0.022
ACPPM	2417.00	-1.280	0.201
APESMA	3351.00	-0.567	0.574
PGA	11348.50	-1.831	0.068

Table 5-33: Statistical results for membership status compared to pharmacist's intervention rate

5.2.6 CPD activity

As there was only one pharmacist who claimed to complete no CPD activities during the year, the CPD grouping was changed to '0-10 hours' and incorporated the pharmacists from the 'None' and 'Less than 10 hours' groups (Table 5-34). A Kruskal-Wallis test showed significant differences between the annual level of CPD activity and intervention rate ($\chi^2 = 18.14$, $df = 3$, $p < 0.001$). A Jonckheere-Terpstra test confirmed a positive trend between the level of CPD activity and the intervention rate ($t = 4.12$, $p < 0.001$), showing that as the level of CPD activity per year increased, the intervention rate also increased. Post-hoc analysis using individual Mann-Whitney tests (using the '0-10 hours' group as the control and a critical p -value of 0.0167) showed that the only significant difference was between '0-10 hours' and 'More than 50 hours' groups ($N = 119$, $\chi^2 = 1129.00$, $Z = -2.87$, $p = 0.004$).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
0 - 10 hours	44	0.133	0.000	0.964	0.064	0.297
10 - 25 hours	170	0.150	0.000	2.193	0.047	0.326
25 - 50 hours	157	0.229	0.000	3.876	0.077	0.508
More than 50 hours	75	0.272	0.000	2.358	0.133	0.593
Unknown	63	0.015	0.000	1.097	0.000	0.138
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-34: Annual CPD activity compared to the pharmacist's intervention rate

5.2.7 Role of the pharmacist

A Kruskal-Wallis chi-square test showed no significant differences between the pharmacist's current role in community pharmacy and their intervention rate ($\chi^2 = 6.66$, $df = 3$, $p = 0.08$; Table 5-35).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Owner	144	0.219	0.000	3.876	0.099	0.449
Manager	74	0.215	0.000	2.291	0.083	0.365
Employee	203	0.173	0.000	3.284	0.055	0.461
Locum/Other	25	0.108	0.000	2.408	0.000	0.247
Unknown	63	0.015	0.000	1.097	0.000	0.138
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-35: Role of the pharmacist compared to the pharmacist's intervention rate

5.2.8 Pharmacy experience

Pharmacists were asked how many years of community pharmacy experience they had, but unfortunately, there were several apparent anomalies indicating that the question may have been misunderstood. For example, a pharmacist who graduated in 1958 indicated that they had only worked for 0.5 years in community pharmacy, but had not worked anywhere else during this period (such as hospital or other pharmacy fields). Also, recent graduates appeared to count their undergraduate and pre-registration experience as well, such as a 2008 graduate indicating they had six years of experience. This data field was therefore deemed unreliable and removed from the analysis.

Pharmacists were also asked how many years they had worked in a hospital environment and this was converted to a dichotomous (Yes/No) variable detailing hospital experience. A Mann-Whitney test showed the pharmacists with hospital experience tended to have a

higher intervention rate, but the difference was only approaching significance ($N = 446$, $\chi^2 = 18612.50$, $Z = -1.91$, $p = 0.06$).

5.2.9 Percentage of working week in community pharmacy

Pharmacists were asked to choose a grouping that reflected the estimated number of hours (1 – 10, 10 – 20, 20 – 40 and over 40 hours per week) and approximate percentage of their working week (0 – 20%, 20 – 40%, 40 – 60%, 60 – 80% and 80 – 100%) that they spent working in a community pharmacy. When these factors were compared to the pharmacist's intervention rate, there did not appear to be any significant influence of either factor (*Kruskal-Wallis* $\chi^2 = 0.65$, $df = 3$, $p = 0.89$ and *Kruskal-Wallis* $\chi^2 = 8.06$, $df = 4$, $p = 0.09$, respectively).

5.2.10 Effect of the individual pharmacist's workload

Several determinants of workload, such as typical working conditions and average prescription volume, were analysed to determine any effects on the pharmacist's intervention rate. Data that remained unknown, such as when the pharmacist had not answered the survey, was excluded from the analysis.

5.2.10.1 Typical working conditions

A *Kruskal-Wallis* chi-square test showed no significant differences between the number of other pharmacists present during the pharmacist's shift and their intervention rate ($\chi^2 = 2.86$, $df = 4$, $p = 0.59$; Table 5-36).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
None	174	0.207	0.000	3.876	0.068	0.460
1	175	0.185	0.000	2.857	0.077	0.398
2	69	0.173	0.000	3.284	0.047	0.297
3 - 4	26	0.200	0.000	0.893	0.113	0.348
5 or more	2	0.102	0.055	0.149	0.055	0.149
Unknown	63	0.015	0.000	1.097	0.000	0.138
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-36: Number of other pharmacists each pharmacist worked with during an average shift

5.2.10.2 Prescription volume

Pharmacists were asked to estimate the number of prescriptions dispensed during a 9-hour shift and choose from the following groupings: Less than 100; 100 – 150; 150 – 200; 200 – 250; Over 250 prescriptions. A Kruskal-Wallis chi-square test showed no significant differences between the estimated number of prescriptions dispensed and their intervention rate ($\chi^2 = 3.21$, $df = 4$, $p = 0.53$). The actual number of prescriptions dispensed during the trial was also compared to the pharmacists' intervention rates, and a bivariate correlation test showed no correlation between the two (*Spearman's rho* = 0.06, $N = 509$, $p = 0.21$).

5.2.10.3 Percentage of time spent on dispensing tasks

The percentage of time pharmacists spent on dispensing tasks, such as taking in/dispensing/checking/handing out the prescription (grouped as follows: Less than 10%; 10-50%; 50-90%; Over 90%), was compared to their intervention rate and a Kruskal-Wallis chi-square test showed no significant differences ($\chi^2 = 3.73$, $df = 3$, $p = 0.30$).

5.2.10.4 Average pharmacist workload within the pharmacy

The average workload (see Chapter 2 for explanation of the calculation used) was compared to the individual pharmacists' intervention rates, and a bivariate correlation test showed a weak, but statistically significant, correlation (*Spearman's rho* = -0.09, $N = 508$, $p = 0.044$).

5.2.10.5 Effect of dispensary technicians

The average workload of pharmacists plus technicians was compared to the pharmacists' intervention rates, and a bivariate correlation test showed no correlation between the two factors (*Spearman's rho* = -0.04, $N = 508$, $p = 0.39$).

5.2.11 Training

A Kruskal-Wallis test showed significant differences between the intervention rates between the different training groups ($\chi^2 = 62.58$, $df = 3$, $p < 0.001$). The Jonckheere-Terpstra test showed a positive trend between the level of training and the intervention rate ($t = 7.55$, $p < 0.001$), indicating that those pharmacists who completed both types of training had a higher intervention rate. Post-hoc analysis using individual Mann-Whitney tests (using 'No training' as the control group and the critical p -value of 0.0125) showed significant differences between the 'No training' and 'Online training only' groups ($N =$

303, $\chi^2 = 6097.50$, $Z = -5.17$, $p < 0.001$) and between the 'No training' and 'Online and face-to-face training' groups ($N = 280$, $\chi^2 = 3908.00$, $Z = -7.47$, $p < 0.001$). There was no significant difference seen between the 'No training' and the 'Face-to-face only' training groups ($N = 110$, $\chi^2 = 618.00$, $Z = -1.74$, $p = 0.08$).

	Pharmacist Count	Intervention Rate				
		Median	Min.	Max.	25 th %ile	75 th %ile
Neither online or face-to-face training	92	0.041	0.000	2.616	0.000	0.150
Online training only	211	0.166	0.000	2.857	0.056	0.321
Face-to-face training only	18	0.101	0.000	1.219	0.029	0.419
Both online and face-to-face training	188	0.269	0.000	3.876	0.121	0.546
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-37: Level of training compared to the pharmacist's intervention rate

5.2.12 Survey responses

The pharmacists' answers to the surveys administered before and after the trial were compared to the pharmacist's intervention rate to determine any relationships with the pharmacist's opinions.

5.2.12.1 Empathy survey

Of the 454 pharmacists who completed the empathy survey, only 442 dispensed a prescription during the trial and therefore had an intervention rate calculated. A bivariate correlation showed no statistical relationship between the pharmacist's empathy score and their intervention rate (*Spearman's rho* = 0.05, $N = 442$, $p = 0.30$).

5.2.12.2 Professionalism score

Of the 455 pharmacists who completed the empathy survey, only 443 dispensed a prescription during the trial and therefore had an intervention rate calculated. A bivariate correlation showed no statistical relationship between the pharmacist's professionalism score and their intervention rate (*Spearman's rho* = 0.03, $N = 443$, $p = 0.58$). Using the six professionalism sub-scales determined by a team of researchers (see Chapter 2), the sub-scale score for each pharmacist was compared to their intervention rate. Although each sub-scale showed varying correlations with the pharmacist's intervention rate, none of the relationships were significant (Table 5-38).

	<i>Spearman's rho</i>	<i>p-value</i>
Altruism score	0.05	0.32
Duty score	0.08	0.12
Honour score	-0.05	0.32
Accountability score	0.05	0.33
Excellence score	0.05	0.35
Respect score	0.00	0.94
Total Professionalism score	0.03	0.58

Table 5-38: Correlation between the pharmacist's professionalism sub-scale scores and their intervention rate

5.2.12.3 Clinical knowledge

Of the 433 pharmacists who completed the clinical knowledge survey, only 421 dispensed a prescription during the trial and had an intervention rate calculated. A bivariate correlation showed there was a moderate, but statistically significant, correlation between the pharmacist's clinical knowledge score and their intervention rate (*Spearman's rho* = 0.19, $N = 421$, $p < 0.001$), where the pharmacist's intervention rate tended to increase as their clinical knowledge score increased (Figure 5-3).

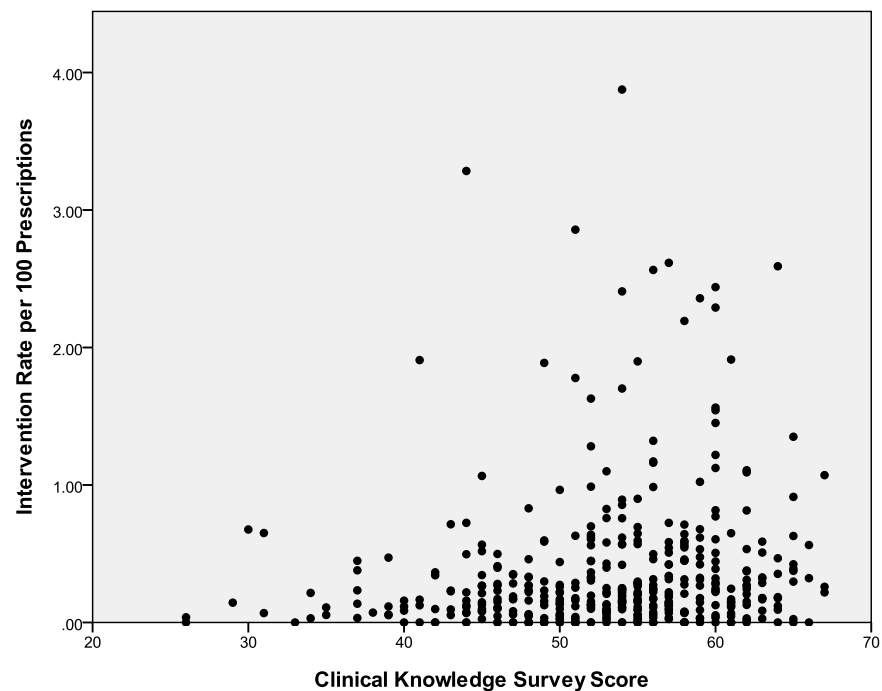


Figure 5-3: Relationship between the pharmacist's clinical knowledge score and intervention rate

When the pharmacists' scores were split into quartiles, a Kruskal-Wallis chi-square test also showed significant differences between the average intervention rate of each quartile

($\chi^2 = 13.94$, $df = 3$, $p = 0.003$), with a post-hoc Jonckheere-Terpstra test showing a significant positive trend, so that as the survey score increased, so did the pharmacist's intervention rate ($t = 3.60$, $p = 0.001$; Table 5-39).

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Quartile	0 - 25%	104	0.145	0.000	3.284	0.055	0.282
	25 - 50%	118	0.183	0.000	3.876	0.083	0.447
	50 - 75%	97	0.209	0.000	2.616	0.075	0.461
	75 - 100%	102	0.283	0.000	2.591	0.126	0.563
Total		421	0.200	0.000	3.876	0.077	0.444

Table 5-39: Clinical knowledge survey score quartiles compared to the pharmacist's intervention rate

Pharmacists who indicated that they completed more than 50 hours of annual CPD also tended to have a higher clinical knowledge score than the pharmacists completing less annual CPD hours ($ANOVA F(2,417) = 2.95$, $p = 0.053$).

5.2.12.4 Pre-trial survey

The pharmacists' answers from their pre-trial survey were compared to their intervention rate to determine any relationships. See Appendix 24 for the relevant tables.

Too busy

Answers to the statement "I believe that pharmacists are already too busy within the workplace which prevents them from taking on any new tasks" appeared to be related to the pharmacist's intervention rate, with those pharmacists who agreed with the statement having a lower intervention rate than the pharmacists who disagreed ($Spearman's\ rho = 0.14$, $N = 445$, $p = 0.002$). This indicates that a pharmacist's perception of how busy they already are may affect their ability to successfully take on additional tasks. See Appendix 24 for the relevant table.

Adapting practice

Answers to the statement "I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment" did not appear to be related to the pharmacist's intervention rate ($Spearman's\ rho = -0.08$, $N = 445$, $p = 0.09$). See Appendix 24 for the relevant table.

Willingness to change

Answers to the statement “I would be willing to change my current practice if a new, better way was available” did not appear to be related to the pharmacist’s intervention rate (*Spearman’s rho* = -0.09, *N* = 445, *p* = 0.07). See Appendix 24 for the relevant table.

Good clinical knowledge

Answers to the statement “I believe I have a good level of clinical knowledge to perform clinical interventions” appeared to be related to the pharmacist’s intervention rate.

Pharmacists who agreed that they had a good level of clinical knowledge tended to have a higher intervention rates than those who disagreed (*Spearman’s rho* = -0.12, *N* = 445, *p* = 0.013). See Appendix 24 for the relevant table.

Confidence in their ability to perform clinical interventions

Answers to the statement “I am confident in my ability to perform clinical interventions” appeared to be related to the pharmacist’s intervention rate. Pharmacists who felt confident in performing interventions tended to have a higher intervention rate than those who did not feel confident (*Spearman’s rho* = -0.14, *N* = 445, *p* = 0.003). See Appendix 24 for the relevant table.

Already performing clinical interventions

Answers to the statement “I already perform clinical interventions on a daily basis” appeared to be related to the pharmacist’s intervention rate. Pharmacists who believed they were already performing interventions tended to have a higher intervention rate than those who did not (*Spearman’s rho* = -0.17, *N* = 445, *p* < 0.001). See Appendix 24 for the relevant table.

Job satisfaction

Answers to the statement “I believe the recording of interventions will increase my level of job satisfaction” appeared to be related to the pharmacist’s intervention rate.

Pharmacists who believed that recording interventions would increase their level of job satisfaction tended to have a higher intervention rates than those who did not (*Spearman’s rho* = -0.11, *N* = 445, *p* = 0.02). See Appendix 24 for the relevant table.

Belief that the recording system will be hard to use

Answers to the statement “I am concerned the recording system will be hard to use” appeared to be related to the pharmacist’s intervention rate. Pharmacists who believed

that the recording system would be hard to use tended to have a lower intervention rate than those who did not (*Spearman's rho* = 0.15, *N* = 445, *p* = 0.002). See Appendix 24 for the relevant table.

Other pre-trial questions

Answers to the statements “I am concerned it will take too long to document interventions through the recording system” and “I believe that a ‘pop up’ prompt would be useful to remind pharmacists to record clinical interventions” did not appear to be associated with the pharmacist’s intervention rate (*Spearman's rho* = 0.05, *N* = 445, *p* = 0.28 and *Spearman's rho* = 0.03, *N* = 445, *p* = 0.56, respectively).

5.2.12.5 Post-trial survey

The pharmacists’ answers from their post-trial survey were also compared to their intervention rate to determine any relationships.

Ease of use of the software

Answers to the statement “I found the software easy to use” appeared to be related to the pharmacist’s intervention rate. Pharmacists who agreed the recording system was easy to use tended to have a higher intervention rate than those who disagreed (*Spearman's rho* = -0.21, *N* = 260, *p* = 0.001). See Appendix 24 for the relevant table.

Sufficiency of training on the software

Answers to the statement “I received sufficient training to use the software” appeared to be related to the pharmacist’s intervention rate. Pharmacists who felt they had received sufficient training tended to have a higher intervention rate than those who did not (*Spearman's rho* = -0.23, *N* = 260, *p* < 0.001). See Appendix 24 for the relevant table.

Good level of clinical knowledge

Answers to the post-trial statement “I have a good level of clinical knowledge to perform clinical interventions” did not appear to be related to the pharmacist’s intervention rate (*Spearman's rho* = -0.01, *N* = 259, *p* = 0.13). This is in contrast to the pre-trial statement, which did correlate with the intervention rate (see section 5.2.12.4).

Confidence in their ability to perform clinical interventions

Answers to the statement “I am confident in my ability to perform clinical interventions” appeared to be related to the pharmacist’s intervention rate. Pharmacists who were

confident in their abilities tended to have a higher intervention rate than those who did not (*Spearman's rho* = -0.14, *N* = 259, *p* = 0.03). See Appendix 24 for the relevant table.

Trial increased awareness of clinical interventions

Answers to the statement “The trial increased my awareness of how many clinical interventions I perform” appeared to be related to the pharmacist’s intervention rate. Pharmacists who felt that the trial increased their awareness tended to have a higher intervention rate than those who did not (*Spearman's rho* = -0.30, *N* = 259, *p* < 0.001). See Appendix 24 for the relevant table.

Performing clinical interventions increased job satisfaction

Answers to the statement “The performing of clinical interventions increased my level of job satisfaction” appeared to be related to the pharmacist’s intervention rate. Pharmacists who felt that performing interventions increased their job satisfaction tended to have a higher intervention rate than those who did not (*Spearman's rho* = -0.25, *N* = 259, *p* < 0.001). See Appendix 24 for the relevant table.

Recording clinical interventions increased job satisfaction

Answers to the statement “The recording of clinical interventions increased my level of job satisfaction” appeared to be related to the pharmacist’s intervention rate. Pharmacists who felt that recording interventions increased their job satisfaction tended to have a higher intervention rate than those who did not (*Spearman's rho* = -0.20, *N* = 259, *p* = 0.001), although the four pharmacists who strongly disagreed had the highest median intervention rate. See Appendix 24 for the relevant table.

Comparison between the estimated number of documented CIs and the number actually documented

During the post-trial survey, pharmacists were asked to estimate their average number of interventions per 100 prescriptions. Comparisons between the pharmacist’s estimated percentage and the number actually documented showed that pharmacists were not good at predicting their documentation rates (*Wilcoxon Z* = -11.91, *N* = 290, *p* < 0.001). Only 39 pharmacists correctly estimated their intervention rate, whilst 216 pharmacists had an actual documentation rate of less than their prediction and 74 pharmacists attained a documentation rate better than their prediction.

5.2.13 Summary table of pharmacist bivariate factors

The previous sections have been summarised into the following table.

		Median CI Rate	p
Gender	Male	0.174	0.84
	Female	0.203	
Age Range	20 - 30	0.177	0.14
	31 - 40	0.205	
	41 - 50	0.239	
	51 - 60	0.174	
	Over 60	0.098	
Graduation Year	Before 1970	0.095	0.01
	1970 - 1979	0.177	
	1980 - 1989	0.266	
	1990 - 1999	0.220	
	2000 or later	0.159	
Additional Qualifications	Control	0.151	<0.001
	AACPA/Other quals	0.232	
CPD Activity	0 - 10 hours	0.133	<0.001
	10 - 25 hours	0.150	
	25 - 50 hours	0.229	
	More than 50 hours	0.272	
Role of the Pharmacist	Owner	0.219	0.08
	Manager	0.215	
	Employee	0.173	
	Locum/Other	0.108	
Training	Neither	0.041	<0.001
	Online only	0.166	
	Face-to-face only	0.101	
	Both	0.269	
Surveys	Empathy		0.30
	Professionalism		0.58
	Clinical Knowledge		<0.001

Table 5-40: Summary table of the analysed bivariate factors compared to pharmacy intervention rate

5.2.14 Non-performing pharmacists

Out of the 509 pharmacists who dispensed a prescription during the trial, 84 did not document any interventions and were therefore examined separately as 'non-performers' to determine any distinguishing factors.

5.2.14.1 Descriptives

Of the 84 non-performers, 30 pharmacists did not complete the online surveys and one pharmacist worked in the pharmacy that did not receive a site visit, therefore some data was missing. Three of the pharmacists were also observed during the observational sub-study.

Gender

Of the non-performing pharmacists, 37 were female, 17 were male and 30 were unknown. Compared to the overall trial, where 56.3% pharmacists were female and 43.7% were male (Table 5-1), there was a higher percentage of female pharmacists who were non-performers and this difference was approaching significance ($\chi^2 = 3.88$, $df = 1$, $p = 0.05$).

Age range

The age ranges of the non-performing pharmacists were spread fairly evenly, but comparison with the overall ages of the PROMISe pharmacists indicated that a slightly higher proportion of older pharmacists did not participate (Table 5-41); however, these differences were not statistically significant ($\chi^2 = 2.64$, $df = 4$, $p = 0.63$).

	Non-performing pharmacists			All PROMISe pharmacists	
	N	%	% removing unknown	N	%
20 - 30	15	17.9	27.7	167	36.46
31 - 40	13	15.5	24.1	116	25.33
41 - 50	13	15.5	24.1	90	19.65
51 - 60	9	10.7	16.7	57	12.45
Over 60	4	4.8	7.4	28	6.11
Unknown	30	35.7			
Total	84	100	100	458	100

Table 5-41: Age ranges of non-performing pharmacists

Graduation year

The graduation years of the non-performing pharmacists were also spread fairly evenly, but comparison with the overall graduation years of the PROMISE pharmacists showed that a slightly higher proportion of pharmacists who graduated before 1970 or between 1980 – 1989 tended to not participate (Table 5-42), although these differences were not statistically significant ($\chi^2 = 1.92$, $df = 4$, $p = 0.75$).

		Non-performing pharmacists			All PROMISE pharmacists
		N	%	% removing unknown	%
Graduation Year	Before 1970	4	4.8	7.4	4.6
	1970 - 1979	7	8.3	13.0	12.8
	1980 - 1989	12	14.3	22.2	19.0
	1990 - 1999	10	11.9	18.5	23.8
	2000 or later	21	25.0	38.9	39.7
	Unknown	30	35.7		
Total		84	100	100	100

Table 5-42: Graduation years of non-performing pharmacists

5.2.14.2 CPD activity

The majority of non-performing pharmacists completed more than 10 hours of CPD activity, with the spread fairly consistent with the CPD activity of all PROMISE pharmacists (Table 5-43; $\chi^2 = 1.53$, $df = 3$, $p = 0.68$).

		Non-performing pharmacists			All PROMISE pharmacists	
		N	%	% removing unknown	N	%
CPD activity	None	1	1.2	1.9	3	0.7
	Less than 10 hours	5	6.0	9.3	45	9.8
	10 - 25 hours	24	28.6	44.4	175	38.2
	25 - 50 hours	17	20.2	31.5	158	34.5
	More than 50	7	8.3	13.0	77	16.8
	Unknown	30	35.7			
Total		84	100	100	458	100

Table 5-43: CPD activity of non-performing pharmacists

5.2.14.3 Empathy score

The non-performing pharmacists had similar empathy scores (46.20 ± 5.73 ; range = 33 – 59) to the overall PROMiSe pharmacists (46.80 ± 6.12 ; range = 25 – 62), with no statistical difference seen (*Mann-Whitney* $\chi^2 = 9618.00$, $Z = -0.98$, $p = 0.33$).

5.2.14.4 Professionalism score

The non-performing pharmacists had similar professionalism scores (78.59 ± 8.87 ; range = 32 – 90) to the overall PROMiSe pharmacists (79.97 ± 7.74 ; range = 19 – 90), with no statistical difference seen (*Mann-Whitney* $\chi^2 = 9322.50$, $Z = -1.34$, $p = 0.18$).

5.2.14.5 Clinical knowledge score

The non-performing pharmacists had similar clinical knowledge survey scores (51.76 ± 7.84 ; range = 26 – 66) to the overall PROMiSe pharmacists (52.98 ± 7.50 ; range = 26 – 67), with no statistical difference seen (*Mann-Whitney* $\chi^2 = 8259.00$, $Z = -1.63$, $p = 0.11$).

5.2.14.6 Training

In comparison with the overall PROMiSe pharmacists, a considerably larger percentage of non-performing pharmacists completed no training during the trial and a lower percentage completed both types of training (Table 5-44), with a chi-square test showing the differences were statistically significant ($\chi^2 = 45.88$, $df = 3$, $p < 0.001$).

		Non-performing pharmacists		All PROMiSe pharmacists	
		N	%	N	%
Training	Neither online or face-to-face training	36	42.9	101	19.0
	Online training only	31	36.9	215	40.5
	Face-to-face training only	3	3.6	19	3.6
	Online and face-to-face training	14	16.7	196	36.9
Total		84	100	531	100

Table 5-44: Training attendance of the non-performing pharmacists

5.2.14.7 Average pharmacist workload

The non-performing pharmacists had a lower average pharmacist workload of 462.10 ± 185.93 (range = 109.62 – 1142.17) compared to the overall PROMiSe average of 480.83 ± 185.55 (range = 109.62 – 1242.29). However, this difference was not significant (*Mann-Whitney* $\chi^2 = 16967.50$, $Z = -0.68$, $p = 0.49$).

5.2.14.8 Software group

Each software group contained similar numbers of non-performing pharmacists with Group One having 25 non-performing pharmacists, Group Two having 22 and Group Three having 37. However, there were significant differences between the groups that performing and non-performing pharmacists were in, with respect to the proportions of each group ($\chi^2 = 7.97$, $df = 2$, $p = 0.02$). Group One contained more than expected non-performers and less than expected performers. Group Two contained less than expected non-performers and more than expected performers. Group Three contained the approximate number of expected performer and non-performers (Table 5-45).

		Performer	Non-performer	Total
Group One	Count	81	25	106
	Expected Count	88.5	17.5	106.0
	% of Total	15.9%	4.9%	20.8%
Group Two	Count	173	22	195
	Expected Count	162.8	32.2	195.0
	% of Total	34.0%	4.3%	38.3%
Group Three	Count	171	37	208
	Expected Count	173.7	34.3	208.0
	% of Total	33.6%	7.3%	40.9%
Total	Count	425	84	509
	Expected Count	425.0	84.0	509.0
	% of Total	83.5%	16.5%	100.0%

Table 5-45: Percentage of performers compared to non-performers

5.2.14.9 Prompted interventions

As PPI step-down interventions were excluded for analysis, non-performing pharmacists were analysed to determine if they did document any PPI step-downs and consequently, did actually participate in the trial. Three non-performing pharmacists each documented one PPI step-down intervention and all were in Group Three. The recalculated intervention rates still remained low (Table 5-46).

Pharmacist	Number of CIs	Number of prescriptions	CI rate incl PPIs	CI rate excl PPIs
1	1	2126	0.047	0
2	1	1079	0.093	0
3	1	893	0.112	0

Table 5-46: Intervention rates of non-performing pharmacists who documented a prompted PPI step-down intervention

5.2.15 Discussion of the bivariate analysis

During the trial, 509 pharmacists dispensed at least one prescription, however, only 425 of those pharmacists documented an intervention. Due to the 84 pharmacists who did not document an intervention and therefore had an intervention rate of zero, the median intervention rate was quite low at 0.17% (range = 0.00 – 3.88). Comparisons between the PROMISe study and previous studies was again difficult due to the different definitions of an intervention and also because many studies did not report individual pharmacist intervention rates, only pharmacy intervention rates. Despite a higher maximum intervention rate, the median rate of the pharmacists was lower than the median pharmacy intervention rate of 0.21% (range = 0.00 – 2.35), which was most likely due to the large number of ‘zero’ intervention rates within the pharmacist group.

5.2.15.1 Influencing factors on pharmacist intervention rate

As with the pharmacies, much data was collected on the individual pharmacist to determine internal and external factors that may have influenced their intervention rate.

Demographics

Age and graduation year did not appear to influence the pharmacist’s intervention rate, even with a slightly higher proportion of older pharmacists documenting no interventions during the trial. This result was quite interesting, as it is a common belief that pharmacist knowledge and enthusiasm decreases as the number of years since graduation increases, however, this dataset showed that the age and graduation year were not associated with the pharmacist’s intervention rate. A possible explanation to this finding may be that the older pharmacists who agreed to participate in the trial were more likely to be proactive with their education and be more willing and enthusiastic to participate. As such, it is possible that these results may not be applicable to all older pharmacists throughout Australia. In addition, the PROMISe pharmacists had a younger average age than Australian pharmacists, which may have caused unequal representation within the PROMISe trial; therefore, the true effect of age may not be adequately determined from the PROMISe results. Despite the expectation that older pharmacists would have a lower intervention rate, another study by Leemans⁷⁵ also found that the age of the pharmacist did not appear to influence the number of interventions documented.

The PROMISe II trial showed that female pharmacists appeared to have a higher intervention rate than their male counterparts.⁸¹ However, unlike the PROMISe II dataset,

the larger PROMISe III dataset did not show the same differences between the genders. There was also no difference between the genders when only using the intervention rate from the first four weeks of the trial. As the PROMISe III dataset was a larger sample that spanned a longer timeframe, it could be considered a better representation of the pharmacist population, so it is possible that there is no difference between the intervention rates of males and females, and the trend seen in the PROMISe II dataset was not representative. This finding was also supported by a previous study by Blake that also found that gender did not appear to influence whether a pharmacist would provide professional services.¹¹⁵

Pharmacists who were AACP members had a significantly higher intervention rate than non-members. It is likely that AACP members have an increased ability to detect and resolve DRPs encountered in community pharmacy, as the accreditation process requires the pharmacist to undertake additional clinical knowledge training. It should also be noted that although only 81 pharmacists indicated that they were accredited to perform medication reviews (and thus were separated as the AACPA group for some analyses), 103 pharmacists were members of AACP. This was most likely due to the remaining 22 pharmacists being in the process of becoming accredited.

SHPA membership was also associated with a much higher intervention rate and the difference was approaching significance. Members of SHPA generally work in the hospital sector and the majority of the 12 SHPA members participating in PROMISe indicated that they were presently working or had previously worked in the hospital environment. This result showing that hospital pharmacists tended to have an increased intervention rate was most likely linked with two main factors. Firstly, hospital pharmacists may be better equipped at dealing with the detection and resolution of DRPs, as this is a skill that they would use on a daily basis within the hospital environment. Secondly, hospital pharmacies often have additional software that allows pharmacists to document their interventions, therefore the hospital pharmacists may not have had to undergo the 'practice change' to document their interventions (see discussion on page 296). Either of these factors may have led to a higher intervention rate by the hospital pharmacists, however, the sample of 12 pharmacists was too small to make definitive conclusions. Given that their intervention rates were much higher than for the average pharmacist, these pharmacists should be more closely studied within the future to determine any attributes that could be modified within the general population of pharmacists to improve intervention rates.

Pharmacists who were members of the PGA tended to have higher intervention rates than non-members, although this difference was only approaching significance. Only pharmacy owners can be members of the PGA and it was expected that owner pharmacists would have a lower intervention rate, as they are generally busier and more business-focused than employee pharmacists, thus being less likely to use a system that took additional time out of their working day. Despite this theory, the opposite trend was found in the PROMISe data. This finding was also supported by the results showing no differences between the intervention rates of owner pharmacists and the employee/manager pharmacists, despite the expectation that owner pharmacists would have had lower intervention rates. The owners were responsible for enrolling their pharmacy in the PROMISe trial and, therefore, may have already been more proactive within their profession compared to other owners. Owners may also be more hard-working and highly motivated within their profession, which may also have resulted in higher intervention rates. Therefore, these results may not be representative of all pharmacy owners in Australia, but be more applicable to those who are interested in and encourage professional services within their pharmacy.

Clinical knowledge

When the pharmacists were grouped according to their additional qualifications, the pharmacists with additional clinical pharmacy qualifications had a higher intervention rate than pharmacists with no additional qualifications. It is likely that this finding was due to the additional clinical knowledge and training that the pharmacists with extra qualifications had undertaken, thereby increasing their ability to detect and resolve the DRPs encountered in community pharmacy. However, it is also possible that pharmacists with more training are naturally more enthusiastic about their profession, and as such may have been more likely to take part in the PROMISe trial, as they would see the benefit of participation. This result was also described by Westerlund⁶⁸, who found that pharmacists had a higher rate of DRP detection compared to prescriptionists (University-trained dispensing technicians) and pharmacy technicians, indicating that a higher level of clinical training corresponded to a higher intervention rate. Another study by Blake¹¹⁵ found that the pharmacist's educational background was associated with the likelihood that the pharmacist would provide professional services, highlighting that the more highly trained professionals were often the more motivated individuals that were more likely to participate effectively.

There was also a significant correlation between the pharmacist's intervention rate and their score on the clinical knowledge survey, indicating that the pharmacists with a higher intervention rate also had a higher level of clinical knowledge. Again, a higher level of clinical knowledge would increase their ability to detect and resolve DRPs, therefore possibly increasing the documentation rate of the interventions as well. Another study examining the DRP reporting rate amongst Spanish pharmacists found that pharmacists with a higher DRP knowledge (according to a survey administered during the trial) were more likely to have a higher documentation rate.¹⁰⁶ The study also found that pharmacists who had previously participated in specific DRP training were also more likely to report DRPs¹⁰⁶, indicating that relevant clinical knowledge training may further increase the number of interventions performed and documented. PROMISE pharmacists tended to be good at assessing their own clinical knowledge, with a correlation seen between the pharmacist's self-assessment of their clinical knowledge and their score of the clinical knowledge survey. This may indicate that pharmacists could identify gaps in their own knowledge, which could be improved using targeted education.

Interestingly, the influence of additional qualifications and a higher clinical knowledge survey score was not detected in the observational sub-study, where there were no significant differences between these groups of pharmacists. This may have been due to the smaller sample size, or due to the pharmacists with 'poor' clinical knowledge trying to 'impress' the observers, thereby inflating their intervention rates, whilst the pharmacists with good clinical knowledge were more confident in their abilities (as seen in the opinions survey in section 5.1.8.4) and consequently did not feel they needed any additional effort.

CPD activity

The number of hours each pharmacist spent on CPD annually was significantly correlated with their individual intervention rate, with the most significant difference seen between the pharmacists who completed 0-10 hours per year compared to the pharmacists who completed more than 50 hours per year. As expected, the pharmacists with a higher level of annual CPD activity had a higher intervention rate and there are two possible explanations for this finding. Firstly, it is likely that CPD activity increases the clinical knowledge of the pharmacist and therefore improves their ability to detect and resolve DRPs in the community pharmacy environment. Secondly, it is also likely that pharmacists who attend education sessions and complete additional training on their own time are

more proactive within their profession, and are therefore more likely to participate effectively in a professional program. This correlation was also found in a previous study by Benrimoj³⁴, which showed that the group of pharmacists who had a higher level of participation in CPD activities prior to the trial appeared to have a higher baseline intervention rate.

However, it is important to remember that this was a self-reported level of annual CPD activity, which means the pharmacists may have over-estimated the hours they actually completed. Adequate CPD hours have been a mandatory requirement in Australia since July 1st 2010 and the pharmacists participating in PROMISE in 2009 would have been aware of the changes about to take place and as a result may not have wanted to indicate if their CPD activity was sub-optimal. The new CPD regulations still rely on the pharmacist self-reporting their activity with approximately 10% of pharmacists being audited each year, so the actual level of CPD activity of an individual pharmacist may never be accurately known. Also, pharmacists may attend CPD activities, but may not absorb the education into their practice, so CPD could be considered a crude measure of a pharmacist's abilities. In an attempt to disentangle these uncertain elements, this result should be considered together with the pharmacist's clinical knowledge survey score discussed in the previous section.

As detailed in the demographics discussion, it was expected that age or graduation year may have been associated with intervention rate. However, this association was not found to be significant. To identify if this was due to the older pharmacists participating in more education, a chi-square test was used to determine if there was a difference between the age or graduation year and the level of annual CPD activity. The results showed a fairly even split between the age or graduation year and the annual CPD activity ($\chi^2 = 19.69$, $df = 12$, $p = 0.07$) and ($\chi^2 = 15.34$, $df = 12$, $p = 0.22$) respectively), indicating that all age and graduation groups undertook a similar level of annual CPD activity.

Training

The level of training correlated significantly with the pharmacist's intervention rate, with the pharmacists who completed both types of training having a higher intervention rate. Analysis also showed that a much larger proportion of pharmacists who documented no interventions also completed no training. This finding may be due to two reasons. Firstly, the pharmacists did not complete the training because they were not interested in

participating in the trial, resulting in no interventions being documented. Alternatively, the pharmacists did not complete the training and subsequently, did not feel comfortable participating in the trial.

Disappointingly, nearly 20% of the participants did not complete any type of training and so it is unknown what effect training would have made on these pharmacists. However, it is likely that training would have improved their intervention rate as the relationship between the two factors was significant. A poor training attendance was also noted by Knapp²⁷, where all pharmacies were represented at the training sessions, but not all participating pharmacists were present, leaving the authors uncertain with regards to what effect the training had on the reported intervention rate.

Pharmacist attitude and practice change

The factors already discussed can also be linked to the pharmacist's attitude towards the profession of pharmacy. Pharmacists who have higher clinical knowledge and complete more annual CPD and targeted training, such as the PROMISE training, are more likely to be motivated and enthusiastic about their profession, and more likely to participate in trials to further improve their pharmacy practice. Several studies have previously commented on the influence that the pharmacist's attitude can have on their ability to provide cognitive services. It was first noted by Rupp⁵⁸, who hypothesised that a pharmacist's willingness and ability to intervene was more a function of the individual pharmacist rather than the pharmacy itself. Westerlund¹⁰² found that interest in participating in an electronic documentation project was significantly associated with the documentation rate during the project, indicating that pharmacists who were more enthusiastic about participation in professional programs would be more likely to have a higher participation rate. A study by Zardain¹¹⁰ also identified that pharmacists would be more likely to implement pharmacy programs if they had a more positive attitude, were confident in their abilities and observed other colleagues performing the service.

Enthusiasm was also noted in the study by Blake, where pharmacists indicated that, if given the chance, they were more likely to work in a pharmacy that provided professional services.¹¹⁵ Pharmacists who felt they had a good clinical knowledge also had a higher level of confidence in their abilities, and both of these opinions significantly correlated with intervention rates during the trial. Therefore, the pharmacist's attitude appeared to be closely linked with their intervention rate with the more motivated and enthusiastic pharmacists participating more effectively in the trial.

Another survey also determined that the most influential factor that affected a pharmacist's behaviour was their past behaviour¹⁴¹, where the ability of pharmacists to provide professional services may be influenced by their previous behaviour. This may suggest that the pharmacists who are more willing to change may be more motivated to provide improved professional services as they can visualise the benefits of improving their services. This was not found in the PROMISE trial, as the pharmacist's answer to the statement "I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment" did not appear to be correlated to their intervention rate. It is possible, however, that this question was interpreted in a different way to what was intended. The question intended to identify if the pharmacists believed that practice adaption was necessary to advance the pharmacy profession. However, in retrospect, pharmacists may have interpreted the statement to mean that they would change their practice to suit the pharmacy environment, even if that meant lowering their standards. Therefore, the pharmacists who disagreed with this statement may have been stating that they would not change their practice to suit the pharmacy, for example, not counselling patients because the pharmacy was too busy. For this reason, the answers to this question should be disregarded from the analysis.

Pharmacists who felt they were too busy to take on additional tasks appeared to have lower intervention rates than their less busy counterparts. Interestingly, there was no correlation seen between the pharmacist's perception of busyness and the pharmacy's average workload. This may suggest that the pharmacist's perception of their busyness was inaccurate or that the measure of workload used within this study was too generalised and inaccurate to provide useful analysis. Pharmacists who were confident in their ability to perform interventions also tended to have higher intervention rates than their less confident counterparts, and their self-assessment of their confidence did not change over the course of the trial. This indicates the importance of self-perception and the effect that a pharmacist's attitude can have on their ability to perform professional services.

The pharmacists who believed the system would be too hard to use before the trial did not use the system as often and finished the trial with a lower intervention rate. This highlights the effect that the pharmacist's state of mind can have on their abilities to use the documentation system. This result was also seen by Christensen¹⁰¹ who found that the pharmacist's perception of how burdensome the task of documentation significantly

contributed to whether the pharmacist would perform any cognitive services. Those pharmacists who did not find the documentation process burdensome were much more likely to perform cognitive services than those pharmacists who found the process burdensome. Again, this highlights the effect that the pharmacist's attitude can have on the delivery of professional services, and the more motivated and enthusiastic the participant is at the beginning of the trial, the more successful their participation will be. There were also four pharmacists who felt strongly that recording interventions did not increase their job satisfaction. This may have been due to these pharmacists recording things that were not interventions, creating a higher workload for themselves, which may have resulted in these pharmacists finding the process tedious and unnecessary.

Participating pharmacists achieved a mean empathy score of 46.8 ± 6.1 (range = 25 – 62), which was comparable to the results in the original article, which surveyed university students studying healthcare, where the mean score over three studies was 46.3 ± 7.6 in undergraduate students.¹⁵⁹ A mean professionalism score of 80.0 ± 7.7 (range = 19 – 90) was also achieved. This was slightly higher than results in the original article where the mean score was 77.8 ± 5.9 , achieved with 231 pharmacy students and recent pharmacy graduates in the United States. Despite this, there was not a significant link between the empathy or professionalism of the pharmacist and their intervention rate. This was disappointing, as it was thought the empathy and professionalism scores may provide insight into the attitudes and work practices of the pharmacist. This finding may be due to two reasons. Firstly, it may indicate that professionalism and empathy do not have any effect on the pharmacist's ability to document interventions. Alternatively, it may indicate that the professionalism and empathy measures used did not accurately predict the pharmacist's attitudes; however, both measures were validated within the literature^{159,160}, therefore this is unlikely.

Interestingly, statistical analysis of the non-performing pharmacists found that there were more than expected non-performing pharmacists in Group One, compared to Groups Two and Three. This may indicate that the software did have an impact on the pharmacist and may have resulted in an increase in participation rates. Provision of an effective and intuitive software system may therefore improve interventions rates amongst community pharmacists.

Workload and staffing levels

The pharmacy intervention rate was significantly associated with prescription volume and pharmacist workload, however, the correlation was not as strong at the individual pharmacist level. There was no correlation between the actual number of prescriptions dispensed by the pharmacist and the pharmacist's intervention rate. This was unexpected, given the results from the pharmacy analysis, and may indicate that other pharmacy factors have more impact on the pharmacist's intervention rate than the actual number of prescriptions dispensed. This finding was also in contrast to the studies by Rupp⁵⁸ and Christensen¹⁰¹, which both found that as the number of prescriptions dispensed by the pharmacist increased, the number of cognitive services that were documented decreased. Interestingly, individual pharmacists were dispensing prescriptions at a lower or similar rate to the national average during the trial, which may indicate that the participating pharmacists had a lower than average prescription volume and thus, perhaps, having available capacity to take on additional tasks. However, this did not appear to result in a higher intervention rate.

The pharmacist workload was calculated from the number of prescriptions dispensed divided by the average number of pharmacist hours per week, resulting in an average within the pharmacy. The average workload could be used as a measure of how busy the pharmacy is. For example, as the workload increases, the intervention rate decreases as the pharmacists may not have enough time to perform or document interventions. However, each pharmacist may have been under different workload pressures, which the average value did not adequately describe, implying that the workload measure may have been too simplistic to be of benefit. It remains unknown how accurate the workload calculation was at the individual pharmacist level.

The effect of dispensary technicians was examined using an adjusted workload calculation that included technicians, however, there was no correlation between the pharmacist's intervention rate and the adjusted workload accounting for technicians. This was interesting, as the addition of dispensary technicians caused the workload to become a non-significant factor in the determination of intervention rate. It might be expected that the additional staff would allow the pharmacist to increase their intervention rate, but this was not found. This shows that workload is a tangible entity and can be extremely hard to define in the community pharmacy environment. Alternatively, the addition of dispensary technicians may decrease the number of interventions being performed, as several of the

points of contact that allow the pharmacist to detect a DRP have been removed. For example, the pharmacist may not access the patient's history or converse with the patient as often when they are working with a dispensary technician. The effect of the dispensary technicians on the pharmacist's intervention rate remains largely unknown.

The percentage of time that the pharmacist spent on dispensing tasks also did not correlate with the pharmacist's intervention rate. It was logical to assume that pharmacists who spent more time dispensing would have a higher intervention rate as they had access to more patient and prescription information that may allow detection of a DRP, so it was interesting that the pharmacists with a higher proportion of time spent on dispensing tasks were not the pharmacists with the higher intervention rates. There are two possible explanations for this. The first is that the pharmacists who spend a higher proportion of their time on dispensing tasks may be more focused on the actual dispensing of the medications (processing the prescription, collecting and labelling stock etc.), rather than patient care. This means that their contact time with the patient may be decreased, which reduces their potential to detect interventions. Alternatively, the proportion of time spent on dispensing tasks may have increased when the pharmacist was working with a technician, as the amount of time required to check prescriptions increased.

There are several solutions that may help to overcome the barrier of workload. A study analysing workflow redistribution found that when one pharmacist was asked to only perform clinical duties (such as analysing drug therapies, counselling patients and documenting interventions) whilst a second pharmacist completed all administrative duties, the number of interventions documented was significantly increased with significant benefits for the patients, without altering the staffing levels within the pharmacy.¹¹⁸ A study that altered workflow within a pharmacy by improving the use of space within the dispensary and increasing the technician's responsibilities also found that the level of pharmacist interaction with the patients was significantly increased.¹¹⁹ Additionally, decreasing the pharmacist workload by increasing the number of pharmacists may also help to overcome both the perceived and actual barrier of workload.

5.3 *Multivariate statistical modelling*

During the bivariate analysis, many pharmacists were identified as ‘non-performers’ of clinical interventions. Multivariate analysis was performed to determine if a statistical model could predict whether a pharmacist would be a ‘performer’. An additional multivariate analysis was also performed to determine if a model could predict the intervention rate of the pharmacist using the influencing factors previously found in section 5.2.

5.3.1 *Model to identify documenting pharmacists*

A logistic regression was performed to determine if a model could possibly predict those pharmacists who would document interventions and those who would not. For this analysis, there were 412 pharmacists who had complete sets of data for analysis. All pharmacists who had documented at least one intervention during the trial were recoded as ‘performers’, with 361 pharmacists meeting this condition. The remaining 51 did not document any interventions and were therefore recoded as ‘non-performers’. The resultant model aimed to predict a dichotomous variable; either ‘performer’ or ‘non-performer’.

A forward stepwise regression was performed and identified five variables that were significantly associated with documenting interventions: level of training, membership to APESMA, role, working in a pharmacy that was manager-operated and average weekly prescription volume of the pharmacy. Pharmacists were more likely to be ‘performers’ if they were members of APESMA, were owners or managers, participated in both forms of PROMISE training, worked in owner-operated pharmacies and worked in a pharmacy with a slightly higher prescription volume (Table 5-47).

	B	S.E.	Wald	df	Sig.	Exp(B)	95% CI	
							Lower	Upper
Training - none			13.672	3	0.003			
Training - online only	1.278	0.527	5.886	1	0.015	3.588	1.278	10.072
Training - face-to-face only	0.596	0.821	0.528	1	0.468	1.816	0.363	9.073
Training - both	1.983	0.563	12.420	1	0.000	7.266	2.411	21.891
APESMA member	20.278	9041.936	0.000	1	0.998	6.4x10 ⁸	0.000	.
Role - owner			15.693	3	0.001			
Role - manager	1.232	0.730	2.843	1	0.092	3.426	0.819	14.341
Role - employee	-0.697	0.397	3.088	1	0.079	0.498	0.229	1.084
Role - locum/other	-1.580	0.593	7.108	1	0.008	0.206	0.064	0.658
Manager run	-0.806	0.361	4.997	1	0.025	0.447	0.220	0.905
Average weekly prescription volume	0.001	0.000	5.526	1	0.019	1.001	1.000	1.001
Constant	0.384	0.589	0.423	1	0.515	1.468		

Table 5-47: Variables included in the logistic regression analysis

The model provided a correct classification in 87.1% of all cases, with 99.2% of performers correctly identified, but only 2.0% of non-performers correctly predicted. This resulted in a poor Nagelkerke R^2 value of 0.187, where only 18.7% of the variance could be explained by the model, resulting in a model that was unlikely to accurately predict participation.

5.3.2 Statistical model for determining the pharmacist's intervention rate

As discussed in Chapter 2, a multinomial logistic regression was used to design a statistical model for determining a pharmacist's intervention rate because a multiple regression could not be used due to the non-parametric nature of the data. The three intervention rate groups used in the analysis were 'Low CI rate', 'Moderate CI rate' and High CI rate' (Table 5-48).

	Clinical intervention rate					
	Count	Median	Min.	Max.	25 th %ile	75 th %ile
Low CI rate	170	0.014	0.000	0.091	0.000	0.054
Moderate CI rate	170	0.168	0.091	0.276	0.128	0.223
High CI rate	169	0.563	0.279	3.876	0.377	0.893
Total	509	0.168	0.000	3.876	0.054	0.375

Table 5-48: Intervention rates seen in each CI rate group used in the multinomial logistic regression model

5.3.2.1 *Bivariate analysis*

Bivariate analysis was conducted on all available factors within the data to determine which ones were influential to the multivariate model. The following factors were considered for inclusion in the logistic regression:

- Additional qualifications
 - None/AACP accreditation vs additional University postgraduate qualification
 - Pearson $\chi^2 = 16.94$, $df = 4$, $p = 0.001$
- CPD hours
 - Combined into 3 groups (0-25 hours, 25-50 hours, over 50 hours)
 - Pearson $\chi^2 = 13.60$, $df = 4$, $p = 0.009$
- Clinical knowledge
 - Correlation using continuous clinical knowledge score and 3 CI rate groups
 - Kendall's tau = 0.136, $p < 0.001$
- Training level
 - 4 groups: none, face-to-face only, online only, both
 - Pearson $\chi^2 = 66.79$, $df = 6$, $p < 0.001$

To decrease the number of groups within the training level variable, chi-square analyses were performed to determine which groups could be combined. There were no significant differences between the rate for pharmacists with no training and face-to-face training (Pearson $\chi^2 p = 0.08$; also supported by statistics in section 5.2.11); therefore, these two groups were combined. A significant difference was still maintained between the pharmacists with online only and both training (Pearson $\chi^2 p = 0.001$); therefore, these two groups were kept separate. This resulted in three training groups: none/face-to-face; online only; and both online and face-to-face training.

In addition, pharmacist opinions had previously been shown to influence the number of interventions performed¹⁰¹ and their intervention rates (section 5.2.12.4), so two scores were derived from six pre-trial Likert scale survey questions. An 'adaptability/willingness to change' score (where the lower the score, the more adaptable/willing to change the pharmacist was) was calculated from answers to the following three statements:

- I believe that pharmacists are already too busy within the workplace which prevents them from taking on any new tasks.
- I would be willing to change my current practice if a new, better way was available.
- I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment.

This score correlated with the 3 groups of CI rate used in the multinomial logistic regression (*Kendall's tau* = -0.126, $p < 0.001$), which showed that as the CI rate increased, the pharmacist became more 'adaptable/willing to change'; therefore, this measure was included in the logistic regression.

A 'confidence' score (where the lower the score, the more confident the pharmacist) was calculated from answers to the following three statements:

- I believe I have a good level of clinical knowledge to perform clinical interventions.
- I am confident in my ability to perform clinical interventions.
- I already perform clinical interventions on a daily basis.

Again, this score correlated with the 3 CI rate groups (*Kendall's tau* = -0.119, $p = 0.002$), which showed that as the CI rate increased, the pharmacist became more 'confident'. However, when the two scores were compared, a significant correlation was seen between the confidence score and the adaptability score (*Kendall's tau* = 0.209, $p < 0.001$). As regression models need to minimise the amount of multicollinearity present between the variables, it was decided that only the adaptability score would be included in the logistic regression as it appeared to be the stronger factor of the two.

To provide a measure of workload, the average pharmacist workload within the pharmacy was also included. It is important to note, however, that the data may not accurately reflect the pharmacist's actual workload because the calculation assigned an average number of prescriptions per pharmacist within the pharmacy.

Therefore, the final factors that were trialled in the logistic regression analysis were:

- Additional qualifications
 - 2 groups (none/AACPA vs additional postgraduate University qualification)
- CPD hours
 - 3 groups (0-25 hours, 25-50 hours, over 50 hours)
- Training
 - 3 groups: none/face-to-face only, online only, both
- "Adaptable/willingness to change" score as a continuous variable
- Clinical knowledge score as a continuous variable
- Average workload per pharmacist within the pharmacy as a continuous variable

Gender, age, graduation year, professional memberships, number of other pharmacists present during an average shift, actual number of prescriptions dispensed during the trial, percentage of time spent on dispensing tasks, number of years of experience, previous

experience working in a hospital, number of hours worked in community pharmacy per week, empathy score and professionalism score were not found to be associated with the pharmacists' individual intervention rates. These factors were therefore not included in the logistic regression.

5.3.2.2 *Missing value analysis*

A missing data analysis was performed to determine any patterns to the missing values, resulting in 416 full datasets. See Appendix 25 for more detail.

5.3.2.3 *Multinomial logistic regression*

As the aim of this modelling research was to determine which factors influenced a higher CI rate, the high CI rate category was used as the 'base' category to determine the probability of the pharmacist having a high CI rate based on the included factors.

The initial model was found to be significantly different from the constant model, indicating that the variables reliably predicted membership to the three CI rate groups ($\chi^2(16, N = 416) = 60.074, p < 0.001$). There was a good model fit (discrimination among groups) with the included predictors ($\chi^2(816, N = 416) = 848.137, p = 0.211$ when using the deviance criterion and $\chi^2(816, N = 416) = 831.846, p = 0.342$ when using the Pearson criteria). Nagelkerke R^2 was 0.151, indicating that 15.1% of variance in the pharmacist's documented CI rate could be explained by the model. The likelihood ratio tests (Table 5-49) indicated that the variables of adaptability score, clinical knowledge score and training differed significantly between the three CI rate groups, but the remaining variables were not significant.

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	848.137 ^a	0.000	0	.
Adaptability score	854.521	6.384	2	0.041
Clinical knowledge score	856.432	8.295	2	0.016
Average pharmacist workload	848.276	0.139	2	0.933
Additional qualifications	851.484	3.347	2	0.188
CPD	857.484	9.347	4	0.053
Training	865.977	17.840	4	0.001
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.				

Table 5-49: Likelihood ratio tests for the initial model

Table 5-50 shows that the ability of the model to classify the cases was unimpressive, with only 48.9% of cases being correctly predicted. However, this was improved for pharmacists in the high CI rate, where 64.6% of cases were correctly classified.

Observed	Predicted			
	Low CI rate	Moderate CI rate	High CI rate	Percentage Correct
Low CI rate	35	41	37	31.0%
Moderate CI rate	16	67	63	45.9%
High CI rate	13	43	102	64.6%
Overall Percentage	15.3%	36.2%	48.4%	48.9%

Table 5-50: Percentage of correct predictions from initial model

5.3.2.4 Refining the model

The model was then re-run by removing the non-significant variables (Table 5-51).

Average workload and additional qualifications were removed, but CPD was approaching significance ($p = 0.053$) and was therefore retained.

Case Processing Summary			
		N	Marginal Percentage
CI rate BINNED into 3 groups	Low CI rate	114	27.3%
	Moderate CI rate	146	34.9%
	High CI rate	158	37.8%
CPD	0-25 hours	203	48.6%
	25-50 hours	145	34.7%
	Over 50 hours	70	16.7%
Training	None or F2F	39	9.3%
	Web	199	47.6%
	Both	180	43.1%
Valid		418	100.0%
Missing		91	
Total		509	
Subpopulation		337 ^a	
a. The dependent variable has only one value observed in 296 (87.8%) subpopulations.			

Table 5-51: Covariate factors included in the refined multinomial logistic regression

Again, the refined model was found to be significantly different from the constant model, indicating that the variables reliably predicted membership to the three CI rate groups ($\chi^2(12, N = 337) = 57.066, p < 0.001$). There was also a good model fit (discrimination

among groups) with the included predictors ($\chi^2(660, N = 337) = 714.020, p = 0.071$ when using the deviance criterion and $\chi^2(660, N = 337) = 681.800, p = 0.270$ when using the Pearson criteria). Nagelkerke R^2 was 0.144; indicating that a slightly lower percentage of variance (14.4%) was explained by the refined model. The likelihood ratio tests showed that all of the variables were now significant factors in the model for CI rate group prediction (Table 5-52 and Table 5-53).

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	779.674 ^a	0.000	0	.
Adaptability score	786.163	6.488	2	0.039
Clinical knowledge score	789.266	9.592	2	0.008
Training	798.266	18.591	4	0.001
CPD	791.315	11.641	4	0.020
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.				

Table 5-52: Likelihood ratio tests for the refined model

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% CI for Exp(B)	
								Lower	Upper
Low CI rate	Intercept	-0.005	1.203	0.000	1	0.997			
	Clinical knowledge score	-0.053	0.018	8.351	1	0.004	0.948	0.915	0.983
	Adaptability score	0.182	0.075	5.866	1	0.015	1.200	1.035	1.391
	CPD 0-25hrs vs CPD over 50hrs	1.220	0.415	8.652	1	0.003	3.386	1.502	7.631
	CPD 25-50hrs vs CPD over 50hrs	0.734	0.427	2.959	1	0.085	2.084	0.903	4.813
	None/F2F vs both training	1.318	0.455	8.408	1	0.004	3.736	1.533	9.106
	Web only vs both training	0.865	0.281	9.447	1	0.002	2.375	1.368	4.124
Moderate CI rate	Intercept	1.217	1.107	1.208	1	0.272			
	Clinical knowledge score	-0.040	0.017	5.356	1	0.021	0.961	0.929	0.994
	Adaptability score	0.039	0.070	0.306	1	0.580	1.040	0.906	1.193
	CPD 0-25hrs vs CPD over 50hrs	0.589	0.323	3.325	1	0.068	1.803	0.957	3.397
	CPD 25-50hrs vs CPD over 50hrs	0.077	0.335	0.053	1	0.819	1.080	0.560	2.080
	None/F2F vs both training	0.215	0.490	0.192	1	0.662	1.239	0.474	3.239
	Web only vs both training	0.680	0.246	7.635	1	0.006	1.974	1.219	3.197
a. The reference category is: High CI rate.									

Table 5-53: Parameter estimates for the refined model

Even after removing the non-significant variables, the ability of the model to classify cases remained unimpressive. Overall, the correct classifications decreased slightly to 47.1% of cases, but the number of correct classifications for the high CI rate was slightly improved to 65.2% of cases (Table 5-54).

Observed	Predicted			
	Low CI rate	Moderate CI rate	High CI rate	Percent Correct
Low CI rate	35	42	37	30.7%
Moderate CI rate	18	59	69	40.4%
High CI rate	13	42	103	65.2%
Overall Percentage	15.8%	34.2%	50.0%	47.1%

Table 5-54: Percentage of correct predictions from the refined model

To account for the inflation in the family-wise error rate associated with 10 predictors, the p -value was recalculated and the critical p -value was $0.05/10 = 0.005$.¹⁴⁹ All of the variables showed significance according to the critical p -value, except the adaptability score and CPD 25-50 vs CPD over 50.

Using the parameter estimates seen in Table 5-53, the following suggestions could be drawn. Compared to pharmacists with a low CI rate, pharmacists with a high CI rate were:

- More likely to have a lower adaptability score (more adaptable/willing to change)
- More likely to have a higher score on the clinical knowledge survey
- 3.74 times more likely to have done both types of training compared to none/face-to-face and 2.38 times more likely to have done both types of training compared to online only
- 3.39 times more likely to have done 50 hours of CPD per year compared to 0-25 hours and 2.08 times more likely to have done 50 hours of CPD per year compared to 25-50 hours

To interpret the continuous variables, the differences in mean were examined between the three CI rate groups (Table 5-55). Pharmacists with a high CI rate had a significantly higher clinical knowledge survey score (mean = 54.9 ± 6.9 , $p = 0.004$) compared to those with a low CI rate (mean = 51.4 ± 8.2). Pharmacists with a high CI rate also had a lower adaptability score (where Strongly Agree = 1 and Strongly Disagree = 5), therefore signifying a more positive attitude (high CI rate mean = 5.7 ± 1.8 and low CI rate mean = 6.4 ± 2.1 , $p = 0.015$).

	Count	Adaptability score			Clinical knowledge score		
		Mean	Std. Error	Std. Dev.	Mean	Std. Error	Std. Dev.
Low CI rate	170	6.43	0.18	2.06	51.41	0.77	8.18
Moderate CI rate	170	5.86	0.12	1.51	52.56	0.58	7.02
High CI rate	169	5.67	0.14	1.75	54.88	0.55	6.88
Total	509	5.96	0.09	1.79	53.12	0.36	7.43

Table 5-55: Descriptive data for the two continuous variables in the refined model

5.3.2.5 Overview of influencing factors

The relationships between the influential factors found in the previous analyses can be seen in Figure 5-4. The bold text shows the four factors found to be significant within the multinomial logistic regression analysis, with the remaining two factors being significant within the bivariate analysis.

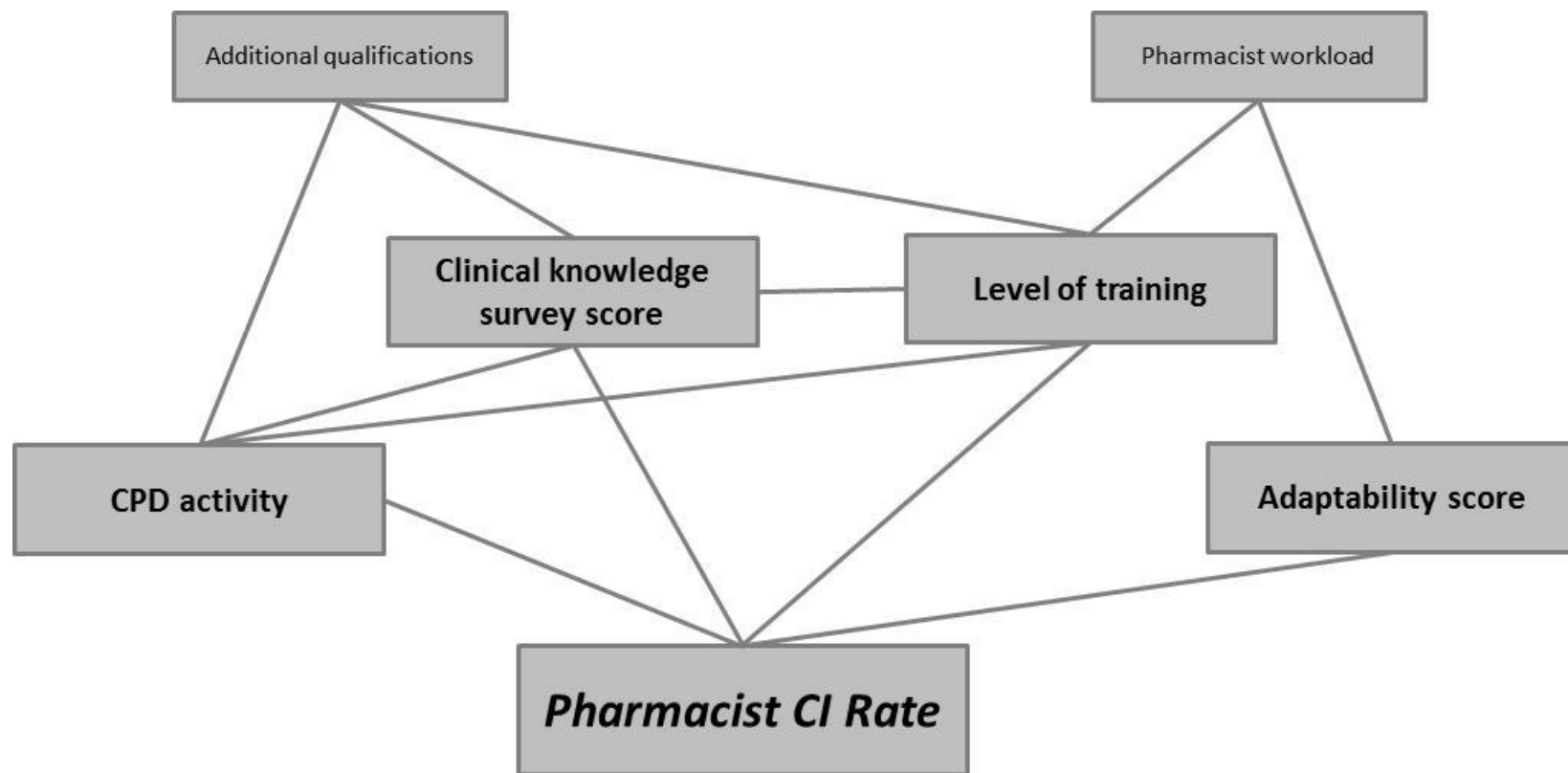


Figure 5-4: Relationships between the significant factors found in the bivariate and multinomial logistic regression analyses

5.3.3 Discussion of the multivariate analysis

No statistical differences in characteristics were seen in the initial analysis between the pharmacists who documented an intervention and those who documented none.

However, the stepwise regression model was successful in predicting whether a pharmacist would document an intervention ('performer') in 87% of cases by using five variables. Pharmacists were more likely to be 'performers' if they were APESMA members, were owners or managers, participated in both forms of PROMISE training, worked in owner-operated pharmacies and worked in a pharmacy with a slightly higher prescription volume. Unfortunately, only 18.7% of variance could be accounted for in the model, indicating that the likelihood of the pharmacist performing at least one intervention could not be predicted in many cases if used on a wider population.

Using the data from the 509 'active' pharmacists, a multinomial logistic regression model was successful in predicting whether the pharmacist would have a high intervention rate in 65.8% of cases according to the pharmacist's number of annual CPD hours, the level of training, clinical knowledge survey score and adaptability score. Considering that the aim of the model was to predict those pharmacists who would be expected to have a higher intervention rate, the model could be considered sufficient for predicting those with a low intervention rate compared to a high intervention rate. The variables included in the multinomial logistic regression were all reasonable as explained in the previous discussion in section 5.2.15. Pharmacists with a higher number of annual CPD hours, a higher level of training and a higher clinical knowledge may have a better ability to detect DRPs, thus increasing their intervention rate. The inclusion of the adaptability score variable also corresponds with previous trials that have noted the importance of the pharmacist's attitude on their ability to provide professional services.^{101,110}

Training was a significant variable included in both multivariate analyses, where a higher level of training was seen in pharmacists who documented at least one intervention (compared to documenting none) and in pharmacists with a higher intervention rate. This is most likely due to the training increasing the awareness and understanding of the project. The importance of targeted training such as this has previously been shown to be more effective at improving the pharmacists' clinical knowledge and other skills.^{124,126} A study that provided extensive DRP training for pharmacists resulted in a significant improvement in the ability of the pharmacist to manage DRPs.¹²¹ However, such a high level of commitment may be unrealistic for the majority of pharmacists. The advantage of

the PROMISE training was that the majority of it could be completed online, reducing the disadvantage for rural pharmacists. In addition, the pharmacists who indicated that they had received sufficient training in the post-trial survey had a higher intervention rate than their less satisfied counterparts, indicating the importance that training may have on the pharmacist's ability to participate in professional programs.

Although the average pharmacist workload was significantly associated with the pharmacist's intervention rate, it did not appear in the multivariate analysis. No amount of manipulation allowed the inclusion of workload into the multivariate model. The process of multinomial logistic regression analysis includes variables based on the strength of their correlation with the dependent variable, possibly indicating that the workload may not have accurately reflected the individual pharmacist's workload. Additionally, unlike in the pharmacy model, the workload was not associated with any of the included variables, therefore it is thought that the pharmacist's workload calculation was not a good predictor of performance at the individual pharmacist level. The FTE pharmacist calculation was based on the average weekly roster with the pharmacy, and therefore included non-participant pharmacists in most pharmacies, such as locums or casual pharmacists not aware of the trial. The average pharmacist workload within their pharmacy was also higher than the average prescription volume dispensed per pharmacist during the trial. This may be due to all pharmacists (including non-participants) being counted in this calculation, which may suggest that the non-participant pharmacists had a higher workload than the participant pharmacists. As such, it is unknown how accurate the workload calculation was at the individual pharmacist level and this is likely to have affected its inclusion in the final multivariate model.

5.4 *Observational sub-study*

As discussed in Chapter 2, the main aim of the observation period was to determine what percentage of performed clinical interventions were actually documented. For each observed pharmacist, two intervention rates were calculated:

- Performed intervention rate (number of observed interventions divided by number of observed prescriptions dispensed)
- Documented intervention rate (number of documented interventions divided by number of observed prescriptions dispensed)

It is important to note that these intervention rates are calculated only on the interventions and prescriptions observed, and are therefore the rates seen during the observational week, not the whole trial.

5.4.1 *Observed pharmacists*

A total of 149 pharmacists were observed during the trial, with 90 pharmacists being observed in the 38 software pharmacies and the remaining 59 pharmacists being observed in the 24 no software pharmacies. The majority of the pharmacists within the software pharmacies completed the online surveys, resulting in 78 complete sets of demographic data for observed pharmacists. Although pharmacists in the no software pharmacies did not have access to the PROMISe intervention recording system, they were still observed to record some interventions. The observers found that 57% of no software pharmacists used the notes section within their dispensing system to record interventions, however the recording of interventions was not consistent and the remaining 43% of pharmacists were not observed recording any interventions during the observational period.

5.4.1.1 *Performance rates compared to documentation rates*

Observed pharmacists performed 779 interventions but only documented 293 (37.6%) of them. When the no software pharmacies were excluded, the software pharmacies documented 279 of the 565 observed interventions (49.4%; Table 5-56). The documentation rate was much lower in the no software pharmacies, with these pharmacists only documenting 14 in 214 interventions (6.5%). Pharmacists were observed to be performing interventions at an average rate of 2.34 per 100 prescriptions, but only documenting at an average rate of 0.85 per 100 prescriptions. Again, when the no software pharmacies were excluded, pharmacists performed interventions at an average

rate of 2.77 per 100 prescriptions and documented interventions at an average rate of 1.33 per 100 prescriptions (Table 5-56).

		Count	Sum	Mean	Std. Error	Std Dev.	Minimum	Maximum	Median	25 th %ile	75 th %ile
No software	Performed CIs	24	214	9	1	5	1	24	8	6	12
	Documented CIs	24	14	1	0	1	0	4	0	0	1
	Pharmacist prescriptions	24	13522	563.42	43.58	213.48	259	1121	522.50	389.50	694.00
	Performed CI Rate	24		1.66	0.19	0.94	0.28	3.90	1.54	0.98	2.12
	Documented CI Rate	24		0.10	0.04	0.18	0.00	0.59	0.00	0.00	0.19
	Pharmacy prescriptions	24	19241	801.71	93.89	459.95	259	2126	746.00	534.00	1043.50
Software	Performed CIs	38	565	15	1	8	3	36	13	10	20
	Documented CIs	38	279	7	1	4	1	19	6	4	10
	Pharmacist prescriptions	38	24724	650.63	71.67	441.81	163	2890	580.00	457.00	732.00
	Performed CI Rate	38		2.77	0.29	1.78	0.42	9.66	2.53	1.60	3.58
	Documented CI Rate	38		1.33	0.13	0.81	0.10	3.33	1.10	0.75	1.88
	Pharmacy prescriptions	38	35359	930.50	108.61	669.50	166	3750	710.00	583.00	1075.00
Total	Performed CIs	62	779	13	1	7	1	36	12	7	17
	Documented CIs	62	293	5	1	5	0	19	4	0	8
	Pharmacist prescriptions	62	38246	616.87	47.08	370.70	163	2890	562.50	450.00	712.00
	Performed CI Rate	62		2.34	0.20	1.60	0.28	9.66	2.06	1.37	3.00
	Documented CI Rate	62		0.85	0.11	0.88	0.00	3.33	0.63	0.00	1.51
	Pharmacy prescriptions	62	54600	880.65	75.74	596.36	166	3750	719.50	548.00	1075.00

Table 5-56: Descriptive statistics of interventions and prescriptions within observed pharmacies

When the performed and documented intervention rates were compared with the number of prescriptions dispensed by the pharmacist and the pharmacy, significant correlations were seen between the number of prescriptions dispensed and the intervention performance rate of the pharmacist (Table 5-57 and Figure 5-5).

	Performed CI rate			Documented CI rate		
	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>
Pharmacy prescriptions	-0.293	62	0.021	-0.001	62	0.995
Pharmacist prescriptions	-0.378	62	0.002	-0.152	62	0.239

Table 5-57: Correlations between prescription numbers with performed and documented intervention rates

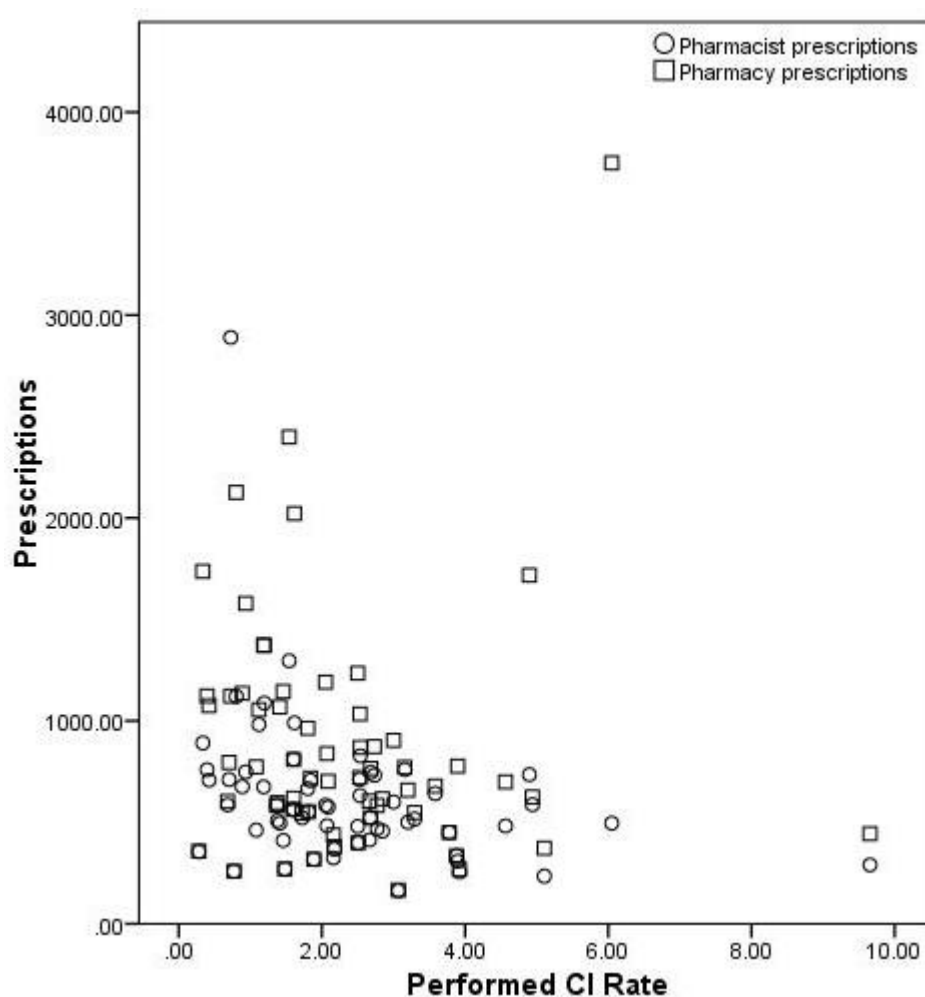


Figure 5-5: Correlation graph between performed CI rate and prescription volume

Within the group of observed pharmacists, the intervention rates decreased as the number of prescriptions increased, indicating that the performance of interventions may

also have been affected by workload. Although only a smaller number of pharmacists were observed, this may indicate that workload may have a greater effect on the performance of interventions rather than the documentation. This finding will be explored more within the discussion.

5.4.2 Influencing factors on performance and documentation rates

Analysis did not reveal any factors that had a significant relationship with the pharmacist's intervention performance or documentation rates. This included factors such as additional qualifications, CPD activity and training which had previously been shown to be correlated with the intervention rate. See Appendix 26 for more detail on the analysis.

5.4.3 Descriptive statistics of workloads

Observers were asked to keep a detailed record of all details affecting the pharmacist's working day.

5.4.3.1 Additional tasks

The additional jobs undertaken by the observed pharmacists were used to obtain an accurate picture of their workloads. During an average week, pharmacists dispensed 617 prescriptions and served 317 patients. They also fixed 9 owing prescriptions, served 11 daily dose pick-up patients, offered 14 CMI's to patients, assisted with 66 OTC requests including 6 pseudoephedrine sales, recorded 3 pseudoephedrine sales through Project STOP and issued 4 Safety Net cards (administrative paperwork required by the Australian Government that can be time-consuming) (Table 5-58). Mann-Whitney test showed no significant differences between the tasks undertaken by no software and software pharmacies.

		Count	Sum	Mean	Std. Error	Std. Deviation	Minimum	Maximum	Median	Percentile 25	Percentile 75
No software	Owing prescriptions	24	193.00	8.04	3.14	15.38	0.00	75.00	3.00	1.00	10.00
	Daily pickups	24	197.00	8.21	2.75	13.47	0.00	46.00	1.00	0.00	12.00
	CMI's offered	24	307.00	12.79	2.55	12.51	0.00	45.00	8.50	4.50	15.00
	OTC requests	24	1486.00	61.92	6.34	31.04	17.00	141.00	55.00	43.50	75.50
	Pseudoephedrine sales	24	160.00	6.67	1.28	6.27	0.00	25.00	5.00	2.50	8.00
	Project STOP	24	77.00	3.21	0.97	4.74	0.00	21.00	1.50	0.00	4.50
	Number of SN cards issued	24	94.00	3.92	0.57	2.78	0.00	9.00	3.50	2.00	6.50
Software	Owing prescriptions	38	385.00	10.13	2.27	13.97	0.00	77.00	5.50	2.00	12.00
	Daily pickups	38	507.00	13.34	3.69	22.76	0.00	123.00	6.00	0.00	18.00
	CMI's offered	38	583.00	15.34	3.23	19.89	0.00	114.00	10.00	3.00	23.00
	OTC requests	38	2586.00	68.05	8.34	51.41	10.00	287.00	53.00	40.00	79.00
	Pseudoephedrine sales	38	183.00	4.82	0.66	4.07	0.00	19.00	3.00	2.00	8.00
	Project STOP	38	80.00	2.11	0.47	2.92	0.00	12.00	1.00	0.00	3.00
	Number of SN cards issued	38	144.00	3.79	0.47	2.91	0.00	14.00	4.00	2.00	5.00
Total	Owing prescriptions	62	578.00	9.32	1.83	14.44	0.00	77.00	4.00	2.00	11.00
	Daily pickups	62	704.00	11.35	2.51	19.73	0.00	123.00	4.00	0.00	13.00
	CMI's offered	62	890.00	14.35	2.20	17.33	0.00	114.00	9.50	4.00	21.00
	OTC requests	62	4072.00	65.68	5.65	44.45	10.00	287.00	53.50	41.00	79.00
	Pseudoephedrine sales	62	343.00	5.53	0.64	5.07	0.00	25.00	4.00	2.00	8.00
	Project STOP	62	157.00	2.53	0.47	3.73	0.00	21.00	1.00	0.00	4.00
	Number of SN cards issued	62	238.00	3.84	0.36	2.84	0.00	14.00	4.00	2.00	5.00

Table 5-58: Descriptive statistics for the types of tasks undertaken by observed pharmacists

When compared to the intervention performance and documentation rates within the observed pharmacists, only one correlation was seen between the intervention performance rate and the number of Safety Net cards issued (Table 5-59). As the number of Safety Net cards issued by the pharmacist increased, the intervention performance rate decreased.

	Performed CI rate			Documented CI rate		
	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>
Owing prescriptions	0.127	62	0.327	0.118	62	0.359
Daily pickups	0.066	62	0.611	0.028	62	0.826
CMLs offered	0.000	62	0.998	0.132	62	0.306
OTC requests	0.048	62	0.712	-0.084	62	0.515
Pseudoephedrine sales	0.069	62	0.597	-0.207	62	0.106
Project STOP	0.165	62	0.200	0.060	62	0.644
Number of SN cards issued	-0.264	62	0.038	-0.099	62	0.444

Table 5-59: Correlations between pharmacist's additional tasks and their performed and documented intervention rates

5.4.3.2 Staffing levels

The observers also recorded the number of other staff members present during each hour of the pharmacist's shift. Each week on average, there was the equivalent of 59 pharmacist hours, 24 technician hours, 10 graduate pharmacist hours and 98 pharmacy assistant hours (Table 5-60).

		Count	Sum	Mean	Std. Error	Std. Deviation	Minimum	Maximum	Median	Percentile 25	Percentile 75
No software	FTE pharmacist hours	24	1407.77	58.66	4.90	24.00	35.00	126.00	47.50	40.00	74.23
	FTE technician hours	24	417.21	17.38	4.59	22.49	0.00	93.50	8.21	0.00	30.50
	FTE graduate pharmacist hours	24	270.50	11.27	4.22	20.66	0.00	70.50	0.00	0.00	16.00
	FTE pharmacy assistant hours	24	2564.07	106.84	13.63	66.78	0.00	245.50	87.50	60.75	156.29
Software	FTE pharmacist hours	38	2253.58	59.30	3.30	20.34	39.75	108.50	53.38	41.25	69.50
	FTE technician hours	38	1089.91	28.68	5.55	34.23	0.00	192.00	32.25	0.00	43.00
	FTE graduate pharmacist hours	38	332.50	8.75	2.83	17.44	0.00	78.50	0.00	0.00	3.00
	FTE pharmacy assistant hours	38	3525.25	92.77	11.46	70.67	0.00	371.50	75.38	42.50	123.00
Total	FTE pharmacist hours	62	3661.35	59.05	2.75	21.64	35.00	126.00	49.50	40.00	71.45
	FTE technician hours	62	1507.12	24.31	3.88	30.53	0.00	192.00	17.50	0.00	37.50
	FTE graduate pharmacist hours	62	603.00	9.73	2.37	18.63	0.00	78.50	0.00	0.00	7.00
	FTE pharmacy assistant hours	62	6089.32	98.21	8.76	68.98	0.00	371.50	83.00	48.25	128.00

Table 5-60: Descriptive statistics for the staffing levels during the shift of an observed pharmacist

When the staffing levels were compared to the performed and documented intervention rates, no significant correlations were seen (Table 5-61).

	Performed CI rate			Documented CI rate		
	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>	<i>Spearman's rho</i>	<i>N</i>	<i>p</i>
FTE pharmacist hours	-0.090	62	0.485	0.111	62	0.391
FTE technician hours	-0.139	62	0.282	0.088	62	0.496
FTE pre-registration hours	-0.232	62	0.069	-0.119	62	0.358
FTE pharmacy assistant hours	-0.217	62	0.090	-0.101	62	0.433

Table 5-61: Correlations between pharmacy's staffing levels and the pharmacist's performed and documented intervention rates

5.4.4 Discussion of observational substudy

Observed pharmacists in the software groups were found to document only 49% of the interventions they performed, with an average performance rate of 2.77% but an average documentation rate of 1.33%. The documentation rate was much higher than the overall intervention rate seen during the trial, which was most likely due to the presence of an observer increasing the documentation (and possibly the performance) of clinical interventions. The effect of observers was previously seen in the Rupp⁵⁸ and Dobie⁶⁰ articles. Both authors used the same documentation system for the interventions, except Rupp used observers to document the intervention, whilst Dobie asked the intervening pharmacist to document the intervention. As shown in Chapter 1, the intervention rate found by Rupp was double the intervention rate found by Dobie, which is very similar to the results found in the PROMISE trial. It is possible that the number of interventions performed increased with the presence of an observer, as the pharmacist may be more likely to perform interventions whilst an observer is present. However, it is more likely that the proportion of interventions that were documented was different between the groups of observed and unobserved pharmacists. This could be due to the pharmacist not wanting to document the intervention due to lack of time or motivation, or the pharmacist may not have realised it was an intervention in the first place. This may indicate that the actual proportion of interventions that were documented during the trial may be even lower than the observed documentation rate of 49%.

Although only a small number of pharmacists were observed, it was possible to analyse the factors that may have contributed to a higher intervention performance rate as well as a higher documentation rate. Interestingly, none of the previously identified factors (level

of training, CPD hours, clinical knowledge survey and adaptability score) correlated with the observed intervention rates. It is unknown if this was due to the small sample size or due to the presence of the observer. The small sample size of 78 pharmacists may have been too small to detect influencing factors, as the intervention rate was an extremely small number in most cases. It is also possible that the observer's presence strongly influenced the pharmacist's intervention rate, negating the effect of the other factors on the rate. In addition, the only correlation seen was between the intervention performance rate and the number of Safety Net cards issued, where the intervention performance rate decreased as the number of Safety Net cards issued by the pharmacist increased. This may indicate that the issuing of Safety Net cards has a significant impact on the pharmacist's workload, resulting in less time to perform interventions, again indicating the impact of workload on the pharmacist's ability to perform and document clinical interventions.

5.5 Time taken to do clinical interventions

Participating pharmacists were asked to note the time, in minutes, that it took to perform each clinical intervention. Additionally, the observing pharmacists were asked to record the time taken by the pharmacist to document the intervention. It should be noted that both the FRED® and Aquarius® dispensing systems had the opportunity to enter a precise number, whereas the FRED® dispensing software also had ‘quick selection’ buttons for 2 minute intervals (2, 4, 6, 8 and 10 minutes) which may have affected the pharmacists’ records.

5.5.1 Time to perform the intervention

The median time for the 5948 interventions was 4 minutes (range = 0 – 45; Figure 5-6). The influence of the ‘quick selection’ buttons can also be seen, with the most frequently recorded times being 4, 2 and 6 minutes (Figure 5-6).

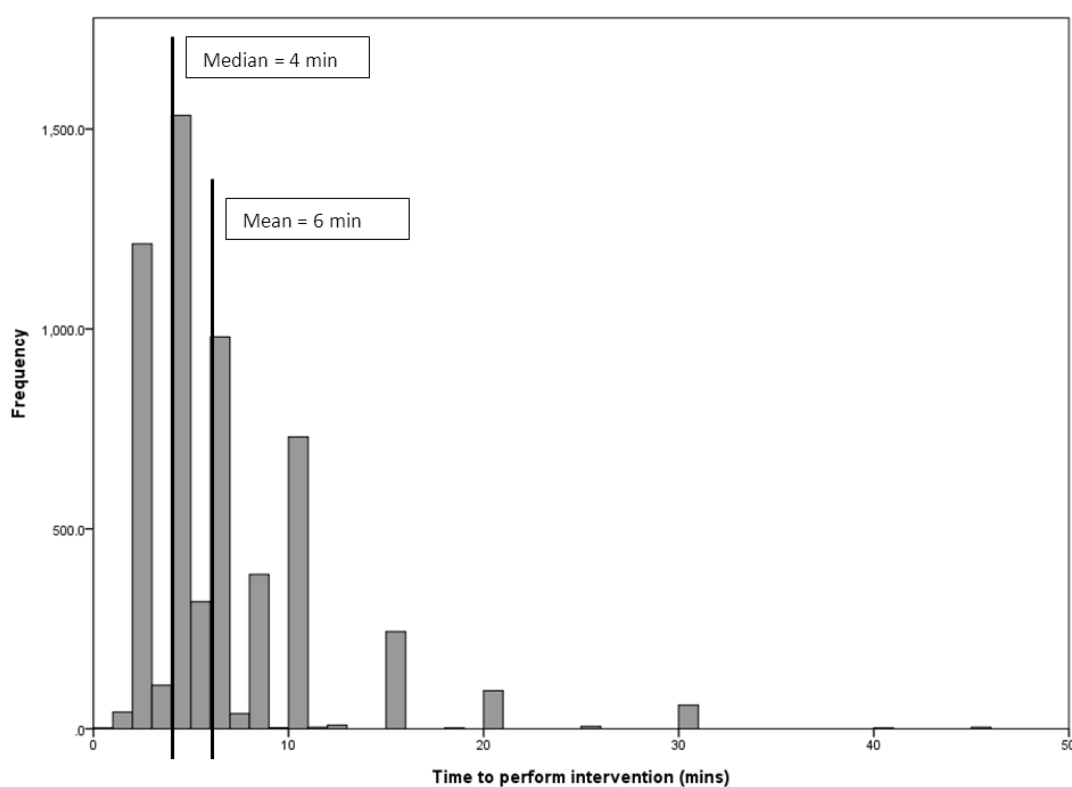


Figure 5-6: Time taken to perform an intervention

Answers to the statement “I am concerned it will take too long to document interventions through the recording system” also correlated with the time that the pharmacist recorded against the intervention. Pharmacists who believed it would take too long to document an

intervention tended to record higher median intervention times (*Spearman's rho* = -0.10, $N = 423$, $p = 0.04$).

There were significant differences between the time taken to perform the intervention and the category of intervention (*Kruskal-Wallis* $\chi^2 = 122.64$, $df = 7$, $p < 0.001$), with compliance, undertreatment, monitoring and toxicity interventions having a higher median time than other interventions (Table 5-62).

	Count	Mean	Std. Error	Std. Dev.	Median	Min.	Max.	25 th %ile	75 th %ile
D	1829	6.06	0.11	4.56	4.00	1.00	30.00	4.00	8.00
O	1183	5.73	0.13	4.29	4.00	0.00	30.00	3.00	7.00
C	557	7.31	0.25	5.88	6.00	0.30	45.00	4.00	10.00
U	272	6.87	0.32	5.22	6.00	1.00	45.00	4.00	10.00
M	140	7.64	0.49	5.72	6.00	1.00	30.00	4.00	10.00
E	1412	5.27	0.10	3.70	4.00	1.00	30.00	2.00	6.00
N	110	7.85	0.83	8.59	4.50	1.00	45.00	2.00	10.00
T	445	6.36	0.20	4.16	6.00	1.50	30.00	4.00	8.00
Total	5948	6.06	0.06	4.66	4.00	0.00	45.00	4.00	8.00

Table 5-62: Time taken to perform an intervention compared to its DOCUMENT category

Interventions that were associated with a referral and situations where a dose administration aid was recommended also required significantly longer time to complete (Table 5-63; *Kruskal-Wallis* $\chi^2 = 9691.00$, $df = 18$, $p < 0.001$).

	Count	Mean	Std. Error	Std. Dev.	Median	Min.	Max.	25 th %ile	75 th %ile
R1	642	5.77	0.17	4.39	4.00	1.00	45.00	4.00	6.00
R2	652	6.19	0.18	4.69	5.00	0.00	30.00	4.00	8.00
R3	846	6.78	0.18	5.14	6.00	0.30	45.00	4.00	10.00
R4	383	5.91	0.24	4.64	4.00	1.00	30.00	4.00	7.00
R5	96	5.17	0.38	3.74	4.00	2.00	20.00	2.00	6.00
R6	527	5.93	0.19	4.34	5.00	1.00	30.00	3.00	8.00
R7	307	7.52	0.33	5.60	6.00	1.00	45.00	4.00	10.00
R8	380	6.57	0.25	4.86	6.00	1.00	30.00	4.00	8.00
R9	1786	7.16	0.12	5.23	6.00	1.00	45.00	4.00	10.00
R10	36	10.57	1.52	9.01	10.00	2.00	45.00	4.00	15.00
R11	76	10.19	0.90	7.80	7.00	2.00	45.00	5.00	12.00
R12	58	11.11	1.04	7.84	10.00	2.00	40.00	6.00	15.00
R13	2437	6.18	0.09	4.41	5.00	1.00	45.00	4.00	8.00
R14	260	6.70	0.33	5.26	4.00	1.00	30.00	4.00	8.00
R15	75	10.19	0.91	7.84	8.00	2.00	45.00	5.00	15.00
R16	540	5.71	0.18	4.11	4.00	1.00	45.00	4.00	8.00
R17	277	7.24	0.36	5.92	6.00	2.00	45.00	4.00	8.00
R18	173	7.42	0.43	5.69	6.00	2.00	30.00	4.00	10.00
R19	111	4.53	0.43	4.50	2.00	1.00	30.00	2.00	6.00
Total	5948	6.06	0.06	4.66	4.00	0.00	45.00	4.00	8.00

Table 5-63: Time taken to perform the intervention compared to recommendation made (see Chapter 2 or Appendix 3 for definitions of the recommendation codes)

There was also a clear relationship between the time taken to perform an intervention and the documented clinical significance (*Kruskal-Wallis* $\chi^2 = 122.64$, $df = 7$, $p < 0.001$; *Jonckheere-Terpstra* $t = 20.72$, $p < 0.001$), with those clinical interventions that were deemed more significant (S3 or S4) taking a longer time to perform (Table 5-64).

	Count	Mean	Std. Error	Std. Dev.	Median	Min.	Max.	25 th %ile	75 th %ile
S1	908	4.95	0.13	3.88	4.00	1.00	30.00	2.00	6.00
S2	2505	5.20	0.08	3.73	4.00	0.00	45.00	2.00	6.00
S3	2119	6.81	0.11	4.85	6.00	0.30	45.00	4.00	10.00
S4	416	9.85	0.35	7.07	8.00	2.00	45.00	5.00	12.00
Total	5948	6.06	0.06	4.66	4.00	0.00	45.00	4.00	8.00

Table 5-64: Time taken to perform an intervention compared to its significance(see Chapter 2 or Appendix 3 for definitions of the significance codes)

5.5.2 Time to document the intervention

The participating pharmacists were asked to record only the time taken to perform the intervention. Each observer noted how long each intervention took to perform *and* document; therefore, the observer data was used to determine the time required to document interventions. The average time taken to document the 279 observed interventions was 2.02 ± 1.07 minutes (range = 0 – 8).

5.5.3 Discussion of time taken to perform and document interventions

On average, it took the pharmacist four minutes to perform the intervention and an additional two minutes to document the intervention. In the FRED® dispensing software, there was a set of ‘quick selection’ buttons available for 2 minute intervals (2, 4, 6, 8 and 10 minutes) which appeared to have an effect on the performance time recorded by the pharmacists. The most commonly recorded times were 4, 2 and 6 minutes, which indicated that the pharmacists mostly used the ‘quick selection’ buttons rather than entering their own time in the text box. This may have led to an incorrect assessment of the time it took to perform an intervention. However, the results still confirm that the average time to perform most interventions is minimal and would have only a small impact on the daily workload of a pharmacist.

The category of intervention appeared to affect the time taken to perform the intervention with compliance, undertreatment, monitoring and toxicity interventions having a higher median time than the other categories. This was likely caused by these interventions requiring more patient interaction and more counselling, and therefore requiring more of the pharmacist’s time to resolve. Pharmacists also reported that the more significant interventions took longer to perform, which would again be the interventions that took more time to resolve.

5.6 Conclusion

Pharmacists had varied intervention rates during the trial, with several factors identified that may have contributed to these differences. The multivariate model revealed several factors that were important in the prediction of a pharmacist's intervention rate: number of annual CPD hours, the level of training, clinical knowledge survey score and adaptability score. Pharmacists with a higher number of annual CPD hours, a higher level of training and a higher clinical knowledge may have a better ability to detect DRPs and be more aware of the trial, thus increasing their intervention rate. The inclusion of the adaptability score variable also indicated the importance of the pharmacist's attitude on their ability to provide professional services. Chapter 6 will examine ways in which intervention rates can be improved through utilising this information. Workload did not appear to be an important factor in predicting a pharmacist's intervention rate, which could be attributed to the workload measure being used for this analysis being a poor predictor for actual workload at an individual pharmacist level.

6 Chapter 6: Qualitative analysis of influencing factors

In addition to the characteristics of the pharmacy and pharmacist that could be quantitatively measured, the barriers and facilitators to performing and documenting clinical interventions were also analysed qualitatively. The data for this analysis was obtained via three methods: focus groups, observation and a software usability survey.

- Focus groups were conducted with 30 owners and managers of participating pharmacies to establish their opinions and perspectives on clinical interventions.
- Each observer was asked to document the barriers and facilitators they noticed for each pharmacist and pharmacy they observed. These observations were also discussed and explored in a focus group attended by all observers.
- A software usability survey (see Appendix 14) was sent to 531 participating pharmacists. A total of 304 completed surveys were returned giving a response rate of 57%.

A number of factors were identified by the participants of the focus groups and the respondents of the software survey. Figure 6-1 illustrates these factors, which will be discussed within this chapter.

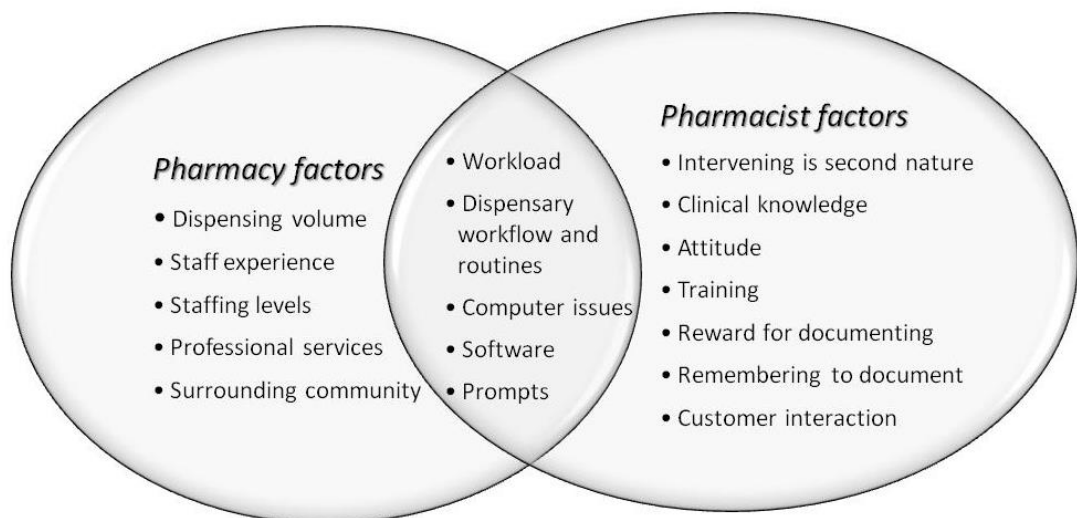


Figure 6-1: Summary of influencing factors to performing and documenting interventions

6.1 Pharmacy factors

The qualitative themes that were identified at a pharmacy level will be discussed within the following section.

6.1.1 Dispensing volume

Some observers commented that in some pharmacies with high prescription volume, the pressure to maintain a high prescription output lessened the chances for the identification of DRPs. This was also raised in the owner/manager focus groups who reported that pharmacies often focus on processing the greatest number of prescriptions possible, as they are remunerated largely through the dispensing of prescriptions. Both focus groups reported that this trend reduces the pharmacists' ability to recognise and document clinical interventions as they are spending less time with consumers, where a number of interventions could be detected through these interactions.

Interestingly, and to the contrary, some observers also reported that the some of the quieter pharmacies with a low prescription turnover also performed a lower number of interventions. This was possibly due to decreased 'flow' of consumers coming into the pharmacy, resulting in a decreased opportunity to perform interventions. The observers also noted that the staff in quieter pharmacies tended to be more focused on business activities rather than clinical activities, therefore decreasing the number of interventions performed.

6.1.2 Staff experience

Observers reported that poorly trained staff were a barrier to interventions, as these staff were receiving and handing out prescriptions to consumers, but may not have the training to bring potential DRPs to the attention of the pharmacist. One observer stated that;

"Your staff should have a minimum amount of training to recognise when there could be a potentially dangerous situation and refer back to you."

Another observer described an experience as;

"There was an instance where a girl in the shop came into the dispensary and got a pack of 72 Nurofen Plus® and sold it before the pharmacist had a chance to stop it. That was because the staff weren't trained or didn't care" (NB:- at the time of the trial, a 72-pack of Nurofen Plus® was a 'Pharmacist Only' or schedule 3 product, and therefore the pharmacist was legally required to be involved with the sale)

Observers reported that pharmacists and pharmacy assistants who had clearly defined roles within the pharmacy facilitated the performance of clinical interventions. They

suggested having one pharmacist concentrating on counselling consumers and another on dispensing tasks. This increases consumer contact and incorporates more routine counselling whilst improving the potential for identifying DRPs. Observers also suggested that pharmacy assistants should have a clear understanding of their role, and of the responsibilities of the other staff members. When there are no gaps in responsibilities, there would be an increased chance of DRPs being identified and acted upon.

6.1.3 Staffing levels

Both observer and owner/manager focus groups revealed that time restrictions were a barrier to performing some interventions and to documenting them. The observers reported that some pharmacies with low staffing levels (high prescription to dispensary staff ratio) had less time for consumer counselling. One observer stated;

“I think the staff are a major issue... if you haven’t got that support you are overwhelmed and you can’t make interventions that you should do”

Furthermore, low staffing levels within a pharmacy meant that many pharmacists worked longer shifts with few meal breaks which increased fatigue, reduced concentration and, ultimately, inhibited ability to recognise DRPs. One of the observers reported that:

“I think one of the barriers is the long hours, they are there almost 12 hours, and they are stuffed and tired. It is mind numbing. They are not interested in doing any interventions”

6.1.4 Dispensary workflow practices and routine

Observers reported that pharmacy layouts including forward dispensing arrangements and easily accessible consumer counselling areas enabled pharmacists to interact more with consumers and facilitated the performance of interventions. This was supported by the owner/managers who said that, in some cases, it was easier to record the intervention into a consumer’s history at the forward terminal. They reported that only a few pharmacies had terminals at the receiving point for dispensed prescriptions, so there was potential to improve the level of documentation with additional computer terminals.

“We’ve got enough computers too....We’ve got them on the front, we’ve got one on each bench, and then one in the consulting rooms as well, so it doesn’t matter, you’ve got to take like 5 steps and you’re on a computer, it makes it easy”

From the observers' point of view, there were two main work systems that seemed to facilitate clinical interventions. The first was adequate dispensary staffing, as mentioned in section 6.1.3. Pharmacies with adequate numbers of dispensing staff or with work rosters that avoided long dispensary shifts tiring pharmacists facilitated the performance of interventions. The owner/managers also noted that some pharmacies were dispensing above the recommended 150-200 prescriptions per day per pharmacist¹⁶⁹, suggesting that some pharmacies needed to employ more staff. Two of the owner/managers stated that:

"If you are doing 500 to 600 prescriptions a day the last thing they will want to do is document clinical interventions."

"A lot of places are working on (a basis of) staff turnover but we need to think of staff to workload in the dispensary. There needs to be adequate dispensary staff to enable adequate staff to patient contact."

The observers also recognised that balanced pharmacy roles facilitate clinical interventions. In particular, pharmacists should have equilibrium between their business and clinical roles. One observer reported that:

"Some (pharmacists) get into stock control and they don't want to do anything else."

Aged care facility medication packing and related administrative issues were also considered a distraction from dispensing, as well as telephone calls, and patients talking to the pharmacist during the dispensing process.

6.1.5 Professional services

The observers generally noted that some pharmacies with more professional services had lower intervention rates due to the increased pharmacist time needed to offer the service. On the other hand, some observers noted that these professional services actually increased the intervention rates within some pharmacies. Again, this may be due to the staffing within the pharmacy. If the staffing levels are adequate, then the pharmacist can devote more time to delivering the professional services and, therefore, have more time to perform clinical interventions.

6.1.6 Community

The observers also felt that the surrounding community also had an influence on the number of interventions performed, including the local GP practices and the typical patient demographics (e.g. young versus an elderly population) within the area.

6.1.6.1 General practitioners

The observers felt that the receptiveness of the local GPs influenced the resolution of the DRPs. For example, one observed pharmacist was apprehensive about contacting the local GP due to a previous adverse discussion. As a result, they were more comfortable dismissing the intervention rather than making contact. In areas where the GPs were approachable and the pharmacy had good rapport with the surgery, there seemed to be an increase in the number of interventions that were resolved.

6.1.6.2 Consumers

Consumers were observed to affect the pharmacy intervention rate in several ways. Firstly, pharmacies where the 'traffic' tended to be regular patients (as opposed to tourists or one-off patients, for example) appeared to have a higher intervention rate. This was thought to be due to the pharmacies having extensive histories for these consumers, as well as the consumers being familiar with the staff and more likely to interact.

Secondly, language barriers also influenced the performance of interventions. Observers noted that several pharmacies had a large consumer base of migrants who did not speak English. This sometimes meant that the pharmacist was relying on the shop assistants to act as translators between themselves and the consumers, thus some information may be lost in translation and some DRPs may not have been identified.

Lastly, the attitude of the consumers also affected the intervention rate. The observers noted that some pharmacies had consumers that believed the doctor was always right and were very resistant to any change suggested by the pharmacist. This made the implementation of the intervention difficult. One observer noted that one pharmacy had consumers that felt the following way:

"I am here for you to dispense and then I leave. I don't want to listen to this nonsense about you wanting to save my life"

6.1.7 Computer issues

Computer issues were one of the main factors influencing documenting interventions and, as such, the observers and owner/managers recognised good computer capabilities as a main facilitator.

6.1.7.1 Access to a terminal

The observers reported that pharmacies with only one computer terminal were less likely to document their interventions. This was due to the terminal always being used for dispensing purposes and pharmacists did not want to interrupt the dispensary workflow.

One observer commented:

“Sometimes it is about the number of computers. I had one pharmacy that had one computer and if they are dispensing, they were dispensing, they are not going to record as well”

The observers felt that an additional computer terminal to allow documentation without interrupting the dispensing process would facilitate documentation. The observers suggested that it could be in the counselling area, as used in forward dispensing, or in the dispensary.

6.1.7.2 Speed of the computer

In general, the results of the software survey showed that respondents reported no barriers to the use of the PROMISe software interface. However, there appeared to be mixed reports regarding the effect of the PROMISe interface on the speed of the dispensary computers. Twenty-nine percent of participants reported the speed of their computer slowed due to the PROMISe software, whereas 47% of participants disagreed and 24% of participants felt no effect. In addition, two pharmacists (one each from FRED® and Aquarius®) reported that during the trial that the user interface slowed their computer to the extent that they required technical support from the software company.

6.1.8 Software

The observers noted that some pharmacies were documenting clinical interventions in another system (as this was already the practice within the pharmacy), which increased the workload of the pharmacist by duplicating the process. This was occurring as the pharmacy was aware that the PROMISe system would be switched off at the end of the

trial and therefore the records may not continue in the form they were used to. This barrier would most likely be overcome if the software system was permanently installed as the pharmacist can use the PROMISE system without the fear that the records would be lost.

The lack of available software within the no software pharmacies was also identified as a barrier. Therefore, the existence of an easy to use documentation system for clinical interventions itself (such as the PROMISE software) created greater awareness of DRPs and their documentation. An observer reported that:

“If the documentation process is easy and simple then they will document... or if they perceive it to be easy”

6.1.9 Discussion of the qualitative analysis of pharmacy factors

Many of the same factors that were identified within the bivariate analysis and multivariate analysis (see Chapter 4) were also reiterated within the qualitative analysis. As seen in the bivariate and multivariate analyses, the observational study and the post-trial focus groups also reported that higher prescription volumes decreased the chances to detect DRPs and document interventions. However, the observers also identified that very low prescription volumes also led to a decreased number of interventions being performed, due to less opportunity to intervene. This ‘J-curve’ effect was also noted by Rupp et al. in his original study in 1988⁵⁷, where the authors commented that the number of interventions performed would increase as prescription volume increased, until a theoretical ‘cut-off point’ was reached, and thereafter the number of interventions would decrease due to the high workload. It is also possible that pharmacists working in less busy pharmacies also have a decreased ability to detect DRPs as their skills would not be used as regularly. This may lead to a decrease in the number of interventions performed due to a lack of experience and possibly a lack of confidence. The effect of the pharmacist’s attitude will be explored further later in this chapter.

The observational study also revealed that workload can be affected by the level of adequate staffing within the pharmacy. They identified two components that contributed to adequate staffing levels, with both an adequate number of staff being required within the pharmacy to handle the workload and the staff also needing to be adequately trained to cope with the demands of the workload. The pharmacists working with pharmacy

assistants that had additional training and clearly defined roles within the pharmacy often had higher intervention rates. This was most likely due to an increased ability of the pharmacy assistant to detect possible DRPs, which were then referred to the pharmacist, resulting in an increase in completed interventions. Additionally, adequately trained staff may decrease the pharmacist's workload and increase the time available for the pharmacist to detect and resolve DRPs.

The finding that catering for ACFs decreased the intervention rate within the pharmacy was also noted in the observational sub-study. The observers found that catering for ACFs could be a distraction from the dispensing process, due to an increase in phonecalls, additional paperwork and checking medication packs. In turn, this decreased the amount of time that the pharmacist spent on performing and documenting interventions, thus decreasing the pharmacy's intervention rate.

The finding that offering professional services decreased intervention rates was also seen within the observational study, where the observers found that an increased number of professional services increased the amount of time that the pharmacist spent on these additional services. This decreased the available time that the pharmacist could spend on detecting and resolving DRPs, resulting in a lower intervention rate.

Both software and no software pharmacies were observed during the observational study, with observers reporting that the presence of the PROMISe software increased the documentation of interventions and therefore, increased the pharmacy's intervention rate. This was expected, as the presence of the software would increase the pharmacist's awareness of the trial, resulting in a larger number of interventions being documented.

6.2 *Pharmacist factors*

The study also aimed to identify the perceived and actual barriers and facilitators to an individual pharmacist performing and documenting clinical interventions. Again, Figure 6-1 shows the factors that may have influenced the pharmacist's intervention rate.

The findings from the focus groups revealed that some interventions may not have been documented because pharmacists failed to recognise them as an intervention or were not rewarded for the documentation. It appears the reasons for this are twofold; intervening is routine practice for pharmacists and therefore pharmacists fail to recognise an intervention, and, in addition, some pharmacists lack the clinical knowledge to recognise

the need for a clinical intervention in the first place. Many of the qualitative findings reinforced the results found during the quantitative analysis.

6.2.1 *Intervening is second nature*

The owner/manager group discussion revealed that pharmacists often did not identify their recommendations for minor DRPs as interventions, since intervening is second nature to most pharmacists. This conclusion was supported by the results of the observer focus group which showed that pharmacists would perform interventions instinctively, without actually recognising their actions were an intervention. The observers estimated that only approximately 50% of the interventions they observed were actually documented by pharmacists and those that were missed were suspected not to be recognised as interventions.

6.2.2 *Clinical knowledge*

The observers reported that in many cases the pharmacist's clinical knowledge and how they used this knowledge was an important driver in the performance of interventions. One observer stated that;

"The knowledge has to be there to do interventions..."

And another extended this by saying;

"I think it is more about the practice, which is to say, if you have got into the habit of being vigilant for interventions then you are more likely to do it... You can have all the knowledge... but it doesn't occur to you to make an intervention"

However, observers also reported some interventions that were missed by pharmacists who were not equipped with adequate clinical knowledge. As one observer said;

"I was in two pharmacies that were really, really quiet and things that could have been done were completely missed and that probably goes back to the knowledge of the pharmacist. So staffing is not the only reason interventions are not done."

The results of the software survey showed that 83% of participants believed that they had good clinical knowledge compared to 2% who disagreed and 15% who reported neutral feelings. In addition, 80% of participants believed that the trial had increased their awareness of how many clinical interventions they performed.

The observers said that continuing education and staff training could be used to improve clinical knowledge. The observers found that AACPA pharmacists tended to be more clinically aware and performed a greater number of clinical interventions than other pharmacists. One observer reported that;

“Accredited pharmacists on staff made a difference as they were looking for them (interventions)”

6.2.3 Purpose for documenting

The outcome of the observer focus group found that the observers believed there was little incentive for employee pharmacists to document interventions because the \$1200 participation payment for the trial was made only to pharmacy owners (who could choose to pass on the remuneration if desired). The owner/managers reported a similar facilitator stating that there was a need to reward employee pharmacists to ensure that documentation of clinical interventions was carried out. Furthermore, it was reported that some employee pharmacists believed that there was no tangible purpose to documenting minor interventions. They perceived no health benefits and in turn saw documenting simply as an addition to their workload.

6.2.3.1 Personal satisfaction

The owner/manager focus group felt that a pharmacist’s sense of personal satisfaction was a driver for performing and documenting interventions. In particular, the documentation of the intervention was a confirmation of its importance and this perceived importance would induce some pharmacists to conduct and document more interventions. One owner/manager reported that;

“I found it pretty rewarding as it reminds you of the job you are actually doing. All the things you can take for granted you are actually documenting.”

6.2.3.2 Medico-legal concerns

The observers reported that pharmacists were most likely to document clinical interventions in cases where they have dispensed an item against their better judgement, for example, when there has been a disagreement with the prescriber. An observer reported that;

“Some who have their hand forced to dispense something they are not completely comfortable with, will document”

6.2.3.3 Good feedback

The observers noted that a driver for documenting interventions was when pharmacists received good feedback. Pharmacists would benefit from positive reinforcement on interventions and it would be useful to know that a GP had responded to a recommendation and the outcome. As one observer put it;

“At the end of the day ultimately we are all like lab rats... we all like a pat on the back... now whether that reward is money, CPD points or the knowledge that you have done a good thing... we all want that pat on the back...But what we want is payback, some reward for doing a good job”

The observers and the owner/managers suggested that allocating CPD points directly to employee pharmacists could overcome this issue and improve intervention rates.

6.2.4 Interactions with the consumer

The observers stated that some pharmacists had low consumer contact due to them being ‘wedded’ to their dispensing terminals, and the owner/manager focus group reinforced this conclusion. They both agreed that the minimal interaction with patients reduced the chance of pharmacists identifying DRPs and performing interventions. One observer reported;

“They (some pharmacists) put the dispensed script there for someone else to hand out. They don’t want to go out into the pharmacy”

The focus groups felt that one way to overcome this and to drive an increase in the level of interventions would be to encourage pharmacists to counsel consumers when handing out all prescriptions.

The observers reported that pharmacists with good communication skills and a willingness to engage consumers in conversation were more likely to have higher intervention rates. One observer described a situation with a pharmacist who engaged the patient;

“There were so many things that came up in conversation which were not directly asked about”

Furthermore, the observers noticed that recommendations from pharmacists were more accepted by consumers when rapport and trust had been established in the relationship. As mentioned previously, good communication between GPs and pharmacists also encouraged pharmacists to intervene and make clinical interventions, particularly when GPs provided pharmacists with feedback from the actions taken as a result of a recommendation.

6.2.5 Workload

The most commonly reported barrier amongst the observed pharmacists was the amount of 'other' tasks that the pharmacist was performing. Many observed pharmacists were the owners that had administration tasks to attend to during the day, thereby decreasing the amount of time spent dispensing and interacting with the consumers.

The observers also noted that overall higher workloads within the pharmacies and the dispensaries decreased the abilities of the individual pharmacists to perform and document interventions. This was generally due to inadequate staffing levels or poorly trained staff, which decreased the amount of time the pharmacist could spend on clinical services.

The observers reported that when pharmacists were busy, only the more potentially serious interventions were performed. In addition, the owner/manager respondents reported that some pharmacies were so busy in periods that there was no time to document immediately after an intervention occurred, where pharmacists would document later in the day if they remembered. An observer stated that;

"It is not the time taken to document but rather when it happens you may not have time to deal with it then"

6.2.6 Entrenched work practices

The owner/managers pointed out that the adoption of a new procedure took time to establish into a dispensary workflow. During the trial, pharmacists adapted their workflow by using strategies to incorporate the documentation of interventions. The software also had features to improve documentation, such as the ability to save an empty draft in a patient's history as a reminder to later document the intervention. One pharmacy was observed to have a highlighted tag system so dispensing assistants could initiate a draft in a patient's history for the pharmacist to complete at a later time. Pharmacists were also

seen to make notes on a writing pad with the patient's name. An owner/manager reported that strategies such as these should be included in training;

"It would be good to have it as the first point of training...It is like scanning as that was hard to get used to."

Both the owner/manager and observer focus group participants reported the physical dispensing routine being a barrier to identifying interventions. The owner/managers reported that pharmacists have difficulty incorporating the documentation of clinical interventions into the current workflow of pharmacies, as it requires a change to their current dispensing routine.

"You would not put a script through and not put a label on as it is part of the process... if you make interventions (and documentation) part of the process by saving a draft, then it will happen"

Observers reported that some pharmacists already had poor dispensing systems, where, for example, the supervision of the provision of Pharmacist Only (or schedule 3) medicines was not always performed, patient history checks were not always completed during the dispensing process if conducted by a dispensary assistant, and where pharmacy assistants would take in prescriptions and hand out dispensed items. This may further decrease the likelihood that the pharmacist would change their practice, as they already had a poor practice in place. Due to this, the observers felt that pharmacists who adhered to quality practice guidelines, such as Pharmacist Only medicine counselling and checking patients' histories, were more likely to perform interventions.

6.2.7 Remembering to document

Owner/manager pharmacists reported that one of the greatest causes of low documentation rates was due to forgetting to enter the intervention details into the computer software. Some of the owner/managers reported that even when there was time to create a draft and save it under the patient history, they could not recall the specific intervention details when it came time to completing the draft at the end of the day. It was suggested that unless dispensing routines were modified to include documentation, then documentation was often forgotten. One respondent reported;

“If they were in a middle of a pile of scripts and they needed to document something, then often it was forgotten”

Another observer stated that;

“I have been in both Promise II and Promise III so I have a good idea what an intervention is, but it is remembering to document it”

Similarly, observers reported that pharmacists would become distracted by internal and external factors which meant that the rate of which interventions were performed was reduced. One observer reported;

“There were always things that were distractions which prevented them from doing it. Another script comes in and they forget”

6.2.8 Attitude

The observers noted that the pharmacist’s attitude to their pharmacy practice largely influenced their intervention rate. Those pharmacists who were more pro-active and engaged with the patients on a regular basis were more likely to perform and document interventions.

Some observers reported experience as being a driver for performing interventions, whereas others reported higher intervention rates in the graduate or newly registered pharmacists. It is possible that this was linked with the level of clinical knowledge (section 6.2.2), where both experience within the pharmacy and also recent graduation could increase the pharmacist’s level of clinical knowledge and their ability to detect DRPs.

6.2.9 Training

The owner/managers also recognised both the face-to-face and online training as a driver for identifying DRPs and documenting interventions, as they improved the pharmacist’s knowledge in the area of DRPs. The respondents said that case histories with the inclusion of the classification and likely outcome should an intervention not occur were a good means of training in PROMISe III. The owner/managers mentioned that including the documentation of clinical interventions into undergraduate training would be important if the system becomes commonplace.

The observers also noted that the level of training within the PROMISe software and DOCUMENT system also affected the pharmacist's intervention rate. For example, locum pharmacists who were observed were unfamiliar with the system and therefore this decreased the number of interventions performed and documented. Conversely, pharmacists who had completed training and were aware of the definition of a clinical intervention were more likely to perform and document interventions.

This underscores the importance of continuing education to maintain a high standard of clinical and practical knowledge, and thereby increase the identification of DRPs. Furthermore, good staff training means that pharmacy assistants are more likely to recognise potential DRPs and refer to the pharmacist.

6.2.10 Software

As mentioned in the previous section, observers felt that the presence of the PROMISe software increased the number of interventions performed and documented. From the software survey, it also appeared that the majority of pharmacists (86%) felt the overall system was easy to use. However, the observers noted that pharmacists with poor computer skills had a decreased intervention rate, which may be due to their inability, or a perceived difficulty, to use the software. These pharmacists may have also been unlikely to complete the online surveys, making it difficult to interpret their thoughts about the software. For these pharmacists, they received an opportunity to comment on these types of problems during the post-trial focus groups, however, very little negative feedback was received with this survey.

6.2.10.1 Complex classification system

The findings from the owner/manager focus group revealed that some pharmacists had difficulties with the classification of interventions. Some respondents reported that when problems arose with classifying interventions, there was a tendency to delete the intervention rather than spend time on its categorisation. One of the respondents stated that;

"If I am still not sure how to classify an intervention, I just cancel out of it."

In addition, respondents to the software survey reported that;

“Sometimes I find it hard to classify the type of intervention and putting into category as each scenario tends to be unique.”

“Even with all the practice examples and DOCUMENT system help, I personally still find it difficult to categorise interventions and it tends to stop me doing them.”

Despite these results, it appears that the majority of the participants were satisfied with the number of classifications. When asked if ‘the number of DOCUMENT intervention classifications should be increased’, 231 (87%) pharmacists responded ‘No’ and 36 (13%) responded ‘Yes’. When asked if ‘the number of DOCUMENT intervention classifications should be decreased’, 225 (84%) pharmacists responded ‘No’ and 42 (16%) responded ‘Yes’. Overall, 190 (71%) pharmacists thought that the number of classification categories was optimal, responding with ‘No’ to both questions.

6.2.10.2 Prompts

There were differing opinions about the use of the prompt from the owner/managers; some thought it was useful whereas others found it annoying. The most annoying times for the prompt to appear was when a patient had been counselled at a previous dispensing on the same issue, and when the dispensary was busy and the identified DRP was minor. As such, the owner/managers suggested that pharmacists should have control over the appearance of the prompt. These suggestions included the ability to turn the prompt off, restricting the prompt to a pharmacist’s initials and restricting the prompt to certain times of the year or public health events.

The respondents of the software survey were also asked about the prompt. Of the 89 pharmacists who answered the question, 34 (38%) felt the prompt was annoying, with 28 (32%) disagreeing and 27 (30%) having neutral feelings. The majority also reported wanting the function to switch off the prompt for patients and/or switch off the prompt completely (77% and 92% respectively). Interestingly, 83% preferred not to restrict the prompt to pharmacist’s initials. The respondents also reported wanting the prompt to change regularly to avoid repetition (67%), with many believing the best option was to coincide the prompt with NPS releases (48%).

All owner/managers agreed that it is beneficial to coordinate prompts with public health initiatives, such as diabetes and cardiovascular disease campaigns.

“I’ve seen some very clever pop ups ... you’ve got somebody on diabetic medication and it does a check and sees if they’re on aspirin, ..., and then you go out and say ‘are you on aspirin’ and then you do that until you’ve done it to death, and you go in and switch it off and say ‘I’ve had enough of that pop up’ you know, and you’ve got a function in there that you can actually turn it off, and then next month you might get another one and you can have a go at that...”

The observers also pointed out that a prompt or report to remind pharmacists of incomplete records within the system would facilitate intervention documentation. However, the majority of respondents to the software survey (69%) reported that a more prominent reminder to complete draft interventions was not necessary, while only 31% reported it was necessary. Of the respondents, 58% believed that a button on the dispensing screen to log a draft intervention for later completion would be beneficial.

6.2.10.3 General reminder

Of the pharmacists who completed the software survey, 208 were exposed to the general reminder during the trial. Of these pharmacists, 77 (37%) felt the reminder was annoying, with 62 (30%) disagreeing and 69 (33%) having neutral feelings.

6.2.11 Discussion of qualitative analysis of pharmacist factors

Many of the influencing factors identified within the quantitative analyses were also noted as influential within the observational substudy and post-trial focus groups, with workload, clinical knowledge and pharmacist attitude being common themes throughout the qualitative analysis.

Workload was the most commonly reported barrier amongst the observed pharmacists, with many ‘other’ tasks impacting on the number of interventions performed and documented. Despite this, the observational sub-study workload analysis only showed one significant correlation with intervention rate, where the intervention rate decreased as the number of Safety Net cards issued increased (see section 5.4.3). This is most likely due to Safety Net cards taking extra time; therefore, increasing the pharmacist’s workload and resulting in a decreased number of interventions performed. None of the other pharmacist tasks correlated with intervention rates within the observational sub-study, despite the observers noting that the amount of administrative tasks the pharmacist undertook was a barrier to performing and documenting interventions (section 6.2.5).

Two Irish studies have previously reported that around 20% of a pharmacist's time was spent on non-professional activities that could be performed by non-pharmacist staff^{116,117}; therefore, by decreasing the amount of time pharmacists spend on non-professional duties, the number of interventions performed and documented could be increased.

Lack of adequate staff tends to lead to a higher pharmacist workload, as evidenced by the observer data (section 6.2.5), which may lead to a decreased intervention rate. This is inkeeping with a pharmacist survey in the USA which showed that 89.6% of pharmacists felt that inadequate staffing levels prevented their uptake of a medication management service.¹⁰⁹ The pharmacists within the PROMISE trial and the observational sub-study also reported that lack of staff was a significant contributor to their intervention rate.

Interestingly, the number of other pharmacists present during the pharmacist's shift did not appear to correlate with their intervention rate. It would be expected that the number of pharmacists present would be an indicator of the workload within the pharmacy, so it was interesting that the average number of other pharmacists present was not associated with the intervention rate of the pharmacist, and may indicate that the belief of not having enough staff has a stronger influence on pharmacist participation than the actual lack of staff.

Perhaps the most interesting finding in regards to workload was within the observational sub-study, where a significant correlation between prescription volume and *performed* intervention rate was found whilst no correlation was found between prescription volume and *documented* intervention rate (Table 5-57). This may indicate that workload does not affect the number of interventions that are documented, however it does affect the number of interventions that are performed. It is possible that a heavy workload impacts on the number of time-consuming, or perhaps less important, interventions that are performed, where the pharmacist finds themselves too busy at that particular time to perform the intervention. Although only a small sample of pharmacists were observed, if this finding was extrapolated out to the general pharmacist population, it could indicate that many interventions were simply not performed due to workload and the number of missed interventions will never be known.

Clinical knowledge was closely linked with the pharmacist's intervention rate within the bivariate and multivariate analysis, and the observers also commented that clinical

knowledge was extremely important as they had seen several missed intervention opportunities due to the pharmacists' lack of knowledge.

The attitude and motivation of the pharmacist was also noted to be an influential factor on the intervention rate of observed pharmacists, with observers noting that the more motivated and enthusiastic pharmacists tended to have a higher intervention rate than their less enthusiastic counterparts. The observed pharmacists who were more proactive and engaged with the patients on a regular basis were more likely to perform and document interventions. Entrenched work practices, which specifically reflect a pharmacist's past behaviour, were also reported as a major barrier to performing and documenting interventions during the observational sub-study. This result was also found by Odedina et al.¹⁴¹, who found that the most important predictor of behaviour was past behaviour. This indicates that practice change is required before a pharmacist can effectively offer additional professional services, as the pharmacist's attitude appeared to be closely linked with their intervention rate with the more motivated and enthusiastic pharmacists participating more effectively in the trial.

The PROMISe focus groups also revealed that intervening is second nature for many pharmacists and that they perform interventions automatically without stopping to realise that their action was an intervention. The observers also noted that interaction with consumers is one of the main drivers to performing interventions and the level of interaction was often a factor of the pharmacist's attitude. Distractions were also a problem for many pharmacists, which could also be attributed to the pharmacist's attitude and work practice, as the level of disruption that the distraction causes may be dependent on the individual pharmacist.

6.3 Conclusion

The qualitative analysis of the results from the focus groups, software survey and observational sub-study reinforced many of the findings within the bivariate and multivariate analyses within Chapters 4 and 5. Workload and dispensing volumes were found to significantly impact on the pharmacist's ability to perform and document interventions, both within the qualitative and quantitative analyses. However, the qualitative analysis revealed that it is not absolute volumes that are always the biggest impact, but that factors such as inadequate staff training, additional professional services

and pharmacist attitude can also significantly impact on workload and cause further decreases in the pharmacist's ability to perform and document clinical interventions.

7 Chapter 7: Improving intervention rates

There are two facets to improving the documentation intervention rate; increasing the number of interventions performed and also increasing the number of interventions documented. As was seen in Chapter 3, an average clinical intervention performed in community pharmacy saved the Australian Government \$360¹⁶⁴, so it is reasonable to assume that improving the number of interventions performed would have a substantial positive impact on reducing healthcare expenditure within Australia. A reduction in healthcare expenditure has also been shown in other clinical intervention studies.^{32,168} The observational sub-study found that pharmacists only documented half of the interventions they performed. Although an increased documentation rate may not increase the actual number of CIs performed, improvements in the documentation rate are clearly desirable, as this will lead to more comprehensive patient records, and also provide key insights into the nature of DRPs that are resolved by pharmacists.

7.1 Improving the documentation rate of the pharmacy

Several factors were found to be associated with the intervention rate of the pharmacy and modifying these factors may help to promote a higher rate of intervention documentation. The results from both the bivariate and multivariate analyses have been considered within this section.

7.1.1 Software

The PROMISE software was integrated into the dispensing systems of participating pharmacies, and pharmacists typically found it was intuitive and easy to use. It was also successful in capturing the required data for subsequent analysis by the research team. Overall, the software was considered a success, with the feedback gained from participants being very positive. However, before a national implementation of this program could be considered, the PROMISE final report recommended that several minor flaws be addressed.¹⁶⁴ These amendments aimed to improve usability of the system as well as promote a more complete patient health record. These amendments included:

- Capturing the date and time that the intervention screen was activated (rather than the date and time of submission to the database) to improve reporting for workload analysis, so that it is known more accurately when the intervention was performed, rather than documented

- Capturing the intervening pharmacist's initials as well as the original dispensing pharmacist's initials, so that it is known more precisely who actually performed the intervention, rather than just who dispensed the prescription
- Real-time separation of the prescription-linked and non-prescription interventions to allow separate intervention rate calculations to be provided within the feedback displays
- Improved indication to the users of completed interventions, such as a descriptive note in the patient's dispensing history
- A context-sensitive information input box to be activated by certain recommendation codes (for example, if 'Dose decrease' was selected, the documenting pharmacist would be asked for the dose before and after the intervention) and a mandatory notes section to help ensure that adequate information was documented with each intervention
- The ability to link with e-health records in the future to increase the accuracy of patient histories
- Improved messaging systems and regular auditing to ensure consistent data within the database
- Creation of a reminder to encourage patient follow-up after an intervention
- Allowing intervention documentation with point-of-sale (POS) software to improve the documenting of OTC interventions
- Standardising the drug codes used by the dispensing software companies to allow more consistent data records within the database

Adjustments to the software system, such as the abovementioned improvements, would lead to improved usability of the documentation system, as well as a more accurate patient record. This would also hopefully increase the intervention rate of the pharmacies, as the documentation system may be seen as easier to use. It would also enable more comprehensive analyses and the subsequent development of recommendations to optimise the performance of clinical interventions.

7.1.1.1 Prompt

Although the prompt did not appear to significantly influence the intervention rate overall, there did appear to be a significant trend from Group One (software only) to Group Three (software with reminders and prompts), where the intervention rate increased as the group number increased. This non-significant finding was most likely due to the specificity of the targeted medications, as the prompt was only activated on 3.8% of the total prescriptions dispensed, which may not have been a large enough percentage of prescriptions to influence the overall intervention rate. The prompt significantly increased the number of interventions documented for esomeprazole and pantoprazole, the two medications that triggered the appearance of the prompt. As discussed in Chapter 4, this

was assisted by the prompt being interruptive and having to be dealt with before the dispensing process could continue. There was also no software feature that allowed the pharmacist to indicate that the intervention was due to the prompt and as a result, it is possible that the prompt data extraction method would have underestimated the true number of prompted interventions. Therefore, it is possible that the actual number of prompted interventions was higher than reported.

The prompt feature was seen as a major advantage of the PROMISe system. It encouraged the pharmacists to undertake a specific intervention and, therefore, could be used as a platform to increase the pharmacist's knowledge in certain therapeutic areas. For example, the prompts could be linked to NPS campaigns and other national health initiatives. This suggestion has beneficial outcomes as the pharmacist's clinical knowledge would improve through the use of educational material linked to the prompt¹⁸¹, as well as targeted patients receiving improved medication or disease management as a result. It could also be beneficial to target specific medications, such as screening for adverse effects of a newly registered medication.

Some pharmacists reported that the prompt was annoying, and expressed an interest in controlling when and how the prompts appeared. A feature that could be explored in the future would be the ability to turn off the prompt for a particular patient or for particular dispensing pharmacists. For example, it may be appropriate to have the ability to deactivate the prompt for specific patients if that particular issue had already been addressed with the patient, or they were deemed unsuitable for the intervention by the pharmacist. This alone would reduce subsequent inappropriate displays of the prompt, and also reduce the effect of prompt fatigue^{39,134}, as fewer irrelevant prompts would subsequently be displayed. It may also be an option for a deactivated prompt to automatically reactivate after a certain time frame so the patient can be reassessed by the pharmacist.

The number of interventions triggered by the prompt decreased over the period of the trial, which could indicate pharmacist fatigue with the prompt. The decline may also have been attributed to the group of eligible patients being exhausted after the first six weeks. A method for combating this decline could be the introduction of rotating prompts. Focus groups with the observers and pharmacists suggested that the prompts could change to target a number of specific health-related issues. Prompts could be rotated periodically,

for example, during one month it may be triggered by certain diabetic medications encouraging pharmacists to discuss issues related to diabetes, and the next month it may target patients with asthma. Related professional development modules could be developed corresponding with each prompt, or as mentioned previously, the prompts could coincide with NPS campaigns (usually four campaigns per annum), which would already provide the essential training and assessment for the pharmacist.¹⁸¹ Remuneration for the prompted interventions may also provide an incentive to document interventions linked to the prompt and, therefore, provide a more consistent rate of intervention.

As was seen in Chapter 4 and Appendix 22, the prompt feature within the PROMiSe system was shown to be a cost-saving measure, with the average cost saving being \$183.60 per pharmacy per year⁴⁰, leading to a decrease in healthcare expenditure. In addition, the prompt has the ability to deliver additional clinical education to the pharmacist, which is likely to increase the number of interventions performed and improve patient outcomes.

7.1.1.2 General reminder

The general reminder significantly increased the number of interventions documented in the hour after the reminder appeared. Although this did not appear to influence the overall intervention rate of the pharmacy, the spike in the number of interventions documented after the reminder was displayed implied that it may have improved the pharmacist's awareness of the trial. Therefore, simple reminders that encourage the pharmacist to document their interventions would be beneficial to the system, as this may help to combat the declining intervention rate discussed in Chapter 3, in combination with the specific prompts.

7.1.2 Workload

Pharmacy factors, such as increased prescription volume and pharmacist workload, were associated with a decreased intervention rate within the PROMiSe trial and have been reported within the previous literature.^{27,61,77,83} Therefore, strategies to overcome these barriers need to be developed. Pharmacy owners and managers need to be educated about balancing the workload of their pharmacists with professional services, such as performing and documenting interventions. The Australian Pharmacy Board and the PGA need to start enforcing the recommended maximum prescription volume per hour to ensure satisfactory workload models. The PROMiSe trial showed that participating

pharmacists were seemingly dispensing similar or lower prescription volumes compared to the recommended volumes. If pharmacists with lower than recommended workloads and prescription volumes are finding that their workloads are significantly impacting on their ability to document their clinical interventions, then pharmacists working in pharmacies that dispense the recommended 'safe' levels would feel an even bigger impact. This may indicate that the current 'safe' levels also need to be reviewed, which may improve the workloads and ability to provide professional services within the current pharmacy environment.

As the current business model remunerates pharmacies based on prescription volume, a different model that remunerates pharmacies based on other professional services may assist with overcoming barriers associated with workload by providing the potential for employing additional staff. For example, remuneration received from a professional service, such as documenting clinical interventions, may provide funds to employ an additional staff member, thus enabling more clinical interventions to be performed and documented, resulting in more remuneration. In addition, the pharmacy media reports a current oversupply of pharmacy graduates within Australia¹⁸², which unfortunately may eventually result in pharmacists working for lower wages. Again, this may provide adequate funds to employ an additional pharmacist. Either way, this additional employee would decrease the other pharmacists' workloads and increase the amount of time they can allocate to professional services, which in turn would likely increase the number of interventions performed and documented.

Prescription volume and pharmacist workload featured heavily within the bivariate analysis, as the majority of factors associated with the pharmacy's intervention rate were also related to prescription volume and pharmacist workload. The size of the pharmacy, financial turnover and trading hours were all negatively correlated with intervention rate. This was most likely due to the bigger, busier pharmacies having a much higher prescription volume and, therefore, usually a higher pharmacist workload, which would decrease the amount of time that the pharmacist could spend on professional services.

The two multiple regression models found that the most significant factors to predict a pharmacy's intervention rate were: prescription volume; pharmacist workload; annual financial turnover; location in or near a medical centre; participation in other pharmacy trials; and, whether the pharmacy catered for aged care facilities. Prescription volume and

pharmacist workload were also individually related to the other factors and were most likely the driving force behind the inclusion of several of these variables. The pharmacies with higher financial turnovers and that catered for ACFs had higher prescription volumes and pharmacist workloads, whilst the pharmacies located in or near medical centres had lower prescription volumes and pharmacist workloads. This showed the major impact that prescription volume and pharmacist workload can have on the pharmacy's intervention rate.

The observational sub-study revealed that the pharmacy and pharmacist prescription volumes were significantly associated with *performed* intervention rate, but not the *documented* intervention rate within the observed pharmacists. This may indicate that workload has variable effects on the number of interventions documented, but can also affect the number of interventions performed. This finding may indicate that improving the workload within the pharmacy will increase the number of interventions performed, thus improving patient care.

Overall, improving the pharmacist's workload would most likely increase the number of interventions performed and documented, increasing the pharmacy's intervention rate. Due to the current remuneration model where pharmacies receive payment for each prescription dispensed, pharmacies would not want to decrease their overall prescription volume. Therefore, improving the pharmacist's workload could be best achieved by increasing the number of pharmacists and/or trained support staff, resulting in a reduction in the pharmacist's workload without decreasing the pharmacy's prescription volume. Additional remuneration to allow the pharmacy to employ additional staff would be most accessible through the remuneration of professional services. The need for adequate staffing levels has also been identified in previous studies, where sufficient staffing levels have improved participation rates and increased the level of participation.^{53,97,107,109} As suggested by Pai¹¹⁸ and Angelo¹¹⁹, minor alterations to the dispensary workflow could also help to improve the pharmacist's workload, without the need for additional staff.

7.1.3 Professionalism

During the bivariate analysis, pharmacies that were part of a banner group were also shown to have a decreased intervention rate when compared with independent pharmacies. Typically, banner group pharmacies tend to be more commercial and

‘supermarket-style’ rather than being ‘professional’ (orientated towards delivering better healthcare in a professional manner). This finding has also been noted in previous studies, where independent pharmacies in Canada had a higher intervention rate than chain pharmacies.⁶⁵ PROMISE pharmacies that the site visitors remarked as looking ‘healthcare-orientated’ or ‘professional’ were also associated with higher intervention rates, therefore, it may be beneficial to switch the focus of these ‘chain-style’ pharmacies. A targeted education campaign within banner group or ‘supermarket-style’ pharmacies in the future may help to shift their focus from commercialism to professionalism, which may then increase the intervention rate.

On the other hand, participation in other pharmacy trials was a negative influence on the pharmacy intervention rate within the multivariate analysis, where participating pharmacies had a lower intervention rate on average compared to non-participating pharmacies. It would be logical that pharmacies participating in other trials would have been more professional, as participation in these trials aims to further the pharmacy profession; however, these pharmacies had a lower intervention rate. This is likely due to an increased demand on the pharmacist’s time that additional trials require that may not have been measurable using prescription volumes and the pharmacist workload measure. Pharmacies need to be encouraged to keep a balance by participating in research to improve the profession, but not to overextend themselves, resulting in their multiple participations being of poor quality.

Increasing the professionalism of the pharmacy is especially important with the recent decrease in pharmacy reimbursement under the PBS. Previously, pharmacies were remunerated for their prescription volume, with bigger profits to be made when pharmacies dispensed certain generic brands of medications. From April 1st 2012, price disclosure laws came into effect within Australia.¹⁸³ This led to the Government dropping the remuneration on each brand of medication, which in turn decreased the payments available to pharmacies to dispense these medications. In addition, a large number of frequently prescribed medications will be coming off patent in 2012, which will lead to an even larger number of generic brands hitting the market. This means that pharmacies will need to look to additional sources, such as professional services, to increase their income. Pharmacy owners and managers therefore need to accommodate this changing remuneration model and aim to increase the professionalism of their pharmacy through offering professional services.

7.1.4 Additional factors

The multivariate analysis showed that pharmacies located in a medical centre had higher intervention rates on average. This is most likely due to the pharmacy having a good relationship with the GPs within the medical centre, increasing the pharmacist's confidence and motivation to perform clinical interventions with the knowledge that the GPs will seriously consider their suggestions. Although adjusting the location of the pharmacy is not achievable in most situations, pharmacies can always strive to improve relationships with the local GPs. Encouraging the pharmacies to build better relationships with local physicians may increase the number of interventions performed and documented. This was also identified by Roberts et al.¹⁰⁷ who found that having good rapport with local physicians was a key factor in successful change management.

The multivariate analysis also showed that pharmacies that catered for ACFs had a lower intervention rate than pharmacies that did not. This may have been due to two factors. Firstly, these pharmacies have an increased number of distractions associated with the facilities, such as interruptive phonecalls, additional paperwork and medication checking. Secondly, these pharmacies process many prescriptions that do not require interaction with the patient, most likely decreasing the number of interventions performed. The pharmacies would not wish to lose their contracts with the ACFs, as they provide an additional source of income; therefore, other measures need to be adjusted. Improving the workloads within these pharmacies, such as utilising a technician to field phonecalls and process the paperwork, would increase the time available for the pharmacist to document their interventions. Encouraging the pharmacy to document the interventions they perform on the medication charts received from the ACFs, as these charts are effectively a prescription, may also improve their intervention rate.

7.1.5 Conclusion

From the results of the PROMISe III trial, it appears that the intervention rate of the pharmacy could be increased by improving the pharmacist's workload. This could be achieved through the regulatory enforcement of appropriate dispensing volumes and the employment of additional staff when required. Other pharmacy factors that were correlated with the pharmacy's intervention rate, such as annual financial turnover, pharmacy location and catering for aged care, may not be as easily modifiable as workload; however, additional support for these pharmacies may allow an increase in

their intervention rate. Encouraging the pharmacies to be more selective with the number of trials they concurrently participate in may also improve their intervention rate. The use of prompts and reminders could also contribute to an improved intervention rate by encouraging pharmacists to perform and document interventions that they may not have otherwise done. The prompts could be activated to coincide with educational programs offered by organisations, such as the NPS, which would facilitate improved health within the community as well as improve the pharmacist's therapeutic knowledge.

7.2 *Improving the documentation rate of the pharmacist*

When provided with the right tools, such as the PROMIS_e software, all pharmacists have the capability to document their interventions. However, individual and environmental factors appeared to be associated with their intervention rate. During the individual pharmacist analysis, several additional factors were also identified within the pharmacist dataset that may help to improve intervention rate of the individual pharmacists, which in turn would improve the intervention rate of the pharmacy and, ultimately, improve patient outcomes.

7.2.1 *Demographics*

There did not appear to be any association between the pharmacist demographics and their intervention rate during the PROMIS_e trial. This was also seen in previous studies on factors influencing the provision of professional services^{75,115}, and indicates that other factors, such as attitude, may be more important. During the bivariate analysis, some professional memberships were associated with a higher intervention rate, such as AACP and SHPA. However, simply joining these organisations would obviously not automatically increase the pharmacist's intervention rate. It is likely that the member pharmacists already had a higher clinical knowledge (due to the nature of these organisations) and, therefore, an improved ability to detect DRPs. These pharmacists may also be more motivated and enthusiastic within their profession, naturally leading to a higher participation rate in professional services.

During the trial, only 425 of the 509 active pharmacists documented an intervention, resulting in 84 or 16.5% non-performing pharmacists. There did not appear to be many differences in the measured parameters between the performing and non-performing pharmacists, with the only significant difference in the level of training, where the non-

performing pharmacists were significantly more likely to have not completed training. Improving the participation rate would be expected to increase the overall intervention rate, with the analysis of non-performing pharmacists suggesting that encouraging training may facilitate an increased participation rate.

7.2.2 *Multivariate analysis*

A multinomial logistic regression was used to model the pharmacist's intervention rate, with four variables contributing significantly to the model: number of annual CPD hours, level of clinical intervention training, clinical knowledge survey score and adaptability score. As discussed in Chapter 5, pharmacists with a higher number of annual CPD hours, a higher level of training, a higher clinical knowledge and an 'adaptable' attitude had higher intervention rates.

7.2.2.1 *CPD activity and incentive CPD points*

The number of hours each pharmacist spent on CPD annually was significantly correlated with their individual intervention rate, with the pharmacists with a higher level of annual CPD activity having a higher intervention rate. As discussed in Chapter 5, it is likely that CPD activity increases the clinical knowledge of the pharmacist and therefore improves their ability to detect and resolve DRPs in the community pharmacy environment. It is also likely that pharmacists who attend education sessions and complete additional training in their own time are more proactive within their profession, and are therefore more likely to participate effectively in a professional program. This has been seen previously in other studies, where the pharmacists who attended educational sessions and additional training were more likely to participate in professional programs or have higher rates of participation.^{34,106,110}

One of the main facilitators that arose from both the focus groups and the online survey was that incentives for pharmacists will encourage the performance and documentation of interventions. It was thought that CPD points would be a sufficient incentive, especially since annual pharmacist registration with the Australian Pharmacy Board now requires that a certain number of CPD points be gained annually before re-registration is approved. Pharmacist intervention rates may therefore be improved by allocating CPD points to each documented intervention or by allocating a set number of CPD points per year if the pharmacist adequately participates in the documentation of interventions. In turn, this

would increase the number of interventions documented, and may also increase the number of interventions performed, ultimately improving patient outcomes.

7.2.2.2 *Clinical knowledge and training*

The outcomes of the observer focus groups showed that one of the main barriers and facilitators to performing clinical interventions was the clinical knowledge of the pharmacist. This was also seen with the pharmacists with additional qualifications, as pharmacists who had undergone additional clinical knowledge training had a higher intervention rate, a finding that has been reported previously in the literature.⁶⁸ A higher score in the clinical knowledge survey administered during the trial was also associated with a higher intervention rate, which has also been found in previous studies.^{106,115} In order to meet professional pharmacy standards, it is important that pharmacists undergo continuing education to improve and maintain their clinical knowledge, thus leading to an increased intervention rate. Any learning activity which improves the pharmacist's clinical knowledge can reasonably be expected to improve their intervention rate. This may include any number of educational activities, such as attendance at conferences, journal readings or self-directed learning. As discussed in section 7.1.1.1, professional development modules could be provided regularly in conjunction with prompts within the intervention documentation software. The PSA and NPS could be key providers of this ongoing education, which would increase the knowledge of the pharmacists, thus contributing to a higher intervention rate and improved patient outcomes.

Extensive online and face-to-face pharmacist training modules were developed and administered to the pharmacists prior to the PROMISe trial. The level of training that the pharmacists completed was significantly correlated with their intervention rate during the trial, and many non-performing pharmacists also completed no training. Encouraging all pharmacists to complete the online intervention training is therefore likely to significantly increase their intervention rate. The number of pharmacists completing the training could be improved through incentives, such as additional CPD points, which should increase the intervention rates of pharmacists and, in turn, improve the intervention rates of their pharmacies and health of their patients.

7.2.2.3 *Attitude and practice change*

There was a significant correlation between the pharmacist's opinions about interventions and their intervention rate, with the pharmacists whose answers indicated they were

more motivated and enthusiastic having a higher intervention rate during the trial. Unfortunately, altering the motivation and enthusiasm of an individual is extremely difficult, and could only be done if the pharmacist was willing to change. The effect of attitude on a pharmacist's ability to provide professional services has been noted in previous studies, with the more motivated, confident and positive pharmacists tending to have a higher level of participation.^{101,102,110}

It is therefore important to educate pharmacists on the importance and significance of interventions, hopefully motivating them to change their practice and facilitate the documentation of interventions. This has been previously identified by Roberts et al. stating that "too much emphasis is still being placed on the skills, knowledge and attitude of the individual pharmacist".⁹⁷ Pharmacists, and pharmacies, need to be equipped with tools to adapt their practice to successfully provide these services and to maintain long-term provision of these services. Another study by Roberts et al.¹⁰⁷ identified seven factors that facilitated practice change within the pharmacy environment, many of which were also identified within the PROMISE trial: good rapport with local physicians; remuneration; appropriate pharmacy layout (such as a private consultation area); patient expectation to provide the service; sufficient staffing levels; good communication and teamwork; and adequate external support and assistance.¹⁰⁷ By identifying which factors will improve practice change within individual pharmacist and pharmacy level, and by providing adequate assistance to implement the professional service, an intervention documentation system is likely to be more successful and more consistently used within the pharmacy. This in turn will lead to an increased and sustained intervention rate.

Pharmacists need to be assisted with implementing practice change to ensure that interventions continue to be documented. Practice change could be assisted by targeting pharmacy students whilst they are still at University. If the documentation of interventions was established as routine pharmacy workflow in the early part of a pharmacist's career, it would be much easier for the pharmacist to incorporate it into their dispensing routine once qualified. It is therefore essential that pharmacists begin to recognise that routine documentation of interventions will not only raise their professional profile and secure their future, but also improve their job satisfaction.

7.2.3 Conclusion

The intervention rate of the pharmacist could be improved through targeted education and training on the documentation system and the identification of DRPs within the community pharmacy environment. Due to the large number of non-participants, it may also be beneficial to improve the individual participation rate, rather than just the intervention rate. Helping the pharmacist to facilitate practice change and alter their dispensing workflow to increase the number of interventions documented would hopefully increase the number of pharmacists participating in this important professional program.

7.3 Remuneration

The PROMISe II trial showed no significant differences between remunerated and non-remunerated pharmacies⁸¹; therefore, the effect of remuneration was not measured within the PROMISe III trial. Only a small upfront and completion payment was used within this trial and therefore, it is unknown what effect a 'per intervention' remuneration scheme would have had in the PROMISe III trial. Lack of remuneration is often cited as a barrier to implementing and maintaining a professional service within the literature^{16,100,107,109,115}, with the multivariate analysis within one study revealing that adequate remuneration significantly increased the rate of provision of cognitive services.¹⁰¹

Recognising that remuneration may have an effect on the overall intervention rate, consultation work was completed by Deloitte¹⁸⁴ to determine the best method to fully compensate pharmacies for their participation and facilitate optimal levels of clinical intervention performance and documentation. This work determined that the remuneration options should include four main elements, as follows.

- *An upfront payment* to cover private costs to pharmacies associated with training and setup of the system.
- *A per-intervention payment* that is either general or targeted for high and low value interventions.
- *A quarterly incentive payment* that is made to pharmacies that have achieved the pre-determined minimum intervention rate.
- *CPD points* to incentivise individual pharmacist participation.

The different combination of payments to the pharmacies and pharmacists aimed to improve the levels of participation by pharmacists and therefore the intervention rate.

This in turn would help to determine the potential health and economic benefits of the clinical interventions.

Through multiple indepth analyses, Deloitte determined that the greatest reduction in healthcare spending by the Australian Government would occur if each pharmacy were remunerated \$4,000 as an upfront payment, \$20 per prescription intervention and a \$1000 quarterly incentive payment. In addition, CPD points would also provide an additional incentive for pharmacists to participate in the program. Under the Fifth Community Pharmacy Agreement negotiated in 2010, the Department of Health and Ageing allocated \$97M towards clinical interventions, which should provide adequate remuneration for most of the pharmacies within Australia.

It is also important to note that the payments are given directly to the pharmacies, not the participating pharmacists, and it would be at the discretion of the pharmacy owner whether the employee pharmacists would receive any of the allocated remuneration. This was also cited as a potential limitation by Knapp²⁷, who also attributed a low intervention rate to pharmacies not passing on the incentive payments to staff. It is therefore extremely important to introduce a CPD point allocation system to ensure the pharmacists are receiving some form of individual payment for the professional service they are providing.

Co-contributational funding from the consumer would be unlikely to provide enough remuneration for the pharmacy to continue the service. Currently, pharmacies receive a dispensing fee from the Government for dispensing medications with the patients paying the remaining cost of the medication up to a set amount. Very few nationwide schemes require additional payment from the consumer, resulting in many consumers feeling that it is the Government's responsibility to fund their healthcare. Co-contributational funding is therefore unlikely to provide a viable source of income unless education is directed towards consumers to increase their understanding of a pharmacist's role. This was also noted in a survey of New Zealand pharmacists, where the pharmacists were reluctant to charge patients directly for services, as such a payment system had not previously existed.¹⁶

7.4 Targeted interventions

The benefit of an intervention system that transmits data to a central repository is that an extensive database of common interventions is created. For example, the PROMISe trial identified that the medications with the highest intervention rates were phenoxymethylpenicillin, erythromycin, prednisolone, tramadol and oxycodone. In the future, an extensive database would allow information to be collated to further increase the number of interventions performed on medications associated with high numbers of DRPs, for example, using the database to formulate specific education programs for pharmacists. The database could also be used to formulate new prompts to be created, by targeting simple, common interventions that have the potential to substantially reduce healthcare resource utilisation and thus expenditure.

As expected, older patients were more likely to require an intervention compared to younger patients, probably due to an increase in the number of concurrent medications as well as a possible decrease in cognition, hearing and/or vision.⁶ By educating pharmacists to be aware of common interventions experienced by this consumer group, it is possible that the number of important interventions would increase, therefore possibly decreasing healthcare utilisation.

7.5 Limitations

During the PROMISe trial, some limitations were detected that may impact on the future implementation of an effective intervention documentation system.

7.5.1 Recruitment

A potential limitation of this trial was that pharmacies were invited to participate; as such it is possible that only proactive pharmacy owners were recruited. This selection bias could have resulted in a positively skewed intervention frequency. However, it is felt that this self-selection bias may have been counteracted by the pharmacists, since many of the involved pharmacists were told to participate by their pharmacy owner, rather than choosing to participate themselves. Therefore, the effect of the recruitment process is unknown. Documentation of clinical interventions has recently become a requirement of the Quality Care Pharmacy Program (QCPP) accreditation¹⁸⁵, which may increase the intervention rate as the QCPP pharmacies aim to meet their re-accreditation

requirements. In addition, offering CPD points may also improve the participation rate, leading to an increase in the number of interventions documented.

7.5.2 Consumers

A limitation of this study was the lack of an adequate consumer sub-study to determine the actual effectiveness of clinical interventions. Further research into the area should include an intervention outcomes measurement, for example, a long term study (such as 12 months) to follow all intervention outcomes. This may improve the understanding of how many interventions are fulfilled within the community and the outcomes of these interventions. It would also allow more accurate costs and savings to be calculated to provide to the government for inclusion in the next Community Pharmacy Agreement. It would not be feasible to have a control group, as ignoring detected interventions would impinge on the professionalism of the pharmacist as well as on the health of the patient; therefore, a follow-up study would be the most ethically feasible.

7.5.3 Workload measure

As identified in section 7.1.2, the measure of pharmacist workload had a varied correlation with the intervention rate of the pharmacy and the pharmacist. The average pharmacist workload was calculated using the prescriptions dispensed by the pharmacy divided by the number of FTE pharmacists per week (see Chapter 2 for calculation). This resulted in an average workload being calculated for the entire trial, which was not specific to each pharmacist within the pharmacy or each week within the trial. This indicated that although the workload was a good estimate at the pharmacy level, it was not accurate and may have been too generalised to provide consistent results within the individual pharmacist statistical analysis. The prescription volumes dispensed were accurate, as each dispensed prescription was tagged with the date and dispensing pharmacists. Ideally, a more accurate average workload could be generated by asking each pharmacist to record the number of hours worked within the pharmacy each week. This would allow for a more accurate workload per pharmacist per week and workload per pharmacy per week to be calculated.

8 Chapter 8: Recommendations and conclusions

8.1 Conclusion

The PROMISe III software was successfully implemented in 185 pharmacies in three States of Australia. The trial resulted in the documentation of 5948 interventions from 2,013,923 prescriptions with a median intervention rate of 0.21%. The rates of individual pharmacies ranged from 0.00% to 2.35% and individual pharmacists ranged from 0.00% to 3.88%, indicating the potential intervention frequency that could be achieved.

Several factors were found to contribute to the variation in intervention rates between the pharmacies and the pharmacists. Within the multivariate analysis, prescription volume and/or pharmacist workload, financial turnover, location, catering for an aged care facility and participation in additional pharmacy trials appeared to significantly affect the pharmacy intervention rate. The busier pharmacies tended to have a lower intervention rate, suggesting that adequate staffing levels with appropriate workloads would increase the level of interventions performed and documented within pharmacies.

The intervention rates of individual pharmacists tended to be associated with their level of training, their clinical knowledge and their professional attitude. Pharmacists who completed both face-to-face and online PROMISe training tended to have a higher intervention rate than other pharmacists. A higher clinical knowledge score was also associated with a higher intervention rate, which may be due to these pharmacists having an improved ability to detect DRPs. The results suggest that by providing ample PROMISe training and additional clinical training, with additional assistance to adapt their practice, the intervention rate of community pharmacists could be increased.

Increasing the intervention rate of both pharmacies and pharmacists will be of immense value to the community, since the average intervention was estimated to save approximately \$360 to the healthcare system (including medication savings).¹⁶⁴

Extrapolation estimates showed that if the PROMISe software was installed in every pharmacy in Australia, an additional \$290M in healthcare costs could be avoided annually.

8.1.1 Recommendations

The full PROMISe software used by Group Three is recommended for national implementation. Although Group Three did not have a significantly higher overall

intervention rate than the other groups, the use of the general reminder and specific prompt is thought to increase the pharmacist's awareness of documenting clinical interventions, and, therefore, may help the pharmacist to adapt to the change in practice. The use of the specific prompt would also improve the pharmacist's clinical knowledge and allow the Government to specifically target problem medications. Specific prompts that rotated on a 4-8 week basis would decrease pharmacist prompt fatigue, and hopefully lead to an increased intervention rate, and therefore, improved patient outcomes and increased cost savings to the Australian healthcare system.

Use of the system could be improved through adequate training, which should also contribute to a higher intervention rate, as seen in Chapter 5. It would be recommended that at least two pharmacists from each pharmacy be required to complete the training in order to ensure the information was translated adequately back to the pharmacy. The training should be provided through a mix of virtual classroom (online) courses and face-to-face seminars, thus minimising the costs of training as well as ensuring all pharmacists were able to access the training.

A key component to the PROMISe software would be the use of the data collected from the central database. This could be used for the ongoing education of pharmacists and by providing pharmacists with additional clinical knowledge training, the intervention rate could be further increased. This database could also be used to improve prescribing practices through analysis of interventions by groups, showing another fundamental benefit of the PROMISe system.

The PROMISe III trial showed that CPD points could be used as an incentive to increase a pharmacist's intervention documentation rate. Therefore, it would be necessary to ensure CPD points were allocated appropriately for the performance and documentation of valid interventions, and not just awarded to a pharmacist for performing their necessary professional duties. The attitude and motivation of the pharmacist was also associated with their intervention rate within the trial; therefore, assistance for the pharmacists to implement change management strategies would help them adapt their practice to include the documentation of clinical interventions and increase their intervention rate.

Ideally, a prospective trial conducted on data collected by the implemented program would also allow confirmation of the healthcare resource utilisation benefits that could only be predicted within the constraints of the PROMISe trial. It is envisaged that random

samples of consumers subjected to an intervention could be identified and contacted to determine their actual health resource utilisation. This would allow more accurate economic values to be assigned to all types of interventions and therefore more precise extrapolations to be applied nationwide, and would become the new gold standard reference for the economic and clinical value of pharmacist-performed clinical interventions worldwide. This prospective study would in turn allow policy makers to better measure the efficacy of the program, and to better target high value areas of interest throughout the health system.

8.1.2 National implementation

Since the PROMISE III trial, the Department of Health and Ageing has allocated \$97M from the Fifth Community Pharmacy Agreement towards the documentation of clinical interventions. Currently, the Mirixa GuildCare® software¹⁵⁸ (a PGA commercial product which is not formally part of the Community Pharmacy Agreement) is the platform for the documentation of interventions. However, this is a separate program from the dispensing software meaning that the intervention records are not adequately attached to the patient's history and there is no centralised collection of clinical interventions. Unfortunately, the system falls well short of what the PROMISE III trial utilised and recommended for a future national rollout. Each dispensing software vendor is currently modifying the PROMISE III software for inclusion into their dispensing system and it is hoped that the software will be available for use during 2012.

8.1.3 *Summary of contributions*

- The PROMISe trial was the largest and longest clinical intervention trial to be run in community pharmacies in Australia, and one of the largest in the world.
- The database collected allowed the frequency of intervention types and the medications commonly involved in clinical interventions to be identified and analysed for trends.
- Several factors were identified that contributed to the different intervention rates between pharmacies, such as prescription volume, pharmacist workload, financial turnover, location, catering for an aged care facility and participation in pharmacy trials. Several factors were also identified that contributed to the different intervention rates between pharmacists, such as their level of training, their clinical knowledge, their commitment to continuing education and their professional attitude. Some of these factors have previously been identified in the literature, however, this thesis applied an extensive multivariate analysis which has not been done in association with any clinical intervention trials previously.
- The innovative prompt system used in the PROMISe trial has many benefits if used in the future and would result in better patient outcomes.
- The PROMISe trial estimated that each intervention saves approximately \$360 to the healthcare system, resulting in the allocation of \$97M from the Fifth Community Pharmacy Agreement towards the documentation of clinical interventions.

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Appendix 1: Original DOCUMENT scope notes

Appendix 2: DOCUMENT flowchart

Appendix 3: Final DOCUMENT scope notes (used in PROMISe III)

Appendix 4: Clinical knowledge survey

*Statements appearing in red were not included in the final 40 statements

For Cases 1-3

- Very relevant = 7
- Moderately relevant = 6
- Only slightly relevant = 5
- Neutral = 4
- Only slightly irrelevant = 3
- Moderately irrelevant = 2
- Totally irrelevant = 1

Case 1:

A slightly overweight, 51yo female patient who regularly visits your pharmacy presents a prescription for perindopril 5mg. The dispensing records indicate that the last antihypertensive agent prescribed for this patient was the perindopril/indapamide combination and it was last dispensed 3 months ago. Please indicate how relevant each piece of additional information would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• Discuss with the patient whether the medication change was intentional.	7	6.89	0.32	7
• Discuss with the patient's doctor whether the medication change was intentional.	7	6.28	1.13	7
• Obtain the patient's blood pressure to determine current efficacy of her antihypertensive treatment.	5	5.11	1.53	1
• Determine the patient's smoking history.	5	4.67	1.64	1
• Discuss with the patient their compliance with the antihypertensive agent.	7	6.50	1.42	7
• Determine if the patient has had a cholesterol level done recently.	5	4.72	1.45	1
• Discuss a weight management program with the patient.	5	5.06	1.55	1

Case 2:

A frail 80yo male patient presents to collect his last repeat from his glyceryl trinitrate sublingual spray prescription. On dispensing, the pharmacist notices that this is the third time this medication has been dispensed in the last two weeks. Please indicate how relevant each piece of additional information would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• Determine if the pain the patient is feeling is actually due to angina.	7	6.89	0.32	7
• Determine if the patient has any expired bottles of GTN spray at home.	5	4.56	1.98	1
• Ask the patient to demonstrate his administration technique.	7	6.67	0.59	7
• Establish whether the patient has a new script for GTN spray at home.	5	4.22	1.99	1
• Determine how long since the patient's GP has reviewed his angina treatment.	7	6.94	0.24	7
• Determine how efficacious the GTN spray is.	7	6.44	1.54	7
• Determine if the patient has changed his diet in the last fortnight.	1	2.89	2.14	1

Case 3:

A 58kg, 35yo female presents to the pharmacy to collect a prescription for methotrexate 10mg weekly from her rheumatologist which is a new medication for her. Please indicate how relevant each piece of additional information would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
<ul style="list-style-type: none"> Determine if the patient has had baseline liver function tests. 	7	6.78	0.43	7
<ul style="list-style-type: none"> Determine if the patient has had a negative pregnancy test and is currently taking/using adequate contraception. 	7	7.00	0.00	7
<ul style="list-style-type: none"> Determine if the side-effects of methotrexate have been explained to the patient. 	7	6.94	0.24	7
<ul style="list-style-type: none"> Determine if the patient has been instructed to take folic acid. 	7	6.39	0.85	7
<ul style="list-style-type: none"> Determine if the patient is also taking regular paracetamol. 	5	4.06	2.07	1
<ul style="list-style-type: none"> Determine how often the patient drinks alcohol. 	6	5.83	1.47	7
<ul style="list-style-type: none"> Determine if the patient is currently taking any over-the-counter antacids. 	2	3.89	2.25	1

For Cases 4-6

- Highly likely = 7
- Moderately likely = 6
- Only slightly likely = 5
- Neutral = 4
- Only slightly unlikely = 3
- Moderately unlikely = 2
- Highly unlikely = 1

Case 4:

A 65kg, 45yo female patient comes into the pharmacy to enquire about possible side-effects. She was commenced paroxetine 20mg daily a few days ago and has been experiencing increasing anxiety (which is the reason the paroxetine was initially started), sweating and tachycardia. She has a medical history of atrial fibrillation and severe lower and is also taking digoxin, ramipril, tramadol and methadone. Please indicate how likely each drug-related problem would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• The commencement of the paroxetine may have resulted in an increase in anxiety for the patient.	6	5.78	1.35	7
• This dose of paroxetine is unlikely to be controlling the patient's anxiety symptoms and an increase in her dose should be considered.	1	2.50	1.62	1
• The paroxetine may have interacted with the tramadol to cause the patient's symptoms.	7	6.61	0.78	7
• The paroxetine may have interacted with the methadone to cause the patient's symptoms.	7	4.50	2.23	7
• The paroxetine may have interacted with the digoxin to cause the patient's symptoms.	1	3.00	1.88	1
• The patient may be experiencing digoxin toxicity and should be referred back to her GP.	1	2.89	2.19	1
• The patient's symptoms could be due to worsening atrial fibrillation and her digoxin dose should be increased.	1	3.00	2.00	1

Case 5:

A slightly overweight, 78yo female patient with a history of hypertension and mild heart failure presents with prescription for frusemide 20mg D to treat her swollen ankles. She is also currently taking lercanidipine 20mg and ramipril 2.5mg D, plus amitriptyline 10mg N for sleep. Please indicate how likely each drug-related problem would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
<ul style="list-style-type: none"> The patient's symptoms are likely to indicate a worsening of her heart failure. 	6	6.50	0.51	7
<ul style="list-style-type: none"> The swollen ankles may be due to an increased fluid intake caused by a dry mouth from the amitriptyline. 	5	4.56	1.34	1
<ul style="list-style-type: none"> Lercanidipine could be causing peripheral oedema. 	7	6.67	0.59	7
<ul style="list-style-type: none"> The swollen ankles may be due to an increased fluid intake resulting from hyperglycaemia. 	2	3.22	1.70	1
<ul style="list-style-type: none"> The patient may need to increase her level of exercise to improve blood flow in her ankles. 	5	3.67	1.78	1
<ul style="list-style-type: none"> The patient may have SIADH which has led to swollen ankles. 	3	3.39	1.65	1
<ul style="list-style-type: none"> The patient may have been experiencing an arrhythmia which has decreased her cardiac output and caused her swollen ankles. 	4	4.11	1.53	1

Case 6:

A lady comes into the pharmacy to collect her elderly husband's prescriptions for him while he is recuperating home. She states there is a new prescription for 'Imdur® 60mg M' that was started in the hospital last week, new medication doesn't seem to be working and her husband is still experiencing chest pain. The husband's history regular dispensing of Somac® 40mg N, Iscover® 75mg M, Lipitor® 20mg N, Duride® 60mg N, Coversyl® 5mg Spiriva® 18mcg M and GTN spray PRN. Please indicate how likely each drug-related problem would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
<ul style="list-style-type: none"> Her husband may be experiencing a decrease in symptom control for his COPD and his shortness of breath is causing the chest pain. 	5	4.56	1.50	7
<ul style="list-style-type: none"> Her husband may be experiencing nitrate tolerance if he has continued to take the Duride® brand that he was initially prescribed, as well as the Imdur® from the hospital. 	7	6.61	0.70	7
<ul style="list-style-type: none"> Her husband needs a higher dose of isosorbide mononitrate to control his symptoms. 	1	3.72	2.27	7
<ul style="list-style-type: none"> Her husband could be experiencing an interaction between clopidogrel and pantoprazole resulting in an exacerbation of coronary symptoms. 	2	3.22	1.73	7
<ul style="list-style-type: none"> Her husband needs to increase the use of his GTN spray to improve his symptoms. 	1	3.56	2.09	1
<ul style="list-style-type: none"> Her husband should have aspirin added to decrease his chest pain symptoms. 	1	2.83	1.82	1
<ul style="list-style-type: none"> Her husband needs to increase his dose of pantoprazole because his chest pain may be due to worsening reflux. 	5	4.56	1.72	1

For Cases 7-9

- Very appropriate = 7
- Moderately appropriate = 6
- Only slightly appropriate = 5
- Neutral = 4
- Only slightly inappropriate = 3
- Moderately inappropriate = 2
- Totally inappropriate = 1

Case 7:

A slightly overweight, 70yo male patient is currently taking warfarin (dose is 5mg/4mg on alternate days). He dental prescription for an abscess for amoxycillin 500mg TDS and metronidazole 400mg TDS. Please indicate how appropriate each recommendation would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• Cease the warfarin whilst taking the antibiotics.	1	1.78	1.52	1
• Discuss the interaction with the patient and recommend an increase in INR monitoring whilst taking the antibiotics.	7	6.89	0.32	7
• Discuss the signs and symptoms of an increased INR with the patient.	7	6.83	0.38	7
• Recommend the dentist change the metronidazole to clindamycin.	2	3.89	2.37	1
• Recommend ibuprofen for pain relief for the dental abscess.	1	1.44	0.86	1
• Halve the warfarin dose whilst taking the antibiotics.	1	2.44	1.89	1
• Change the warfarin to aspirin whilst using the antibiotics.	1	1.11	0.32	1

Case 8:

A 65yo female with airways disease has a recent dispensing history containing Seretide® 250/25 (2 puffs BD) Ventolin® inhaler (1-2 PRN). She presents a 3 month old prescription to the pharmacist for prednisolone 25mg reads '25mg BD for three days, then 12.5mg BD for three days'. On further discussion, the pharmacist determines patient is currently experiencing a worsening of the respiratory symptoms and is unsure what dose of prednisolone should be taking. Please indicate how appropriate each recommendation would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• Advise the patient not to take the prednisolone 25mg at all.	1	2.11	1.88	1
• Commence OTC pantoprazole 20mg daily to decrease the risk of GI bleeds whilst taking the prednisolone.	1	2.28	1.41	1
• Dispense the prescription as written and instruct the patient to take it with food.	1	3.89	2.40	1
• Contact the patient's GP and determine what prednisolone dose she should currently be taking.	7	6.67	0.84	7
• Advise the patient to cease the Seretide® whilst she is taking the prednisolone tablets.	1	1.06	0.24	1
• Advise the patient to increase the use of her Ventolin® inhaler in preference to using the prednisolone.	1	1.89	1.28	1
• Advise the patient to discuss with her doctor about increasing the strength of her Seretide® to the 500/50 Accuhaler.	6	4.78	2.07	7

Case 9:

A 120kg, 40yo male smoker with osteoarthritis is taking esomeprazole 40mg daily, but currently has no GI symptoms. only other medication he is currently taking is regular paracetamol for his OA pain that he buys over-the-counter, dispensing history shows ketoprofen and cephalixin dispensed several months ago. Please indicate how appropriate each recommendation would be in this case.

	Researchers			Writer's answer
	Mode	Mean	Std Dev	
• Dispense the prescription with dietary advice about avoiding reflux triggers.	5	4.17	1.79	1
• Recommend the patient return to the GP to reduce his dose to 20mg daily.	7	6.06	1.16	7
• Recommend the patient return to the GP to trial using esomeprazole on a PRN basis.	7	5.83	1.42	7
• Discuss a weight management program with the patient.	6	6.33	0.59	7
• Discuss smoking cessation with the patient.	6	5.89	1.41	7
• Recommend the patient have his vitamin B12 levels checked.	4	3.67	1.85	4
• Recommend the patient stop the regular paracetamol and change back to ketoprofen to control his OA pain.	1	1.22	0.73	1

Appendix 5: Patient leaflet for prompt

Appendix 6: Pharmacist leaflet for prompt

Appendix 7: Owner/manager survey

Appendix 8: Site visit form

Appendix 9: Site visit staff roster template

Appendix 10: Pharmacist background survey

Appendix 11: Pharmacist intervention opinions survey

Appendix 12: Pharmacist empathy survey

Appendix 13: Pharmacist professionalism survey

Appendix 14: Pharmacist software survey (post-trial)

Appendix 15: Observer intervention record form

Appendix 16: Observer hourly log form

Appendix 17: Observer daily log form

***Appendix 18: Observer barriers/facilitators form
(software pharmacies)***

Appendix 19: Observer barriers/facilitators form (no software pharmacies)

Appendix 20: Halls professionalism survey

Pharmacist Name: _____ Pharmacy Approval No.: _____

Halls' Pharmacist Survey

Please choose the appropriate response for each item:

*** 1: My professional organisation competently represents my views on pharmacy issues.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 2: If I do not monitor patient drug therapy, an unfavourable therapeutic outcome is probable.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 3: My pharmacy colleagues and I should be the only ones who determine and set standards for our practice.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 4: I often wish that I had chosen another occupation.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 5: My employer should establish specific guidelines for making professional decisions in my work.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 6: I can maintain an acceptable standard of practice without undertaking continuing education programs.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 7: My professional organisation fails to promote advancement of the profession of pharmacy.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 8: Patients probably would not be harmed if I failed to instruct them concerning the proper use of their medications.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 9: The only professional standards I will accept are those established by my pharmacy colleagues.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 10: There is no occupation I could be happier in than pharmacy.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 11: The opportunity to exercise professional judgement in my work should be determined by my employer.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 12: Continuing education such as self-study or seminars is essential for my work.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 13: My professional organisation does not help to ensure quality practice.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 14: Optimal drug therapy for the patient is impossible to achieve without my services.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 15: I would be willing to modify the basic standards which guide my practice in order to conform to the wishes of the public.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 16: The practice of pharmacy is gratifying and satisfying to me.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 17: My employer has the right to review and change the professional decisions I make.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 18: My daily practice is all the continuing education I need.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 19: My professional organisation provides me with a better understanding of the values and beliefs of my profession.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 20: The health care of the patient would suffer without my services.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 21: Only another pharmacist is qualified to judge the competence of my work.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 22: If I had the opportunity to begin over again, I would still choose to practice pharmacy.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 23: I would depart from my employer's policies when I judge it professionally necessary.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 24: I would attend continuing education seminars only if they were required for re-registration.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 25: The official statements and standards of my professional organisation are important guides to my practice.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 26: Patient care would suffer very little if I failed to provide drug information to the doctor.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 27: Pharmacists who violate professional standards should be judged only by their pharmacy colleagues.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 28: I feel dedicated to pharmacy because I believe in my work.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 29: My employer has the right to influence my professional decisions because my employer is the one who pays my salary.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 30: My involvement with drug therapy has little consequence on the prevention of adverse drug reactions to the patient.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 31: Standards for professional competence which guide my practice are best defined and established via government regulation.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 32: Continuing education is of little importance to my practice.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 33: The practice of pharmacy promoted by my professional organisation is close to my personal ideal.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 34: Patient care would be unsatisfactory without my services.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 35: The public should be allowed input into the development of standards for professional competence which guide my practice.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 36: I want others to enter pharmacy because I am proud of the unique skills and knowledge they would acquire.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 37: My employer has no right to place limitations on the decisions I make concerning professional matters.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 38: My practice would suffer if I did not undertake continuing education programs.**

Strongly Agree Agree Neutral Disagree Strongly Disagree

☐ ☐ ☐ ☐ ☐

*** 39: Patient drug compliance is improved by my explanation of drug therapy to patients.**

Strongly Agree

☐

Agree

☐

Neutral

☐

Disagree

☐

Strongly Disagree

☐

*** 40: I would modify the professional standards which guide my practice only in response to recommendations made by my pharmacy colleagues.**

Strongly Agree

☐

Agree

☐

Neutral

☐

Disagree

☐

Strongly Disagree

☐

Thank you for completing this survey.

Please ensure your name is written on the top of the survey and
return it to your observer or fax it to: (03) 6226 8534.

You will receive your \$50 Coles/Myer voucher once this survey is returned to the
Project team.

Appendix 21: Examples of recorded interventions

Appendix 22: Article detailing the analysis of the prompt

Appendix 23: Pharmacy multivariate analysis

Multivariate analysis of pharmacy factors

One pharmacy owner only answered the initial online survey (not the subsequent survey), therefore data for opening hours, number of professional services, pharmacy size in m², financial turnover in 2007/08, banner group membership, catering for an aged care facility and whether they have had a pre-registration pharmacist in the last 2 years was missing. A different pharmacy did not receive a site visit, therefore data for collecting prescription details/payments and number of dispensing terminals was missing.

	N	Mean	Std. Deviation	Missing		No. of Extremes ^a	
				Count	Percent	Low	High
LogCIRate	185	-0.667	0.434	0	0.0	3	0
Actual Prescription Volume	185	12953.790	7210.841	0	0.0	0	4
Average Pharmacist Workload Per Week	184	479.458	196.098	1	0.5	0	5
Pharmacy Opening Hours per Week	184	59.220	12.496	1	0.5	0	4
Total Number of Professional Services Offered	184	6.902	2.262	1	0.5	0	0
% of time pharmacist collects prescription details from patient	184	25.840	25.580	1	0.5	0	10
% of time pharmacist collects payment from patient	184	18.510	24.029	1	0.5	0	10
Location	185			0	0.0		
Pharmacy Size in m2	184			1	0.5		
Pharmacy \$ Turnover in 2007/08	184			1	0.5		
Member of a Banner Group	184			1	0.5		
Cater for aged care facility	184			1	0.5		
Pharmacy has had a pre-registration pharmacist within the last 2 years	184			1	0.5		
Number of Dispensing Terminals	184			1	0.5		
a. Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR).							

Table 9-1: Missing value analysis

Proving assumptions

For dichotomous variables (including dummy coded variables), a split of less than 90/10 was desirable, otherwise the influence of the values in the smaller group can be influential. Binary variables all appeared to be acceptable. The following factors had equal to or less than 90/10 split, therefore could be used as grounds for exclusion at a later date.

- Medical centre (17; 9.2%) vs other (168; 92.8%)
- Participates in additional pharmacy trials (170; 92.4%) vs non-participants (14; 7.6%)
- Provides 3 or more professional services (162; 88.0%) vs 0-2 professional services (22; 12.0%)

Several continuous variables also had non-normal distribution.

1. Actual prescription volume - *Kolmogorov-Smirnov* $D(185) = 0.145, p < 0.001$; *Shapiro-Wilk* $F(185) = 0.919, p < 0.001$; improved with a log transformation (*Kolmogorov-Smirnov* $D(185) = 0.052, p = 0.020$; *Shapiro-Wilk* $F(185) = 0.990, p = 0.020$). However, the decision was made to separate this variable into a categorical variable to improve its performance within the model.
2. Average pharmacist workload - *Kolmogorov-Smirnov* $D(184) = 0.059, p = 0.020$; *Shapiro-Wilk* $F(184) = 0.959, p < 0.001$; not greatly improved with a log transformation (*Kolmogorov-Smirnov* $D(184) = 0.064, p = 0.063$; *Shapiro-Wilk* $F(184) = 0.979, p = 0.007$), therefore the variable was converted to a categorical variable.

3. Pharmacy opening hours per week - *Kolmogorov-Smirnov* $D(184) = 0.141, p < 0.001$; *Shapiro-Wilk* $F(184) = 0.903, p < 0.001$; not improved with a log transformation (*Kolmogorov-Smirnov* $D(184) = 0.107, p < 0.001$; *Shapiro-Wilk* $F(184) = 0.948, p < 0.001$), therefore the variable was converted to a binary variable – ‘conventional’ vs ‘extended trade’.
4. Total number of professional services offered - *Kolmogorov-Smirnov* $D(184) = 0.126, p < 0.001$; *Shapiro-Wilk* $F(184) = 0.973, p < 0.001$, however the histogram appeared normal. Not greatly improved with a log transformation (*Kolmogorov-Smirnov* $D(184) = 0.064, p = 0.063$; *Shapiro-Wilk* $F(184) = 0.979, p = 0.007$), therefore the variable was converted to a binary variable – ‘0-2 services’ vs ‘3 or more services’.
5. Percentage of time the pharmacist collects prescription details and collects payment - *Kolmogorov-Smirnov* $D(184) = 0.200, p < 0.001$ and *Shapiro-Wilk* $F(184) = 0.845, p < 0.001$; *Kolmogorov-Smirnov* $D(184) = 0.274, p < 0.001$; *Shapiro-Wilk* $F(184) = 0.763, p < 0.001$ respectively, however there were a large number of zeros within the variable (for example, many pharmacists collected prescription details and payment 0% of the time), therefore transformation was not attempted. Variable was converted to a binary variable – ‘high’ vs ‘low’ patient contact time.

Model 1 (tables)

Model Summary ^g										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R ² Change	F Change	df1	df2	Sig. F Change	
1	.208 ^a	0.043	0.038	0.415436	0.043	8.157	1	181	0.005	
2	.269 ^b	0.072	0.062	0.410204	0.029	5.646	1	180	0.019	
3	.307 ^c	0.094	0.079	0.406417	0.022	4.37	1	179	0.038	
4	.330 ^d	0.109	0.089	0.404325	0.014	2.857	1	178	0.093	
5	.361 ^e	0.13	0.106	0.400497	0.022	4.419	1	177	0.037	
6	.381 ^f	0.145	0.116	0.39821	0.015	3.039	1	176	0.083	1.799
a. Predictors: (Constant), Caters for aged care										
b. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2										
c. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload										
d. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M										
e. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M, Pharmacy\$Turnover 2.5to4.0M										
f. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M, Pharmacy\$Turnover 2.5to4.0M, Participates in pharmacy trials										
g. Dependent Variable: Log CI Rate										

Table 9-2: Stepwise regression model for all variables

ANOVA ^g						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.408	1	1.408	8.157	.005 ^a
	Residual	31.238	181	0.173		
	Total	32.646	182			
2	Regression	2.358	2	1.179	7.006	.001 ^b
	Residual	30.288	180	0.168		
	Total	32.646	182			
3	Regression	3.08	3	1.027	6.215	.000 ^c
	Residual	29.566	179	0.165		
	Total	32.646	182			
4	Regression	3.547	4	0.887	5.424	.000 ^d
	Residual	29.099	178	0.163		
	Total	32.646	182			
5	Regression	4.256	5	0.851	5.306	.000 ^e
	Residual	28.39	177	0.16		
	Total	32.646	182			
6	Regression	4.737	6	0.79	4.979	.000 ^f
	Residual	27.908	176	0.159		
	Total	32.646	182			

a. Predictors: (Constant), Caters for aged care

b. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2

c. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload

d. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M

e. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M, Pharmacy\$Turnover 2.5to4.0M

f. Predictors: (Constant), Caters for aged care, Pharmacy area 150 to 250m2, High Pharmacist Workload, Pharmacy\$Turnover 1.5to2.5M, Pharmacy\$Turnover 2.5to4.0M, Participates in pharmacy trials

g. Dependent Variable: Log CI Rate

Table 9-3: ANOVAs for stepwise regression model for all variables

Model		Unstandardised Coefficients		Standardised Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-0.595	0.038		-15.748	0.000	-0.669	-0.520					
	Caters for aged care	-0.185	0.065	-0.208	-2.856	0.005	-0.313	-0.057	-0.208	-0.208	-0.208	1.000	1.000
2	(Constant)	-0.567	0.039		-14.539	0.000	-0.644	-0.490					
	Caters for aged care	-0.159	0.065	-0.178	-2.451	0.015	-0.288	-0.031	-0.208	-0.18	-0.176	0.972	1.029
	Pharmacy area 150 to 250 m2	-0.184	0.077	-0.173	-2.376	0.019	-0.337	-0.031	-0.203	-0.174	-0.171	0.972	1.029
3	(Constant)	-0.529	0.043		-12.366	0.000	-0.614	-0.445					
	Caters for aged care	-0.136	0.065	-0.152	-2.081	0.039	-0.265	-0.007	-0.208	-0.154	-0.148	0.943	1.060
	Pharmacy area 150 to 250 m2	-0.192	0.077	-0.181	-2.505	0.013	-0.344	-0.041	-0.203	-0.184	-0.178	0.969	1.032
	High Pharmacist Workload	-0.136	0.065	-0.151	-2.090	0.038	-0.264	-0.008	-0.172	-0.154	-0.149	0.970	1.031
4	(Constant)	-0.500	0.046		-10.874	0.000	-0.591	-0.409					
	Caters for aged care	-0.139	0.065	-0.156	-2.143	0.033	-0.268	-0.011	-0.208	-0.159	-0.152	0.942	1.061
	Pharmacy area 150 to 250 m2	-0.164	0.078	-0.154	-2.097	0.037	-0.318	-0.010	-0.203	-0.155	-0.148	0.924	1.082
	High Pharmacist Workload	-0.128	0.065	-0.143	-1.981	0.049	-0.256	0.000	-0.172	-0.147	-0.14	0.966	1.035
	Pharmacy\$Turnover 1.5 to 2.5M	-0.110	0.065	-0.123	-1.690	0.093	-0.239	0.018	-0.166	-0.126	-0.12	0.951	1.052
5	(Constant)	-0.456	0.050		-9.089	0.000	-0.555	-0.357					
	Caters for aged care	-0.123	0.065	-0.138	-1.892	0.060	-0.251	0.005	-0.208	-0.141	-0.133	0.929	1.077
	Pharmacy area 150 to 250 m2	-0.133	0.079	-0.126	-1.692	0.092	-0.289	0.022	-0.203	-0.126	-0.119	0.893	1.120
	High Pharmacist Workload	-0.130	0.064	-0.145	-2.031	0.044	-0.257	-0.004	-0.172	-0.151	-0.142	0.966	1.036
	Pharmacy\$Turnover 1.5 to 2.5M	-0.169	0.070	-0.188	-2.401	0.017	-0.308	-0.030	-0.166	-0.178	-0.168	0.801	1.249
	Pharmacy\$Turnover 2.5 to 4.0M	-0.168	0.080	-0.163	-2.102	0.037	-0.326	-0.010	-0.124	-0.156	-0.147	0.818	1.222
6	(Constant)	-0.277	0.114		-2.423	0.016	-0.502	-0.051					
	Caters for aged care	-0.118	0.065	-0.133	-1.830	0.069	-0.246	0.009	-0.208	-0.137	-0.128	0.927	1.079
	Pharmacy area 150 to 250 m2	-0.118	0.079	-0.111	-1.491	0.138	-0.273	0.038	-0.203	-0.112	-0.104	0.881	1.135
	High Pharmacist Workload	-0.117	0.064	-0.130	-1.824	0.07	-0.244	0.010	-0.172	-0.136	-0.127	0.952	1.050
	Pharmacy\$Turnover 1.5 to 2.5M	-0.185	0.071	-0.206	-2.624	0.009	-0.325	-0.046	-0.166	-0.194	-0.183	0.787	1.271

	Pharmacy\$Turnover 2.5 to 4.0M	-0.171	0.079	-0.165	-2.146	0.033	-0.327	-0.014	-0.124	-0.16	-0.15	0.818	1.222
	Participates in pharmacy trials	-0.197	0.113	-0.124	-1.743	0.083	-0.420	0.026	-0.145	-0.13	-0.122	0.958	1.043
a. Dependent Variable: Log CI Rate													

Table 9-4: Coefficients for stepwise regression model for all variables

Casewise Diagnostics^a				
Case Number	Std. Residual	LogCIRate	Predicted Value	Residual
185	-3.071	-2.000	-0.777	-1.223
a. Dependent Variable: Log CI Rate				

Table 9-5: Outlying case for model 1

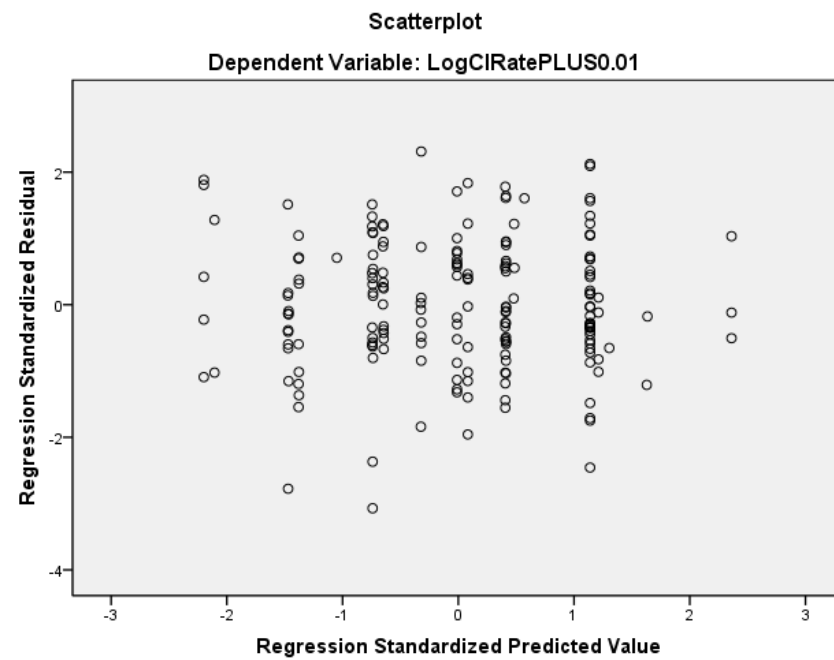


Figure 9-1: Residual plot for model 1 (the clumps of data are likely due to all the included variables being of a binary nature)

Model 2 (tables)

Model Summary ^f										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R ² Change	F Change	df1	df2	Sig. F Change	
1	.258 ^a	0.067	0.061	0.410296	0.067	12.925	1	181	0	
2	.313 ^b	0.098	0.088	0.404516	0.031	6.21	1	180	0.014	
3	.345 ^c	0.119	0.104	0.400788	0.021	4.365	1	179	0.038	
4	.368 ^d	0.136	0.116	0.39812	0.017	3.407	1	178	0.067	
5	.386 ^e	0.149	0.125	0.396173	0.013	2.754	1	177	0.099	1.811
a. Predictors: (Constant), Pharmacy\$Turnover 1.5to4.0M										
b. Predictors: (Constant), Pharmacy\$Turnover 1.5to4.0M, Caters for aged care										
c. Predictors: (Constant), Pharmacy\$Turnover 1.5to4.0M, Caters for aged care, Participates in pharmacy trials										
d. Predictors: (Constant), Pharmacy\$Turnover 1.5to4.0M, Caters for aged care, Participates in pharmacy trials, Location in a medical centre										
e. Predictors: (Constant), Pharmacy\$Turnover 1.5to4.0M, Caters for aged care, Participates in pharmacy trials, Location in a medical centre, High Pharmacist Workload										
f. Dependent Variable: Log CI Rate										

Table 9-6: Stepwise regression model 2

Coefficients ^a													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	-0.539	0.045		-12.044	0.000	-0.628	-0.451					
	Pharmacy\$Turnover 1.5 to 4.0M	-0.219	0.061	-0.258	-3.595	0.000	-0.339	-0.099	-0.258	-0.258	-0.258	1.000	1.000
2	(Constant)	-0.496	0.047		-10.446	0.000	-0.589	-0.402					
	Pharmacy\$Turnover 1.5 to 4.0M	-0.200	0.060	-0.236	-3.302	0.001	-0.319	-0.080	-0.258	-0.239	-0.234	0.984	1.016
	Caters for aged care	-0.159	0.064	-0.178	-2.492	0.014	-0.284	-0.033	-0.208	-0.183	-0.176	0.984	1.016
3	(Constant)	-0.279	0.114		-2.442	0.016	-0.504	-0.054					
	Pharmacy\$Turnover 1.5 to 4.0M	-0.208	0.060	-0.246	-3.469	0.001	-0.327	-0.090	-0.258	-0.251	-0.243	0.979	1.021
	Caters for aged care	-0.148	0.063	-0.165	-2.331	0.021	-0.273	-0.023	-0.208	-0.172	-0.163	0.977	1.023
	Participates in other pharmacy trials	-0.234	0.112	-0.147	-2.089	0.038	-0.455	-0.013	-0.145	-0.154	-0.147	0.990	1.011
4	(Constant)	-0.294	0.114		-2.590	0.010	-0.518	-0.070					
	Pharmacy\$Turnover 1.5 to 4.0M	-0.209	0.060	-0.247	-3.508	0.001	-0.327	-0.092	-0.258	-0.254	-0.244	0.979	1.021
	Caters for aged care	-0.135	0.063	-0.151	-2.125	0.035	-0.259	-0.010	-0.208	-0.157	-0.148	0.965	1.036
	Participates in other pharmacy trials	-0.240	0.111	-0.151	-2.158	0.032	-0.460	-0.021	-0.145	-0.160	-0.150	0.989	1.012
	Location in/near a medical centre	0.188	0.102	0.129	1.846	0.067	-0.013	0.390	0.145	0.137	0.129	0.987	1.013
5	(Constant)	-0.283	0.113		-2.502	0.013	-0.507	-0.060					
	Pharmacy\$Turnover 1.5 to 4.0M	-0.207	0.059	-0.244	-3.486	0.001	-0.324	-0.090	-0.258	-0.253	-0.242	0.979	1.022
	Caters for aged care	-0.119	0.064	-0.133	-1.869	0.063	-0.245	0.007	-0.208	-0.139	-0.130	0.944	1.059
	Participates in other pharmacy trials	-0.221	0.111	-0.139	-1.982	0.049	-0.441	-0.001	-0.145	-0.147	-0.137	0.978	1.023
	Location in/near a medical centre	0.180	0.102	0.124	1.770	0.078	-0.021	0.381	0.145	0.132	0.123	0.985	1.016
	High Pharmacist Workload	-0.106	0.064	-0.117	-1.659	0.099	-0.231	0.020	-0.172	-0.124	-0.115	0.960	1.042

a. Dependent Variable: Log CI Rate

Table 9-7: Coefficients for regression model 2

Model 3 (tables)

Casewise Diagnostics ^a					
Case Number	Std. Residual	Log CI Rate	Predicted Value	Residual	Cook's Distance
185	-3.336	-2.000	-0.661	-1.339	0.045
a. Dependent Variable: Log CI Rate					

Table 9-8: Outlying case for model 3

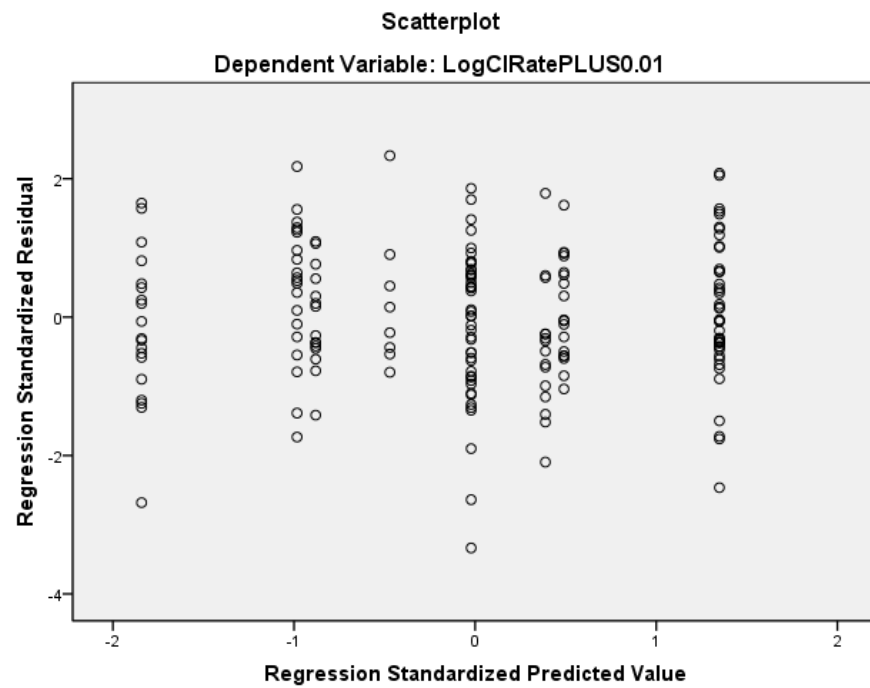


Figure 9-2: Residuals plot for model 3

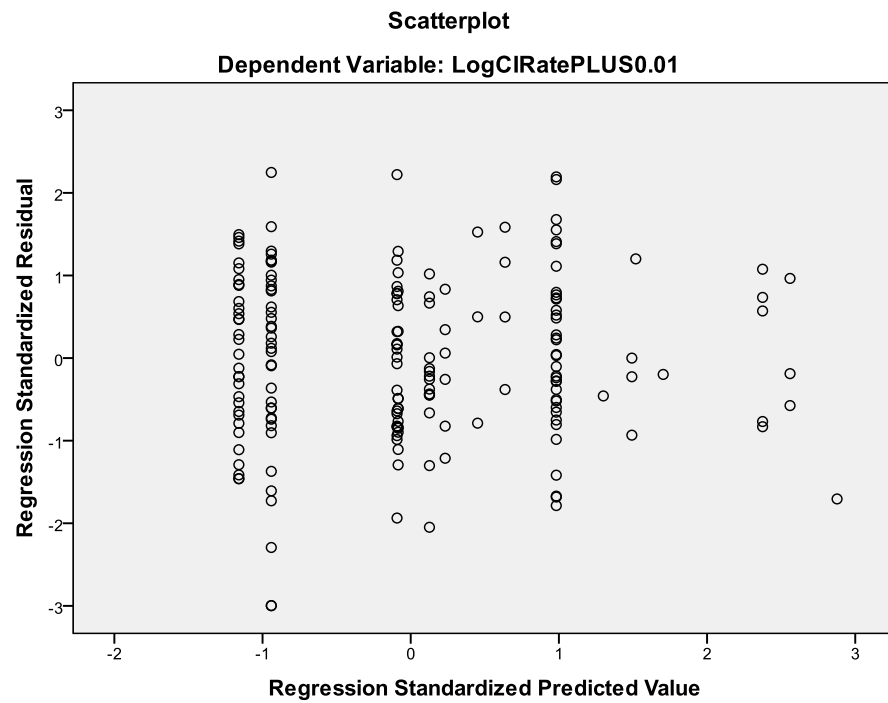


Figure 9-3: Residuals plot for prescription volume model

Appendix 24: Tables from the ‘Pharmacist Opinions’ analysis

Pre-trial survey answers:

“I believe that pharmacists are already too busy within the workplace which prevents them from taking on any new tasks”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Too busy	Strongly Agree	29	0.083	0.000	1.124	0.047	0.173
	Agree	99	0.178	0.000	2.408	0.056	0.353
	Neutral	129	0.198	0.000	3.876	0.056	0.365
	Disagree	139	0.221	0.000	2.564	0.091	0.472
	Strongly Disagree	49	0.265	0.000	3.284	0.118	0.582
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-9: The pharmacist’s perception of busyness and their intervention rate

“I believe it is important for pharmacists to adapt their practice to suit the current pharmacy environment”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Adapt practice	Strongly Agree	245	0.202	0.000	3.876	0.088	0.458
	Agree	168	0.197	0.000	2.857	0.059	0.359
	Neutral	14	0.103	0.000	1.451	0.067	0.378
	Disagree	10	0.327	0.000	2.358	0.126	0.588
	Strongly Disagree	8	0.011	0.000	0.985	0.000	0.268
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-10: The pharmacist’s ability to adapt and their intervention rate

“I would be willing to change my current practice if a new, better way was available”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Willingness to change	Strongly Agree	259	0.191	0.000	3.876	0.078	0.498
	Agree	153	0.215	0.000	2.857	0.091	0.372
	Neutral	16	0.121	0.000	0.562	0.047	0.214
	Disagree	6	0.000	0.000	0.422	0.000	0.126
	Strongly Disagree	11	0.075	0.000	0.985	0.000	0.448
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-11: The pharmacist’s willingness to change and their intervention rate

“I believe I have a good level of clinical knowledge to perform clinical interventions”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Good level of clinical knowledge	Strongly Agree	93	0.219	0.000	2.591	0.079	0.508
	Agree	230	0.210	0.000	3.284	0.088	0.458
	Neutral	97	0.162	0.000	3.876	0.056	0.297
	Disagree	21	0.111	0.000	0.964	0.027	0.422
	Strongly Disagree	4	0.031	0.000	0.985	0.000	0.524
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-12: The pharmacist’s self-assessment of their clinical knowledge and their intervention rate

“I am confident in my ability to perform clinical interventions”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Confidence in ability	Strongly Agree	105	0.279	0.000	2.616	0.083	0.694
	Agree	228	0.170	0.000	3.284	0.082	0.404
	Neutral	84	0.199	0.000	3.876	0.064	0.317
	Disagree	24	0.109	0.000	0.964	0.019	0.401
	Strongly Disagree	4	0.031	0.000	0.985	0.000	0.524
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-13: The pharmacist’s confidence in performing CIs and their intervention rate

“I already perform clinical interventions on a daily basis”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Already perform interventions	Strongly Agree	128	0.263	0.000	2.616	0.122	0.589
	Agree	187	0.177	0.000	3.876	0.076	0.398
	Neutral	102	0.144	0.000	2.564	0.047	0.297
	Disagree	22	0.258	0.000	0.771	0.062	0.422
	Strongly Disagree	6	0.123	0.000	0.985	0.000	0.450
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-14: The pharmacist’s current level of performing CIs and their intervention rate

“I believe the recording of interventions will increase my level of job satisfaction”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Increase job satisfaction	Strongly Agree	126	0.210	0.000	3.284	0.091	0.546
	Agree	170	0.204	0.000	2.857	0.086	0.475
	Neutral	102	0.177	0.000	3.876	0.060	0.332
	Disagree	37	0.109	0.000	0.617	0.038	0.290
	Strongly Disagree	10	0.357	0.000	2.591	0.056	0.964
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-15: The pharmacist’s belief in increased job satisfaction and their intervention rate

“I am concerned the recording system will be hard to use”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Belief that system will be hard to use	Strongly Agree	11	0.268	0.000	1.908	0.095	0.391
	Agree	89	0.147	0.000	3.876	0.052	0.310
	Neutral	153	0.162	0.000	2.857	0.048	0.398
	Disagree	137	0.219	0.000	3.284	0.091	0.448
	Strongly Disagree	55	0.314	0.000	2.193	0.168	0.649
	Unknown	64	0.017	0.000	1.097	0.000	0.144
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-16: The pharmacist’s belief that the system would be hard to use and their intervention rate

Post-trial survey answers:

“I found the software easy to use”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Software was easy to use	Strongly Agree	73	0.290	0.000	3.284	0.154	0.597
	Agree	152	0.220	0.000	3.876	0.087	0.508
	Neutral	23	0.128	0.000	1.451	0.036	0.328
	Disagree	12	0.121	0.000	1.908	0.045	0.752
	Strongly Disagree	0					
	Unknown	249	0.100	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-17: The pharmacist’s assessment of the ease of use of the system and their intervention rate

“I received sufficient training to use the software”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Received sufficient software training	Strongly Agree	79	0.320	0.000	3.284	0.171	0.712
	Agree	140	0.208	0.000	3.876	0.075	0.425
	Neutral	28	0.134	0.000	2.591	0.110	0.343
	Disagree	11	0.310	0.000	0.985	0.056	0.595
	Strongly Disagree	2	0.176	0.036	0.315	0.036	0.315
	Unknown	249	0.100	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-18: The pharmacist’s assessment of sufficient software training and their intervention rate

“I am confident in my ability to perform clinical interventions”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Confidence in ability to perform CIs	Strongly Agree	41	0.235	0.028	2.358	0.132	0.725
	Agree	186	0.248	0.000	3.876	0.119	0.533
	Neutral	27	0.219	0.000	1.451	0.034	0.498
	Disagree	5	0.041	0.027	0.310	0.036	0.074
	Strongly Disagree	0					
	Unknown	250	0.104	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-19: The pharmacist’s confidence in their abilities post-trial and their intervention rate

“The trial increased my awareness of how many clinical interventions I perform”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Trial increased awareness of CIs	Strongly Agree	68	0.425	0.000	3.876	0.217	0.703
	Agree	141	0.222	0.000	2.616	0.114	0.467
	Neutral	37	0.125	0.000	2.591	0.058	0.206
	Disagree	9	0.328	0.034	1.563	0.139	0.570
	Strongly Disagree	4	0.144	0.036	1.888	0.074	1.032
	Unknown	250	0.104	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-20: The pharmacist’s assessment of the trial increasing awareness and their intervention rate

“The performing of clinical interventions increased my level of job satisfaction”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Performing CIs increased job satisfaction	Strongly Agree	68	0.329	0.025	3.284	0.180	0.709
	Agree	151	0.220	0.000	3.876	0.119	0.460
	Neutral	32	0.112	0.000	2.591	0.056	0.306
	Disagree	7	0.139	0.027	1.563	0.056	0.566
	Strongly Disagree	1	0.111	0.111	0.111	0.111	0.111
	Unknown	250	0.104	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-21: The pharmacist’s assessment of performing interventions increasing job satisfaction and their intervention rate

“The recording of clinical interventions increased my level of job satisfaction”

		Pharmacist Count	Intervention Rate				
			Median	Min.	Max.	25 th %ile	75 th %ile
Recording CIs increased job satisfaction	Strongly Agree	42	0.497	0.000	2.358	0.149	0.725
	Agree	123	0.235	0.000	3.876	0.126	0.562
	Neutral	66	0.163	0.000	1.899	0.058	0.389
	Disagree	24	0.211	0.027	1.563	0.118	0.324
	Strongly Disagree	4	1.000	0.036	2.591	0.074	2.240
	Unknown	250	0.104	0.000	2.857	0.000	0.249
Total		509	0.168	0.000	3.876	0.054	0.375

Table 9-22: The pharmacist’s assessment of recording interventions increasing job satisfaction and their intervention rate

Appendix 25: Pharmacist logistic regression analysis

Logistic regression for pharmacist intervention rate

From the database, all pharmacists have a known CI rate (including rates of zero), known training level (as participation was recorded) and known ‘additional qualifications’ (as they were coded as ‘none’ if unknown). One pharmacist did not have a workload recorded as the pharmacy did not receive a site visit, therefore the number of full-time equivalent pharmacists was not recorded. The other missing values are due to the pharmacists not completing the surveys (Table 9-23).

	N	Mean	Std. Deviation	Missing		No. of Extremes ^a	
				Count	Percent	Low	High
CI rate	509	0.325	0.491	0	0.0	0	43
Adaptability score	445	5.955	1.794	64	12.6	0	16
Confidence score	445	6.299	2.311	64	12.6	0	38
Clinical knowledge score	419	53.120	7.425	90	17.7	11	0
Average pharmacist workload	508	478.037	185.158	1	0.2	0	9
Additional qualifications	509			0	0.0		
CPD	446			63	12.4		
Training	509			0	0.0		

a. Number of cases outside the range (Q1 - 1.5*IQR, Q3 + 1.5*IQR).

Table 9-23: Missing value analysis

Table 9-24 shows the differences in mean between the pharmacists with the data present and not present. The mean CI rate was much higher in the group where the surveys were answered, indicating that the pharmacists who answered the surveys may have been more motivated.

	t	df	# Present	# Missing	Mean(Present)	Mean(Missing)
Adaptability score	7.7	256.2	445	64	0.357	0.104
Clinical knowledge score	6.8	326.6	419	90	0.367	0.132
CPD	7.8	249.0	446	63	0.357	0.010

Table 9-24: Separate variance t-tests

Table 9-25 shows that 416 cases have all data, 24 are missing only the clinical knowledge score and 59 are missing all survey data. As seen previously, the remaining case is missing a figure for the pharmacist workload.

No. of Cases	Missing Patterns ^a							Complete if ... ^b
	CI Rate	Additional quals	Training	Average pharmacist workload	CPD	Adaptability score	Clinical knowledge score	
416								416
24							X	440
59					X	X	X	508
Patterns with less than 1% cases (5 or fewer) are not displayed.								
a. Variables are sorted on missing patterns.								
b. Number of complete cases if variables missing in that pattern (marked with X) are not used.								

Table 9-25: Missing data patterns

Ideally, the MCAR test should be non-significant, as this means the distribution of missing values is unpredictable. For this dataset, the MCAR test was approaching significance and may therefore be predictable ($p = 0.06$). However, this is expected, because the pharmacists who did not fill out one survey, often did not fill out another survey, resulting in a predictable missing value distribution (Table 9-26).

EM Correlations ^a				
	CI Rate	Adaptability score	Clinical knowledge score	Average pharmacist workload
CI Rate	1			
Adaptability score	-0.160	1		
Clinical knowledge score	0.127	-0.168	1	
Average pharmacist workload	-0.083	0.098	-0.028	1
a. Little's MCAR test: Chi-Square = 19.044, DF = 11, Sig. = .060				

Table 9-26: Distribution of missing values

Appendix 26: Observational data analysis

Influencing factors on performance rates

During the sub-study, 90 pharmacists were observed in software pharmacies, with 6 of these pharmacists performing no interventions and 19 recording no interventions. Therefore, 5 pharmacists did not perform or record any interventions, 14 performed interventions but did not record any, and 1 pharmacist recorded an intervention but did not perform any (indicating that the pharmacist recorded something that the observer did not feel was an intervention). Transformation did not improve the data (*Kolmogorov-Smirnov statistic* = 0.16, *df* = 65, $p < 0.001$); so non-parametric statistical tests were used.

Demographics

Of the 78 pharmacists who completed the surveys, 44 were female and 34 were male, with no significant difference in intervention performance rate between the two genders (*Mann-Whitney U* = 644.50, $Z = -1.04$, $p = 0.29$). Age range was related to performance rate with pharmacists over 50 years of age having the highest performed intervention rate followed by pharmacists in the 20-30 year age range (*Kruskal-Wallis* $\chi^2 = 16.76$, *df* = 3, $p = 0.001$); however, there was no relationship seen between graduation year and the performed intervention rate (*Spearman's rho* = 0.03, $N = 78$, $p = 0.79$).

Additional qualifications

Interestingly, there was no apparent relationship between pharmacists with additional qualifications and their intervention performance rate (*Kruskal-Wallis* $\chi^2 = 2.05$, *df* = 2, $p = 0.37$), despite a trend being seen in the overall analysis of pharmacist's documented intervention rates (see section 5.2.4). HMR accreditation was also not an influencing factor, with no difference seen between the 15 accredited and 63 non-accredited pharmacists (*Mann-Whitney U* = 392.00, $Z = -1.02$, $p = 0.31$).

CPD activity

CPD activity also did not appear to have a relationship with intervention performance rate in this group of pharmacists (*Kruskal-Wallis* $\chi^2 = 5.91$, *df* = 3, $p = 0.12$).

Workload

There did not appear to be a relationship between the intervention performance rate and the average pharmacist workload within the pharmacy (*Spearman's rho* = -0.15, *N* = 85, *p* = 0.16).

Professionalism score

The professionalism score that was run on PROMISE pharmacists had only previously been tested on undergraduate pharmacy students. Therefore, it was compared to the Hall's Professionalism Survey that was completed by observed pharmacists (see Appendix 20). Of the 149 pharmacists, 143 completed the Hall's Professionalism Survey for Pharmacists;¹⁶¹ however, only 77 of these pharmacists had completed the original professionalism survey. Analysis showed good correlation between the scores (*Spearman's rho* = 0.355, *N* = 77, *p* = 0.002) indicating that the initial professionalism survey was a good predictor of the Hall's professionalism score.

For the pharmacists within the software pharmacies, there did not appear to be a relationship between the intervention performance rate and either professionalism score (*Spearman's rho* = 0.12, *N* = 77, *p* = 0.29 for the initial professionalism survey; *Spearman's rho* = -0.07, *N* = 83, *p* = 0.51 for the Hall's professionalism survey).

Empathy score

Seventy-six observed pharmacists completed the empathy survey. There did not appear to be a relationship between the intervention performance rate and the pharmacist's empathy score (*Spearman's rho* = -0.02, *N* = 76, *p* = 0.84).

Clinical knowledge survey score

Seventy-one observed pharmacists completed the clinical knowledge survey. There did not appear to be a relationship between the intervention performance rate and the pharmacist's clinical knowledge score (*Spearman's rho* = 0.11, *N* = 71, *p* = 0.37).

Training level

There did not appear to be a relationship between the intervention performance rate and the pharmacist's level of training (*Kruskal-Wallis* χ^2 = 2.98, *df* = 3, *p* = 0.40).

Adaptability/willingness to change score

There did not appear to be a relationship between the intervention performance rate and the pharmacist's adaptability/willingness to change score (*Spearman's rho* = -0.03, *N* = 78, *p* = 0.78). See Chapter 5 for the calculation process.

Confidence score

There did not appear to be a relationship between the intervention performance rate and the pharmacist's confidence score (*Spearman's rho* = -0.03, *N* = 78, *p* = 0.83). See Chapter 5 for the calculation process.

Influencing factors on documented rates

Of the 90 pharmacists who were observed in software pharmacies, 19 did not record any interventions during their observation period, resulting in 66 pharmacists who had an observed intervention recording rate. Again, transformation did not improve the data (*Kolmogorov-Smirnov statistic* = 0.12, *df* = 65, *p* = 0.02); therefore, non-parametric statistical tests were used. The effect of the observation week on the observed pharmacies was discussed previously in Chapter 4.

Demographics

There was no significant difference in intervention recording rate between the two genders (*Mann-Whitney U* = 694.00, *Z* = -0.55, *p* = 0.59) or the age range of the pharmacist (*Kruskal-Wallis χ^2* = 5.83, *df* = 3, *p* = 0.12). There was also no relationship seen between graduation year and intervention recording rate (*Spearman's rho* = 0.01, *N* = 78, *p* = 0.91).

Additional qualifications

Again, there was also no apparent relationship between pharmacists with additional qualifications and their intervention recording rate (*Kruskal-Wallis χ^2* = 4.37, *df* = 2, *p* = 0.10), despite a trend being seen in the overall pharmacist group (see Chapter 5 for details). HMR accreditation was also not an influencing factor, with no difference between the accredited and non-accredited pharmacists with regards to their recording rates (*Mann-Whitney U* = 374.50, *Z* = -1.25, *p* = 0.21).

CPD activity

CPD activity also did not appear to have a relationship with intervention recording rate in this group of pharmacists (*Kruskal-Wallis* $\chi^2 = 0.77$, $df = 3$, $p = 0.86$).

Workload

There did not appear to be a relationship between the intervention recording rate and the average pharmacist workload within the pharmacy (*Spearman's rho* = -0.01, $N = 85$, $p = 0.94$).

Professionalism score

There did not appear to be a relationship between the intervention recording rate and either professionalism score (*Spearman's rho* = 0.01, $N = 77$, $p = 0.39$ for the initial professionalism survey; *Spearman's rho* = 0.05, $N = 83$, $p = 0.64$ for the Hall's professionalism survey).

Empathy score

There did not appear to be a relationship between the intervention recording rate and the pharmacist's empathy score (*Spearman's rho* = 0.01, $N = 76$, $p = 0.91$).

Clinical knowledge survey score

There did not appear to be a relationship between the intervention recording rate and the pharmacist's clinical knowledge score (*Spearman's rho* = 0.03, $N = 71$, $p = 0.78$).

Training level

There did not appear to be a relationship between the intervention recording rate and the pharmacist's level of training (*Kruskal-Wallis* $\chi^2 = 5.83$, $df = 3$, $p = 0.12$).

Adaptability/willingness to change score

There did not appear to be a relationship between the intervention recording rate and the pharmacist's adaptability/willingness to change score (*Spearman's rho* = -0.06, $N = 78$, $p = 0.61$). See Chapter 5 for the calculation process.

Confidence score

There did not appear to be a relationship between the intervention recording rate and the pharmacist's confidence score (*Spearman's rho* = -0.06, $N = 78$, $p = 0.61$). See Chapter 5 for the calculation process.

Appendix 27: PROMISe Trial article in AnnPharm 2011

Appendix 28: DOCUMENT article in IJCP 2012

Appendix 29: Clinical knowledge tool article in IJPP 2012