INTRODUCTION OF THE INTUBATING LARYNGEAL MASK AIRWAY INTO PARAMEDIC PRACTICE

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Abstract

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Background. It has been noted in many research papers that paramedic laryngoscopic tracheal intubation is an infrequently performed airway skill which is difficult to execute, this has been supported by many articles highlighting complications and poor success rates in the paramedic population. A major concern raised in the literature on paramedic tracheal intubation is the ability for this workforce to perform this skill and maintain their confidence and competence in this skill which is performed infrequently.

Although laryngoscopic tracheal intubation is the method used almost exclusively by paramedics there are other devices available to achieve tracheal intubation. The implementation of a new device, an innovation, to perform tracheal intubation into a field such as paramedic practice where laryngoscopic tracheal intubation is held in such high regard is expected to face implementation challenges.

Research Purpose. To examine the qualitative factors that affects the implementation of the Intubating Laryngeal Mask Airway into paramedic practice. Of particular interest are the educational practices which are affected by the introduction of an innovation.

Research Design. A sequenced exploratory descriptive research design will use quantitative and qualitative data sources to answer the study's purpose. Data collection was achieved through a questionnaire which captured quantitative data and then a series of interviews which allowed deeper exploration of the findings.

Findings. Paramedics had increased confidence when using the ILMA for tracheal intubation in their routine practice and achieved similar

tracheal intubation success rates with the ILMA as the laryngoscope. The overall laryngoscopic tracheal intubation success rate was 91% (42/46) and the overall ILMA tracheal intubation success rate was 92% (48/52). A blended approach to AAM education improves confidence and competence. The paramedics' achieved an appropriate level of confidence and competence in ILMA tracheal intubation using manikins alone without the conventional in-theatre training component.

Conclusion. Paramedic competence and confidence in AAM is influenced by a number of operational and educational factors and the introduction of the ILMA has been shown to be a suitable alternative to the laryngoscope for paramedic tracheal intubation.

During the introduction of the ILMA a major change to the normal training methodology demonstrated that the traditional reliance on the hospital theatre to achieve progress along the learning curve toward competence and confidence in AAM practice can be improved.

The successful introduction of an innovation into paramedic AAM practice requires a method which ensures the training process is efficient and the change to practice is effortless and sustained with maximum learning and the support of the workforce.

The social change required for the introduction of an AAM innovation can be rapidly adopted after careful consideration of the social system and the characteristics unique to each innovation as described in Rogers Diffusion of Innovation (Rogers 2003) theory when developing the educational strategies.

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Declaration of Originality

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.

Michael McCall

Signed

Date 21st September 2012

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Statement of Ethical Conduct

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.

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Commonly Used Abbreviations

AAM	Advanced Airway Management
AHA	American Heart Association
ARC	Australian Resuscitation Council
CPR	Cardio Pulmonary Resuscitation
CSO	Clinical Support Officer
EMS	Emergency Medical Service
EMT	Emergency Medical Technician
ICP	Intensive Care Paramedic
ICU	Intensive Care Unit
ILMA	Intubating Laryngeal Mask Airway
LMA	Laryngeal Mask Airway
PILMAT	Prehospital Intubating Laryngeal Mask Airway Trial

Definition of Terms

In-theatre experience	Time spent in a hospital theatre to perform AAM on patients undergoing various surgical procedures
In-service	Training which is provided to paramedics during their normal duties and not whilst attending specific training programs away from their workplace
Out of Hospital	The clinical practice area where paramedics deliver care outside of recognised medical facilities

Chapter 1 Introduction

1.1 Introduction

Tracheal Intubation is one of the most critical and complex group of emergency clinical skills in providing Advanced Airway Management (AAM). AAM is concerned with one of the first priorities in providing emergency patient care, ensuring a “clear and controlled” airway. This is an immediate critical patient care step because if the airway is not quickly and adequately secured the patient’s status will rapidly decline. The array of airway management skills varies from the simple, patient positioning which first aiders master during basic resuscitation (CPR) training, to the more complex psychomotor techniques such as fibre-optic intubation only mastered by anaesthetists. The most common and maximum security of the airway is obtained by tracheal intubation (Barnes, MacDonald et al. 2001) the passing of a flexible tube into the trachea, the main upper airway leading to the lungs, thus providing a direct conduit between the lungs and outside the patient's mouth, this is the prime and most frequently performed paramedic AAM skill. The laryngoscopic is used to view the upper airway primarily to perform of laryngoscopic tracheal intubation but is also used to view the upper airway in the rare critical situation of a complete airway obstruction where manual efforts have failed.

As the introduction to this thesis this chapter provides background information on paramedic practice and the training and performance of paramedic AAM with emphasis on tracheal intubation; establishes the needs for research into paramedic tracheal intubation; outlines the research purpose and questions; provides a definition of terms and a thesis summary.

Paramedic tracheal intubation is a widely practiced skill which has caused varying degrees of uneasiness within the emergency health care community. Paramedics strongly support their ability and value in performing this critical skill for providing quality care to people who require emergency airway assistance. Paramedics' ability to continue this practice is being challenged by emerging research conducted by medical specialists that questions the success of paramedic tracheal intubation (Katz and Falk 2001; Garza, Algren et al. 2004; Wang, Lave et al. 2006; Goedecke, Herff et al. 2007; Wirtz, Ortiz et al. 2007; ARC 2010) and subsequent calls for the practice to cease (Bledsoe 2006; Committee 2008). One possible explanation for this finding is the majority of Emergency Medical Services tracheal intubation is not taught as a standalone skill but merely one in a range of emergency airway skills paramedics learn. Given the vital importance of paramedic tracheal intubation it is imperative that paramedic led research focuses on critically examining the group of skills commonly termed AAM to inform the educational preparation of paramedics to effectively manage the increasing difficult airway.

Without urgent attention to the ability of paramedics to perform tracheal intubation patients' requiring emergency airway management may be placed at increased risk of severe injury. Many people who require emergency airway management by paramedics are rarely in hospital situations. Working with these people, who are typically critically ill, in the out of hospital environment generally requires a laryngoscopic technique of tracheal intubation, which involves adequate patient positioning and insertion of the device into the throat to the entrance of the lungs. Historically, this technique was implemented by ambulance services because it was the prime technique used by anaesthetists in hospital situations. With very few or no alternatives at the time, anaesthetists as the initial teachers of paramedic AAM were uncritically transferred their in hospital techniques of tracheal intubation to paramedic education programs. This is of concern because there are marked differences between emergency airway management requirements between the in and out of hospital environments.

The out of hospital environment has some special characteristics which are very rarely encountered in a hospital (Garza, Gratton et al. 2008). For example, significant scene distractions, less than optimal lighting and cramped space. Conclusions made from the in-hospital studies are therefore not able to be directly transferred to the out of hospital environment where paramedics practice (Konrad, Schupfer et al. 1998; Graham 2004; Kusunoki, Nakatsu et al. 2004). Like most out of hospital clinical developments, the transfer of AAM skills occurred from the in-hospital to the out of hospital environment with relative ease and at times lacking robust analysis of the risks and value to the patient or paramedic practice. Out of hospital clinical advances appear to occur on the premise of what is required in the emergency department for the critical patient surely must be needed in the out of hospital environment, which is certainly the case for paramedics who need to acquire AAM knowledge and skills.

It is timely for some critical analysis of the structure of the AAM paramedic training programs. Under the supervision of anaesthetists, ambulance services training have historically been undertaken with small controlled group of paramedics. After the initial training sessions, paramedics are expected to spend time in the theatre environment to practice their knowledge and skills to develop their competence. Ambulance Tasmania's inaugural advanced airway management training program specifies a trainee must perform 30 tracheal intubations whilst supervised in theatre and perform the other advanced airway management skills to proficiency level on a mannequin in a classroom setting. In reality, however, the minimum number of successful tracheal intubations required during clinical training varies greatly between healthcare professionals. For example, in the USA trainee anaesthetists require 20 – 57 successful intubations, nurse anaesthetists need to perform 200 intubations, emergency medicine residents are required to complete 35 intubations, while Paramedic students are only needed to complete 5 successful intubations. This highlights there is vast inconsistency when it is the same skills being taught for AAM and tracheal intubation (Wang, Seitz et al. 2004).

Most advanced airway management training programs now partially rely on simulated patient encounters to supplement the real patient experiences (Hall, Plant et al. 2005). One reason for this shift in educational delivery is hospital theatres consistently have a number of competing trainees from various medical specialities, including Paramedics. The opportunities for tracheal intubation are therefore becoming highly competitive across the different health professions and for paramedics this means the AAM training opportunities are ever decreasing.

Until recently, little attention has been paid to using other techniques or devices as an alternative tracheal intubation method in the out of hospital environment. There are now other airway devices, such as the Laryngeal Mask Airway (LMA) used by some out of hospital emergency care providers', available for providing a lower level of airway security. Some of these devices are able to be employed as a 'rescue airway' when tracheal intubation fails. The use of these rescue airway devices are included in the recommendations of the major recognised international resuscitation bodies, e.g. Australian Resuscitation Council, European Resuscitation Council and American Heart Association. Despite these alternative options, very few Australian ambulance services employ a secondary tracheal intubation device. Without engaging with the new technologies or approaches to emergency airway management the paramedic field is being subjected to questions about who is best to perform these skills and what is the best method of education to ensure safe competent continual practice remains unclear. This critical gaze upon paramedicine is of concern because, even when the potential risks to the public are put aside, the AAM has become recognised an essential set of out of hospital Intensive Care Paramedic competencies. In other words, tracheal intubation is an essential knowledge and skill set in the scope of practice for paramedic level EMS providers.

In Tasmania, there have been some activities underway designed to develop paramedics competency in tracheal intubation. In 2005, a

Prehospital Intubating Laryngeal Mask Airway Trial (PILMAT) was implemented to assist with the difficulty AAM qualified paramedics had in maintaining the practice in laryngoscopic tracheal intubation. The trial showed there were many competency issues within the participating paramedic study group performing tracheal intubation (McCall, Reeves et al. 2008). Much of the paramedics desire to maintain competency arose from the perceived need by other health professionals (Thomas, Abo et al. 2007; Vrotsos, Pirrallo et al. 2008; Deakin, King et al. 2009). Furthermore, previous international studies also show out of hospital tracheal intubation to be a rarely performed skill in which is difficult to maintain competence (Bradley, Billows et al. 1998; Katz and Falk 2001; Garza, Algren et al. 2004; Wang and Yealy 2006; Berlac, Hyldmo et al. 2008; Committee 2008; Deakin, King et al. 2009).

Alternative methods of tracheal intubation which have less initial and ongoing training requirements would provide advantages to both the paramedic and the EMS organisation. The introduction of the Intubating Laryngeal Mask Airway (ILMA) (LMA Group of Companies) represents a major change from the traditional laryngoscopic tracheal intubation training, being a short duration training program and the exclusive use of simulation only. The ILMA has been evaluated in many settings by a variety of health practitioners and reported to have many positive attributes to its inclusion into paramedic practice (Brain, Verghese et al. 1997; Agro, Brimacombe et al. 1998; Choyce, Avidan et al. 2000; Lu, Yang et al. 2000; Burgoyne and Cyna 2001; Martel, Reardon et al. 2001; Mason 2001; Waltl, Melischek et al. 2001; Chu 2003; Reeves, Skinner et al. 2004; Timmermann, Russo et al. 2006; Tentillier, Heydenreich et al. 2007; Timmermann, Russo et al. 2007). In the absence of paramedic research focussing on tracheal intubation it is unclear however whether ambulance Intensive Care Paramedics (ICP) would be accepting of these alternatives. It seems there are many unanswered questions in relation to paramedic AAM training and paramedic use of the ILMA. Paramedic research examining choice of devices, insertion practices and the associated preparation of paramedics performing emergency tracheal intubation is urgently required because early evidence suggests paramedics trained to use devices such as the ILMA have high success rates (Barnes, Reed et al. 2003; Reeves, Skinner et al. 2004; Bollig, Lovhaug et al. 2006; Guyette, Greenwood et al. 2006; McCall, Reeves et al. 2008; AHA 2010). It is this gap in knowledge that this research seeks to address.

The remainder of this thesis will outline a study that was established to investigate paramedic tracheal intubation using both the traditional laryngoscope and the ILMA in the context of confidence, competence and success. It does this by examining the effect the PILMAT trial had on paramedic AAM and measures their changes in attitude, confidence and competence when compared to the traditional AAM training program. By examining the routine practices of the training and operational aspects of both AAM and ILMA greater insights into the key influences for paramedics in these areas will be generated. The study findings may increase understandings of the influence the training process has on paramedic AAM confidence and competence in ways that may lead to improvements in paramedic tracheal intubation education. Such knowledge may also enable training providers to develop high quality and evidence based programs for preparing and sustaining a more competent EMS paramedic workforce.

1.2 Research Purpose

The purpose of the research is to offer insight into qualitative factors that affect the implementation of the Intubating Laryngeal Mask Airway into the Advanced Airway Management practices of paramedics. Building on previous work conducted in the PILMAT study in which the technical effectiveness of the ILMA as an airway management tool was demonstrated, this study focuses on key factors associated with paramedics' attitudes towards the ILMA including self-reported confidence and competence in its use. Of particular interest to the study is the way in which AAM educational practices can be informed through greater understanding of paramedic attitudes to the introduction of an innovation such as the ILMA into practice. Rogers Diffusion of Innovation theory (Rogers 2003) including the five characteristics of the persuasion phase is employed as a framework to analyse and discuss the findings.

1.3 Research Questions

In order to achieve the research purpose the following research questions are addressed:

1. What are paramedics' attitudes towards the ILMA as a device for AAM in comparison with other standard devices?
2. What are the key factors that influence paramedics' attitudes towards the introduction and use of the ILMA?
3. What factors impact on paramedics' self-reported confidence and competence in using the ILMA?
4. How can AAM educational practices better respond to the introduction of new innovations such as the ILMA?

To answer these questions a research design which would enable paramedics involved in the PILMAT trial to report on the introduction of the ILMA as an innovation and the influences to its acceptance was necessary.

1.4 Research Design

From the research purpose and questions it can be seen the inquiry in this study is about how the introduction of the ILMA into paramedic practice is related to confidence, the device/ technique being used and the training which has been undertaken to lead to competence. A sequenced exploratory descriptive research design was develop to capture and analyse paramedics' attitudes to the introduction of this innovation. Firstly, a quantitative questionnaire was used to collect data for analysis using statistical tests for frequency and association of the paramedics' confidence and competence of tracheal intubation. Secondly, paramedics were invited to participate in semi structured interviews that were recorded and transcribed as text for thematic analysis to examine the AAM educational methods and their influences on confidence and competence.

By triangulating these results and findings these research procedures facilitated some description of the phenomena of paramedic tracheal intubation. In line with the research purpose however, a more in depth account of paramedics' experience of tracheal intubation required a theoretical framework to allow further interpretation and explanation of the process and affects of introducing and innovation. Rogers (Rogers 2003) Diffusion of Innovation theory provides a model to help explain the paramedics' attitudes to the introduction of an innovation, in this case the ILMA. The characteristics of the persuasion phase offer a pertinent framework on which to organise and explain the study findings so that they can inform educational practice.

The method by which a new device is implemented into a workgroup has an influence on the ease to which it is accepted or rejected. The notion of diffusion of innovative change within groups is a theoretical perspective written about by Everett Rogers and has application to this study. Rogers (Rogers 2003) theory provides principles about the process of innovation and details the steps an individual will go through when deciding to adopt an innovation. Rogers defines an innovation as "*an idea, practice or object that is perceived as new by an individual or another unit of adoption*" (Rogers 2003 p12) and diffusion as "*the process in which an innovation is communicated through certain channels over time among the members of a social system*" (Rogers 2003 p5). Diffusion of innovation is a process where information about a new device or procedure is communicated from person to person which is why it is defined as a social process.

The diffusion of innovation process (see Figure 5) includes many aspects of an organisation which is involved in accepting change. The introduction and decision to accept that change, in this case the introduction of the ILMA, has fundamental components which are described in the persuasion phase of Rogers theory, which is presented in more detail in the methods chapter. The persuasion phase has a number of components which were considered during the introduction of the ILMA into paramedic practice and provides a well-suited framework for its evaluation.

1.5 Significance of the Research

Understanding the process involved in the introduction of an innovation into paramedic AAM practice for the successful outcome of ensuring efficient social change appears essential in todays' EMS. The barriers to the introduction of an alternative and technically effective form of tracheal intubation by using the ILMA need to be identified and appreciated. This research may provide a greater understanding of the qualitative factors that impact on paramedic uptake of the ILMA and its association to confidence and competence. The addition of a successful alternative tracheal intubation device will impact on the quality of AAM provided by paramedics with resulting improvement to patient outcomes.

EMS education requires strategies which can effectively deliver the required outcomes within the constraints placed upon it in today's health care environment. Understanding the strategies which ensure appropriate levels of confidence and competence allows the highest quality of paramedic practice to be delivered to the community. The ability of the findings to inform the development of paramedic education and especially AAM training may provide advancements which can improve paramedic out of hospital patient care.

1.6 Background to the Research

1.6.1 Australian Health Care and Paramedic Practice

The Australian health care system like many in other first world countries is a very dynamic national and state government scheme which attempts to keep pace with the rapidly evolving field of medicine. One area of health care in Australia undergoing significant developments is the out of hospital delivery of emergency care performed by ambulance paramedics[1]. Within each Australian State and Territory a government department (often Health) manages the delivery of ambulance (EMS) services, as stated by the Productivity Commission "*State and Territory governments are responsible for regulatory arrangements for protecting life, property and the environment, and they have primary responsibility for delivering emergency services (including fire and ambulance services) directly to the community*" (Productivity Commission 2010 report, Chapter 9, Emergency Management). The majority of out of hospital paramedic emergency health care is undertaken by the government public health agency which in 2009-10 was estimated to cost $2.1 billion (Productivity Commission report 2011).

The role of an EMS (paramedic) service has been very much an evolutionary process from a need to attend and transport the sick and injured during early wars to the current duty to provide critical often time sensitive patient care. Within Australia each State based EMS service operates within the State Government structure and most function as an independent body with close ties to the state health and emergency service agencies. Paramedics have adjusted from the initial community need of providing care and transport of the critically ill and injured to nowadays providing a mobile medical service which is called upon not only to manage emergencies but also a range of acute and often chronic medical conditions. This changing role has obviously provided a stimulus

[1] The current term paramedic used in this document refers to the previous title of ambulance officer.

to modify the training which paramedics undertake, from the fundamental advanced first aid and vocational technical courses to in recent years developing tertiary and postgraduate qualifications.

Paramedics work within a well-equipped mobile medical resource, the Ambulance. The prime role of the Paramedic, to respond to emergencies, necessitates their training is required to cover the full spectrum of potential acute clinical conditions. Emergencies involving heart disease, diabetes, poisons, paediatrics and pregnancy are just a few of the many areas Paramedics must be able to successfully manage. In order to effectively manage the range of emergencies, Paramedics must have the correct equipment and techniques. The ambulance vehicles of today are well equipped with a range of specialist equipment to enable paramedics to capably manage the common medical emergencies.

Most Australian ambulance services deliver patient care in a number of specialist areas, some of the common areas they are involved in include:

- Patient transport, the basic transport of a patient with a non-acute condition who requires minimal to no care during transport;
- EMS, a service which responds to emergencies and acute medical conditions where clinical assessment and appropriate care are delivered by the attending paramedics. This service involves a small number of practitioner levels, most often two levels; a general practising level of Paramedic and an advanced practitioner level of Intensive Care Paramedic or Critical Care Paramedic;
- Rescue, most ambulance services provide specially trained rescue officers to provide medical support to other emergency services who are the lead agency in specific emergency incidents. Very few EMS now perform as a lead agency at a rescue incident;
- Retrieval service, the three commonest forms of retrieval service are by road, rotary wing aircraft and fixed wing aircraft. Specially trained Paramedics are frequently employed to provide care in these specialist environments.

Contemporary paramedic practice has evolved from being the provision of isolated basic emergency care to an extension of the hospital emergency department providing an emergency medical service. This extension from the emergency departments was welcomed by the paramedic workforce as it initially provided support and education for significant advances to the paramedics' scope of practice. Over time this has led to the emergency medical profession providing an overseeing and governing role of the state run ambulance services. Much of the development in paramedic practice has been from the involvement of the Emergency Medicine discipline and other specialist medical areas such as Anaesthetics.

All Australian States and Territory Ambulance Services aim for the base level paramedic qualification to be at a Bachelor degree level. Most Universities now provide a course in this health service area. Most EMS services are transitioning from an in-house vocational model to the pre-employment tertiary model with some services requiring to fill immediate staff shortages with a combination of in-house and tertiary programs. Although there is currently no national or state registration requirements most EMS services require completion of a continuing education program in order for the individual paramedic to continue to practice.

Within the EMS function, the paramedics and intensive care paramedics are able to undertake an extensive clinical patient assessment and provide care according to their state-based protocols or guidelines. Within the range of treatments they are able to provide are a number of critical techniques and procedures along with a range of essential medications to manage the common conditions suffered by those who are critically ill or injured. A crucial skill set which in some States was introduced as a speciality which is now included in most ICP competencies is AAM. AAM is a key skill area which is essential to the provision of out of hospital emergency care in the life-threatening situations paramedics are often confronted with. This is a fundamental out of hospital advanced skill set because the patient must always maintain an open and clear airway in order to allow adequate respirations and thus ventilation to occur. The effective delivery of AAM education and the performance of the most frequently used and critical skill of tracheal intubation is the focus of this thesis.

Within most major centres and cities in Australia each ambulance is staffed by two paramedics, often one may be a student paramedic, with Intensive Care Paramedics being dispersed throughout the workforce. Within some States there is a paramedic quick response resource which provides a rapid response usually in cars and often at the ICP practitioner level. As one moves away from the major centres and towards the rural areas the ambulance staffing changes commonly to a single paramedic supported by an honorary or volunteer assistant. These assistants normally complete a base level of training in a vocational system in order to provide the knowledge and skills required to be effective 'partners'. In some rural and remote small populations where an ambulance is deemed necessary but call out volume is low it may only be staffed on a needs basis by local volunteers who again have received basic emergency care training.

Tasmania is recognised for being a small State with a small population of 510,000[2] dispersed around the State which provides challenges for health care and this is especially true for EMS services. The dispersed Tasmanian population has lead to the EMS workforce having a high proportion of rural paramedics. Rural paramedic practice creates a number of unique training and operational requirements.

The provision of health care to rural Australia is currently experiencing difficulties especially due to a decrease in the rural workforce, "*In urban areas in Australia, there is one doctor for every 970 people, but in rural areas there is one for every 1328 people" (Alliance 2011).* These rural health difficulties increase the publics' reliance on the paramedic EMS.

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[2] ABS 13/10/11

The operational aspects and the training requirements for rural paramedic practice are not well defined and so there exists a blend of both operational responses and practitioner levels which currently permeate rural paramedic practice in Australia. There is a mixture of paramedic level practitioners and Intensive Care level paramedic practitioners working in the rural EMS environment in Australia. Paramedic practice in rural areas evolved from the cities and major centres and therefore the care they deliver has been very similar if not in some areas the same as their urban counterparts.

It is difficult to find an analysis of the quantity of work undertaken by rural paramedics. A study presented in 2009 (Mulholland, Stirling et al. 2009) comparing urban and rural paramedic cases in Tasmania and Victoria demonstrated the rural paramedic attended similar case types to their urban counterparts. Paramedics working in both communities had comparable percentages of the common patient presentations with frequency the only significant difference. This supports the base curriculum requirements for paramedics to be employed in both locations with the same emergency patient care requirements including AAM.

1.6.2 History of paramedic initiated AAM

The paramedic practice of AAM commenced from its use in the management of the critically ill and injured by Emergency Physicians and since has continued to be based on their practice and the oversight provided by anaesthetists. An overview of the history of AAM and the relationship of confidence and competence will be presented.

Tasmanian Paramedics first commenced AAM training in 1996. Prior to this time AAM was a skill set in Tasmania restricted to in hospital practitioners, ICPs gradually completed training programs until it was incorporated as a component into the ICP skill set. The catalyst for AAM to be included into the paramedics skill set was a need to provide optimal airway care to patients in the out of hospital environment. Indeed, early paramedic patient care guidelines indicate performing laryngoscopic tracheal intubation was focused on the patient in cardiac arrest. Patients with this clinical condition are known to have a higher tracheal intubation success rate and be easier to intubate than other patient cohorts (Wang, Kupas et al. 2003; Garza, Algren et al. 2004; Davis, Fisher et al. 2006). Since then, most out of hospital emergency services now include a wide range of clinical conditions where tracheal intubation is deemed appropriate (Appendix 1). With the expansion of clinical indications and patient cohorts where paramedic laryngoscopic tracheal intubation is authorised, the concurrent research and development of tools and techniques required to perform out of hospital tracheal intubation in these more diverse patient groups has not occurred.

Within hospital operating theatres laryngoscopic tracheal intubation over the past decade or so has changed from the primary method of airway security to using other less invasive and more appropriate airway techniques and devices (Fulton, Jacoby et al. 2002). Although the out of hospital environment has aspects vastly different to the frequently controlled in hospital setting, many of the same principles may apply. Airway management by anaesthetists' in hospital can be achieved using many techniques and an array of options. The option chosen is based on the one best suited to the individual patient's needs and the experience of the individual anaesthetist. Tailoring the method used to provide definitive airway care and having tracheal intubation alternatives if one device or technique fails ensures an appropriate level of clinical care and increases patient safety. With in hospital specialists such as anaesthetists and emergency physicians having the highest level of AAM skill and competency they provide a vital resource to other areas of the health care community.

There are many alternative advanced airway devices which have been proposed to be of value in the out of hospital environment (Barnes, MacDonald et al. 2001; AHA 2010) and these will be reviewed in more depth later in this chapter. For example, the King Tracheal Tube (King Systems), Combitube (Nellcor) and the Laryngeal Mask Airway (LMA

Group of Companies) are some alternative airway devices which can be used in place of tracheal intubation. Apart from a reduction in the frequency of tracheal intubation, another reason for the introduction of these alternatives is to equip the Paramedic level provider with appropriate techniques which lie between base level and ICP skills. Despite a general reduction of in hospital tracheal intubation, the out of hospital environment continues to see tracheal intubation as the ultimate goal of airway management for the critically ill and injured. This belief may stem from the initial difficulty experienced by the paramedic workforce in obtaining authority to perform the skill. For example, in Tasmania in the early times of out of hospital Advanced Life Support the anaesthetic community was very reluctant to allow paramedics to perform tracheal intubation (Stevens and Dalwood 1993, unpublished) and it took a number of years and extensive research to convince the general medical community of the value this skill would provide and that paramedics could perform it successfully.

It seems tracheal intubation is recognised by paramedics as a prestigious skill and is therefore highly valued yet paramedics also report they are not always appropriately prepared for this task. Thomas et al (Thomas, Abo et al. 2007) conducted focus groups with paramedics and concluded tracheal intubation to be a “defining procedure” to the paramedic profession. He noted paramedics expressed it to be “an essential duty” to their patient care. Despite the high regard for this skill, paramedics also acknowledge there may be some concerns related to skill competence and confidence. In this same study by Thomas et al (2007) paramedics attributed their inadequacies in tracheal intubation performance to the current manner of initial and ongoing training. Another study (Youngquist, Henderson et al. 2008) also highlights the inadequacies with paramedic AAM education. Two critical issues which were identified to influence an individual’s maintenance of tracheal intubation skills were: a lack of opportunity to practice and the individuals being unaware of their performance level, both of which are critical components of an effective education program.

Paramedic tracheal intubation appears to be at a crossroads where the AAM skill set has being widely included into ICP training but the issues concerning the paramedics' ability to maintain the skill of laryngoscopic tracheal intubation yet to be fully addressed. Within the anaesthetic community there has been a move away from performing laryngoscopic tracheal intubation on most patients to providing the care required with the suitable tools and techniques. The outcome and survival of critically ill or injured patients is influenced by the airway care provided by paramedics in the out of hospital emergency environment. AAM must provide paramedics with the ability to safely manage patients' airways in the extremes of emergency situations they may encounter.

Paramedic AAM is facing concerns about if the practice should continue and some unique difficulties in relation to maintaining competence which they will need to effectively manage in order to ensure professional practice.

1.6.3 Emerging educational technologies for safely teaching paramedics AAM

Many EMS provide training utilising two approaches, their traditional apprenticeship model is now being supported by the integration of the appropriate sciences with the aim of achieving practitioner competence. A common method of conducting training in EMS organisations is by the intensive block release, this has been the traditional manner which has been the easiest to achieve due to staff rostering. This intensive condensed approach to learning skills has been shown to be less optimal than learning skills which are conducted over a number of separate training sessions (Moulton, Dubrowski et al. 2006) but suits the ambulance operational demands and is leading to an increase in the use of simulation. There are new educational technologies emerging that may be useful for safely and effectively teaching paramedics AAM.

In the health disciplines, clinical skills training is increasingly using simulation to teach students core clinical skills prior to them entering the hospital setting to perform these skills on actual patients. These shifts in education reflect the way medical education has continued to develop and change over the past decades from a system with separation between the pure sciences normally conducted in the tertiary environment and an apprenticeship model in the hospital setting. This division between the two major educational components caused clinicians to raise concerns about the ability of medical students entering the hospitals to perform key clinical skills. This lead to the development in many medical schools curricula the inclusion of a greater focus on the integration of the basic sciences with clinical skills training.

At the same time of the changes being made to advance the clinical skills training of medical students, there were other concerns starting to be raised about the discovery of patient injury and deaths being attributed to medical error. Over the next years the concern caused by the increasing disclosure of the medical error rate began the growth of the medical quality and safety movement. The quality and safety agenda had a focus on ensuring all levels and areas of clinical practice had a mechanism in place which greatly reduced or prevented the occurrence of medical error. One approach to achieving this was the introduction of simulation to provide the initial skills training in an environment removed from the patient where the student was safe to make mistakes and learn in a less pressured environment and provide the opportunity for the variety of health care workers providing a patient’s care to improve team work skills. Simulation is now being used as a primary mechanism for health practitioners to practise and maintain skills and techniques which are infrequently or rarely performed as part of their normal practice but are critical skills for the practitioner to maintain competence in.

The successful use of simulation has seen it develop and be used by many areas in health education. It is now used for initial skills training as well as maintaining skills performance and other aspects of health care which improve quality and safety, such as teamwork and communication. This developing use of simulation has also occurred in EMS training, many EMS services now rely on the use of simulation for paramedic training and most have or are progressing from the simple individual skill simulation with the resource of a task orientated manikin to a dedicated simulation area, ‘simulation centres’, involving many props and resources including medium to high fidelity manikins.

Laryngoscopic tracheal intubation has been shown to be a difficult skill to learn, perform and maintain (Katz and Falk 2001; Parry and Owen 2004; Schaefer 2004; Cook, Green et al. 2007; Goedecke, Herff et al. 2007; Nolan 2007; Wirtz, Ortiz et al. 2007). An area of paramedic training which has had a reliance on the use of simulation is AAM. Despite this, a number of medical professionals have voiced their concern about the ability of ambulance paramedics to maintain their competency in laryngoscopic tracheal intubation (Gerbeaux 2005; Bledsoe 2006; Deakin, King et al. 2009). These opinions may stem from studies of medical trainees with limited experience which has shown to significantly influence their performance of airway skills (Bradley, Billows et al. 1998; Garza, Gratton et al. 2003; Whymark, Moores et al. 2006), but there are increasing studies of paramedic tracheal intubation which highlight concerning trends of poor performance (Garza, Algren et al. 2004; Wang and Yealy 2006). Laryngoscopic tracheal intubation has been the mainstay of paramedic AAM since its inception. Over recent years this practice has received criticism from other health professionals and one major EMS governance body who believe paramedic laryngoscopic tracheal intubation should not continue (Joint Royal Colleges Ambulance Liaison Committee 2008).

A number of studies and editorials in the USA have also concluded and recommended the performance of paramedic out of hospital tracheal intubation to have unacceptably high failure and complication rates (Katz and Falk 2001; Goedecke, Herff et al. 2007). To date these studies stem from the medical community with very little formal response or studies from the EMS community. The EMS profession must engage into the debate and research on paramedic out of hospital tracheal intubation to ensure their practice is consistent with contemporary clinical practice and provides the required standard of out of hospital care the public require. This study may provide information on paramedic tracheal intubation which will examine contemporary practice and improve the standard of paramedic care.

The competency of paramedics performing tracheal intubation has been reported to vary greatly with the commonest criteria used to judge performance being the tracheal intubation "success rate", the number of successful tracheal intubation as a percentage of the number of attempts. A study by Katz and Falk (Katz and Falk 2001) of 108 paramedic laryngoscopic tracheal intubations discovered a misplaced tracheal tube rate of 25%, with 8% of the tracheal tubes placed inappropriately in the hypopharynx[3]. In this study the paramedics were employed by 43 separate providers in the one state, although a standard clinical protocol was implemented. Once again in this study the training undertaken by the paramedics was identified as a factor in their inability to achieve an acceptable laryngoscopic tracheal intubation learning curve. Each provider set their own individual training program and there was no mention of a tracheal intubation skills maintenance process. In this studies relatively small state EMS, servicing a population of approximately 850,000, the lack of standard educational programs and the vast number of EMS providers could be expected to produce a major effect on clinical performance, the divergence in educational processes can also be expected to have an influence on the competency level of tracheal intubation across this one state.

It seems there is a symbiotic relationship between education programs to prepare paramedics for AAM, skill mastery, confidence and competence.

[3] The area in the throat immediately above the voice box.

1.6.4 The relationship between confidence, competence and AAM mastery

Competence, as defined by the Council of Ambulance Authorities is, "*the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/or superior performance in a profession/occupational area*" (Authorities 2010). These generic definitions acknowledge competence to be more than simply carrying out a skill they acknowledge it is a performance level which integrates the complex knowledge and abilities together to optimally perform in a specific work setting. The development of competence is therefore not simply learning new knowledge and the performance of individual skills in a classroom setting where the workplace is difficult to reproduce, nor is it as simple as learning by doing as in an apprenticeship model where the novice learns from the expert. Competence is more likely a combination of both which brings together the novice learning new skills and knowledge (the "sciences"), demonstrating the appropriate attitudes and values and then combining these to perform in the workplace under supervision. In the above definition the knowledge and performance areas are obvious and one must think about the meaning of 'attitudes' and 'values' within the context of skill performance. An attitude about performing a skill is the individual's confidence and their values relate to how well the skill conforms to their work and personal needs.

One group of medical officers (Stewart, O'Halloran et al. 2000) stated their view on confidence was closely related to what they could do and their description of not being confident was closely related to their perceived 'anxiety' levels in their future performance of a skill. Roger's (Rogers 2003) diffusion of innovation model explains this as 'uncertainty', an uncomfortable state where alternatives compel the individual to examine the superiority of the new device or procedure against current practice. This state of uncertainty would be decreased if the new skill is seen to match the current practice in a number of ways thereby having a positive effect on confidence.

Confidence can be expected to increase when the new skill is viewed as providing advantages to improve current practice and fills a gap within their practice. For example paramedics were feeling they required an easier to use and maintain method of tracheal intubation and the introduction of a new device such as the ILMA would be viewed in a positive light and with increased confidence than if another device was offered which they felt was more complex.

It has been reported that confidence is closely linked to experience in a particular skill. Marel et al (Marel, Lyon et al. 2000) examined junior doctors skills performance between study years and concluded there was a significant correlation between their reported confidence and their experience in all skills examined. Yet another study (Morgan and Cleave-Hogg 2002) examined the relationships between clinical experience, confidence and results of a scenario test using simulation. They discovered an association between clinical experience and confidence, indicating a strong correlation between the number of times a skill is performed and the subsequent confidence in that skill. This places importance on the number of times a skill such as tracheal intubation is performed during training and the confidence a paramedic would have in initially performing the skill in the out of hospital setting. Both these studies indicate a strong relationship between self reported confidence and the number of times a skill is performed but this is not true for the relationship between confidence and competence which was supported in a study by Barnsley (Barnsley, Lyon et al. 2004).

Confidence is important to the AAM qualified paramedic who often is the senior paramedic at an incident and is expected to be able to manage all situations in a confident manner, from the simplest call for advice through to the critical poly-traumatised patient requiring tracheal intubation. Due to the infrequent and decreasing number of emergency calls requiring tracheal intubation, the paramedic is in a greater need for feedback to increase their confidence. The paramedic has limited clinical support in their workplace to provide feedback and a boost to their confidence, so they require other mechanisms in order to provide this much needed growth in confidence. To engender and develop paramedics' confidence and competence successful training programs need to be developed, implemented and evaluated which utilise new and emerging technologies.

The training of an ambulance paramedic in tracheal intubation, where they complete primarily a theatre-based training program and then return to the out of hospital environment without any exposure (simulated or real) for extended periods, can be expected to have a detrimental effect on both their confidence and competency levels. Therefore unless paramedics can be adequately supported for their ongoing training needs their level of competency in advanced and intensive care practice must be questioned. There are currently no options to paramedics to perform laryngoscopic tracheal intubation in the out of hospital environment, but they must be available to ensure patients are not put at undue risk by not having an alternative should the single method of tracheal intubation fail or when the level of the provider is not authorised to perform laryngoscopic tracheal intubation. Studies in both the out of hospital and in hospital environments have shown the laryngoscopic method of tracheal intubation is not the optimal method in specific patient groups. The adult traumatic cardiac arrest and the paediatric patient groups were described by Garza et al (Garza, Algren et al. 2004) as patient cohorts who are at a high risk of tracheal intubation failure in the out of hospital environment. A retrospective study in 2008 reviewed all adult trauma patients transported over a three year period and concluded, "*Prehospital intubation is associated with increased mortality among trauma patients at all distances from the hospital*" (Cudnik, Newgard et al. 2008).

These difficulties have led to recognised EMS professional bodies recommending AAM options be available. The National Association of EMS Physicians (NAEMSP) produced a position paper in 2006 (Physicians 2006) stating "*All agencies should have available for use at least one blindly inserted nonsurgical airway device as a rescue or* *alternative to endotracheal intubation*". This was supported by the Scandinavian Society for Anaesthesiology in their published pre-hospital airway management guidelines (Berlac, Hyldmo et al. 2008), which state "*Health care providers lacking expertise and day-to-day routine in drug-assisted endotracheal intubation should use alternative methods to secure the airways of critically ill or injured patients*". These views are not supported by the paramedic profession which strongly defend their need to perform the single laryngoscopic method of tracheal intubation.

The success of out of hospital tracheal intubation is said to be dependent on a number of environmental factors. In this uncontrolled environment, the intubation often has to be performed in difficult lighting, restricted resources, with a lack of assistance and in the unprepared patient. Excessive time spent to achieve successful tracheal intubation in a patient who requires the procedure may have detrimental effects on the patients' status, even if it is only delayed by seconds. Interruption to cardiac compressions, increased risk of pulmonary aspiration, increasing hypoxia and potential increases in intracranial pressure are significant complications which can occur when tracheal intubation attempts are prolonged. In the critical out of hospital patient where tracheal intubation has been decided as the appropriate airway management strategy the sooner it is achieved the decreased risk there is to the patients overall status. New devices are now currently available to offer alternative approaches to tracheal intubation.

1.7 Alternatives to Laryngoscopic Tracheal Intubation

In contemporary AAM, especially laryngoscopic tracheal intubation, the increased focus on patient safety has demanded the professions performing this skill have a secondary backup device to employ if unsuccessful to ensure a high level of airway care and patient safety. The key national United States paramedic advisory body, the National Association of EMS Physicians, published a position paper recommending paramedics must have "*at least one blindly inserted nonsurgical airway device as a rescue or alternative to ETI*" (Physicians 2006). This position does not mention the rescue or alternative device should be capable of tracheal intubation, but if this was possible it would be a significant advantage.

There are a variety of techniques employing various devices which can be used to perform tracheal intubation most of which are confined to in hospital settings due to either a lack of portability or a high level of clinical complexity. Some of the other methods used in hospital to perform tracheal intubation are:

- fiberoptic bronchoscopy tracheal intubation
- Nasal tracheal intubation
- rapid sequence intubation
- Light-guided intubation
- Tracheostomy – surgical airway
- Intubating laryngeal mask airway

Many of the above methods either require specialist equipment or extensive training which is beyond the capacity of a non-specialist mobile paramedic ambulance service. Again the most common method of performing in hospital tracheal intubation is by using the laryngoscope.

Most EMS systems have a small array of airway management techniques ranging from the basic life support manual techniques through to advanced intensive procedures with often include laryngoscopic tracheal intubation. Intermediate level airway intervention such as the LMA and other supraglottic devices are a common paramedic skill but fail to provide the level of airway security, access and control as that provided by tracheal intubation. As tracheal intubation is seen as the ultimate airway care which can be provided by Paramedics the need to discover techniques and educational methods to ensure this level of out of hospital care can be effectively delivered is essential. There are a number of techniques and tools which can be used to achieve tracheal intubation in the hospital environment but many are not suited to the out of hospital setting.

There exists an ever increasing range of airway devices suitable for use in the out of hospital environment which provide a lesser degree of airway security whilst being attractive because of their reduced training requirements and less risk of adverse events. These airway devices exist across a broad range of clinical effectiveness from providing an intermediate level of airway care and protection through to alternative tracheal intubation devices. The intermediate level devices are classified as 'supraglottic' producing a seal around the airway above the trachea at the junction of the oesophagus and trachea. These are considered less ideal than tracheal intubation because they fail to provide a secure direct route into the lungs but are easier to train and operate as they commonly employ a blind technique. The most common supraglottic airway used by EMS professionals is the LMA.

During the past few decades there have been a number of alternative devices developed as adjuncts to assist with maintaining a clear and patent airway. The LMA has been developed into a number of different adaptations to provide specific needs one such device which has been widely accepted and endorsed by in hospital clinicians is the Intubating Laryngeal Mask Airway (ILMA).

1.7.1 The Intubating Laryngeal Mask Airway

During the period 1981 - 1988, Dr Archie Brain developed a new airway device which substantially changed airway management (Brain, Verghese et al. 1997). The Laryngeal Mask Airway was designed to provide an airway device to be used in the gap between the facemask and tracheal intubation and only in recent times has it been used in Emergency Medicine and paramedic practice. One adaptation of the LMA was the ILMA which allows for the clinician to perform tracheal intubation by passing a tube through the device.

In an emergency situation the ILMA can be used simply as a supraglottic airway device by non-ICP trained personnel allowing tracheal intubation to occur when the AAM trained personnel arrive. This dual role of the ILMA ensures not only efficiency but increases the level of patient safety, if any other airway device is used prior to the arrival of the AAM trained ICP it has to be removed prior to laryngoscopic tracheal intubation being performed with subsequent risks to the patients airway and ventilation.

The ILMA has been successfully used to perform tracheal intubation by paramedics in the theatre setting (Reeves, Skinner et al. 2004) with no studies found on its use by paramedics in their routine practice. The Tasmania PILMAT trial involved paramedics using the ILMA in their routine out of hospital practice to perform tracheal intubation.

1.7.2 The PILMAT trial

In 2005, a study introduced the ILMA to paramedics employed in Tasmanian Ambulance Service (now Ambulance Tasmania). General Paramedics and ICPs volunteered to complete a short manikin based training program on the introduction and use of the ILMA for paramedic tracheal intubation. The objective of the study was to evaluate the use of the ILMA in the out of hospital setting by paramedics in critically ill and trauma patients. The PILMAT data was used in this study to allow associations to be examined between the paramedics' attitudes, reported confidence and competence in tracheal intubation to their real performance in this area. The PILMAT trial involved quantitative data which could be used to show associations between it and the qualitative data in this study. Therefore the PILMAT data allowed an improved level of data triangulation which increases the rigor of this study.

The study was a prospective cross-sectional interventional study. There were two practitioner groups identified – Paramedics with advanced airway management (AAM) training and those without this training (non-AAM). The ILMA was used as a first choice of airway device in all patients identified by paramedics as requiring an airway adjunct due to inadequate airway patency and/or ventilation. Tracheal intubation could be attempted via the ILMA by paramedics involved in the trial when intubation was indicated as per the Tasmanian Ambulance Service clinical protocols.

For eighteen months during 2005 and 2006 the researcher collected data during the PILMAT trial on the efficiency and effectiveness of paramedics' use of the ILMA. During this study, data was collected on the logistics, clinical and situational aspects for every out of hospital ILMA use. This is a very comprehensive quantitative data source and was supported by follow up structured interviews on every paramedic use of the ILMA. The PILMAT trial data was analysed for association by using descriptive statistics in Microsoft Excel (Microsoft Corporation, USA). Copies of the PILMAT trial data collection form is attached as Appendix 2.

The paramedics involved in the PILMAT study functioned in a variety of clinical settings, a number were performing as part of two paramedic professional crew, others were the only permanent crew member supported by a volunteer officer and others worked as a single response paramedic with no support. The ILMA could be used by the paramedics in clinical situations where they were the only responding paramedic to other situations where multiple paramedics were present to perform patient care.

Prior to the PILMAT trial, tracheal intubation had only been authorised for those paramedics who had successfully completed the Tasmanian Ambulance Service in house four week AAM program. The PILMAT trial sought to evaluate the performance of tracheal intubation using the ILMA by paramedics who had not been AAM trained. So the inclusion criteria for the ILMA training program was any qualified paramedic, anticipating there would be a number of non-AAM paramedics performing tracheal intubation using the ILMA without the option of using the laryngoscope, although the numbers would be small. The remainder of this thesis presents research that builds on these findings to report on the introduction of the ILMA as an innovative approach to AAM and examine the influences on its diffusion as a standardised practice.

1.8 Outline of the Thesis

Chapter one introduces the thesis by providing an overview of EMS, the history of paramedic AAM practice and current paramedic practice in Australia. Paramedic AAM and the traditional methods of training were described along with the notion of confidence, competence and the use of simulation. An outline of the current concerns in relation to EMS tracheal intubation were discussed along with alternatives and the PILMAT trial.

The second chapter explores the literature surrounding AAM especially tracheal intubation, the training processes and performance in this area by paramedics. It specifically outlines the current difficulties and adverse events which have been reported and the aspects of confidence, competence, the use of simulation and in hospital training. Finally this chapter reports areas of paramedic AAM which remain unknown and introduces the Intubating Laryngeal Mask Airway.

Chapter three describes the research design and Rogers Diffusion of Innovation model employed in this study including the data collection methods and an overview of the data analysis process. In this study there were two areas of data collection, a detailed questionnaire and key person interviews with supplementary data used from another study (PILMAT) where the ILMA was used by paramedics. There are both qualitative and quantitative data in this study and the methods used to analyse and collate the various data items is described in chapter three along with the measures employed to minimise bias.

Chapter four is the findings chapter which details the results of the data collection and analysis. An extensive analysis and comparison of both the qualitative and quantitative data findings are presented. The findings are presented in reference to paramedic tracheal intubation, confidence and competence, use of the laryngoscope and ILMA, and the AAM educational strategies.

Chapter five is the discussion chapter where the findings are critiqued and used to answer the questions of this study. The findings will be debated in relation to the current literature and how they contribute to both the current knowledge in this area and future practice. The discussion is presented in two sections, the first exploring the introduction of the ILMA as an innovation to AAM practice and in the second section a model for diffusing AAM innovations into the paramedic workforce.

Chapter six is the conclusion to this study which provides an overview of the entire study and includes its limitations, strengths and contributions it has made to the relevant areas of paramedic AAM practice. Recommendations are presented which have a focus on the paramedic tracheal intubation, including the use of the ILMA, and the educational considerations for the introduction of innovations into paramedic AAM practice.

Chapter 2 Literature Review

2.1 Introduction

The paramedic workforce has tracheal intubation as a core skill which is traditionally performed using the laryngoscope with limited if any options available for the array of airway management situations the paramedic may encounter in the out of hospital emergency environment. A number of options to providing quality emergency airway care have emerged during the past decade and some have been trialled and used by EMS services.

Drawing on the available evidence base this chapter presents a critical overview of advanced airway management with particular attention paid to tracheal intubation, paramedic AAM education and use of the ILMA. The central concepts of confidence and competence are explored in the context of AAM, education and skills maintenance. A description of the ILMA, the innovation at the centre of this research, and its use is provided and available evidence on its introduction, usage and success is reported. The lack of evidence relating to the introduction of innovations into paramedic AAM, paramedic AAM confidence in the use of the ILMA is then established.

The chapter will show as with many areas of paramedic practice the literature from the paramedic profession on the topic of AAM is scarce. Paramedic AAM performance, their perspective in relation to AAM training and especially what influences their confidence and competence is typically reported by the medical profession. Occasionally paramedics are involved in classroom studies but very few manage the research process and studies involving the EMS workplace in relation to AAM practice are rare.

The details and a summary of the literature review methodology can be found in Appendix 3.

2.2 Paramedic AAM

Airway management is a multifaceted area of patient care that demands different levels of intervention depending on the severity of the airway compromise. The rudimentary default method of providing a clear airway rests with simple manual techniques and ventilation using a bag-valve-mask which are skills more typically employed by community first aid providers, such as St. John Ambulance. A number of other intermediate airways, including the laryngeal mask airway, combitube and the laryngeal tube, are also available for use by health care professionals (Vertongen, Ramsay et al. 2003; Cook 2006; AHA 2010; ERC 2010), These methods and approaches to airway management relate to lower acquity patient scenarios, which are not the focus of this study. Instead, the literature review concentrates on the more targeted issues related to advanced airway management that paramedics typically respond to as emergency situations.

Paramedic AAM is nationally an undefined set of skills and techniques within the industry which are authorised within each State ambulance service with the majority of AAM practised by paramedics Australia wide having a customary set of skills. The commonly practised AAM skills are:

- Tracheal intubation using the Mackintosh laryngoscope
- Bougie assisted tracheal intubation

The most common AAM skill performed by paramedics is laryngoscopic tracheal intubation which is restricted to the higher skill levels, commonly Intensive Care Paramedic (ICP) or Critical Care Paramedic levels. Paramedics almost exclusively use the laryngoscope as the device and method of tracheal intubation. Within hospitals there is an array of specialist tools and techniques which can be employed to perform a difficult intubation or when tracheal intubation fails. The most common secondary airway device used by paramedics is the LMA. This device is a supraglottic[4] airway device (SAD) which provides a lesser degree of airway security than tracheal intubation but is recognised as much easier to use (Choyce, Avidan et al. 2000; Burgoyne and Cyna 2001; Martel, Reardon et al. 2001). The management of a failed tracheal intubation by ICPs currently rests with reverting to using this less than optimal level airway, the LMA. The LMA is the airway used by most ambulance paramedics and is a general paramedic level skill, not restricted to ICPs, and some ambulance services are now investigating the use of alternative supraglottic airway devices (Committee 2008). The supraglottic airway devices, which sit above the glottis (vocal cords) are an improvement on the basic airway devices (such as the oropharyngeal airway), are much easier to use and do not require specialist tools such as the laryngoscopic to insert, but they do not provide the degree of airway patency or care offered by tracheal intubation.

There are limited tracheal intubation options available to EMS services and some have been studied in settings other than the paramedic working environment, for example the classroom, although most studies have included paramedics to various degrees. One study involved performing tracheal intubation through the LMA-unique and in other studies use of the Airtraq, Combitube and the ILMA have been reported.

The Airtraq (Aust Distributors, REM Systems, Sydney, NSW) has been studied (Woollard, Mannion et al. 2007) and has been shown is a device which is suited to the inexperienced out of hospital provider to perform tracheal intubation. The Combitube (Aust Distributors, Medshop Australia, Preston, Victoria) is an airway device which does not provide tracheal intubation but is an intermediate airway and internationally often used as a backup for the failed tracheal intubation situation (Rumball, Macdonald et al. 2004). The standard LMA has a structure which allows for the passing of a tracheal intubation tube although not specifically designed for this purpose and in a study where paramedics attempted tracheal intubation

[4] Supra glottic refers to the area immediately above the glottis or vocal cords.

through the LMA-unique they were rarely successful (Barnes, Reed et al. 2003).

There are limitations with performing tracheal intubation in the uncontrolled environments in which paramedics work. The imperative to have a method of tracheal intubation which is easy to train, use and especially an ability to achieve a relatively high level of competence during initial training is necessary in the paramedic practice environment as a paramedics first emergency tracheal intubation may be the most difficult in their career and be performed with little or no assistance. The often limited space, lack of resources and the vast range of environmental factors from lighting to emotional family and friends all greatly influence the techniques and procedures able to be performed by paramedics (Garza, Gratton et al. 2008).

The laryngeal mask airway is a common device used in-hospital theatres for routine procedures (Weksler, Klein et al. 2004), where the patient has an empty stomach. In hospital, where tracheal intubation fails, there are a number of other devices such as: the intubating laryngeal mask airway and fiberscope, which can be used as secondary devices to facilitate tracheal intubation, in most paramedic practices a secondary tracheal intubation device is not available. This reliance on the laryngoscope and lack of alternatives increases the risk of failure and adverse events happening.

2.3 Errors, Difficulties and Adverse Events with Paramedic Tracheal Intubation.

A number of studies have now quantified the unacceptably high levels of adverse event and errors attributed to paramedic laryngoscopic tracheal intubation (Katz and Falk 2001; Garza, Algren et al. 2004; Goedecke, Herff et al. 2007; Wirtz, Ortiz et al. 2007; ARC 2010). These reported issues have not been isolated to one specific practice level or country they have been widespread across modern EMS services and as such should be considered as a realistic view of the current practice of paramedic laryngoscopic tracheal intubation. This poor performance has caused the major UK paramedic body, the Joint Royal Colleges Ambulance Liaison Committee, to recommend: "*tracheal intubation without the use of drugs has little value in pre-hospital practice*", "*The current format of paramedic training is inadequate for training pre-hospital intubation*", and "*Improving training for all paramedics is not considered feasible, both for operational reasons and difficulties in delivering the training*" (Committee 2008). This is a strong criticism from a body which has representation from the major medical colleges and societies in the UK and one of the first from within the paramedic community. These comments created a severe rebuttal from the paramedics themselves and their respective representative bodies (College of Paramedics 2008).

Performing tracheal intubation is known to involve significant risks, it is a difficult skill to master (Wang and Katz 2007) and failure rates by ambulance paramedics is reported to be between 8% and 50% (Sanson-Fisher, Rolfe et al. 2005; Vleuten and Schuwirth 2005). The most devastating complication, which is almost certainly fatal is the unrecognized oesophageal intubation, where the tracheal tube is not placed into the lungs via the tracheal but instead unknowingly placed into the oesophagus with a direct route to the stomach thereby ceasing ventilation, only a few studies have reported the incidence of this by ambulance paramedics. The incidence of this event occurring varies across the many paramedic systems, one study (Wirtz, Ortiz et al. 2007) states during a review of tracheal intubation in 192 patients by ambulance paramedics in New York City they found 9% were unrecognized oesophageal intubations, another study (Sreevathsa, Nathan et al. 2008) looking at patients in cardiac arrest found it to be somewhere between 2.9% and 16.7% with a 25% misplacement rate reported by Katz and Falk (Katz and Falk 2001) in a eight month study period, levels which are unacceptably high. Due to the devastating outcome these figures are unacceptable and lead to the questions being raised against paramedics performing tracheal intubation.

In an editorial by Patrick Gerbeaux MD he asks and goes on to answer the question “*Should emergency medical service rescuers be trained to practice endotracheal intubation?*” (Gerbeaux 2005). He discusses three areas, firstly competence and the perceived lack of tracheal intubation training; secondly the service the EMS systems are attempting to deliver and is tracheal intubation the best method of providing out of hospital airway management; and thirdly, the cost involved in providing out of hospital care especially in relation to a rarely performed skill like tracheal intubation. He identifies the problems with out of hospital tracheal intubation within the above three areas and highlights the current difficulties with the solution that with appropriate training and the financial support EMS practice can include tracheal intubation. There is little doubt that the more patients a paramedic successfully intubates per year the greater their success rate (Deakin, King et al. 2009).

One study (Garza, Gratton et al. 2003) examined the effect general experience had on paramedic laryngoscopic tracheal intubation and found there was a significant correlation between the total number of tracheal intubation attempts and success rate, opposed to the findings of Morgan and Cleave-Hogg (Morgan and Cleave-Hogg 2002). The study by Garza et al also concluded, in ninety eight paramedics attempting tracheal intubation on 1,066 adult non-traumatic cardiac arrests, there was no correlation between the paramedics’ general experience and their tracheal intubation success rates. The paramedics who attempted more tracheal intubations were more successful, which further exposes the rural paramedic where their attempt rate is low. Therefore the rural paramedic who is expected to have a lower emergency workload than their urban counterparts faces difficulty in maintaining competence in a critical skill such as tracheal intubation if the tracheal intubation success rate is correlated to the number of attempts.

Recent published guidelines suggest the decision of when to perform tracheal intubation is based on the education completed (Wang and Katz 2007) and the experience of the operator (Herff, Wenzel et al. 2008), which has been refuted by other studies (Garza, Gratton et al. 2003). The above mentioned studies indicating poor performance in paramedic tracheal intubation by way of unrecognised oesophageal intubation was not examined in detail to determine if there was any correlation between the operators' level of education, experience and confidence.

Tracheal intubation is commonly considered a difficult psychomotor skill to learn and maintain. Many EMS providers operate a two-tiered response system, in which they restrict the more complex skills to a higher clinical level, in Australia the Intensive or Critical Care Paramedic. A study in 1998 (Bradley, Billows et al. 1998) where Emergency Medical Technicians (EMT), a base level provider, were trained on manikins to perform laryngoscopic tracheal intubation found their success rate was well short of the rates reported by the higher clinical level paramedics. In this study the EMTs achieved a laryngoscopic tracheal intubation success rate of only 49%. It is unsure if this reflects less than adequate training, or the influence of confidence, or the unmatched cognitive levels. Paramedics with low experience in airway management have a high risk of being unsuccessful with laryngoscopic tracheal intubation and thus potentially reducing patient safety and outcomes.

The difficulty in performing out of hospital tracheal intubation is supported by a number of studies (Doran, Tortella et al. 1995; Wang, Kupas et al. 2003) where they found a number of factors were associated with intubation failure by paramedics. Information obtained from these studies paints 'not a good picture' of paramedic laryngoscopic tracheal intubation. The many factors causing these difficulties in out of hospital tracheal intubation, such as level of consciousness, combative patients, vocal cord view, patient weight and a gag reflex, are not easily managed or taught during many of the AAM educational programs and are rarely experienced in the hospital operating theatre setting where a degree of paramedic tracheal intubation training occurs. With factors not easily controlled in the out of hospital environment and the increasing scope where paramedic laryngoscopic tracheal intubation is performed there is a need to investigate alternative methods of performing tracheal intubation.

Laryngoscopic tracheal intubation a difficult skill is considered to require a degree of muscular effort to perform successfully. A trial (Timmermann, Russo et al. 2006) did discover the male medical students were more successful with laryngoscopic tracheal intubation than were female students, whereas this was not found when using the ILMA. There were no other articles discovered dividing tracheal intubation success rates between male and female practitioners.

The idea that some females during initial laryngoscopic tracheal intubation training may not have developed adequate strength in specific muscle groups to appropriately use the laryngoscope is one potentially not limited to only females. Male paramedics who have limited experience with manual work or sports involving the arms are also potentially unable to correctly use the laryngoscope. The impact this lack of muscular strength has on performing laryngoscopic tracheal intubation has never previously been mentioned and may contribute to some of the difficulties attributed to use of the laryngoscope for tracheal intubation by paramedics. Using the ILMA does not require the same strength either during its insertion or when performing tracheal intubation and thus provides another less published advantage for infrequent intubators such as the EMS paramedics. This supports the notation that proper use of the laryngoscope is arduous and may be a reason why laryngoscopic tracheal intubation is viewed as a difficult skill.

There has been clinical predictors evaluated which has been shown to influence the success of out of hospital tracheal intubation (Davis, Fisher et al. 2006). Perfusion status, Glasgow Coma Score and End Tidal Carbon Dioxide levels have been analysed in this study by Davis et al to indicate a positive correlation to tracheal intubation success, within a large urban EMS system. Like many studies of this type, there is no mention of the technique used to perform the tracheal intubation; it is assumed the tracheal intubation was performed using the laryngoscope.

Recent studies have made recommendations on a specific patient group, those with a ‘traumatic head injury’ (Dunham, Barraco et al. 2002; Salomone, Ustin et al. 2005; Bernard 2006) advocating tracheal intubation to be a critical management step influencing patient outcome when performed early by ICPs. With tracheal intubation now stated to have a significant influence on patient outcome in this small patient cohort, the issue of providing appropriate training and tools to ensure success is a priority.

One of the key difficulties paramedics have with tracheal intubation is having a clear understanding of when to perform the skill, an area where guidelines have been developed but the cognitive process required in many out of hospital situations is complex (Garza, Algren et al. 2004). The issue of providing a patient with optimal airway care goes beyond the mere success of tracheal intubation. The initial question is, “*are the correct patients receiving the intubation attempts?*”(Garza, Algren et al. 2004) The study by Garza of an EMS over 66 months reviewing 2,669 tracheal intubations discovered there was a significant difference in intubation non-attempts and failure in specific patient cohorts. The risk of tracheal intubation non-attempt and failure was found to be higher in the paediatric patient and adult traumatic cardiac arrest cohorts. Therefore the issue of intubation non-attempt appears to be a significantly undiscovered area, which if evaluated would potentially display a poorer picture of out of hospital tracheal intubation. The basis for this non-attempt issue appears to be a lack of confidence and education often related to the novice practitioner, which can potentially be reduced or eliminated with improved training and the introduction of other techniques. With the paramedic performing very few tracheal intubations their opportunity to develop these advanced skills beyond the level of a novice must be questioned.

The history of paramedic tracheal intubation highlights a number of concerns in relation to performance which adds to the notion that tracheal intubation is a difficult and at times complex procedure to perform. According to Roger’s Diffusion of Innovation theory, this level of difficulty and complexity provides an opportunity for a less complex skill or procedure to be embraced by paramedics especially if it provides a perceived advantage and is compatible with the current paramedic values (Sanson-Fisher 2004).

2.4 AAM Tracheal Intubation Training

The emphasis placed on the application of tracheal intubation during resuscitation is recognised by a number of renowned international resuscitation bodies, which within their recommendations state:

Table 1: International resuscitation bodies statement on tracheal intubation

Resuscitation Body	Recommendation
Australian Resuscitation Council (ARC)	*"Endotracheal intubation remains the gold standard for airway maintenance and airway protection in CPR."* (ARC 2010)
American Heart Association (AHA)	*"The endotracheal tube was once considered the optimal method of managing the airway during cardiac arrest. There is considerable evidence that without adequate training or ongoing skills maintenance, the incidence of failed intubations and complications is unacceptably high." (AHA 2010)*
European Resuscitation Council (ERC)	*"Tracheal intubation is perceived as the optimal method of providing and maintaining a clear and secure airway. It should be used only when trained personnel are available to carry out the procedure with a high level of skill and confidence. "* (ERC 2010)

Of note is the statement by the ERC which makes the only reference to operator confidence as a critical component to performing tracheal intubation. Both the AHA and the ERC highlight the crucial role adequate training plays in performing the skill. The emphasis on tracheal intubation as a significant AAM skill is supported by most of the recognised international resuscitation bodies and therefore its inclusion into the scope of AAM ambulance paramedic practice justified. This is despite a lack of clear evidence on the benefits of out of hospital tracheal intubation (ERC 2010).

The recognised resuscitation bodies (ARC, AHA & ERC) also state a significant determinant when deciding the optimal method to maintain the airway and ventilate a patient, including the technique of tracheal intubation, should be ‘provider experience’ (AHA 2010; ARC 2010; ERC 2010) which they define as six to twelve applications per annum. This is the number of occurrences they deem necessary in order for the practitioner to maintain a minimum degree of experience in order to maintain competence. Paramedics generally have low tracheal intubation experience rates in the out of hospital environment, with annual median frequencies in many rural services less than one tracheal intubation per paramedic per annum (Bradley, Billows et al. 1998).

Paramedic tracheal intubation is often reported to be an infrequently performed skill (Bradley, Billows et al. 1998; Burton, Baumann et al. 2003; Garza, Gratton et al. 2003; Wang, Kupas et al. 2005; Wang, Abo et al. 2007; Committee 2008; McCall, Reeves et al. 2008; Deakin, King et al. 2009) with many studies indicating each paramedic undertakes the skill once or twice annually. The most reported annual performance is five times and with many not performing the skill once annually.

Teaching AAM skills to paramedics has generally involved a blend of simulation and real patient experience. Initial skill training in tracheal intubation is often provided by paramedic educators commonly using manikins, of which there is an assortment with varying degrees of difficulty (Parry and Owen 2004; Schaefer 2004; Cook, Green et al. 2007). The other common training component is a time period spent in a hospital operating theatre under the supervision of an anaesthetist, where tracheal intubation can be performed on real patients. The duration of the operating theatre component varies between EMS services and the availability of this training component is quickly decreasing (Johnston, Seitz et al. 2008). Some ambulance services implement a mentor process whereby the learner is supervised during their initial workplace clinical performance of the skill. It is unknown which of these training components provide the greatest benefit, and if paramedic tracheal intubation taught on manikins alone is effective.

As is the case with most clinical skill training, the concern for patient safety has influenced the use of patients to teach tracheal intubation. Laryngoscopic tracheal intubation is a complex psychomotor skill which has a high risk for causing patient harm and this has been well documented to occur in the paramedic profession (Bledsoe 2006; Goedecke, Herff et al. 2007; Nolan 2007). Studies showing from 9% up to 25% of unrecognized misplaced tracheal tubes by paramedics with subsequent patient demise (Katz and Falk 2001; Wirtz, Ortiz et al. 2007) are alarming and cause concern.

When tracheal intubation training commenced for paramedics it was almost exclusively conducted in the hospital theatre setting. This occurred to ensure the ‘traditional owners’ of tracheal intubation, the anaesthetists, could provide close supervision and have a degree of control and thus influence on the competence levels obtained by the paramedic trainees. For this reason many of the early paramedic AAM programs were of long duration, e.g. in Tasmania the inaugural program was 12 weeks in hospital. On acceptance of the ICPs’ ability to perform this skill a more relaxed approach saw the in hospital training time decrease significantly and the introduction of varying levels of manikin based training. The ideal mix of theatre and manikin training experience is not known.

The potential for patient harm in association with a number of other interprofessional factors invoke fear in paramedical personnel learning tracheal intubation on patients in the hospital operating theatre environment (personal communication). The ethical issue, the pressure of time, and a high complication rate has recently necessitated the teaching of tracheal intubation to be initially undertaken using simulation in many Emergency Medical Systems (Owen and Plummer 2002; Barsuk, Ziv et al. 2005; Hall, Plant et al. 2005).

One unique difference between in hospital and out of hospital tracheal intubation which has been studied is the position of the patient. In hospital the vast majority of patients requiring tracheal intubation are at waist height on a bed or trolley. In the out of hospital environment the majority of patients are on the ground or at floor level. Kusunoki et al (Kusunoki, Nakatsu et al. 2004) studied this difference by having staff anaesthetists perform tracheal intubation on the ground and compared it to when they performed the skill on a table. They concluded performing tracheal intubation on the ground was more difficult and took longer to achieve, even for the experienced anaesthetists. This places some doubts around the exclusive training of AAM to paramedics in hospital environments by anaesthetists and further highlights the difficulty with out of hospital tracheal intubation.

This difference between the learner and the educator can be a factor which influences learning, as highlighted by Rogers (2003) in his diffusion of innovation theory. Learning is best achieved when the learner and the educator has similar social status, education and beliefs which is referred to as ‘homophily’. Paramedics learning AAM in the theatre environment by medical specialists in the majority of instances includes little homophily as both have different performance expectations.

ICPs learning the technique of laryngoscopic tracheal intubation have followed a similar training process used for training medical students and to lesser extent anaesthetists. If laryngoscopic tracheal intubation training is seen as just mastering a psychomotor skill then the training processes can be structurally similar. This approach looks simplistically at learning to perform a motor skill and not involving the cognitive processes required in a difficult skill such as tracheal intubation. Paramedics require a different level of cognitive ability to perform tracheal intubation because of the environment in which they work. The sterile, controlled, well-resourced clinical in hospital environment is vastly different to the out of hospital environment where paramedics practice.

A lack of clinical support combined with a low skill usage provides unique circumstances for the paramedic to maintain AAM. The ICP is not a novice with basic airway skills but they do have very limited clinical application of AAM skills, which require other opportunities for skill development to ensure confidence and thereby competence, and an investigation into the suitability of other devices to perform tracheal intubation.

There are differences in the performance of many skills between the in hospital and out of hospital environments. This questions the exclusive use of theatre experience for teaching paramedics. Wang et al (Wang, Seitz et al. 2004) discovered paramedic student tracheal intubation success varied across the various environments. Their study showed tracheal intubation success was achieved at the lowest level in the intensive care unit and the out of hospital settings. This outcome of a low success in the out of hospital environment and the highest success being achieved in the theatre setting would support the inclusion of theatre experience for paramedic tracheal intubation training. The immediate training environment correlated with the work environment is stated in Bandura's behaviouralist approach to the Social Cognitive Theory to have a significant effect on learning (Bijl and Shortridge-Baggett 2001).

The complexity of a new device or procedure will increase the learners' ability to learn and time period which they take to become competent and confident. Roger's (Rogers 2003) theory proposes an innovation which is difficult to understand and use due to its complexity will take an increased time to adopt. Therefore if a new device or procedure is seen to provide advantages and is less complex then it is expected to be adopted more rapidly. As tracheal intubation is a complex skill this requires careful consideration on the best methods to train paramedics.

One study (Hall, Plant et al. 2005) has compared paramedic tracheal intubation training on manikins to operating theatre training and conducted the evaluation on live patients in the operating theatre. This study showed paramedics trained on manikins were as effective as those trained on real patients. This study, like most others, has evaluated the learning curve for tracheal intubation using the laryngoscope, but none have examined the learning curve when using the ILMA. The results from these studies cannot be easily transferred to the out of hospital setting because we know the controlled setting of the hospital operating theatre has different and unique challenges to the uncontrolled out of hospital environment. Traditional AAM training programs may not fully prepare the paramedic for out of hospital emergency airway management. For many years the traditional theatre environment for teaching paramedic AAM has been supplemented by the use of manikins and various forms of simulation training.

The ability for the learner to trial the new device or procedure is stated by Roger's in the persuasion phase of the diffusion of innovation model to provide less uncertainty in the learner and thus contribute to increasing their acceptance. Limited opportunity to trial a new complex technique like tracheal intubation and then having expectations of being competent to employ the skill in the workplace may be a contributor to less confidence. Utilising simulation and manikins to "learn by doing" (Rogers 2003) then becomes a critical learning component of AAM competencies and is expected to increase both the learners' confidence and adoption.

2.4.1 Maintaining Competence

One of the obstacles to providing an adequate range of experiences, either real or simulated, during initial training and the resources required to implement an effective skills maintenance program are the financial constraints. There are studies (Owen and Plummer 2002; Parry and Owen 2004; Cook, Green et al. 2007; Jordan, Silsby et al. 2007) suggesting for students to have adequate training in airway skills and specifically laryngoscopic tracheal intubation they require introduction to a variety of different airway manikins. This is to provide a range of experiences to several anatomical variations, which they will encounter in patients and thus ensuring the learning is related to actual clinical practice. The cost of providing a range of manikins to ensure adequate trainee exposure to the varying degrees of airway difficulty would stretch the budget of most EMSs. Organisations must work within financial constraints and having a clear understanding of where and to what degree manikin use is most effective would provide a guide to ensuring a cost effective training requirement is achieved.

The complexities which are implemented for skills training varies amongst health care professionals. Keeping the training process to the simplest effective model has the advantage of being achievable, more realistic and more likely to invoke a change in practice (Handfield-Jones, Mann et al. 2002). This is also supported in Roger's (2003) Diffusion of Innovation theory where less complexity leads to a more rapid adoption. The new ideology of learning being a continual life process and not being completed at the end of a specific training program has been embraced in the area of medical education. Traditional paramedic AAM training programs have a well-developed credentialing process but are still developing adequate skill maintenance programs, especially for the rural paramedic.

Anaesthetic simulators, clinical skills laboratories combined with lectures, self-assessment and personal study are being used to train personnel in AAM skills (Goldmann and Ferson 2005). There are a number of inherent logistical problems in providing advanced clinical training into an ambulance paramedic system. Ultimately which ever educational methodology is implemented it is required to produce paramedic practitioners who can perform AAM at the necessary level in this unique environment. Therefore ensuring the initial training provides the practitioner with high levels of both confidence and competence in order for them to deliver a level of patient care which ensures minimal risk to the patient is a critical aspect for paramedic tracheal intubation to continue.

2.4.2 Confidence and Competence

One group of medical officers (Stewart, O'Halloran et al. 2000) stated their view on confidence was closely related to what they could do and their description of not being confident was closely related to their perceived 'anxiety' levels in their future performance of a skill. With the significant time between a paramedics' performance of AAM skills their confidence would be expected to decrease and processes to aid their maintenance of confidence should be implemented. If tracheal intubation is a difficult skill to perform as reported by Wang and Katz (Wang and Katz 2007) then individual paramedics anxiety towards the next time they are required to perform this skill in an emergency situation must increase as the time period since their last successful performance gets longer.

Confidence has been described in one way as the degree to which and individual is willing to perform a task. An individual's confidence has been shown to be closely correlated to their experience in a particular skill (Morgan and Cleave-Hogg 2002) but not always related to the individual's competence in a particular skill (Stewart, O'Halloran et al. 2000). Experience has been cited as the mechanism to have the greatest effect on increasing confidence. When a practitioner has confidence to perform a skill one failure will not necessarily affect their future confidence level. Confidence provides the practitioner with the ability to evaluate the risk of undertaking the task or skill and allows them to judge when to stop a skill if unsuccessful. Whereas the overconfident practitioner will tend to perform skills they are not adequately trained to do and fail to adequately evaluate the risks involved in performing the skill.

Confidence can also be affected by the quality of the training which has been delivered. A trainee who has experienced multiple negative experiences during their training, including inappropriate or a lack of performance feedback, will have increased anxiety and a low level of confidence in performing the specific skill (Cottrell, Thammasitiboon et al. 2008). Therefore training program structure and resources may have an impact on the trainee's confidence regardless of the number of experiences provided. A passionate and dynamic educator may have a positive impact on not only the student's desire to learn but also their level of confidence in comparison to a busy medical specialist for whom the trainee is not a priority. One of the educator characteristics which will increase a student's confidence is their ability to provide constructive feedback. Clear feedback on the student's performance which focuses on what they did correctly or incorrectly is the type of feedback which improves confidence. Praise and compliments are not that effective (Cottrell, Thammasitiboon et al. 2008).

There are two major phenomena involved in learning and competence according to Handfield-Jones et al (Handfield-Jones, Mann et al. 2002). They first explain competence will always decline unless something has an influence on the individual's performance. Their rationale is the ever increasing medical advancement requiring continuous training, and the more complex and the less confidence skills, e.g. tracheal intubation, require feedback to maintain competency. Providing feedback to the paramedic during routine work activities is difficult primarily because of the unscheduled nature of when paramedics perform AAM skills. Secondly, in Handfield-Jones et al's article they suggest after performance of a skill, confidence and potentially competence is temporarily improved for a short period. The difficulty remains, with a complex skill like tracheal intubation, how long after each performance does competence improve to a satisfactory level and with the paramedics' very low frequency of practice this alone is not expected to be sufficient to maintain competence. An investigation into paramedic AAM practice to discover their perceptions of the requirements to maintain their confidence is required.

Yet another survey (Marel, Lyon et al. 2000) of medical trainees found their confidence to be high at the end of their formal training program (2 years) and then to experience a significant development of the skills which they performed regularly in the first postgraduate year. During the postgraduate years if there was a continual level of clinical exposure there would be improved confidence and competence. Paramedics do not experience this continual exposure in AAM skills therefore their confidence and competence is expected to decrease. This increase in performance immediately after education has been supported in other studies (Konrad, Schupfer et al. 1998; Handfield-Jones, Mann et al. 2002; Wang, Seitz et al. 2004) and justifies the common paramedic apprenticeship model of initial training followed by a supervised practice period, but is difficult to maintain in skills which are so infrequently performed.

Any relationship between experience and confidence could be expected to be associated to the complexity of the individual skill being performed. A study involving medical students in 2002 in a classroom setting (Morgan and Cleave-Hogg 2002), included basic and advanced airway management skills and correlated a relationship between clinical experience and confidence. They concluded there was a significant correlation between clinical experience and levels of confidence. But when assessing the skill found no correlation between clinical experience and performance levels. Therefore, an individual's confidence may increase with increased clinical experience, but this may not be reflected in an increased level of competence. Therefore experience can produce a positive influence on confidence but not necessarily on competence. The Paramedic may be confident in performing tracheal intubation because of frequent out of hospital application of the skill but still require a formal process to ensure the required level of competence.

This further supports the requirement for a practitioner to regularly perform a skill after initial training in order to maintain competence and confidence, and justifies the logistical difficulties and financial constraints often involved in providing appropriate clinical supervision in the workplace immediately post training. There is limited information on paramedics' confidence after successful completion of an AAM training program.

There is evidence that specific feedback on performance has an important influence on confidence (Cottrell, Thammasitiboon et al. 2008) and this is why during initial training students receiving feedback on performance significantly have an increase in confidence, such as when performing laryngoscopic tracheal intubation in-theatre being observed by the anaesthetist or in-service being observed by a clinical educator. Cottrell et al (Cottrell, Thammasitiboon et al. 2008) in a study involving medical students, found when clear specific feedback was received by the students they were 6.6 times more likely to feel confident.

Although in this same study they concluded performance and feedback was more influential on confidence than regular performance alone, "*while students' confidence was dependent on the educational process, it was not related to the number of times a clinical experience was performed*."(Cottrell, Thammasitiboon et al. 2008). In the busy environment of the hospital theatre providing clear specific feedback is often difficult to achieve and is more suited to training performances on a manikin in a classroom environment. The strategies for effective learning, development of confidence and competence cannot be separated and confidence is expected to decline without feedback or regular performance. Infrequent paramedic tracheal intubation practice and its effect on confidence and a comparison between the laryngoscope and the ILMA is unknown.

The experience and confidence of paramedics has been identified as a major reason why, in unusual and difficult intubation situations, they delay or abandon tracheal intubation attempts (Garza, Algren et al. 2004). The paediatric cardiac arrest and the adult traumatic arrest patient cohorts are identified as specific clinical presentations where paramedic confidence has a significant influence on whether an attempt at tracheal intubation occurs. The degree to which this is due to operator confidence and whether the use of an alternative tracheal intubation tool or technique, reported to be easier to use, influences the confidence levels and thus reducing the tracheal intubation non-attempt rate is unknown. Likewise in the study on tracheal intubation non-attempt (Garza, Algren et al. 2004), there was no mention of simulation training and the degree of skill maintenance undertaken by the paramedics, all of these training components are linked to maintaining confidence and must be considered together.

The learning experience obtained by paramedics in the hospital theatre environment has been questioned. The relevance and opportunities for practice are not as high as expected and the use of manikins and simulation has increased. This change in learning requires careful scrutiny to evaluate the worth of manikin (simulation) only training in traditional areas such as AAM. Both laryngoscopic and ILMA methods of tracheal intubation will be examined in further detail to determine how each may have an influence on paramedic confidence. The clinical presentation in which tracheal intubation is frequently performed, cardiac arrest, and the patient cohorts where it is known to be difficult to perform out of hospital tracheal intubation: the unconscious non-trauma patient, the patient with a suspected unstable cervical spine and the multi trauma patient with inadequate breathing and a poor airway will be compared for paramedic confidence between the two tracheal intubation methods.

2.4.3 Simulation and In Hospital Training

Discussing the history of simulation, Bradley (Bradley 2006) states along with many others that "*Simulation provides a safe, supportive educational environment*" which makes this type of training popular. The use of simulation to teach health professionals has increased over the past decade (Good 2003; Bradley 2006) and continues to be the educational area currently undergoing the greatest development. The reasons for developing simulator training have been many from: the recognition that medical students have been ill-prepared for their expected role (Bradley 2006), limited access to training opportunities, to the advancement of patient safety (Abrahamson, Denson et al. 2004). One obvious benefit of simulation which must rate highly in the current trend of protecting patients from human error is the ability of simulation to provide a safe environment in which to perform technically difficult and potentially harmful procedures, such as tracheal intubation (Good 2003; Bradley 2006)

The use of simulation in many areas of medical training (Bradley 2006) have proven its value in the training of airway skills for both medical students and paramedics, but most confirms it should not be used as the single method of teaching. Advantages in using simulators to teach tracheal intubation, as described by Owen and Plummer (Owen and Plummer 2002) are now universally accepted. They are:

1. No risk to the patient;
2. Students can practice as often as required;
3. Many attempts can be made in quick succession;
4. Practice can be scheduled;
5. Errors can be allowed;
6. Procedure can be undertaken slowly or stopped;
7. Different situations can be created;
8. Different techniques and equipment can be tried;
9. Difficulty can be increased incrementally;
10. Environment can be controlled;
11. students can become confident prior to attempting the skill on a patient;

Further explanation on the above advantages specifically in relation to Paramedic practice can be found in Appendix 4.

All the above reasons must not only lead to improved learning but also a safer health service. The other critical component of skill training is timely and objective feedback. The ability to provide effective feedback by being able to pause the procedure when performing emergency skills can only be achieved using simulation. The success of teaching paramedics tracheal intubation using manikins alone has not been reported, especially when using a tracheal intubation method different to the traditional laryngoscope.

Education in complex skills requires a change in cognitive thinking and often needs the student to view a clinical problem from a different viewpoint, sometimes termed “cognitive re-organisation” (Handfield-Jones, Mann et al. 2002). This educational concept is the basis for the use of simulation centres, not to teach single skills, but the integration of skills into a complete patient management scenario. Training using simulation, particularly with manikins, can have learning outcomes focused on a large range of the common educational taxonomies. The easiest and most common use is in the training of psychomotor skills but immersive simulation often involves higher cognitive levels of evaluation and analysis.

A study (Johnston, Seitz et al. 2008) released from the University of Pittsburgh has quantified the student paramedics experience in the hospital theatre environment. They found their paramedic students spent a median of between seventeen (17) to thirty-two (32) hours in the theatre setting for between a median of six and ten attempts at tracheal intubation, and 25% of the students did not fulfil the annual national accreditation requirement of five tracheal intubations. This national requirement for five intubations is much lower than the requirements found in other areas (Konrad, Schupfer et al. 1998; Shysh 2000). This number is much lower than the figures recommended for learning this skill and to achieve an acceptable success rate, and it may be reflected in the complication and poor EMS tracheal intubation success rates which have been reported in some USA studies (Bradley, Billows et al. 1998; Katz and Falk 2001; Wang, Kupas et al. 2003; Garza, Algren et al. 2004; Wang, Lave et al. 2006). The difficulty of the theatre environment being unable to provide a suitable experience for paramedic students in tracheal intubation in an acceptable timeframe has been another major driver in the use of simulation for paramedic AAM training. The extended time paramedics spend in theatre to achieve a small number of AAM experiences is inefficient.

The close association between some aspects of paramedic education, for example AAM, to other in hospital health disciplines requires paramedic education to compete with the same patient cohorts (Barnsley, Lyon et al. 2004; Wang, Seitz et al. 2004) in order to use patients for training purposes and frequently the organisational and education resources of the hospital programs are also involved in accommodating paramedic education. This occasionally perceived intrusion of paramedics, who don't work in the hospital environment, into the traditional in hospital areas where there are more formalised educational requirements frequently place paramedic education as a low priority and with a 'do it if we can' approach. If this training experience is difficult or impossible to achieve by other means this places paramedic education in a difficult situation. An example of this has been where having paramedics attend theatre has occasionally created conflict with other health care trainees and difficulties in paramedics being recognised as having a genuine educational need.

The routine use of tracheal intubation in theatres has declined significantly over the past decades and thus the opportunities for paramedics to practice this skill have also greatly declined (Committee 2008; Johnston, Seitz et al. 2008). This decreased in theatre training opportunity has placed an increased demand on the use of simulation and manikin training for paramedics to achieve competency in laryngoscopic tracheal intubation. This reduction in theatre training has similarly changed the methods available for paramedics to maintain their laryngoscopic tracheal intubation skills.

Paramedic AAM education has used the task orientated 'airway manikin' type simulators to provide initial mastery of the basic airway management skills which include; all the common manual techniques, oropharyngeal and nasopharyngeal airway insertion, airway aspiration, LMA insertion, tracheal intubation and cricothyroid puncture. The more advanced patient simulators are normally used in a patient care scenario simulation which incorporates a range of not only clinical but also cognitive, behavioural and professional abilities. The hospital environment, especially in theatre, does not provide the opportunity or degree of relevance to paramedic practice to enable this complete level of paramedic AAM training, it is not just because of the limited number of training opportunities but also the environmental challengers which are dissimilar to the out of hospital setting (Kusunoki, Nakatsu et al. 2004; Garza, Gratton et al. 2008). Therefore simulation remains as a cornerstone for the training of paramedics in AAM.

Many of the studies evaluate the use of simulators in isolation, the relationship of the three educational domains when using simulators is lacking (Good 2003; Abrahamson, Denson et al. 2004; Hall, Plant et al. 2005). The majority of studies involving tracheal intubation simply report on the outcome 'success rate' which is a reflection of the result of a psychomotor skill with few studies attempting to evaluate or report the cognitive processes involved in tracheal intubation, which is especially relevant to the out of hospital setting. Morgan & Cleave-Hogg (Morgan and Cleave-Hogg 2000) in their study of medical students and the reliability of using simulators to assess performance found there was poor correlation between written examination scores and simulator performance. But like many others, they discovered the students had a positive experience when exposed to simulators during their education (Owen and Plummer 2002; Reeves, Skinner et al. 2004).

The solitary use of basic airway manikins for teaching laryngoscopic tracheal intubation to non-anaesthesia personnel was found to be inadequate by Mulcaster et al (Mulcaster, Mills et al. 2003). In this study they reported after performing 20 successful training laryngoscopic tracheal intubations on a manikin the students were then assessed on real patients in theatre. During the assessment on the real patients there was a 9.4% failed intubation rate and 24% experienced complications during the tracheal intubation attempt, the majority of the students participating in this study were student paramedics. This study does raise the concern that laryngoscopic tracheal intubation training using manikins may be cost effective but is it adequate when considering most of the basic airway manikins provide no significant challenge to the competent practitioner and a degree of increased difficulty is desired to continue the development of the student's performance.

In a study by Goodwin and French (Goodwin and French 2001) they reported an individual skill trainer or patient simulator may be a useful tool for assessment of performance in a simulated emergency situation when combined with practice and formal teaching. Individual skill trainers and a crude level of simulation are used in many EMS organisations as the prime component of their airway training programs. This key use of AAM simulation is focused on low to medium fidelity manikins incorporating the basic airway skills with little opportunity to truly experience the implementation of AAM skills in the range of circumstances encountered by paramedics in their working environment. Doubt also exists on the transference of skills and techniques learnt on simulators to actual patient encounters (Bier, Crystal et al. 2006). It is unknown if the complexity of the skill has an influence on this transference or the influence training techniques and operator confidence has on the ability to successfully utilise manikins for AAM training.

In a study by Lebuffe et al (Lebuffe, Plateau et al. 2005) they used simulation as an instrument to evaluate the performance of both beginning and advanced anaesthetic residents to successfully carry out two theatre airway management scenarios. They concluded; "*mannequin based simulation appears a reliable and valid tool to test the performance of anaesthesia residents during critical airway situations*". The use of simulation to provide additional training for out of hospital physician trauma airway management after completion of a recognised trauma course, by Barsuk et al (Barsuk, Ziv et al. 2005), demonstrated simulation improved the performance of the physicians by decreasing the common mistakes in managing airway problems, and recommended graduates from the original trauma program would benefit from simulation based airway management training.

In a study by Abrahamson et al (Abrahamson, Denson et al. 2004) where anaesthesiology residents were paired, one to receive standard training whilst the other undertook training on a simulator, they report those students trained on the simulator achieved proficiency in a shorter time period. The other finding reported in this study was that after the initial training on a manikin the students required fewer experiences in theatre to achieve the required standard. The ability for the students to achieve proficiency sooner may be due to a number of factors, but more importantly it supports the use of manikins during initial tracheal intubation training which appears to decrease the requirement for training on real patients thereby also having an effect of increasing patient safety.

Simulation training has been seen as the only safe and effective method to teach and learn difficult airway management techniques (Good 2003). A patient in the operating room requiring emergency or difficult airway skills is rare and if it does happen the paramedic student is unlikely to be allowed to manage such a patient. The experience of Owen & Plummer (Owen and Plummer 2002) when teaching medical trainees tracheal intubation found the use of multiple airway simulators an advantage in experiencing and managing varying degrees of airway difficulty. When using only one simulator for tracheal intubation training the trainees become familiar with that specific simulator and develop techniques which can only ensure successful performance on that specific device. The issue of teaching paramedics to adequately manage the difficult airway in the uncontrolled unsupervised out of hospital setting is a priority. Most studies have centred on using the traditional tools and techniques of tracheal intubation and finding new methods of training, but, few have looked at using new techniques and tools to achieve tracheal intubation.

Therefore, the degree of success an AAM training program can provide when using manikins is dependent upon the type of manikin used. It may not be appropriate to just mandate a minimum time period or number of attempts for manikin training but also the type of manikin/s to be used for each AAM skill may need to be specified in order to achieve the required training outcomes.

There are a number of studies evaluating the use of patients, cadavers and manikin approaches to teaching AAM or combinations of these methods. Wang et al (Wang, Seitz et al. 2004) reported a success rate of 87% when paramedic students trained on patients in hospital, while Doran et al (Doran, Tortella et al. 1995) reported a similar success rate, 88%, of paramedics in a high volume city setting. Schaefer (Schaefer 2004) makes the statement that "*manikins are useful for only rudimentary, basic training. They are static and do not provide accurate clinical feedback for teaching and practicing skills*." This appears to exclude the modern high fidelity simulators where more than rudimentary basic skills can be performed and the manikin is able to respond to management by not only changing clinical signs and symptoms but also by altering physical characteristics. In a comparison of cadaver to manikin training by paramedics, Bier (Bier, Crystal et al. 2006) stated the paramedics reported more confidence in performing airway skills on cadavers than on the manikins primarily due to the 'look and feel' of the real anatomy. The development of manikins has increased the realism of their airways anatomy with some developers utilising actual patient CT images as templates for ensuring life like anatomy of airway specific manikins.

It has been stated, simulation is as effective in teaching tracheal intubation as using human subjects and others conclude it is superior to actual patient training (Good 2003). Two training groups of paramedic students were compared in a study by Hall et al (Hall, Plant et al. 2005) where both cohorts initially received identical manikin training, they were then randomised with one cohort spending 10 hours on a patient simulator while the others successfully undertook 15 tracheal intubations in the operating theatre. After this training both cohorts were tested by performing 15 intubations in the operating theatre. The cohort taught using simulation, achieved a higher success rate on first attempt (84% compared to 80%) and a higher overall success rate (88% compared to 85%). These results indicate tracheal intubation training using manikins (simulation) are at least as effective as training in the operating theatre. It must also be remembered this study was conducted in the controlled closely supervised hospital theatre setting.

The use of simulation and manikins for initial training allows the individual to practice and experiment with the new device or procedure which will decrease their uncertainty, improve confidence and provide a big advantage in their acceptance of the new device or procedure. This ability to trial and 'play' is referred in Roger's (Rogers 2003) model as 'learning by doing' the trialability characteristic of the persuasion phase.

Performing laryngoscopic tracheal intubation is a difficult psychomotor skill and with repeated practice it does provide operator fatigue. Owen et al (Owen and Plummer 2002) in a study of medical students and paramedics in a simulation facility where they were performing tracheal intubation found the optimal duration of training was between 75 and 90 minutes. They discovered sessions longer than 90 minutes were very fatiguing, but within this timeframe the students were able to make between 12 and 14 attempts at tracheal intubation. An AAM training program should plan for the student's fatigue by ensuring each student does not spend more than this recommended 75 to 90 minutes practicing tracheal intubation on a manikin with adequate breaks between, remembering this study's findings only refer to performing laryngoscopic tracheal intubation and when using other tracheal intubation methods this time period may not be relevant.

The PILMAT study where ICPs (AAM practitioners) and paramedics (non-AAM practitioners) completed a very short manikin only tracheal intubation training program found the participants successfully performed tracheal intubation using the ILMA in the field on acutely ill and injured patients (McCall, Reeves et al. 2008). During the 12 months after this short manikin-based program the paramedics achieved tracheal intubation success rates using the ILMA (92%) which were comparable to the laryngoscopic tracheal intubation (91%) success rates. The paramedics in this study were able to demonstrate the short manikin based training did provide the training required for them to use the ILMA, especially for those AAM practitioners (ICPs) but the paramedics who had no previous tracheal intubation training or experience (Paramedics) were also able to effectively perform ILMA tracheal intubation on patients, achieving a 100% success rate.

Until recently many only used basic airway skills trainers to teach the specific aspects of paramedic AAM. The ideal portion of an AAM training program dedicated to simulation training has not been researched despite the many studies involving the different applications of manikin training. A significant emphasis is placed on the initial training process which is reflected in some studies where an AAM skill is taught and examined in the same day, normally following vocational or apprenticeship models. Less research and effort has traditionally been aimed at the paramedics' ability to maintain their levels of confidence and competence until recently. A major factor facing paramedics is their ability to maintain advanced skills, such as AAM, in a low clinical practice environment.

Gandini and Brimacombe (Gandini and Brimacombe 2004) found medical staff, after a short training program favoured the LMA over the traditional facemask for the ventilation of neonates. Their change in confidence when using the LMA was significant, increasing from 8% to 97% as the favoured ventilation device. This study included medical staff that had not previously used the LMA and after this short training, it was their preferred device, indicating the ease which inclusion of the LMA into paramedic practice has occurred. This suggests the initial training program can have a significant influence on operator confidence but other studies (Handfield-Jones, Mann et al. 2002) has shown this confidence is likely to decline if there is no continual skill exposure.

Self-reporting is used in other fields of health care but it does involve a degree of self-reporting bias. Katz and Falk (Katz and Falk 2001) drew attention to the problem of detection bias whereby paramedic tracheal intubation errors and adverse events went undetected by paramedics. Therefore, there exists a lack of knowledge regarding the true performance of out of hospital tracheal intubation, with current understandings providing the “best case” scenario as the true performance of paramedic tracheal intubation is likely to be worse not better than current reporting.

One of the more recently developed advanced airways which has undergone extensive in hospital study and is now accepted as a primary device for anaesthetics and emergency physicians for difficult tracheal intubations is the intubating laryngeal mask airway (ILMA) (Reardon and Martel 2001). The ILMA is a device now recommended and used for practitioners who are classified as infrequent performers of tracheal intubation and has been reported as easier to learn and use but the requirements needed to maintain competence when using this device for tracheal intubation is unknown at present.

There is a need to ensure future training methodologies are developed to suit the paramedic workforce requirements which take into account the unique challenges of the organisation, the individual and the patient care requirements. Emergency Medical Systems which have a state/county wide structured training program and a formal skills maintenance process tend to have higher tracheal intubation competency levels (Dunham, Barraco et al. 2002). The recent focus on Quality and Safety and inter professional practice may have an influence on the AAM skill requirements of paramedics.

2.5 The Uncertain Areas of Paramedic AAM

The success rate of out of hospital laryngoscopic tracheal intubation has been shown to vary greatly between studies with many results being unacceptable for a variety of reasons. There are very few options for paramedics to provide optimal airway care when their sole method of tracheal intubation fails and paramedics revert to employing the basic techniques, such as the facemask or LMA. The difficulties produced by the default, facemask technique, are the reasons why tracheal intubation was initially introduced into the out of hospital environment, but suitable options are available which require evaluation.

The vast majority of the paramedic AAM literature deals with the dominant method of tracheal intubation, the laryngoscope, with a number of recent studies involving some of the less optimal supraglottic airway devices. Some of the literature involves the performance of tracheal intubation by different EMS skill levels often linking poor performance to the lower clinical skill levels. The reliance on laryngoscopic tracheal intubation to be the ultimate and primary method of providing an adequate airway and ventilation does not appear to be as strong in the in hospital culture (Fulton, Jacoby et al. 2002) as it does in the out of hospital environment. There are alternatives which can be implemented and these require investigation.

At its inception paramedic AAM training and performance was led and the responsibility of the medical profession. The advancement of paramedic practice and development of the EMS profession has seen the influence of the Medical profession on EMS is declining. With the paramedic profession slowly developing its own identity and rapid expansion of their scope of practice, there has been a rise in the medical profession literature questioning paramedic AAM performance. In the literature there are varying models of AAM training with the majority involving a traditional apprenticeship vocational education model. This style of training makes the assessment of competence in a complex areas such as AAM problematic because it simplifies the performance to just the manual or physical skills.

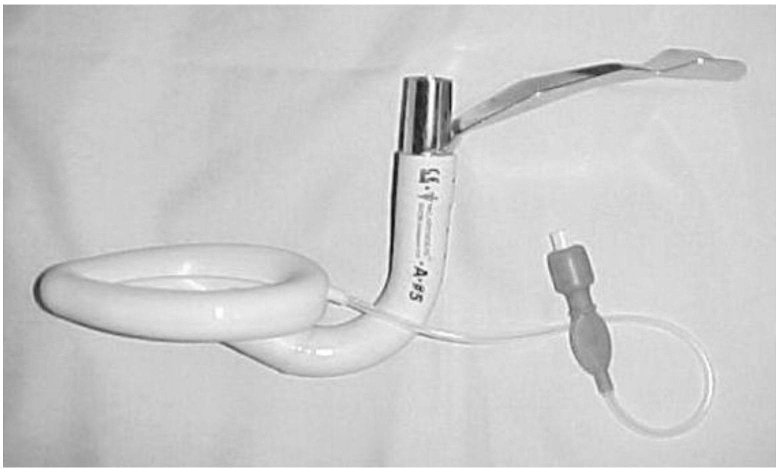
There is a ground swell now questioning the value of tracheal intubation in the out of hospital environment (Gerbeaux 2005) some stating paramedic tracheal intubation should be stopped due to the high level of error (Bledsoe 2006). The difficulties experienced with out of hospital laryngoscopic tracheal intubation, including the logistic difficulties with its training and varying success rates, has prompted many areas of the medical profession to question the validity and worth of paramedics performing this technique (Gerbeaux 2005; Bledsoe 2006). This is of particular importance when the application of this skill has been shown not to improve patient outcome (Committee 2008). So the concept of paramedic tracheal intubation is currently on a ‘shaky footing’, possibly influenced by ICPs having only one intubation technique (laryngoscopic) to manage all clinical patient extremes and the identified educational difficulties which have been highlighted.

With research indicating the ability of novice practitioners to successfully perform tracheal intubation using the ILMA, the specific area of ICP practice has not been studied to determine if they can perform the skill after a short manikin based educational program. A comparison of operator confidence when performing tracheal intubation between using the laryngoscope and the ILMA has not been reported. In order to appreciate the introduction of the ILMA as an innovation and the paramedic affects it is important to understand the development and function on this device.

2.6 The Intubating Laryngeal Mask Airway (ILMA)

Modifications to the standard LMA-Classic involving slight changes to some of its features has occurred in many formats, for example the LMA-Supreme, LMA-ProSeal, LMA-Unique and the LMA-Flexible (LMA Group of Companies) all of which retain the same overall structure and shape of the standard LMA. One major and significant alteration of the standard LMA has been the development of the Intubating Laryngeal Mask Airway. Based on its ease-of-use and retaining the major feature of the laryngeal mask cuff the ILMA was specifically created to: eliminate the need for manipulation of the neck, remove the need to place fingers into the mouth, and enable an easy method of tracheal intubation, especially in the situation of the difficult to maintain airway.

Figure 1: The ILMA.



The ILMA was designed by Dr A Brain as a modification to the standard laryngeal mask airway to assist with tracheal intubation in the patient with a difficult airway. The standard laryngeal mask airway had developed significant general acceptance as an alternative airway device in both the hospital theatre and out of hospital settings. The intubating laryngeal mask airway was developed and has been used almost exclusively in the hospital environment. It is unknown if it can be effectively used in the out of hospital emergency situation. Studies have shown it may have a role in this area, its efficiency has been studied in: the extremes of nuclear, biological and chemical environments (Wedmore, Talbo et al. 2003); patients with cervical spine injury (Waltl, Melischek et al. 2001; Komatsu, Nagata et al. 2004; Komatsu, Nagata et al. 2005); the obese patient (Frappier, Guenoun et al. 2003); and the rural trauma patient (Young 2003). The above suggesting the intubating laryngeal mask airway is effective in managing the patient with a difficult airway (Fukutome, Amaha et al. 1998), which in the out of hospital situation there are few other options.

The ILMA incorporates a number of new features with the aim of enabling the operator to perform tracheal intubation especially in the patient with known or expected difficulty. Features such as the ‘epiglottic elevating bar’, the ‘handle’ and the ‘guiding ramp’ are all designed to ensure the maximum chance of tracheal intubation success. In the manufactures Instruction Manual it states the ILMA ‘*permits single-handed insertion from any position without moving the head and neck, from a* *neutral position, and without placing fingers in the patient's mouth'* (Limited 2001) all of which provide significant advantages to paramedic practice.

There have been a number of studies during the past decade on the use of the ILMA in hospital and few in the out of hospital setting. The majority of these have concluded the ILMA is a device which is easy to train health care workers in, results in short intubation times (Pandit, MacLachlan et al. 2002) and has a short learning curve (Reardon and Martel 2001; Caponas 2002; Tentillier, Heydenreich et al. 2007). The majority of studies involving use of the ILMA have been conducted in hospital and used non-paramedic personnel where they have found its use to have many advantages (Agro, Brimacombe et al. 1998; Asai, Wagle et al. 1999; Lu, Yang et al. 2000; Vlymen, Coloma et al. 2000; Burgoyne and Cyna 2001; Dries, Frascone et al. 2001; Martel, Reardon et al. 2001; Mason 2001; Combes, Sauvat et al. 2005; Timmermann, Russo et al. 2006; Timmermann, Russo et al. 2007; Sreevathsa, Nathan et al. 2008).

In the many studies on the use of both the LMA and the ILMA, the training has been shown to be effective after a short manikin based training program (Reeves, Skinner et al. 2004; Timmermann, Russo et al. 2006; McCall, Reeves et al. 2008), a program using cadavers (Choyce, Avidan et al. 2000) and in anaesthetised patients (Asai, Wagle et al. 1999; Timmermann, Russo et al. 2007), these studies indicate a short learning curve. In a study by Guyette et al (Guyette, Rittenberger et al. 2006) basic emergency care providers were able to obtain a 78% success rate in placing the LMA after a short classroom training session using a basic manikin.

A meta-analysis of ILMA use was conducted by Caponas (Caponas 2002) in 2002. The conclusion to this analysis was the ILMA is a valuable adjunct to airway management, especially in the management of difficult airway cases. He also concludes ILMA tracheal intubation success is more likely when the operator has practised 20 previous insertions. This article raises two reported advantages of the ILMA, the first its effective use when airway difficulties are encountered (expected or unexpected) and second the steep learning curve to successful ILMA use. One area reported as a reason for the development of the ILMA was to provide an easy method of tracheal intubation in the difficult airway situation (Limited, 2001).

Use of the LMA has been shown to be easier and the preferred method of ventilation by novice practitioners (Association 2005). The novice applies rules, leading on to the advanced beginner who has a broader focus which includes pattern recognition and intuition. The movement from novice to competency has also been described as a change from a rule-based performance to a context-based performance which engages intuition and intellect (Leach 2002). "*Novices ventilate and intubate quicker and safer via Intubating Laryngeal Mask than by conventional bag-mask and laryngoscopy*", Timmermann et al (Timmermann, Russo et al. 2007) conclude. In this study final year medical students with no airway management experience were more successful with both ventilation and tracheal intubation using the ILMA, and they also demonstrated laryngoscopic tracheal intubation was a difficult skill to perform for inexperienced practitioners.

A study of novice users performing tracheal intubation by Timmermann et al (Timmermann, Russo et al. 2006), involved medical students performing tracheal intubation using two different methods, the laryngoscope and the ILMA. After attending a lecture and demonstration of both techniques each student was allowed three attempts to perform successful tracheal intubation using each method in a random order. Tracheal intubation on first attempt with the laryngoscope was achieved in 50.4% of students, while first attempt with the ILMA was successful in 90% of the students. The other critical finding was 13.4% of students failed the three attempts at laryngoscopic tracheal intubation, whilst none failed when using the ILMA.

When using a laryngoscope and inserting the standard LMA the patient’s head has to be moved substantially in order to perform the procedures successfully and this is not suitable in many patients who require these procedures in the out of hospital emergency environment. The use of these devices, laryngoscope and LMA, has a limitation of only being able to be completed in one position in relation to the patient. When using the ILMA, it can be inserted and tracheal intubation successfully performed in any position in relation to the patient (Limited 2001), therefore in situations where laryngoscopic tracheal intubation would appear difficult or impossible, such as confined spaces and patients trapped in a vehicle, ILMA tracheal intubation can be performed with relative ease. The ILMA has been specifically designed to perform tracheal intubation with no head or neck movement, paramedics utilising the ILMA for tracheal intubation in critically injured trauma patients may greatly reduce the risk of further patient harm and provide a much easier solution to a difficult airway management situation. During a study which simulated manual cervical spine immobilisation the study by Reeves et al (Reeves, Skinner et al. 2004) determined AAM trained paramedics were able to successfully perform tracheal intubation with the cervical spine immobilised using the ILMA in the hospital theatre environment.

Figure 2: Performing tracheal intubation using the ILMA

The paramedic environment provides a unique challenge for care of the severely traumatised patient, this emotional and difficult physical environment along with the pressure of expedient transport requires careful attention to adequate spinal immobilisation. Performing tracheal intubation in a severely traumatised patient is one of the most difficult intubation situations paramedics are confronted with and occasionally temporary cervical spine immobilisation is lost whilst performing the procedure.

A comparison between laryngoscopic tracheal intubation and ILMA tracheal intubation during elective surgery, the study concluded the ILMA provided no advantage unless there were airway difficulties, but also stated the ILMA was a safe and quick device to use in trauma patients where no or minimal neck movement was desirable (Waltl, Melischek et al. 2001). The conclusion from Waltl et al's study demonstrated "*significantly less cervical spine extension occurred at $C_{1/2}$ in every patient intubated with the ILM (Fastrach) compared with direct laryngoscopy*." This ability to successfully perform tracheal intubation with no or minimal movement of the cervical spine, significantly less movement than when using the laryngoscope, would provide a significant advantage to the paramedic management of severely traumatised patients requiring definitive airway control.

Studies which have specifically included paramedics have been conducted in the classroom situation or in-hospital settings and found they were easily trained in its use, the ILMA was accepted as a valuable device for out of hospital AAM and was a preferred device to have available to manage a patient's airway and perform tracheal intubation. (Reeves, Skinner et al. 2004).

The ILMA has been shown in a number of studies to be simple to use with some concluding the ILMA as an effective method of tracheal intubation (Lu, Yang et al. 2000; Reardon and Martel 2001; Pandit, MacLachlan et al. 2002). Studies in the use of the ILMA have focused on its use by in hospital practitioners (Agro, Brimacombe et al. 1998; Asai, Wagle et al. 1999; Choyce, Avidan et al. 2000; Lu, Yang et al. 2000; Vlymen, Coloma et al. 2000; Burgoyne and Cyna 2001; Martel, Reardon et al. 2001; Pandit, MacLachlan et al. 2002; Combes, Sauvat et al. 2005;

Timmermann, Russo et al. 2006; Timmermann, Russo et al. 2007; Sreevathsa, Nathan et al. 2008), and a small number of these did involve novice AAM practitioners (Choyce, Avidan et al. 2000; Burgoyne and Cyna 2001; Timmermann, Russo et al. 2006; Timmermann, Russo et al. 2007). There was only one study found involving the use of the ILMA by paramedics (McCall, Reeves et al. 2008) which is the PILMAT study undertaken by myself as the precursor of this thesis. Although these paramedics practicing tracheal intubation may not be novices there are a number who are inexperienced in relation to AAM.

Use of the ILMA by Medical Consultants, registrars and resident medical officers all categorised as AAM 'novices' during routine theatre conditions as studied by Burgoyne and Cyna (Burgoyne and Cyna 2001) concluded:

"the ILM[5] *is as easily inserted and effectively used as an LMA by novices and because it allows the option of facilitating endotracheal intubation may be the preferred device for maintaining an airway during resuscitation".* It is in the resuscitation situation where paramedics are most often required to perform tracheal intubation.

One specific study investigated use of the ILMA in the emergency out of hospital difficult intubation, Tentillier et al (Tentillier, Heydenreich et al. 2007). The participants in the study were emergency physicians working on mobile intensive-care units, over a six-month period they performed 45 ILMA tracheal intubations. Their success rate for ILMA tracheal intubation was 91% in patients considered as being difficult to intubate. The commonest classification of a difficult intubation in this study was the obese patient (36%) a common difficult tracheal intubation situation. Tracheal intubation of the obese patient using the ILMA was also studied by Combes et al (Combes, Sauvat et al. 2005), where they discovered the ILMA was an effective airway device for both lean and obese patients.

[5] ILM refers to the ILMA

Their conclusions state airway management with the *"ILMA was simpler in obese patients in comparison to lean patients*". Paramedics face these same difficulties. These senior Emergency Physicians recommend the ILMA to be used in out of hospital emergencies.

Novice participants in the study by Timmermann et al (Timmermann, Russo et al. 2007) were more successful with ILMA ventilation and tracheal intubation then with bag-mask ventilation and laryngoscopic tracheal intubation. In this study when observing laryngoscopic tracheal intubation failure the subsequent ILMA ventilation was 100% successful and ILMA tracheal intubation 84% successful. Because of these results this study also concluded: *"training programs should extend the ILMA to conventional airway management techniques for paramedical and medical personnel with little experience in airway management."*

A major concern when performing laryngoscopic tracheal intubation is the duration of interruption to ventilation, the patient cannot be provided with adequate Oxygen or ventilation whilst the laryngoscope is in place and thus causing a significant risk of oxygen lack with subsequent possible brain damage. Because the ILMA can be inserted and used as an airway device allowing Oxygen therapy and or ventilation during the procedure of tracheal intubation it greatly reduces the risk of Oxygen depletion and consequential patient harm. Laryngoscopic tracheal intubation is a procedure which must be adequately prepared for and performed in an expedient manner, whereas when performing ILMA tracheal intubation because Oxygenation and ventilation can be continued throughout the procedure it can be instigated sooner and accomplished in a less stressed and anxious manner (Limited, 2001)

Another study compared inexperienced practitioners insertion of the LMA and ILMA in cadavers (Choyce, Avidan et al. 2000). In this study by Choyce et al, the participants were asked to perform tracheal intubation on cadavers using the ILMA, which was completed successfully by 67% of the participants. The ILMA was inserted significantly faster than the LMA by a medium time of 3.5 seconds. As the standard LMA is used by many ambulance services this study suggests by replacing it with the ILMA would enable a short or time to adequate ventilation as well as providing a conduit for tracheal intubation and inexperienced practitioners should use the ILMA rather than the LMA for emergency ventilation. A similar study was undertaken by Burgoyne and Cyna (Burgoyne and Cyna 2001), where they found very comparable tracheal intubation success rates for both devices.

Martel et al (Martel, Reardon et al. 2001) reviewed ILMA use over a 12 month period in a busy emergency department by emergency physicians. Their findings were very positive towards using the ILMA in emergency situations. They found ventilation via the ILMA was achieved in less than 15 seconds with subsequent tracheal intubation in less than one minute. These times are impressive but reflect the in hospital environment where equipment is readily accessible, extra assistance available and other resources and help close by. The times to successful ventilation and tracheal intubation have not been examined in the out of hospital environment when using either the laryngoscope or the ILMA, but as some studies have concluded the ILMA easier to use (Martel, Reardon et al. 2001) has an acceptable success rate (Timmermann, Russo et al. 2006; McCall, Reeves et al. 2008) and an acceptable time for insertion and tracheal intubation on manikins (Pandit, MacLachlan et al. 2002; Timmermann, Russo et al. 2006).

In a commentary by Barry Issenberg and William McGaghie in the journal Medical Education they summarise their comments on clinical skills training by stating "*exposure, practice and assessment are necessary to ensure that core attributes, such as clinical skills, will be mastered and maintained*" (Issenberg and McGaghie 2002). Very little is known on the educational requirements for paramedic ILMA tracheal intubation initial training and the ongoing maintenance of the skill, what is recommended by the recognised international resuscitation bodies pertains to the training requirements for laryngoscopic tracheal intubation. As the ILMA is now being recognised as a device which is easy to use and quick to learn by novice and inexperienced health care workers an evaluation is required on its use by paramedics.

This propels the ILMA into being a suitable alternative to the laryngoscope for the infrequent paramedic practice of tracheal intubation and an evaluation of its use by paramedics is warranted.

2.7 The ILMA and Paramedic Practice

The organisational barriers which exist to changing paramedic practice in an area customarily viewed as the pinnacle of paramedic practice is unknown, even if the new skill is proven to be more efficient and effective. There is no doubt the ILMA has been shown to have advantages over laryngoscopic tracheal intubation in the in hospital situation and it is not known how is this viewed from the paramedic's perspective and what barriers will they perceive to the introduction of the ILMA.

According to Rogers (Rogers 2003) Diffusion of Innovation theory, there are a number of critical factors which determine if or how long it may take for an innovation like the ILMA to be adopted. The evidence supporting the ILMA did contribute to ensuring the paramedics involved in the PILMAT trial to see the advantage it may bring to their practice. This advantage is only one of five criteria which Rogers proposes as important when introducing a new device or procedure and the other four criteria will require examination to determine their influence during the PILMAT trial

To date most of the published information on training and use of the ILMA has been conducted by the medical community with only one study involving paramedics use of the device in the out of hospital environment (McCall, Reeves et al. 2008). With the introduction of the ILMA into the paramedics' scope of practice it is unknown how the novice and experienced practitioner will accept the change and its influences on their confidence and competence.

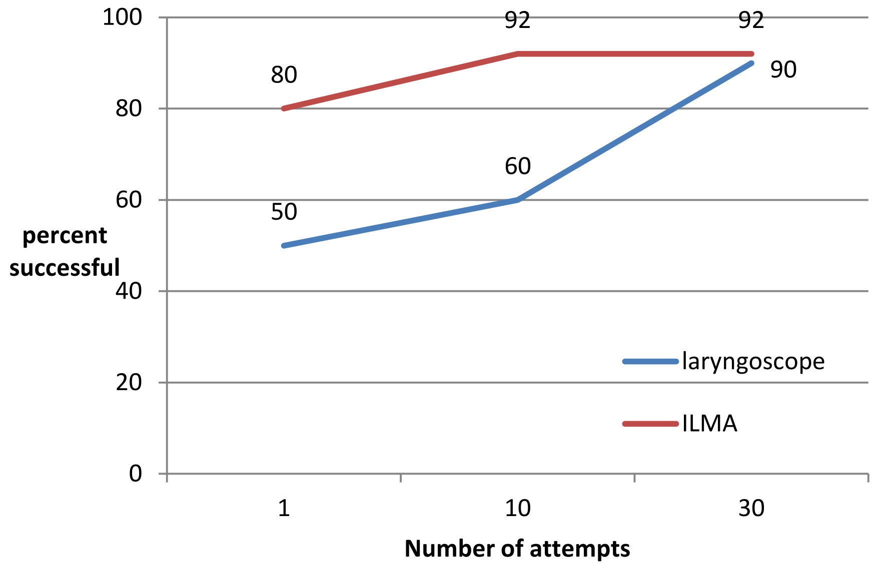
The study by Reeves et al (Reeves, Skinner et al. 2004) demonstrated the AAM paramedics were as effective as the hospital doctor who occasionally performed tracheal intubation. This observational in-theatre study of tracheal intubation using the ILMA involving ambulance paramedics (AAM trained), medical officers (tracheal intubation trained) and emergency department residents (never performed tracheal intubation). These three groups of participants used the ILMA to perform tracheal intubation on anaesthetised adults in the operating theatre where in-line manual stabilisation of the cervical spine was applied. Tracheal intubation success and time to successful tracheal intubation was measured. ILMA tracheal intubation failure was 7% for ambulance paramedics, 20% for the medical officers and 16% for the emergency department residents. The mean time (seconds) to intubate were 32 seconds for the ambulance paramedics, 32 seconds for the medical officers and 36 seconds for the medical residents. These results clearly demonstrate AAM trained ambulance paramedics' have the ability to perform tracheal intubation using the ILMA. This study was seen as a pilot trial to evaluate the use of the ILMA by paramedics with the aim supporting a further study with paramedics using the ILMA in the out of hospital setting, the resultant trial was the 'Prehospital Intubating Laryngeal Mask Airway Trial (PILMAT)".

A search of the literature found no studies where the ILMA and the laryngoscope were used in the out of hospital field by paramedics and a comparison made between their respective success rates. One study by Timmermann et al (Timmermann, Russo et al. 2007) compared final year medical students' use of the ILMA and laryngoscope to perform tracheal intubation and found they were more successful when using the ILMA. The PILMAT trial (McCall, Reeves et al. 2008) results of ILMA tracheal intubation by ambulance paramedics indicated this technique was as successful and required fewer attempts than the traditional laryngoscopic tracheal intubation. When using the ILMA these paramedics were 1.74 times more likely to be successful on tracheal intubation first attempt when using the ILMA than when using the laryngoscope. This study involved both AAM trained and non-AAM trained paramedics over a 12 month period and their use of the ILMA as an intermediate airway and as a tracheal intubation. The novice non-AAM trained paramedics, although only attempting a small number of out of hospital tracheal intubations using the ILMA did have a 100% tracheal intubation success rate. This study (McCall, Reeves et al. 2008) exclusively trained the paramedics in ILMA tracheal intubation using manikins alone.

Most EMS services currently use the laryngoscope for tracheal intubation and the LMA as an intermediate airway device, with both these devices providing the paramedic a single purpose in airway management. The ILMA can perform the function of the LMA whilst also providing a secondary tracheal intubation device in the situations where either the use of the laryngoscope fails for whatever reason or its use is inappropriate. This dual role in the management of a critical patient's airway has another advantage to paramedics because of the reduction in the equipment required to be carried due to the mobile nature of paramedic practice. Currently most EMS services do not have a secondary tracheal intubation method to employ in the critical situation of a failed laryngoscopic tracheal intubation; the ILMA may be a suitable device which may replace the LMA whilst providing an alternative tracheal intubation method.

The ILMA is a new tool for the out of hospital setting which may change the tracheal intubation training requirements. It has been shown to be superior in ease of use and skill maintenance to other commonly used airway devices such as the Combitube (The Kendall Company) (Vertongen, Ramsay et al. 2003; Barnes 2005). This device initially slow to be taken up, is now seen as such a success it is recommended in the anaesthetic community as a priority in managing the difficult airway (Agro, Brimacombe et al. 1998) and failed intubation (Martel, Reardon et al. 2001). The ILMA may provide advantages and the resolution of some current difficulties in out of hospital AAM, but we know very little of the learning curve for paramedics when using the ILMA in the out of hospital setting, especially for tracheal intubation. A number of studies have indicated a high initial tracheal intubation success rate when using the ILMA (Choyce, Avidan et al. 2000; Caponas 2002; Reeves, Skinner et al. 2004; Tentillier, Heydenreich et al. 2007; Timmermann, Russo et al. 2007; McCall, Reeves et al. 2008).

Figure 3: Published Laryngoscopic and ILMA learning curves.



This study will examine the paramedic's perception of AAM, use of the ILMA and its addition into their scope of practice. Specifically I will examine the training methods, barriers, and the opinions of ambulance paramedics to the inclusion of the ILMA into their scope of practice. This study will compare the influence of training methods and implementation of paramedic tracheal intubation in Tasmania using the traditional laryngoscopic method and the tracheal intubation technique using the ILMA.

2.8 Summary

Internationally Paramedics are at risk of having tracheal intubation removed as a core skill because of concerns they are unable to achieve and maintain competence in the out of hospital environment. This is of concern because the literature does not reflect paramedics' attitudes about tracheal intubation practice or training and without in-depth understanding it will be difficult to develop effective clinical education programs.

Paramedic tracheal intubation has exclusively utilised the laryngoscope as the tool and technique to perform the skill which has been based on its use by anaesthetists and their historical influence on paramedic AAM. Paramedics have infrequent practice of laryngoscopic tracheal intubation and the effect this infrequent practice has on paramedic confidence and competence has been reported to lead to frequent errors and difficulties.

This research will identify the components of AAM training which contribute the most influence on paramedic confidence and competence and propose a framework for AAM education. The current unease and worries about the value of teaching AAM using manikin-based simulation and the value of in-theatre real patient experience will be detailed so decisions can be made on their suitability and appropriate implementation into paramedic AAM education.

Evaluating the introduction of ILMA tracheal intubation into paramedic practice will provide information regarding this device as a suitable alternative to using the laryngoscope. The training methodologies used for AAM and the introduction of the ILMA during the PILMAT trial will be evaluated in light of Rogers (Rogers 2003) Diffusion of Innovation model. Having this understanding of the AAM training elements will provide paramedic educators and training program developers with valid components which they can include into AAM training programs and the implementation of other innovations. Knowing the paramedic's attitude towards tracheal intubation and the mechanisms to maintain competency will provide information to facilitate future AAM training.

An evidence base to support paramedics’ AAM training needs to be developed and this study will provide information regarding the paramedics view on their competence and confidence of AAM training and effective measures which increase these areas for future AAM development..

Chapter 3 Research Design

3.1 Introduction

Eliciting paramedics' attitudes towards the introduction of the ILMA as an innovation in AMM: their self-reported competence and confidence levels and the key factors that impact on these levels required a research design that enabled the capture of data that provided a quantitative measure and qualitative information. To this end a sequenced exploratory descriptive research design was employed. Data collection was achieved through a questionnaire which captured quantitative data and then a series of interviews which allowed deeper exploration of the emerging findings from the questionnaire. Findings were considered in light of the available evidence base and current practices in AAM education and training and the components of AAM training which contribute the most influence on paramedic confidence and competence were identified. The current unease and worries about the value of teaching AAM using manikin-based simulation and the value of in-theatre real patient experience will be detailed so decisions can be made on their suitability and appropriate implementation into paramedic AAM education.

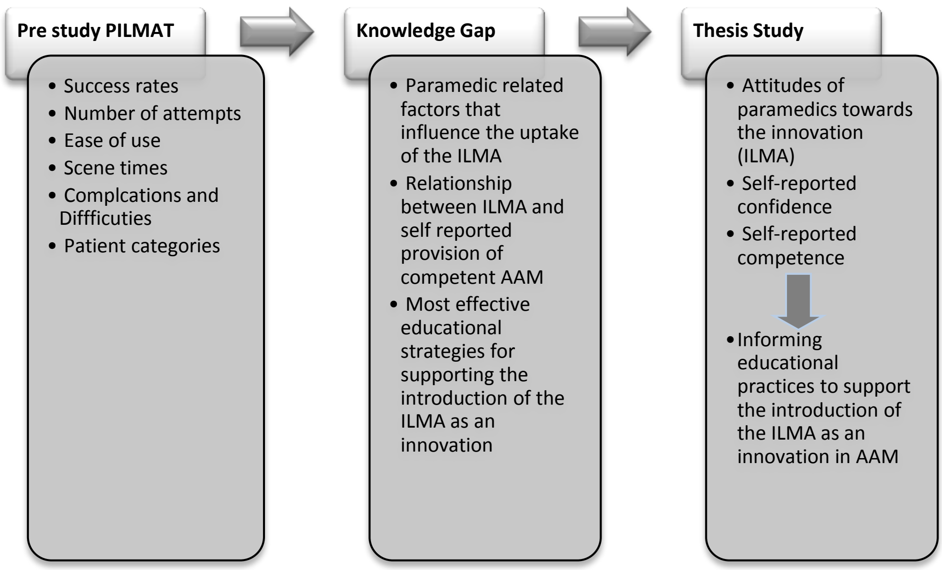
Roger's Diffusion of Innovation Model (Rogers 2003) contributes the theoretical framework upon which training methodologies used for AAM and the introduction of the ILMA during the PILMAT trial will be evaluated. Having Roger's understanding of the AAM training elements will provide paramedic educators and training program developers with valid components which they can include into AAM training programs and the implementation of other devices and procedures. Knowing the paramedics' attitude towards tracheal intubation will provide information to facilitate future AAM training.

3.2 Research Design

The design of this exploratory descriptive study draws from and builds on the conduct of a preceding study. In 2005 a trial, Prehospital Intubating Laryngeal Mask Airway Trial (PILMAT) involving paramedics using the

Intubating Laryngeal Mask Airway (ILMA) was funded by the compulsory state government accident insurance organisation the Motor Accident Insurance Board (MAIB). There was state wide a total of 88 paramedics credentialed to perform ILMA tracheal intubation during the PILMAT trial which concluded after eighteen months with quantitative outcome data. The study reported in this thesis advances the findings of the PILMAT trial through generating insight into the perceptions and attitudes of the paramedics to AAM training and the introduction of the ILMA. Quantitative data supporting these findings was gathered using a questionnaire. Interviews were then conducted to gather further qualitative data related to the attitudes of paramedics to the ILMA. Figure 1 illustrates the relationship between the PILMAT study and the research conducted for this thesis.

Figure 4: PILMAT and Thesis.



The introduction of the ILMA into paramedic practice to perform tracheal intubation was an innovative action for improving the management of the critically ill or injured patient’s airway. The introduction of an innovation into practice, regardless of its demonstrated efficacy, may be complicated by the reactions of people to the innovation. The introduction of the ILMA is an example of such a process. As a useful theory for examining and explaining the process and paramedic adoption of the ILMA for this study Rogers Diffusion of Innovation (Rogers 2003) theory was employed.

The education and training to learn about the ILMA and its use for tracheal intubation is where the innovation is imparted to paramedics. This training can be explained as a diffusion of innovation which is where information about the inclusion of a new innovation is explained. Rogers theory (Rogers 2003) provides principles about the process of innovation and details the steps an individual will go through when deciding to adopt an innovation. Rogers defines an innovation as "*an idea, practice or object that is perceived as new by an individual or another unit of adoption*" (Rogers 2003, p12) and diffusion as "*the process in which an innovation is communicated through certain channels over time among the members of a social system*" (Rogers 2003, p6). Diffusion of innovation is a process where information about a new device or procedure is communicated from person to person which is why it is defined as a social process and why the way in which the communication occurs is so important. The principle opportunity for communicating information about the ILMA is during AAM education and training sessions. For this reason the study places particular emphasis on findings that can inform AAM education.

It is the training program which predominately determines whether the paramedic makes the decision to use the new device to perform tracheal intubation or continue with the difficulties experienced with laryngoscopic tracheal intubation. Understanding how the ILMA functions and improves patient outcomes was a core component of the training programs. According to Rogers (Rogers 2003) this process involves the following processes in order: knowledge, persuasion, decision, implementation and confirmation.

It is in the training where the knowledge stage occurs and the individual learns about the new device or procedure, the background knowledge and how it operates. Ultimately though the paramedic will make the decision of whether they will use the device which is reflected in the persuasion phase of Roger's theory (Rogers 2003). Next is the persuasion phase where the individual decides if they are in favour of the innovation or feels adverse to its use. During the decision phase the individual undertakes activities which guide them to making a choice to either refuse or accept the innovation. The innovation is put into use during the implementation phase and finally affirmation is sought in the final confirmation phase.

As the literature review shows, paramedics decision to take up and continue to use a device is influenced by a number of factors. Roger's (Rogers 2003) theory accounts for this with some explanation about the rate the individual adopts or rejects the innovation is based on the following five attributes: relative advantage, compatibility, complexity, trialability and observability, which are shown in Figure 5 (page 96). Relative advantage refers to the benefits and costs which will result from the adoption of the innovation. This advantage can be expressed in a number of different ways dependent upon the type of the innovation and the organisation within which it is being introduced. The advantage is not so much an objective advantage but the measures which may be used are: comfort, effort, profitability and social prestige. The relative advantage of an innovation has been reported as one of the best predictors for the rate of adoption (Rogers 2003). And so for a tracheal intubation education program for paramedics it will be the advantage of the prestige the skills set commands, but also an advantage is provided in terms of feeling more confident to manage a patient's airway with less effort.

An innovation that matches with the individuals experience, needs and values satisfies the second attribute compatibility. The extent to which the innovation meets the needs of the individual has a large influence on compatibility. Complexity is the difficulty the innovation is perceived to present in relation to its understanding and use. An innovation which matches the user's needs and is perceived as easy to use will lead to an increased chance of being adopted or be adopted quicker.

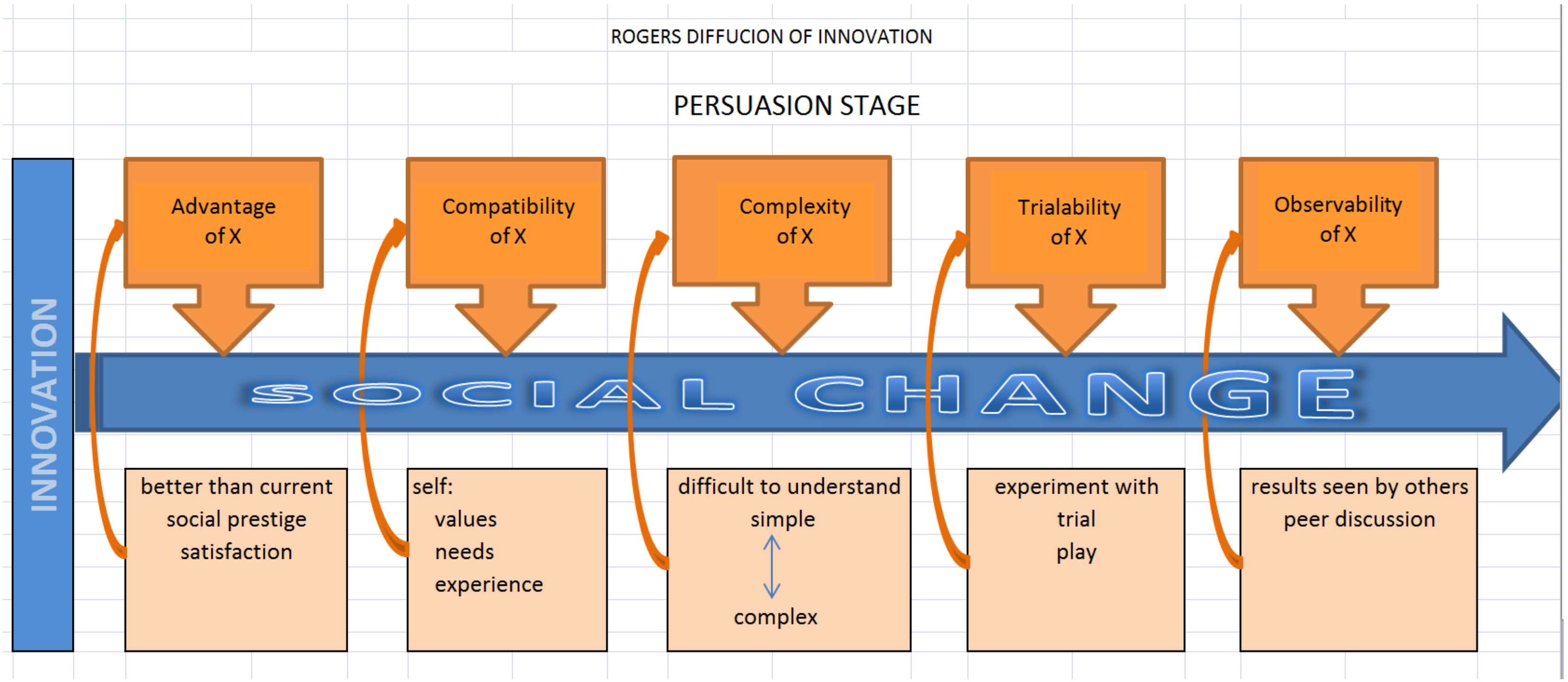


Figure 5: A diagrammatic representation of Rogers Diffusion of Innovation's persuasion phase (Rogers 2003).

The fourth characteristic, trialability is the capacity for the innovation to be trialled and experimented with on a controlled basis. Trialability has a positive influence on the adoption of an innovation. The capacity of others to see the results of the use of an innovation has a positive effect on its adoption, this is termed observability.

In summary, innovations which are viewed as having relative advantage, are compatible with current practices, are not complex, can be trialled and their use is observable will be more rapidly adopted. The ILMA has been reported as easier to use (Reardon and Martel 2001; Caponas 2002; Pandit, MacLachlan et al. 2002; Tentillier, Heydenreich et al. 2007) and requires minimal training which can be associated with Roger's theory and supported by the PILMAT trial. Roger's diffusion of innovation theory (Rogers 2003) is used to provide a theoretical interpretation of the findings and by doing so, the study will generate information from the paramedic's perspective in relation to these training components to inform their use in future programmes.

3.3 Setting up the study

3.3.1 Description of the research setting

This study was undertaken in Tasmania, Australia, which is a small State of approximately 68,119 square kilometres with a population of 510,2006[7]. It has a government run three tier ambulance service whereby Voluntary, Paramedic and Paramedic Intensive Care, Emergency Medical Services (EMS) provide the only public emergency medical response state wide.

Much of the services provided by Tasmanian paramedics can be understood as rural emergency service because Tasmania is recognised as a predominantly rural state. In a study it is important to clarify the way

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[7] March 2011, Australian Bureau of Statistics figures

rurality has been operationalised as a term in the thesis. The Australian Institute of Health and Welfare (AIHW) recommend the use of the Australian Standard Geographical Classification (ASGC) when determining an areas remoteness classification (AIHW 2011). When using this classification method there are no areas within Tasmania classified as a 'Major City' with the four largest population areas of Hobart and Launceston classified as 'Inner Regional' and Devonport and Burnie classified as 'Outer Regional'. Almost all of the other areas in Tasmania according to ASGC are classified within a 'remote' classification area except for a very few of the regional centres classified as 'Outer Regional'. Within Tasmania the Local Government Area classifications use only the two terms of 'Cities' and 'Municipalities' to classify each of the population areas, those populations classified as a 'city' in this model are those four major locations mentioned above (Hobart, Launceston, Devonport and Burnie) which fall into the ASGC as either Inner or Outer Regional areas.

Ambulance Tasmania regards Hobart, Launceston, Devonport and Burnie as urban based ambulance stations. In this study these urban centres are used in this study to classify an 'Urban Paramedic' in Ambulance Tasmania as they compare closely with the ASGC. Nevertheless, each of these urban stations have regional operations centres and all other paramedics working within these four regional operational stations will be classified as a 'Rural Paramedic'.

The state ambulance service responded to approximately 70,000 incidents in the 2009-2010 financial period and had 255 salaried paramedic personnel with a total number of 49 response stations (Commision 2011). There is a significant proportion of ambulance response to rural emergencies and many Paramedics work in both areas and even when an ambulance crew is rostered to an urban centre they may respond several times during their shift to emergencies in rural areas. As discussed in the introduction, this is specialised work that requires targeted AAM paramedic training.

In Tasmania, the base education for paramedics EMS training has developed over the past ten years from a Diploma to an Associate Degree[8]. After this foundational qualification has been successfully completed Paramedics undertake a six month in-house Intensive Care program and then an optional short course in AAM which includes tracheal intubation. In July 2006, the PILMAT trial resulted in 58 Paramedics qualified in AAM state wide and the Tasmanian Ambulance Service employed 145 salaried paramedic staff and had 503 volunteer officers (Commision 2011). The voluntary staff provided initial ambulance response in many of the remote centres with salaried paramedics working in many of the rural communities.

At the time of this study, the Tasmanian Ambulance Service was one of the smallest in Australia and had a culture within its practitioners of self-development and continuing education. AAM was a much desired skill set which was frequently discussed amongst this paramedic workforce and there was strong desire for more paramedics to participate in the PILMAT training.

3.3.2 The Participants

Participation in this study was voluntary and all permanent employees of the government ambulance service. The only inclusion criterion for participation in this study was paramedics who volunteered to take part in the initial PILMAT study and Figure 6 depicts the relationship between the PILMAT trail and this current study.

By selecting all the paramedics from the PILMAT trial to be involved in this study ensured the total population was included, both those paramedics who were AAM training and a small number who had not been trained in AAM. The inclusion of the total population meant there was no requirement to select a sample of the population.

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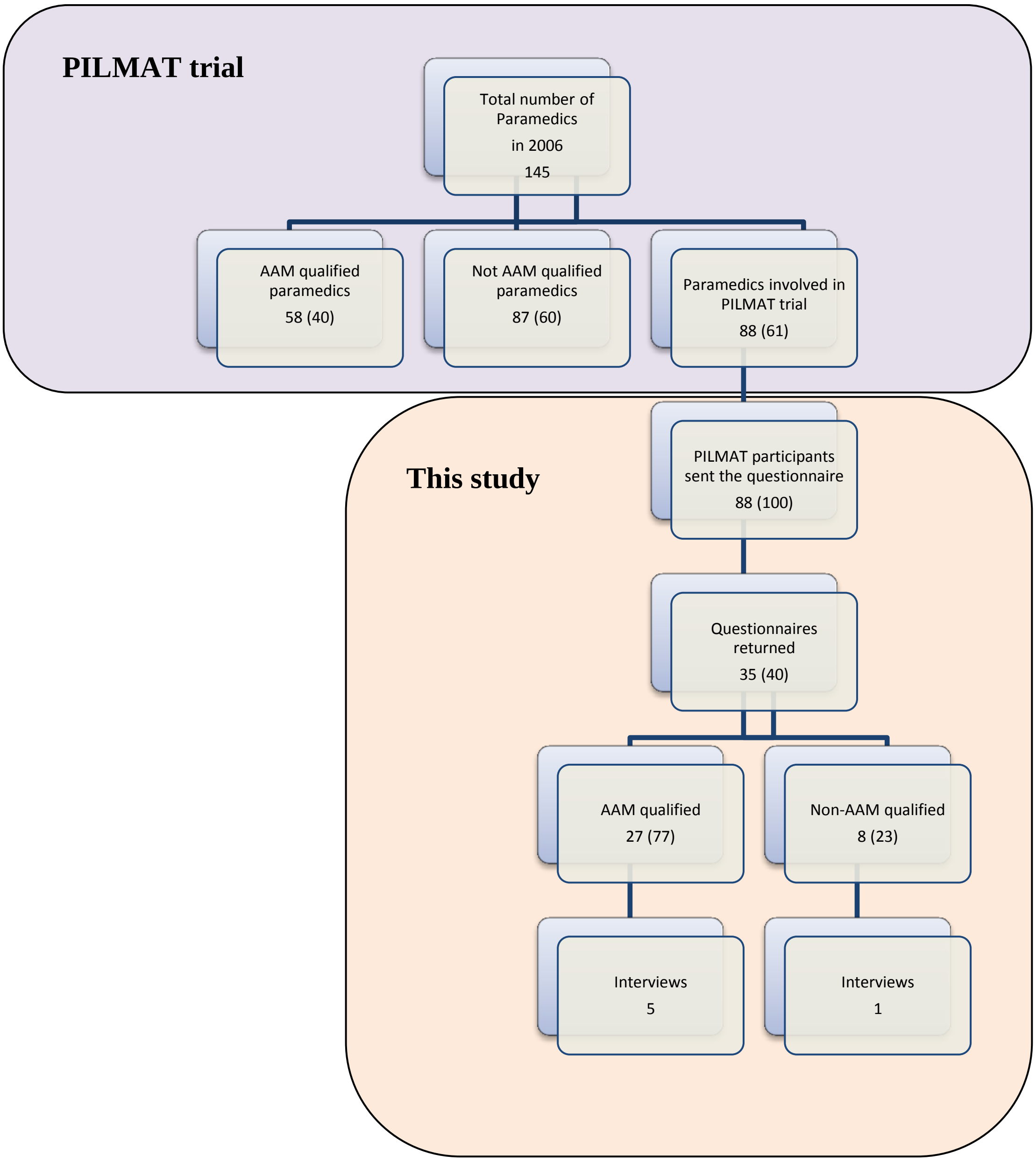
[8] The Associate Degree was the base paramedic qualification at the time of this study.

Figure 6: The details of the relationship between the PILMAT trial and this study



The majority of paramedics (77%) meeting the inclusion criteria were AAM qualified and had varying levels of tracheal intubation experience, with a small number not having completed the AAM training and thus had no tracheal intubation experience. The participants were not exposed to a formal AAM skills maintenance or continuing educational program at the time of this study. The participants were located state wide in all the urban operational centres and in a number of the rural ambulance stations. There were no specific exclusion criteria and all participants in this study were current practicing salaried paramedics and held certification in ILMA practice with the majority also holding AAM certification.

3.3.3 Ethical Considerations

Ethics approval for this study was obtained from the University of Tasmania Human Research Ethics Committee (Tasmania) Network, approval number H9503, by the submission of a 'Social Sciences - Minimal Risk' application form. The application included an 'invitation to participate' letter which included consent to participate, which is attached as Appendix 5.

Each paramedic who matched the inclusion criterion was invited to participate and involvement in the study was on a voluntary basis. The information sheet and an invitation to participate were sent to each paramedic in writing via Australia Post to their private residential address. The information sheet briefly explained the purpose of the research, why they were chosen to participate, the security and anonymity of the information they will provide, and the formal approval granted through the University of Tasmania.

The anonymity of the participants was assured in the first instance by the questionnaire being anonymous and containing no personal information with demographic details only. The researcher was unaware of the participants who were involved as the questionnaires were distributed by an independent body and as previously mentioned the questionnaires had no personal information included. The participants were assured in the information letter they received the information they provided would be kept secure and confidential with no means of recording or identifying the individual respondent. During this study there were no ethical issues which arose from either the data collection or storage processes.

3.4 Data sources and collection

3.4.1 Collecting data about the paramedic AAM training

The overarching purpose of this study was to offer insight into the qualitative factors that affect the implementation of the ILMA into advanced airway management practices by paramedics and the most efficient and appropriate means for collecting this data was a questionnaire.

3.4.2 Questionnaire development

The questionnaire was developed by the researcher in a way that ensured the content and focus of the questions was constructed to obtain the specific training and ILMA information from paramedics. The questionnaire was paper based (Appendix 6) and comprised of nine (9) pages divided into the following subject areas:

Table 2: Outline of the questionnaire

Topic area	Number of questions	Scale used
1. General Demographics	7	Nominal
2. Confidence	9	Likert
3. Advanced Skills	9	Likert
4. Laryngoscopic Tracheal Intubation	15	Likert
5. ILMA Tracheal Intubation	29	Likert
6. Skills Maintenance	10	Likert
7. Summary	11	Likert

These subject areas outlined in Table 3 were chosen to provide information to adequately answer the research questions and provide information on paramedics' attitude to tracheal intubation in relation to the introduction of the ILMA and its influence of confidence, technique and training. The questionnaire contained a focus on the main areas identified in Roger's (Rogers 2003) Diffusion of Innovation theory: advantage, compatibility and complexity. The general demographics would enable the responses to be categorised into the various operational aspects of paramedic practice, such as: rural or urban, time AAM qualified, and if they had performed tracheal intubation via ILMA etc.

A five point Likert rating scale was used in the questionnaire with the criteria ranging from: 1 = strongly disagree, 2 = disagree, 3 = unsure, 4 = agree and 5 = strongly agree. The Likert scale was used because it is an ordinal scale which has no equal intervals between the scale points and therefore analysis of the degrees of difference between the scale points is inappropriate (Polit and Beck 2006). This allowed the respondents to indicate the level to which they agree or disagree with each of the statements. The structured questionnaire was useful for this study because:

- It was an appropriate method for measuring and classifying paramedic attitudes towards the ILMA and its training;
- It allowed the collection of quantitative data which is unambiguous and allows for a rigorous process to count the answers;
- It enabled the respondents to choose a time and place to think and provide the responses which suited themselves.

Although the majority of the questionnaire utilised the Likert scale for responses a more appropriate scale was used for some questions. For example, where the participants' demographics were recorded and when their confidence in performing tracheal intubation in specific patient cohorts was reported. The demographics required the participants to record specific objective information which could not be recorded in a

Likert scale. The questions asking for the participant's confidence levels in performing tracheal intubation in special clinical circumstances still utilised a five point scale but the labels: strongly agree, agree, unsure, disagree and strongly disagree were not appropriate and replaced with labels which related to the specific questions. The labels for the five points in these scales asking about confidence levels ranged from 1 = 'not at all' confident through to 5 = 'very' confident.

The questionnaire was trialled and tested for face and content validity by a pilot trial. The questionnaire was developed into draft format then distributed for comments on design, spelling, comprehension and content. A draft copy of the questionnaire was sent to my research supervisors and colleagues. Next a pilot trial was conducted of the questionnaire to interstate paramedic students not familiar with the study or actual device (ILMA). A class of 20 paramedic students was asked to complete the questionnaire and provide feedback on any of the above areas. They provided some valuable structural and terminology comments which was used to refine the final draft of the questionnaire. Once this was completed the questionnaire was ready to distribute.

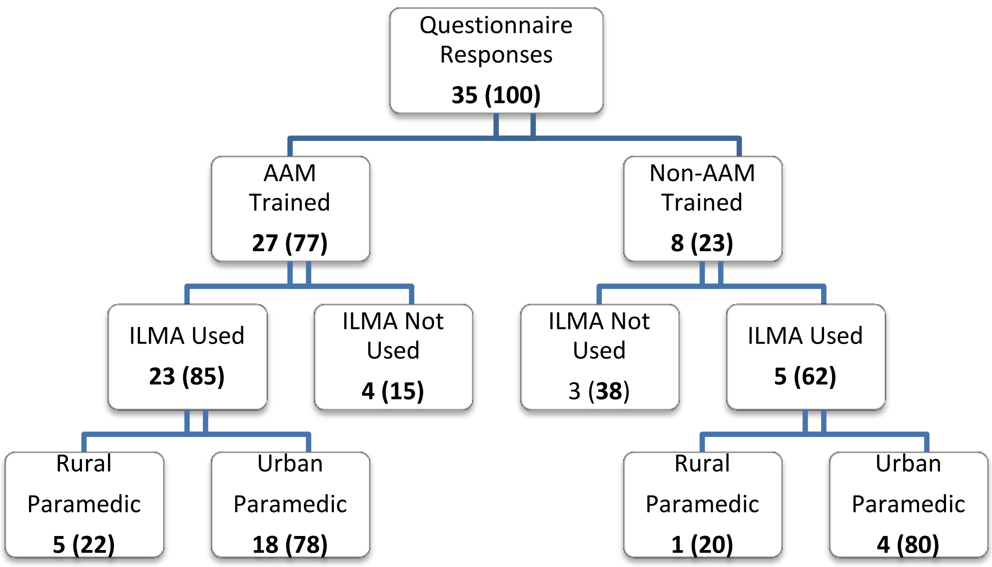
3.4.3 Questionnaire distribution

Once the questionnaire development was complete it was sent to the University of Tasmania, Department of Rural Health (UDRH) and the ILMA participant list was compiled by the Tasmanian Ambulance Service Superintendent of Training and the UDRH sent the questionnaire to all paramedics on the list. This ensured the total paramedic population involved in the PILMAT trial received the questionnaire. The questionnaire was distributed to all the participating paramedics which eliminated the risk of sampling bias. This total population inclusion was possible because of the small number and working in a small close knit accessible organisation. The response to the questionnaire would therefore provide a more representative sample of the total population. The questionnaire was distributed 24 months after the commencement of the PILMAT trial. The questionnaires were distributed with return paid envelopes addressed to the UDRH. Once they received the completed questionnaires they posted them on to me.

The questionnaire was sent in August 2007 with an email six weeks later to act as a reminder to those who had not completed and returned the questionnaire. A follow up letter was distributed via mail a short time after the initial distribution of the questionnaire and a second copy of the questionnaire was distributed via email by the UDRH to those who had not responded after a set period.

The questionnaire response was 35 from a population of 88 which is a response rate of 40%. A summary of the returned questionnaires is shown in Figure 7.

Figure 7: Questionnaire response, n (%)



The data gained from the questionnaires provided a rich quantity of information about paramedic attitude towards tracheal intubation training and practice which included a number of areas which contained unexpected results. For example, the paramedics' reported they were more confident with using the ILMA for tracheal intubation but stated it should not be the first choice of device to perform this skill. There were other areas of response which begged to be further explored to discover some of their meanings and enable a clearer interpretation as to why the paramedics felt the way they did. To ascertain this information and expand the understanding behind their responses a small number of key person interviews were undertaken.

3.4.4 Collecting data about paramedics views on AAM

The interviews were conducted in an attempt to confirm and find the reasons for some of the questionnaire outcomes. For this to occur, it was important to identify those paramedics who would be able to provide the rich information about paramedic AAM.

Targeting key informants

The choice of paramedics to collect more indepth data from was not random but rather based on their willingness to speak about their experiences in more detail for the study. The use of key informant interviews is appropriate when descriptive information is required especially to support the quantitative data obtained in the questionnaires and the information required is best sourced from people with that specific knowledge (Polit and Beck 2006). This is a sampling technique known as 'purposive sampling' technique or 'key informant interview', which is a common qualitative sampling process undertaken where the researcher has knowledge of the population and therefore can hand pick those as key informants (Polit and Beck 2006).

Included in the original questionnaire distribution was a form asking if the responding paramedic agreed to participate in an interview if requested. The selection of key paramedics to be interviewed was taken from the list of paramedics who had returned a questionnaire and agreed to be interviewed by indicating this on the interview request form. Five key paramedics were chosen and contacted to arrange interviews at a time and place suitable to them. The paramedics were chosen for interview within the following criteria in order to provide the information required:

1) A Non-AAM trained paramedic; in order to obtain knowledge and experience on the new ILMA training program by a paramedic who had not been exposed to the traditional AAM training program and who could provide information without influence from the AAM training.
2) An experienced AAM trained paramedic; a paramedic who had a broad experience with the traditional AAM techniques who could make comparisons to using the ILMA. This paramedic could provide information to make comparisons between paramedic confidence in the use of both devices, the laryngoscope and ILMA. The extensive experience of this paramedic was sought to also provide information regarding AAM skills maintenance.
3) A rural paramedic; PILMAT involved a number of paramedics working in a rural environment and inclusion of this category would allow examination of the confidence, clinical experience and skills maintenance of rural paramedics. This is said to differ greatly between the urban environment where skill use is higher and practice is easier to achieve and the rural environment where skill usage is lower and training resources scarce. The urban environment also differs because it is the norm for paramedics to work in pairs where support can be gained from fellow paramedics. In the rural environment paramedics often work alone or with lower skilled honorary officers and these circumstances are expected to have an influence on confidence, clinical experience and skills maintenance.
4) A clinical educator; in order to obtain information specifically on the educational processes both of the traditional AAM program and the new ILMA program a clinical educator was chosen to be interviewed. They would provide valuable knowledge on the training and skills maintenance areas of the research questions.

These key informants were subsequently invited to participate in interviews as part of the research. Using interviews in this study to collect data allowed the interviewer to probe for clarification or more detailed information on specific lines of interest. Using semi-structured interviews allow those being interviewed to tell their stories in their own words which enabled a more subjective account of their experiences (Bowling 2005). This information was further enriched through the use of key informant, where key people are selected due to their status in relation to the topic and provide information which can be considered more relevant due to the position and thus the knowledge they hold.

A summary of the areas the key paramedics were chosen to satisfy is displayed in Table 3 below.

Table 3: Summary of the key people selected for the interviews

Sample Criteria	Number interviewed
Non-AAM trained	1
Experienced AAM trained*	2
Rural paramedic	1
Clinical educator	2

* This group also provided urban paramedics

Many of those interviewed although selected within a specific criterion did have experience which overlapped into one of more of the other criteria. For example, the rural paramedic was also an experienced AAM paramedic and the clinical educators had experience in the rural environment. Therefore the division of the responses into the sample criteria could not be isolated as was seen to enrich the data collected as it accurately reflected the workforce.

Conducting the interviews

Once the key informant paramedics were identified they were contacted by phone and a suitable time and place was agreed to where the interview would occur. Once a mutually accepted date and time had been agreed the interviews were conducted at the workplace at the interviewee's request. A comfortable private setting was found and a general introduction to the format of interview was undertaken. Approval was then discussed and obtained from the interviewee to digitally record the interview and to have a copy of the transcript supplied if they required. A total of five interviews were conducted resulting in a total of 94 minutes of digital recordings.

The interviews aimed to gather qualitative data and were semi-structured commencing with broad introductory questions to elicit the interviewee's general involvement and use of the ILMA to more focused questions when specific examples, feelings or emotions were presented. The interview structure (Appendix 7) introduced at the commencement of each interview provided a starting point and the participant's responses provided avenues of further inquiry during the interview. Although the interviews did become somewhat tailored to the interviewee's responses the interviewer ensured the main themes planned to be investigated during the interviews were examined.

3.5 Preparing data for analysis

The data collection phases yielded two data sets. These data sets were the quantitative questionnaire data and the qualitative interview data set and therefore they have to be managed differently to enable the appropriate analysis for each to be undertaken.

3.5.1 Cleaning the quantitative questionnaire data

Prior to any data analysis the data must be reviewed and checked for any errors which may cause inappropriate analysis and results. This was completed by employing the processes of 'cleaning' and 'modifying' the data. The completed questionnaires were stored in a data file was developed using SPPS (Statistical Package for the Social Sciences, IBM) where initially a variable was developed for each questions response. Each returned questionnaire was individually identified by using a sequential number format. As the quantitative data was entered into the SPSS software it was reviewed to identify any instances of data being incorrectly entered or coded. Subjecting the data to this level of scrutiny is known as ‘Data Cleaning’ (Argyrous 2005).

The data cleaning activity involved two processes. Firstly the entered data was scanned to check for errors made during the data entry process, and secondly it was checked to ensure it conforms to the specified data criteria. The process of checking for data errors commences with looking for values which fall outside the possible range. For each of the variables a descriptive statistical analysis was performed looking at minimum and maximum values, missing values and the means of each variable. This calculation allows for quick identification of values which can be classified as ‘outliers’ and corrections can be made if required. It is important to critically review the outliers, they may be the correct value or they may be incorrectly entered data (Argyrous 2005). Any found for correction had the original data reviewed to ensure the correct value was entered or in the case of an invalid response assigning a value for the missing data.

The other method used to review and screen the data was to choose a specific variable to display in SPSS as a ‘case summary’, where an overview of the variable is produced and obvious data which is outside the norm can be quickly identified (Argyrous 2005; Pallant 2007). The descriptive analysis process also enabled identification of any missing data which can be reviewed. The data was also checked for consistencies between the variables, for example a response indicating the paramedic was not AAM qualified could then not indicate and comment on their experience of the AAM training program.

The data coding in this study was ‘cleaned’ by conducting a descriptive statistical analysis on each variable to check for missing data entry and to review any outliers. Variables which should have a degree of correlation were also matched to ensure the correct correlations were present.

Once the dataset had been checked for errors and descriptive statistics completed on each variable, a number of specific variables were modified or new variables created in order to allow detailed analysis to test the specific research questions. New variables were created by modifying existing ones. For example, the questionnaire asked for the year the paramedics obtained their AAM qualification. This was then calculated to provide a new variable recording how many years of experience each paramedic had in AAM. This original variable asking for their year of AAM qualification also recorded those paramedics not AAM qualified, and a new variable was then created to record which paramedic was AAM qualified and which was not. During this process no variable is deleted but a new variable is created using the original 'cleaned' variable data. The process used to create new variables involved a dichotomy of the data into agree or disagree categories.

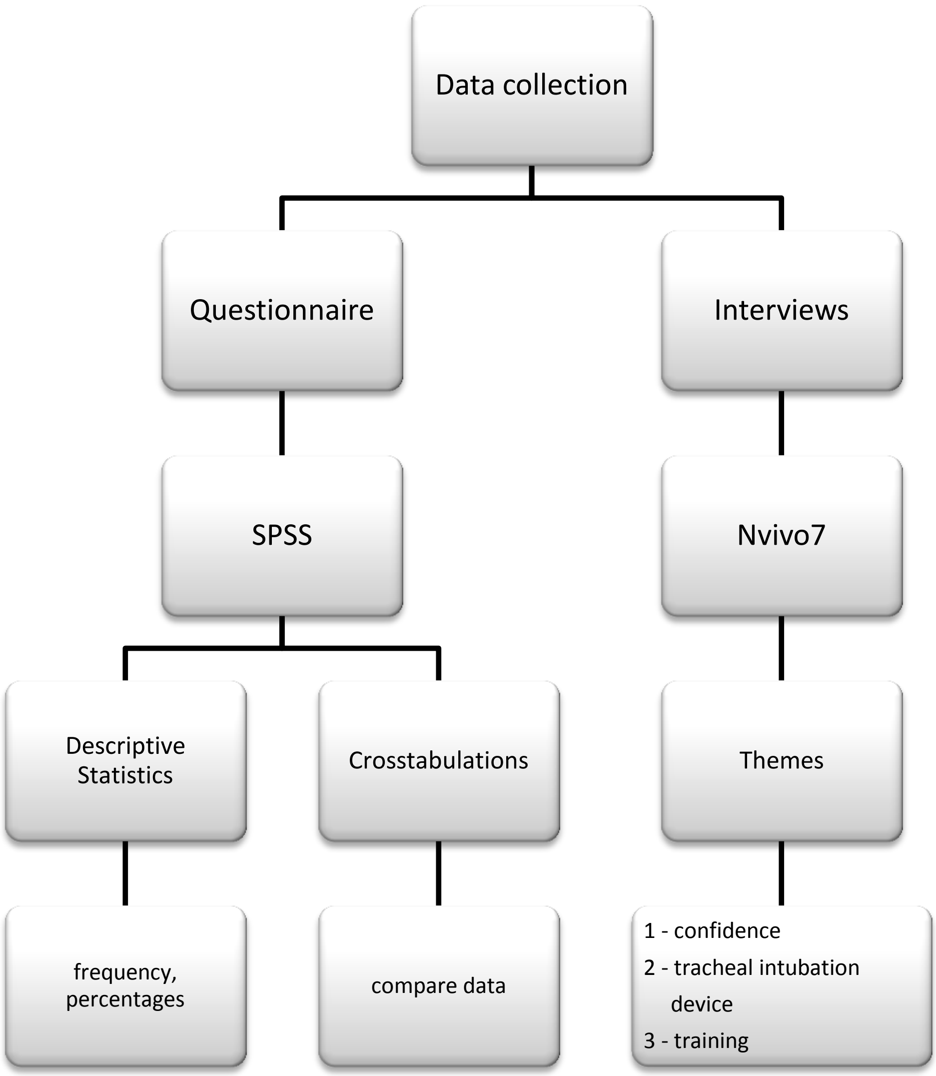
The qualitative data was not subjected to a cleaning process, however, it was necessary to create texts from the interview audio recordings to prepare the data for analysis.

3.5.2 Creating qualitative texts for analysis

The interviews were recorded on a portable digit recorder. Each of these recordings were transcribed verbatim into individual word documents (Microsoft Word 2007). In this transcription process all aspects of the conversation were captured in the text creation, including the 'ums' and 'arrs' which added meaning to sections of the discussions. Ensuring the recordings are transcribed accurately including pauses and other vocal additions guarantees the true meanings of the sentences and content being conveyed is kept. These subtle inclusions can provide a striking change to the context and meaning of the responses.

The way the process of the data collection unfolded and how it progressed into the data analysis cycles is presented in Figure 8.

Figure 8: The data analysis process



3.5.3 Analysing the quantitative data

The quantitative data provided a rich source of information about the paramedics' evaluation and attitude towards: AAM, the use of the ILMA and the training program which they had completed. Two methods of analysis were used to examine different aspects of the data: 1) analysis of the descriptive statistics and 2) comparing data for associations using crosstabulation analysis. To enable this analysis each description on the Likert scale corresponded to a numerical value which was kept consistent throughout the data entry. The values recorded were:

Table 4: The Likert scale used in the questionnaire.

Likert Scale	1	2	3	4	5
Criterion	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree

Descriptive statistics including the frequency, percentages, (median and standard deviation) for each data variable was used to describe the information and synthesise the data in forms which enables easier interpretation and reporting. It specifically allowed those paramedics who were in agreement, disagreement or unsure of their beliefs to be identified. This method of analysis also provides greater objectivity by grouping and displaying the quantitative data, such as competence of confidence, in ways which are easily comprehended (Pallant 2007).

Descriptive Statistics

In order to understand the quantitative data responses the following tests allowed the number of responses either agreeing or disagreeing to each statement in the questionnaire. Each variable in the questionnaire where the Likert scale was used was analysed using the SPSS descriptive analysis function. This provided the following information on each variable: frequency, percentages, median and standard deviation. The initial descriptive analysis of the Likert scale showed many of the responses contained nil or only a small number, which made meaningful analysis unfeasible. In order to enable analysis the 5 point Likert scale's responses were dichotomised initially into 'agree' and 'disagree' with the 'unsure' category removed, i.e. 'strongly agree' and 'agree' were combined and 'disagree' an 'strongly disagree' were combined leaving out the 'unsure' category. This dichotomy proved inappropriate as some of the question responses had high numbers in the 'unsure' category and low responses in the other categories.

To ensure the use of all the data the Likert scale criteria was finally dichotomised into the following, Table 5, with the 'unsure' responses included in the disagree dichotomy.

Table 5: Final dichotomy of the results for all variables.

Likert Scale	1	2	3	4	5
Criterion	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
Dichotomised into	Disagree			Agree	

The 'unsure' responses were included in the 'disagree' dichotomised response because it was judged as a negative response, i.e. not in agreement. On the Likert scale the middle rating of three was titled 'unsure', the decision was made if this score was chosen as the response it was not indicating an agreement and thus the unsure category was deemed to be in part a disagreement with the question or statement. This decision was also supported by initial tests indicating there were insufficient numbers in the dichotomised data to perform some tests and by placing the 'unsure' responses into the 'disagree' category allowed these tests to be undertaken. The descriptive statistics were finally reported in this format of either agree or disagree with the statement in the questionnaire.

So as to understand any association between related variables a crosstabulation analysis was conducted which allowed the level of association to be examined. The crosstabulation is a representation of two variables and shows the joint frequency distribution which provides a summary of the variable to allow a clear view of the relationships between the variables (Argyrous 2005). For example, a crosstabulation performed between ILMA tracheal intubation confidence and skill level would clearly identify if this confidence was elevated in a specific skill level.

These analytic techniques were appropriate for analysing the numerical data yielded by the questionnaire data collection. As the interview data was text based, alternative means were required for the analysis of meaning and this will be outlined in the next section.

3.5.4 Analysing the qualitative data

When undertaking the interviews a number of approaches ensured the appropriate level of quality was applied to the data collection and analysis. Utilising key informant interviews provided a number of advantages . This type of interview obtains data directly from those with the knowledge, the paramedics who had undertaken the training and used the devices were providing the information thereby increasing the data validity (Polit and Beck 2006). As the interviews were semi structured the interviewees could provide new and expanded information not expected during the questionnaire and interview planning phase. This unrestricting approach to the interviews enabled probing and clarification by the interviewer into areas not anticipated. It also allowed the interviewee to discuss areas and topics they felt important and not be restricted to the researcher's judgment. This increases the scope and relevance of the data obtained thereby improving its credibility.

There are a number of measures whereby bias can be reduced whilst conducting open-ended interviews. Commonly used methods are: interviewer training in establishing rapport, putting interviewee at ease and the interviewer appearing to be non-judgemental (Bowling 2005). The critical element which could cause interview bias in this study was the behaviour of the interviewer, as the interviewer was involved in the training of ILMA tracheal intubation to the paramedics there would be a potential for their responses to be influenced by them, especially if showing approval or surprise to the responses.

At the beginning of each interview the interviewee was put at ease and a clear explanation of the interview process was provided and any concerns the interviewee had was answered. The interviewer ensured during the process they did not indicate approval or disapproval to any of the responses, mannerisms or questions from the interviewee. The interviewees were also reassured if they did not wish to answer any question or not have their comments recorded they could do so and the digital recorder was placed in front of the interviewee so they were provided the opportunity to stop or pause the recording at any stage. All the interviews were conducted without interruption.

Qualitative data elicited from the interview transcriptions underwent thematic analysis which comprised coding, cross comparison between transcripts and across data sources. This process enabled potential themes to emerge. This process is illustrated in Figure 9.

The qualitative data analysis was supported by NVivo 7 software (QSR International Pty Ltd, 2002).

The information and outcomes emerging from the interview data was evaluated using Roger’s diffusion of innovation theory (Rogers 2003) to identify where the paramedic responses matched the theory. For example paramedic confidence can influence their perceived advantage the ILMA may provide and it would also have an effect on their perception of the complexity of using the device. Areas such as ‘ease of training’ and the ‘clinical application’ directly relate to the complexity and compatibility components of Rogers diffusion of innovation theory. A thematic analysis of the interview content was conducted to group frequent responses and identify information which would support the outcomes from the questionnaires The general themes identified in the interview analysis are detailed in Figure 9.

Figure 9: The qualitative data analysis process.

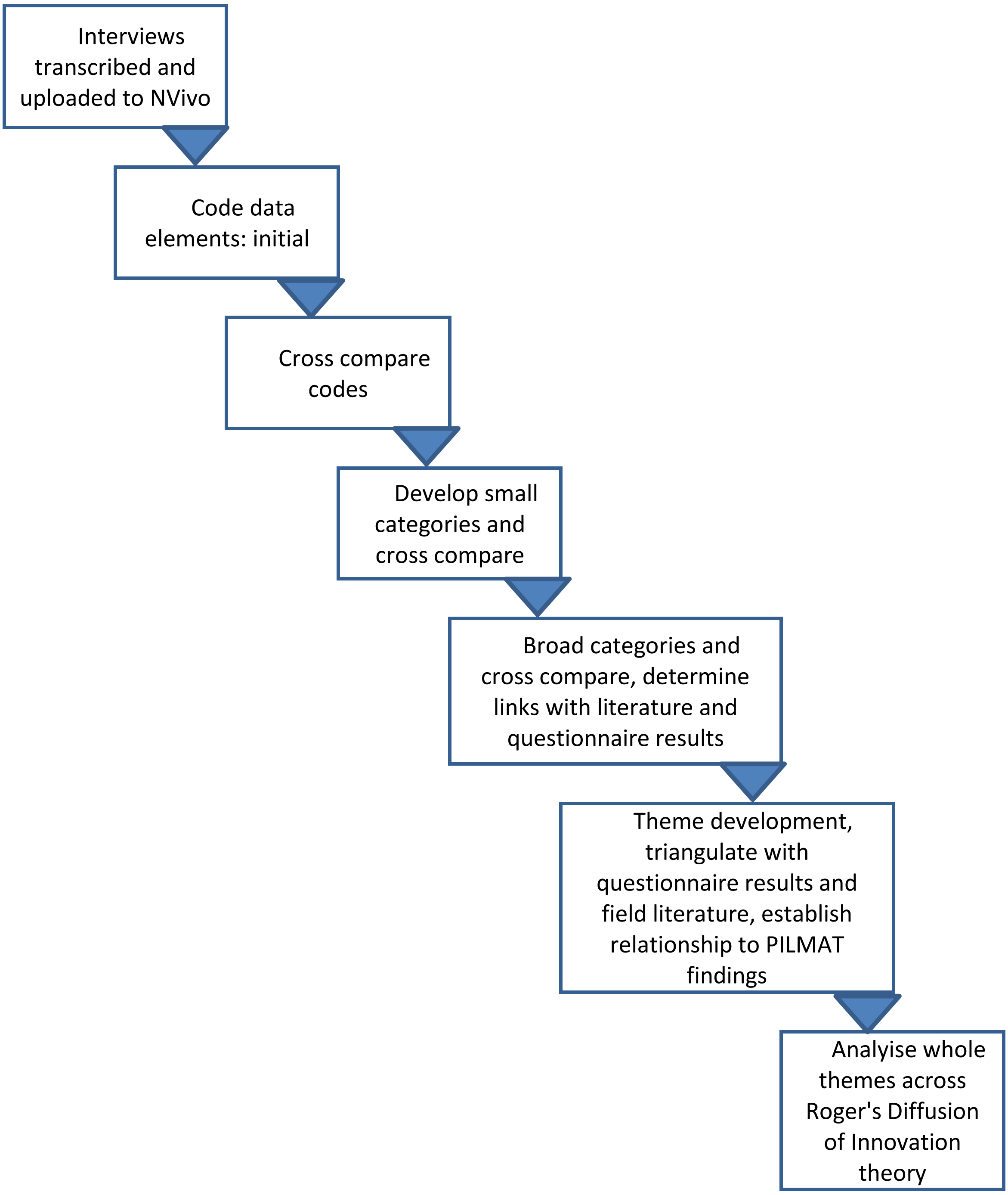


Table 6: Themes identified in the analysis of the interviews and how they matched to Roger's diffusion of innovation theory.

Theme	Diffusion of innovation criteria				
	Relative advantage	Compatibility	Complexity	Trialability	Observability
Competence	X	X		X	X
Confidence in ILMA use			X	X	X
Use of the ILMA	X	X	X	X	X
Laryngoscope use	X	X			
Difficulties	X		X		
Training	X		X	X	
Manikin / simulation			X	X	
In hospital training				X	
Skill level suited to use both devices		X	X		
Skill maintenance	X	X	X		

Information around these themes was sorted and recorded in the N-Vivo7 software (QRS International Pty Ltd, 2002) from which analysis and reporting occurred.

3.5.5 Rigour

Ensuring quality in qualitative research is a challenge which does not have a statistical test or universal rules but rests with the individual researcher to involve into the research design measures which demonstrate the collection, analysis and interpretation of the data has been thoroughly planned, examined and reported (Polit and Beck 2006).

Table 7: Provisions made to address trustworthiness

Quality	Explanation	Measures taken in this study
Credibility	The study tests or measures what it intended, "How congruent are the findings with reality?" (Shenton 2004)	Use of appropriate and recognised methods Researcher familiar with participants and organisational culture Population included in sample Negative case analysis Triangulation Inclusion of different practicing levels and at different locations, including a diverse voice Iterative questioning during interviews Background and experience of researcher Examination of previous research Participation voluntary and able to withdraw at any time
Transferability	The extent to which the findings can be applied to other situations, a wider population. (Shenton 2004)	Background and context of study reported Detailed description of the topic
Dependability	Enabling a future researcher to repeat the study to gain similar results, the study is viewed as a 'prototype'. Closely linked to credibility. (Shenton 2004)	Use of 'overlapping methods' Detailed methods chapter
Confirmability	The degree to which the study's findings are the result of the experiences and ideas of the participants rather than the characteristics and preferences of the researcher. (Shenton 2004)	Triangulation Data checking Accurate transcription of interviews Admission of study's weaknesses Inclusion of an 'audit trail' Detailed methods chapter

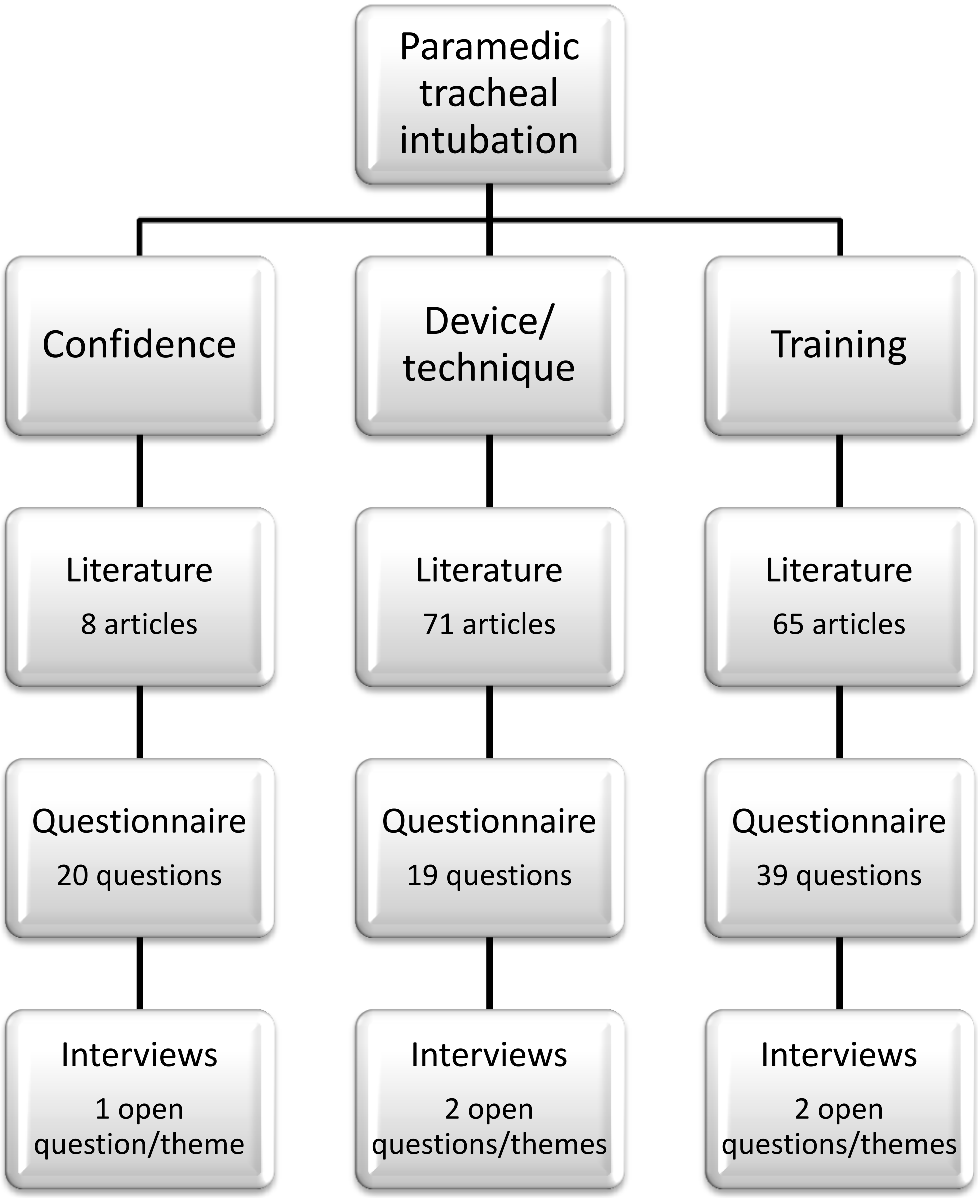
The standards which are normally applied to qualitative research in order to maximise both reliability and validity are formed within the title of 'trustworthiness' (Shenton 2004). The degree of confidence a researcher has in their data is defined by trustworthiness and the four measures are: credibility, transferability, dependability and confirmability (Shenton 2004;

Polit and Beck 2006). How these were addressed in this study are detailed in Table 7. This study included a number of measures which ensured a rigorous approach was employed to make certain the researcher provided an appropriate level of rigor and increased the level of confidence in the study data.

The common process which adds to the confirmability aspect of trustworthiness a researcher has engaged with their study is the recording of an ‘audit trial’ (Polit and Beck 2006). An audit trial can be developed with two inherent structures, firstly displaying a trial of how the data was gathered and processed, and secondly by detailing how the theories used within the study guided the research process.

All of the paramedics involved in the PILMAT trial were initially included in the questionnaire data collection of this study. The decision to include all paramedics was to increase the validity of results by reducing the sampling bias and this was facilitated by the relatively small participant numbers. Despite not all of those who were invited replied using the complete population negated the need to choose a sampling method which has the potential to induce bias.

Figure 10: The theory audit trial used in this study.



3.6 Summary

This study has collected both quantitative and qualitative data in the form of a detailed questionnaire followed by interviews of key personnel. The questionnaire was structured to provide objective data on the paramedics' confidence, tracheal intubation method and training they had been exposed to during their work as a paramedic and whilst involved in the PILMAT trial. The interviews involved key personnel chosen for their knowledge and experience in the specific areas contained within the research questions of this study.

This study has accomplished rigor and quality in its approach by employing an organised approach to its design, data management and analysis. The results of this approach are presented in the Finding chapter and the integration between the themes and theory and presented in the Discussion chapter.

Chapter 4 Findings

The literature review shows that a major concern raised in relation to paramedic tracheal intubation is the ability for this workforce to maintain their competency in a skill which is performed infrequently. It also shows the field has come under scrutiny and critique from specialists who are not paramedics. Alternative devices are now available for paramedics to safely and effectively respond to advanced airway management situations. The methods chapter shows, however, that while the PILMAT trial was effective in preparing paramedics with the knowledge for using the ILMA further research was required for examining how this innovative approach is being perceived by paramedics and whether it could be diffused or rejected as standard practice.

The purpose of this chapter is to present the research findings on the paramedics' experiences of tracheal intubation practice with the focus on their confidence, device/technique used and the training they have undertaken in the Tasmanian Ambulance Service. The questionnaire provided the quantitative results and interviews explored these findings and discovered other new information and as such the findings will be presented based on the quantitative data and supported by the qualitative quotes to provide further clarification or confirmation. The new information discovered during the interviews will be presented in the relevant context and supported where appropriate with quantitative data.

The Findings chapter presents findings which combine data from the questionnaire and interviews. Thus qualitative and quantitative data is presented together to support the development of the following key areas addressing the research questions:

- Status of paramedic tracheal intubation
- Laryngoscope and the ILMA: Confidence
- Initial use of the ILMA: choice and success
- Training strategies

The characteristics of the paramedic participants are presented first to provide background to the remaining findings.

Presentation of the quantitative and qualitative data together is consistent with the iterative research design. It contributes to the trustworthiness of the study findings through corroboration of evidence across data sources (Pope & Mays 2006) which supports the credibility of the findings (Hansen 2006). The presentation of both data types together allows each element to be fully explored and offers the opportunity to provide a complete picture from the real world perspective. In this way a more comprehensive understanding of the complexity of the phenomena of interest is also achieved (Hansen 2006).

The qualitative and quantitative findings are presented combined under headings which reflect the main elements of the research questions. The quantitative data will be presented primarily in tables followed by qualitative data which supports or provides additional clarity to the topic. The presentation of both data types together allows each element to be fully explored and offers the opportunity to provide a complete picture from the real world perspective. Incorporating the narrative data adds meaning and context to the quantitative data and conversely the quantitative data can add precision to the narrative (Traynor 2010).

The combining of both data types produces more comprehensive knowledge on which to make the judgements required In order to inform practice and education. This presentation of data ensures there are no gaps or missing factors in the data collection and their subsequent reporting as both data types will not only complement each other but may inform specific areas not covered by the other data type.

In this study the priority has been on the quantitative data which is further explored and examined using the qualitative data. The design used in this study has meant to effectively report the results a similar method of presenting the quantitative data then providing the associated qualitative data is appropriate. Reporting the results in this manner provides a greater degree of triangulation as both sets of data can be easily compared.

The overarching argument presented in this chapter is paramedics report difficulty in maintaining laryngoscopic tracheal intubation competence and the introduction of the ILMA would provide a tracheal intubation option which would be easier to use and maintain competence. Paramedics had increased confidence when using the ILMA and achieved similar tracheal intubation success rates with both the ILMA and the laryngoscope. Confidence in ILMA tracheal intubation was achieved without the conventional in-theatre training component and a subsequent reduction in the training time required. The use of simulation is invaluable to provide the initial skill introduction, confidence and competency levels with patient experience providing a small final cap to their confidence levels.

4.1 Characteristics of Paramedic Participants

All the paramedics surveyed had successfully completed the inaugural ILMA training program and were authorised to perform tracheal intubation using the ILMA. The participants' questionnaire responses came from across the State of Tasmania and included paramedics not previously trained in tracheal intubation.

The majority (28/35) of paramedics surveyed currently worked from an urban ambulance station. In accordance with the Ambulance Tasmania criteria, the urban population at the time were the populations of Burnie, Devonport, Launceston and Hobart.

Very few (8/32) respondents had any form of airway management training outside of the Ambulance Service. Only some (4/32) respondents had received airway management training through other employment or activities. This additional training involved basic airway care and not skills associated with AAM, such as tracheal intubation. Sixty percent (21/35) of the respondents were qualified ICPs with a further twenty six percent (9/35) CSOs and therefore had training and experience in AAM.

Table 8: Characteristics of paramedic participants	
Years of AAM experience: mean (SD)	6.33 (4.07)
AAM training	
Tasmania	60.0% (21/35)
Interstate	40.0% (14/35)
Additional AAM qualifications	
registered nurse	12.5% (4/32)
Other	12.5% (4/32)
None	75.0% (24/32)
Skill level	
Paramedic	14.3% (5/35)
Intensive care paramedic	60.0% (21/35)
clinical support officer	25.7% (9/35)
Location of practice	
Urban	80.0% (28/35)
Rural	20.0% (7/35)
ILMA tracheal intubation	
Yes	80.0% (28/35)
No	20.0% (7/35)

1. There were 35 participants who returned the questionnaires and 32 of these were qualified in AAM.
2. Seven of the 35 participants had not used the ILMA to perform tracheal intubation.

The average length of AAM experience was 6.3 years. The paramedics' experience in AAM varied between one year to greater than 10 years, with over 50% (19/35) of the paramedics having greater than four years of AAM experience in the out of hospital clinical setting. The paramedics' AAM experience only reflects the years of experience and not their clinical experience or the number of times that tracheal intubation has been performed. There is evidence (Burton, Baumann et al. 2003; Garza, Gratton et al. 2003; Rumball, Macdonald et al. 2004; Wang, Kupas et al. 2005; Deakin, King et al. 2009) suggesting paramedics perform tracheal intubation on an infrequent basis, which is reportedly between one and two actual patient performances annually. This being the case, for the surveyed paramedics four years of AAM experience can be calculated to only equate to between four and eight actual patient skill performances of tracheal intubation.

A small number of paramedics (5/35) had not received AAM training and therefore had no previous AAM experience. These respondents completed the same ILMA training program and then performed tracheal intubation on patients using the ILMA only with no opportunity to revert to using the laryngoscope. They had no secondary method of tracheal intubation unlike the AAM qualified paramedics who if presented with difficulties using the ILMA could revert to performing laryngoscopic tracheal intubation.

Table 9: Demographics of the paramedics interviewed

Total number of interviews	100% (5/5)
Paramedics interviewed	80% (4/5)
CSOs interviewed	20% (1/5)
AAM qualified Paramedics interviewed	80% (4/5)
Non AAM qualified Paramedics interviewed	20% (1/5)
Paramedics working at an rural station	40% (2/5)
Paramedics working at an urban station	60% (3/5)

Most respondents had used the ILMA in an actual patient care situation (28/35). A number of respondents (7/35) had participated in the ILMA training program but had not actually used the ILMA in a patient care situation. Of these seven who had not performed ILMA tracheal intubation all were AAM qualified. All non AAM qualified paramedics performed ILMA tracheal intubation in a patient care situation. The PILMAT study was conducted over a twelve month period and seven paramedics during this period had not encountered a patient who required definitive airway management by use of a supraglottic device, such as the ILMA, or required tracheal intubation.

A small number of interviews were conducted with paramedics who had been involved in the ILMA training program the majority were AAM qualified paramedics and were working at a urban station.

Many qualities may influence a paramedic's practice in AAM and some of these will be examined in more detail, specifically in relation to the introduction of the ILMA and the different training strategies and how they may influence paramedic confidence.

4.2 Status of Paramedic Tracheal Intubation

AAM skills and especially tracheal intubation is viewed by paramedics as skills which are critical to their delivery of effective out of hospital patient care. Tracheal intubation is considered an essential ICP skill in the same way as the other basic airway skills and some of the more common advanced skills performed by ICPs, i.e. skills they must perform.

Table 10: Frequency table of responses to the question 'The following are essential skills to performing the role of a paramedic?'

	Agree	Disagree	Missing	p value
Defibrillation	100% (35/35)	0.0% (0/35)	0.0% (0/35)	*
Intravenous cannulation	100% (35/35)	0.0% (0/35)	0.0% (0/35)	*
Intraosseous cannulation	96.9% (34/35)	0.0% (0/35)	2.9% (1/35)	*
Chest decompression	94.1% (33/35)	0.0% (0/35)	5.7% (2/35)	*
External cardiac compression	100% (35/35)	0.0% (0/35)	0.0% (0/35)	*
External cardiac pacing	85.6% (30/35)	8.6% (3/35)	5.7% (2/35)	*
Cricothyroid puncture	91.2% (32/35)	2.9% (1/35)	5.7% (2/35)	*
Rapid sequence intubation	85.6% (30/35)	8.6% (3/35)	5.7% (2/35)	*
Tracheal intubation	94.1% (33/35)	0.0% (0/35)	5.7% (2/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in some categories.

1. The Likert scale data from the questionnaire was dichotomised into agree or disagree categories, agree and strongly agree were combined into the agree category and unsure, disagree and strongly disagree combined into the disagree category.

Paramedics believe tracheal intubation (94.1%) to be an essential paramedic skill. It was considered as essential as chest decompression and as important as defibrillation, intravenous cannulation, external cardiac compression and intraosseous cannulation. Tracheal intubation was considered more essential than cricothyroid puncture, rapid sequence intubation or external cardiac pacing. In relation to paramedics performing tracheal intubation one respondents stated, *"I think that we should still be aiming to have a high number of people with advanced airway management."*

Tracheal Intubation, the key AAM skill is considered by paramedics an essential skill for them to perform. It is unclear in this response why high numbers of paramedics to perform this skill is required, from the individual's perspective it may be due their desire to be trained, the prestige, it is unlikely the individual paramedic would be aware of the overall clinical requirement or frequency of use of this skill.

4.3 Laryngoscope and the ILMA

The use of the laryngoscope and the ILMA to perform tracheal intubation utilise very different techniques and therefore the comparisons which can be made are limited to outcomes and few other specific measures.

Table 11: Confidence in both devices

Confidence in laryngoscope	Confidence in ILMA: yes	Confidence in ILMA: no
yes	20	2
no	8	2

Paramedics who were confident in laryngoscopic tracheal intubation were 1.14 (95% CI 0.81, 1.59) times more likely to be confident in ILMA tracheal intubation than were paramedics who were not confident in laryngoscopic tracheal intubation. This 14% elevation in proportion was not statistically significant (p=0.457).

The questionnaire responses provided information on the paramedics' level of confidence with each technique and when they are used in specific clinical situations. A measure of competence needs more than just the successful completion of the ILMA or AAM training program. In this study three measures were used to define competence. Each has a direct link to the paramedic's ability to perform the skill. They are time on scene, overall success rate and the success rate on first attempt at tracheal intubation.

Time on scene is a measure with many influences, one of which reflects the speed or ease at which tracheal intubation is performed. In the situations where tracheal intubation is performed by paramedics, minimising scene time is a major priority to ensure the patient is delivered to definitive care in the shortest possible time. Therefore in these situations it is expected the performance of tracheal intubation has a considerable influence on scene time.

The overall success rate indicates how successful paramedics were performing tracheal intubation with both devices in their normal work environment, which again has many factors influencing its outcome. The success rate at first attempt of tracheal intubation is a common measure which further clarifies the success and easiness of the overall success rate. In Table 12 the confidence data came from the questionnaire and the data for the criteria used to define competence came from the PILMAT trial.

Table 12: Confidence and Competence using both ILMA and laryngoscope

	Laryngoscope		ILMA		Difference		
	Mean	(SD)	Mean	(SD)	Mean	(SD)	P-value
Confidence (n=32)	3.75	(1.48)	4.19	(1.09)	0.44	(1.37)	0.080
Competence							
- time on scene*	33.7	(14.99)	28.9	(10.63)	4.80	(13.10)	0.140
- overall success rate	90%	(42/46)	92%	(48/52)			0.860
- success at first attempt	62%	(26/42)	88%	(42/48)			0.005

* Laryngoscope n=34, ILMA n=31

1. Confidence scores were from a Likert scale of 1-5, rating 1 being strongly disagree and 5 indicating strongly agree.

2. Time on scene is displayed in minutes and taken from the PILMAT trial data.

The mean reported level of confidence was higher with ILMA tracheal intubation (4.19) than the level reported with laryngoscopic tracheal intubation (3.75). The difference between these levels of confidence is probably of importance though not of statistical significance (p=.080).

The mean 'time on scene' was greater when the laryngoscope was used for tracheal intubation (33.7 minutes) than when the ILMA was used (28.9 minutes). The difference of 4.80 minutes is of importance though not of statistical significance. The measure 'success at first attempt' was greater for ILMA tracheal intubation (62%) than for laryngoscopic tracheal intubation (88%), this difference is important and is of statistical significance (p=0.005). The criteria used to define and evaluate competence will be discussed in more detail in the remainder of this chapter.

4.3.1 Paramedic confidence in tracheal intubation

Studies (Stewart, O'Halloran et al. 2000; Morgan and Cleave-Hogg 2002) have indicated competence in a skill is closely linked to confidence. Confidence is reportedly linked to the experience of performing an individual skill or process (Shysh 2000; Issenberg and McGaghie 2002; Garza, Gratton et al. 2003; Greenberger, Reches et al. 2005) whereas the general clinical experience has been shown not to correlate to competency in performing a skill (Garza, Gratton et al. 2003).

The newly introduced intermediate airway management skill, ILMA insertion, was reported by the participants as the airway skill in which they had the greatest confidence. Most respondents indicated they are most confident in *"ILMA insertion"* (33/35). The high level of confidence in this intermediate use of the ILMA may have originated because of its ease of use. Roger's diffusion of innovation theory indicates ease of use has a direct effect on the rate of adoption of an innovation and this is supported by the innovation in this occasion, the insertion of the ILMA, was judged by paramedics as the skill they have most confidence in.

Table 13: Frequency table of responses to the question 'I am very confident to perform the following skills?'

	Agree	Disagree	Missing	p value
Laryngoscopic tracheal intubation	62.8% (22/35)	28.6% (10/35)	8.6% (3/35)	.034
Paediatric tracheal intubation	34.2% (12/35)	57.0% (20/35)	8.6% (3/35)	.157
Cricothyroid puncture	22.8% (8/35)	68.4% (24/35)	8.6% (3/35)	.005
Tracheal intubation of an adult HI GCS5	51.3% (18/35)	39.9% (14/35)	8.6% (3/35)	.480
Confirming tracheal tube position	91.2% (32/35)	2.9% (1/35)	5.7% (2/35)	.000
Manage the difficult airway	85.5% (30/35)	11.4% (4/35)	2.9% (1/35)	.000
Manage can't intubate can't ventilate patient	34.2% (12/35)	59.9% (21/35)	5.7% (2/35)	.117
ILMA insertion	94.1% (33/35)	5.7% (2/35)	0.0% (0/35)	.000
ILMA tracheal intubation	79.8% (28/35)	11.4% (4/35)	8.6% (3/35)	.000

Note: p values relate to chi-square analysis performed without the missing category in each variable.

The majority of Paramedics were confident performing both laryngoscopic and ILMA tracheal intubation. The respondents did indicate a higher level of confidence when performing tracheal intubation using the ILMA to when using the traditional laryngoscopic method. The results showed 63% of the respondents' report they are confident to perform laryngoscopic tracheal intubation in comparison to 80% confident to perform ILMA tracheal intubation. The difference in paramedic confidence between laryngoscopic tracheal intubation and confidence with ILMA tracheal intubation is noteworthy.

Those surveyed reported least confidence in performing cricothyroid puncture (23%), paediatric tracheal intubation (34%) and to manage the can't intubate can't ventilate patient (34%) situation. These are the less frequently encountered paramedic AAM skills and support the notion mentioned above of a strong link between frequency of practice and confidence.

The general AAM skills, especially tracheal intubation, were reported as ones which the participants were confident to perform. Three of the four tracheal intubation skills: laryngoscopic tracheal intubation (63%), tracheal intubation of an adult head injury with a Glasgow Coma Score of 5 (51%) and ILMA tracheal intubation (80%) paramedics reported to be confident to perform. The other tracheal intubation skill, paediatric tracheal intubation (34%) was reported as one of the least confident skills to perform. Paediatric tracheal intubation is reported as an infrequent and difficult skill to perform (Garza, Algren et al. 2004).

Paramedics expressed an increased level of confidence towards performing their first out of hospital ILMA tracheal intubation.

Table14: Frequency of responses to the question 'When performing tracheal intubation?'

	Agree	Disagree	Missing	p value
I am confident to perform blind tracheal intubation	34.3% (12/35)	62.8% (22/35)	2.9% (1/35)	.086
I was confident to perform my first out-of-hospital laryngoscopic tracheal intubation*	36.7% (11/30)	60.0% (18/30)	3.3% (1/30)	.194
I was confident to perform my first out-of-hospital ILMA tracheal intubation	51.4% (18/35)	48.6% (17/35)	0.0% (0/35)	.866

*AAM qualified paramedics only, n30

When asked to rate their confidence prior to performing the first out of hospital tracheal intubation using both devices, more of the respondents reported increased levels of confidence prior to their first use of the ILMA than the laryngoscope. Only 37% (11/35) of respondents were confident to perform their first out of hospital laryngoscopic tracheal intubation in contrast to over 51% (18/35) of respondents confident in performing their first out of hospital ILMA tracheal intubation. The increased confidence when performing their first ILMA tracheal intubation indicates success of the ILMA training program.

During the PILMAT trial, nearly all of the participants (96%) after the initial training program were confident to use the ILMA in an emergency situation. Use of the ILMA by paramedics is only implemented in an emergency clinical situation where the patient requires critical airway care, therefore each use of the ILMA by paramedics is undertaken in anxious circumstances, situations where a confident performance is essential for a successful outcome and a suitable level of patient safety is required.

The majority of respondents were not confident in the skills they perform less often. It was of note in both the survey and the interview data that the amount of time since their last use of AAM skills was strongly linked to a loss of confidence as this interview excerpt suggests:

"I have gone eight, nine, ten months without doing a cardiac arrest and that makes it hard, your confidence goes down"

The influence or relationship which is made between confidence and the training events was confirmed "the educational process makes a difference to students' level of confidence" by Cottrell et al (Cottrell, Thammasitiboon et al. 2008) who then goes on to state "students were more than six times more likely to be confident when they performed a clinical experience and received feedback." This equates to a structured training process where the students have ample opportunity to perform the skill and importantly receive feedback on their performance. Therefore just making the training resources available for paramedics to individually practice a skill may not provide an increase in confidence as would providing the opportunity to perform the skill and receive feedback. A number of the paramedics interviewed commented on an increased opportunity to practice was desirable, and one supported the above notion of receiving feedback as important:

"every few months even if a CSO[9] came out for a day and you practiced for a few hours and even possibly the same with laryngoscopic intubation if they brought the manikin out once every few months it would be good, I think if they could do that every few months it would help maintain your confidence and skills not an assessment just a refresher"

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[9] A Clinical Support Officer who has the responsibility of undertaking the operational training requirements.

Paramedics have clearly expressed confidence in performing tracheal intubation utilising both the traditional laryngoscope and the newly introduced ILMA. It has been reported there can be very little relationship between self-reported levels of confidence and competence (Barnsley, Lyon et al. 2004). With the reported comparable ILMA tracheal intubation success rate similar to when using the laryngoscope, the lower blind tracheal intubation confidence level supports this described lack of relationship between confidence and competence.

4.3.2 Influences on confidence

"*Paramedics and EMS physicians attribute paramedic ETI performance to a myriad of factors involving EMS education, organisation, oversight, retention, and professionalism*." (Thomas, Abo et al. 2007).

Confidence in tracheal intubation has been influenced by a number of training activities and the other factors which may have some degree of effect are whether or not the paramedic completed their AAM training in Tasmania, whether or not they work in a rural or urban location, their clinical skill level and their previous AAM experience.

In our sample more of the paramedics who completed their AAM training in Tasmania were confident with ILMA tracheal intubation although this was not statistically significant (p=0.106). Conversely more of those not AAM trained in Tasmania were confident with laryngoscopic tracheal intubation (p=0.056). More of the paramedics working in a rural location reported confidence in ILMA tracheal intubation and confidence in laryngoscopic tracheal intubation was higher in this group as well though in neither case did this difference reach statistical significance.

Table 15: Factors associated with confidence in the use of each device.

	confidence in ILMA tracheal intubation yes	p-value	confidence in Laryngoscopic tracheal intubation yes	p-value
Trained in Tasmania				
- yes	95.2% (20/21)		81.0% (17/21)	
- no	80.0% (4/5)	0.106	100.0% (5/5)	0.056
Work location				
- rural	100% (7/7)		85.7% (6/7)	
- urban	84% (21/25)	0.552	64.0% (16/25)	0.387
Skill level				
- Paramedic	50.0% (1/2)		0*	
- ICP	95.2% (20/21)		66.7% (14/21)	
- CSO	77.8% (7/9)	0.105	88.9% (8/9)	0.046
Influenced by AAM experience				
yes	31.8% (7/24)		22.7% (5/22)	
no	70.8% (17/24)	0.550	77.3% (17/22)	0.681
Considered ILMA easier to use				
yes	50.0% (12/24)		45.5% (10/22)	
no	50.0% (12/24)	1.000	54.5% (12/22)	0.648

* Paramedics were not authorised to perform laryngoscopic tracheal intubation

1. Some of the questionnaires had responses to specific items missing or incorrectly completed, for example only 26 of the responses had the location where they were trained in AAM correct, with 7/35 not AAM trained.

The paramedic skill level reflects a higher level of training and clinical experience, with the paramedic level being the base level practitioner, ICP a higher clinical level and CSO the same clinical level as ICP but with additional training and quality assurance responsibilities. These increasing levels of clinical practice could be expected to be associated with increased confidence.

The ICPs more often reported confidence with ILMA tracheal intubation and the CSOs more often reported confidence in performing laryngoscopic tracheal intubation. Higher proportions of paramedics who reported they were not influenced by their AAM experience, than of paramedics who reported they were influenced, were confident in the use of each device. These large differences in proportions did not reach statistical significance. There was no difference in the proportions confident in the use of the ILMA between those who considered the ILMA easier to use. Among those who considered the ILMA easier to use, less than half were confident in laryngoscopic tracheal intubation whereas more than half of those who did not consider the ILMA to be easier to use were confident in laryngoscopic tracheal intubation.

Two criteria that have been distinctive in this study are the exclusive use of manikins for training ILMA tracheal intubation and the paramedics having a choice of which device they could use to perform tracheal intubation. These two criteria were examined as outcomes of the confidence of the participants to undertake either ILMA or laryngoscopic tracheal intubation.

Association between confidence in performing tracheal intubation and whether or not the paramedics believed manikin training to be essential was examined. All respondents who were confident in ILMA tracheal intubation believed manikin training was essential for initial tracheal intubation training. Whereas only 75% (3/4) of those not confident believe manikin training to be essential (p=.125). There was little difference in the proportions of those confident or not confident in laryngoscopic tracheal intubation who believed manikin training to be essential.

Table 16: Associations between confidence and belief about the essential use of manikin training and belief about which device should be first choice.

	Manikin training essential	p-value	ILMA First choice	p-value
Confidence in ILMA tracheal intubation				
yes	100.0% (28/28)		53.8% (14/26)	
no	75.0% (3/4)	0.125	75.0% (3/4)	0.613
Confidence in laryngoscopic tracheal intubation				
yes	95.2% (20/21)		65.0% (13/20)	
no	100.0% (10/10)	0.677	40.0% (4/10)	0.255

Having confidence in the use of a device or technique to perform tracheal intubation could be associated with favouring that device when there is a choice. Just over one half of the paramedics who were confident in performing ILMA tracheal intubation indicated it should be used as first choice in specific clinical circumstances. Whereas 75% of those not confident in performing ILMA tracheal intubation indicated it should be the first choice (p=.613). A higher proportion of those confident in laryngoscopic tracheal intubation than those not confident in its use believed the ILMA should be first choice.

Paramedic confidence was reported to be influenced by their first patient experience. When their first use of the ILMA was a positive one this increases their self-assessed level of competence which must have a degree influence on confidence. If a difficult or challenging clinical situation was their first ILMA encounter and/or they experienced difficulties this reduced their confidence level for future use, as a respondent conveyed,

"I came across trismus[10] *and I guess that knocks your confidence"*

The AAM qualified paramedics reported the acquisition of the new skill, ILMA tracheal intubation, was made easier and their confidence levels were higher by their past training and experience in laryngoscopic tracheal intubation. This has previously been mentioned in relation to their previous knowledge of the upper airway, but Morgan et al (Morgan and Cleave-Hogg 2002) found during stimulated anaesthetic scenarios medical students clinical experience had no prediction to level of performance. It must be remembered in this study the AAM qualified paramedics were senior clinicians with overall more general experience than the non-AAM qualified paramedics. In relation to the benefits provided by the general AAM training, one paramedic stated:

"I think that once you have that training and you have got that confidence you feel so much more confident about handling a lot of patients whether they be head injuries or cardiac arrest or just respiratory failures. ……. if you don't do the laryngoscope training at least on some real anatomy situations whether it is theatre or other if you don't get that

[10] Trismus is clenching of the teeth together normally making it impossible to place anything in the mouth.

and you just go on the plastic models I think there is always some doubt in your mind"

One of the AAM qualified paramedics felt that their past training in similar supra-glottic devices[11] outside of Ambulance Tasmania also increased their confidence in the use of the ILMA, as stated,

"I felt very confident on my first use of it I don't know if that is because I have put lots of standard LMAs in as well, but yes I had no concerns at all about putting it in."

The paramedics did report their level of confidence could have been substantially increased with additional practice in the short time after the ILMA training program. One respondent stated;

"I felt quite comfortable actually at the job at the first time when I had a problem I thought ok I have to think about this. So I guess in retrospect, the actual training was fine but me personally should have grabbed the ILMA a few more times and had a few more practices with it on a manikin. I did have a few goes after we did the training session but I think I don't know that I did 20 or 30 or 40, I probably did 10 or a dozen."

Another reported;

"the training I thought was very basic but I thought it was quite adequate for what it was, I would have liked to have done it a few more times just as a play myself but I didn't have a manikin so I was just looking at it thinking what you went through. Actually the first time I used it was easier than I thought it would have been and we tubed through it".

During an interview one of the AAM qualified paramedics expressed their increased confidence in using the new ILMA skill in comparison to the "more invasive" laryngoscopic tracheal intubation method. One participant stated,

[11] Supra-glottic devices are artificial airways which locate above the glottis (vocal cords) such as: Laryngeal Mask Airway, i-gel and King LTS-D.

“I would say I felt more confident with the ILMA because it was not as invasive”

The use of the ILMA was reported to be easy to use and in the literature less challenging to use in patients deemed as difficult to perform tracheal intubation. The questionnaire asked paramedics their view on the use of the ILMA in some common difficult tracheal intubation situations

4.3.3 Interval between Training and First Use

The elapsed time from training to first use was reported by Wang et al (Wang, Seitz et al. 2004) and was stated as not related to tracheal intubation success, but it may be related to confidence.

During the interviews the paramedics expressed an initial lack of confidence prior to performing ILMA tracheal intubation successfully for the first time in the clinical situation, which if the interval was short provided an additional training value and a boost to confidence. As one paramedic expressed about their first use,

“it was fairly soon after the training, it was a good refresher”

Just like any new critical skill, when performed for the first time on a live patient paramedics expectedly would be anxious and have a feeling of relief and confidence when it turns out successful. One respondent explained,

“*initially, I was a little bit hesitant and nervous but once the first one came up and I got that in okay and everything worked fine*”.

This initial anxiety would be expected to increase as the interval from training to first live performance increases. The initial lack of confidence was expressed in relation to the period of time between the training and the first skill performance, which appears not to have such a dramatic influence on ILMA tracheal intubation confidence as reported by Wang (Wang, Seitz et al. 2004). Paramedics speaking about their first use of the ILMA, stated:

"it was a few months between the training and my first use but I was relatively confident to use it"

But when the initial use was a negative experience, even by an experienced AAM paramedic who was also a paramedic educator, they were left not only with a bad experience but it did have a substantial effect on their confidence, as told by an experienced AAM paramedic,

"It was a little while before within a couple of months I did the first one (ILMA insertion). My experience on that one was a negative experience for me and I don t know if the outcome would have been any different if I had done anything different on that particular case anyway. I thought my confidence did go right down with it and I was wondering if I would use it again"

As this negative first use has a large impact on operator confidence it supports the concept of undertaking the first few live performances under the supervision of a more experienced practitioner so they are there to mitigate the potential negative outcomes. It is not known how experience in-theatre using the ILMA for tracheal intubation would influence this confidence level. In the out of hospital setting it is unknown when the next tracheal intubation will be required to be performed, so the notion of the novice who has been trained using manikins alone undertaking their initial live patient tracheal intubation to provide continuous supervision may be unrealistic due to the time which may be required to wait for their first tracheal intubation. This initial supervised practice does occur in other aspects of paramedic training but was missing from the Tasmanian AAM program, but it does occur in other Australian State Ambulance Service AAM programs.

4.3.4 Confidence in specific presentations

Laryngoscopic tracheal intubation is taught during the formal AAM training program and therefore the results in this area only included those paramedics who were AAM qualified and had completed the ILMA training program.

Paramedics expressed their confidence as high when asked about performing laryngoscopic tracheal intubation in four specific out of hospital critical patient presentations. All of the respondents were confident to perform laryngoscopic tracheal intubation in the cardiac arrest patient and in the unconscious non-trauma patient. In contrast the paramedics' confidence levels when performing tracheal intubation using the ILMA in the same specific patient presentations reported lower levels of confidence.

Table 17, Tracheal intubation confidence using both devices in four specific patient presentations.

Tracheal intubation confidence in:		confidence in ILMA tracheal intubation yes	p-value	confidence in Laryngoscopic tracheal intubation yes	p-value
Multi trauma, inadeq breathing & poor airway					
	yes	89.3% (25/28)		86.4% (19/22)	
	no	10.7% (3/28)	.664	13.6% (3/22)	*
Unstable C spine					
	yes	78.6% (22/28)		63.6% (14/22)	
	no	21.4% (6/28)	.404	36.4% (8/22)	*
Cardiac arrest					
	yes	96.4% (27/28)		100.0% (22/22)	
	no	3.6% (1/28)	.879	0.0% (0/22)	*
Unconscious non trauma					
	yes	92.9% (26/28)		100.0% (22/22)	
	no	7.1% (2/28)	.034	0.0% (0/22)	*

* p value not possible due to <5 distribution in categories

While a crosstabulation was conducted, there was little within group difference between the use of both devices. However an increase in ILMA tracheal intuabtion confidence was identified in the unstable cervical spine patient (ILMA 78.6%, laryngoscope 63.6%, p.404) but was not significant.

The level of confidence to perform laryngoscopic tracheal intubation in specific patient conditions was highest in the cardiac arrest (95%) and the unconscious non-trauma patients. The patient in cardiac arrest has been reported to be one of the easier clinical presentations for tracheal intubation with it being the basis for the introduction of tracheal intubation into paramedic practice and subsequently having a high tracheal intubation success rate.

It appears the difficult or more complex clinical situations lead to a decrease in the paramedics' confidence in performing tracheal intubation using either device. The lowest levels of laryngoscopic tracheal intubation confidence were reported by paramedics with AAM experience in patients with an unstable cervical spine[12] (82%) and the multi-trauma inadequate breathing and poor airway (86%) patient groups. With the standard performance of laryngoscopic tracheal intubation requiring manipulation of the cervical spine many practitioners are daunted by the patient with a suspected cervical spine injury. The multi trauma patient presents a similar scenario to the patient with a cervical spine injury, because this type of patient must be assumed to have a cervical spine injury. Garza et al (Garza, Algren et al. 2004) studied the rate of paramedic tracheal intubation non attempt and failure, and concluded the trauma patient was perceived as more difficult to intubate and therefore the paramedics' confidence level may also influence their competence and decision not to attempt tracheal intubation.

The collected data indicated that under the same critical clinical conditions a change in tracheal intubation tool and thus method, from the laryngoscope to the ILMA, did have an impact upon the paramedics level of confidence. In all four critical clinical situations paramedics had more confidence in performing ILMA tracheal intubation than laryngoscopic tracheal intubation. This is a major finding in light of the considerable differences in the training methodologies used for each technique, with laryngoscopic tracheal intubation utilising both live patients and manikins over a greater time period and the ILMA training program exclusively utilising manikins and only a one day training program.

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[12] The unstable cervical spine is often managed based on a high index of suspicion in patients who have experienced a significant degree of trauma.

This increase in reported confidence to perform ILMA tracheal intubation is after a unique training program which was: short in duration, exclusively used manikins and involved no in-hospital time. Paramedics who had completed the extensive AAM training program and had a number of years' experience in laryngoscopic tracheal intubation still reported higher levels of confidence with ILMA rather than laryngoscopic tracheal intubation.

During the twelve month PILMAT trial the research protocol required paramedics to use the ILMA as their first choice for any acute airway care requiring assisted ventilation, maintaining patency and tracheal intubation. Overall 94% of those paramedics surveyed in this study stated they were confident in general insertion of the ILMA, with only 6% of respondents reporting a lack of confidence. When asked specifically about their confidence in performing tracheal intubation using the ILMA, 80% of the respondents indicated they were confident. In comparison, the paramedics who reported confidence to perform laryngoscopic tracheal intubation was 63% of respondents, 17% lower than those who reported being confident in performing ILMA tracheal intubation.

During the interviews the paramedics expressed a desire for more practice in order to increase their ILMA tracheal intubation confidence level. The ILMA training program was short only allowing paramedics to perform the new skill (ILMA tracheal intubation) very few times. The most a paramedic would have practiced the skill on a manikin during the training program was no more than eight times. Although this was very few skill performances it did produce a level of confidence post training at higher levels of confidence than with the traditional laryngoscopic tracheal intubation method.

Practitioner confidence is reported to be influenced by a diverse number of both inherent and operational factors. The complexity of the skill, frequency of practice (Vrotsos, Pirrallo et al. 2008), clinical experience (Morgan and Cleave-Hogg 2002) and the period immediately post training (Kovacs, Bullock et al. 2000) all have been reported to have a considerable influence on the confidence level of the practitioner. There may be many more factors which influence confidence. In this study there are a number of factors which have been examined to determine if they have any influence on practitioner confidence when performing tracheal intubation. The training factors which will be examined are:

- educational methodologies,
- first use experience,
- frequency of updates, and
- period between skill performances.

There may be a direct link between confidence and education and so the course structure of tracheal intubation was examined in more detail later in this chapter.

The ILMA as the innovation introduced was reported by the paramedics to have high levels of confidence and an examination of the characteristics of this device and technique will be examined next.

4.4 Initial use of the ILMA

The educational strategies employed during the PILMAT training program were considered by some as the 'bare minimum' requirements in order to achieve a minimum level of confidence and competence prior to implementing the skill into routine practice. Despite this course being seen as minimal in nature the competency level required for authorisation of practice was not reduced. Even after this condensed ILMA training program the participants did report and the outcomes has demonstrated it was a success.

The majority (22/35) of participants indicated their initial impression of the ILMA as being required for paramedic tracheal intubation. After attending the training program and using the ILMA in their clinical practice this impression changed slightly to 69% agreeing it "has an important role" in paramedic tracheal intubation and the majority 97% (34/35) of the respondents agreeing the ILMA should be part of paramedic practice.

Table 18: Frequency of responses to questions regarding Paramedic ILMA application?

	Agree	Disagree	Missing	p value
My initial impression was the ILMA was not required for tracheal intubation	37.1% (13/35)	62.9% (22/35)	0.0% (0/35)	.128
I now think the ILMA has an important role in tracheal intubation	68.6% (24/35)	31.4% (11/35)	0.0% (0/35)	.028
My experience with laryngoscopic tracheal intubation influenced my use of the ILMA^	23.3% (7/30)	76.7% (23/30)	0.0% (0/30)	.003
The receiving hospital staff being unfamiliar with the ILMA influenced my use of it	14.3% (5/35)	82.8% (29/35)	2.9% (1/35)	.000
I used the ILMA because of the research study	48.6% (17/35)	51.4% (18/35)	0.0% (0/35)	.866
The ILMA should be part of ambulance practice	97.1% (34/35)	0.0% (0/35)	2.9% (1/35)	*

p value not possible due to insufficient data and therefore <5 distribution in categories.
^ AAM paramedics only, n30

The respondents who were AAM qualified reported their past laryngoscopic tracheal intubation experience had no influence on their use of the ILMA in their clinical practice. This is despite the AAM qualified paramedics indicating that during training they believed they had an advantage by being more familiar with the anatomy of the upper airway. The paramedics reported they relied upon some of the unique laryngoscopic techniques when performing tracheal intubation which are not employed when performing ILMA tracheal intubation. Most paramedics (31/35) testified it important to visualise the vocal cords when performing tracheal intubation, this is not done when performing ILMA tracheal intubation. Utilising a blind intubation technique, such as with the ILMA, the practitioner relies upon technique and a number of ‘checks’ to confirm successful placement. Respondents reported the placement checks were satisfactory when compared to actual visualisation of the tube through the cords.

When comparing visualising the tube through the vocal cords to performing the tube placement checks to determine successful tracheal intubation, paramedics believed the tube placement checks (83%) to be adequate. Ensuring correct tube placement is one of the major complications raised by various studies (Bradley, Billows et al. 1998; Katz and Falk 2001; Sanson-Fisher, Rolfe et al. 2005; Vleuten and Schuwirth 2005; Wang and Yealy 2006; Wirtz, Ortiz et al. 2007; Sreevathsa, Nathan et al. 2008) highlighting the inability of paramedics to perform tracheal intubation, therefore having the paramedics confirm their confidence in the checking procedures in spite of actual visualisation of the tube through the cords means ILMA tracheal intubation can be effective.

The value of having the ILMA as part of their scope of practice not only for tracheal intubation but also to use it as a basic airway device, similar to an LMA, was also reported. This dual function of the ILMA is one of its major advantages, functioning as an intermediate and an advanced airway management tool provides multiple uses for a single device. This is important for patient care as both the intermediate and advanced airway provider can perform their skills using the one device and on arrival of the advanced airway provider they do not have to remove the intermediate airway tools, as stated by one respondent,

".. and if the ILMA doesn't work then at least you can leave the ILMA in there without the tube and then you at least have some form of airway"

The concept of 'blind'[13] tracheal intubation is not expected to be practised by many ambulance paramedics worldwide and during this study it was discovered only to be practiced by Tasmanian Paramedics. The 'blind' tracheal intubation technique is postulated, however, to be one of the benefits when performing ILMA tracheal intubation (Limited 2001). Being able to visualise the vocal cords during laryngoscopic tracheal intubation (opposite to the blind technique) is the key to procedural success, which in certain conditions is very difficult. Therefore performing ILMA tracheal intubation which utilises the 'blind' technique is completely

[13] Blind tracheal intubation is the technique implemented when the upper airway and vocal cords are not sighted.

opposed to a paramedics' conventional training. The responses indicated over 62% of the respondents were unsure or not confident when using the blind technique of ILMA tracheal intubation. Yet the ILMA tracheal intubation success rate shows they had competence in this technique.

4.4.1 ILMA Tracheal Intubation

Although the majority of participants reported confidence in using the ILMA when it came to comparing this new technique with the traditional laryngoscopic method they felt the new ILMA technique inferior in clinical practice.

Just over half of respondents qualified in AAM reported laryngoscopic tracheal intubation to be both easier (16/30) and quicker (17/30) to perform than ILMA tracheal intubation. This result is only just in the majority which again highlights a difference in the acceptance of the ILMA over the laryngoscope, with the ILMA being accepted in a much shorter time period. Paramedics had increased confidence after initial training with ILMA tracheal intubation and the reported high confidence levels to use the ILMA in emergency clinical situations, yet they reported laryngoscopic tracheal intubation easier and quicker to use. Laryngoscopic tracheal intubation training and use has been extensive and occurring for a considerable period whereas the ILMA training program was very condensed and was only used for a short time in practice.

Table 19: When comparing laryngoscopic to ILMA tracheal intubation, AAM qualified paramedics felt ILMA tracheal intubation was?

	Agree	Disagree	Missing	p value
Easier	46.6% (14/30)	53.3% (16/30)	0.0% (0/30)	0.715
Quicker	43.3% (13/30)	56.7% (17/30)	0.0% (0/30)	0.465
Requires less training	80.0% (24/30)	20.0% (6/30)	0.0% (0/30)	0.001

Note: p values relate to chi-square analysis performed without missing category in each variable.
1. AAM qualified paramedics' n30

Many studies have indicated performing tracheal intubation using the ILMA to be an easier skill than using the laryngoscope, this would be expected to correlate with ILMA tracheal intubation training to be easier and shorter in duration. The teaching and implementation of ILMA tracheal intubation was considered to require less training than laryngoscopic tracheal intubation and this was reflected in the following respondents statements,

".. from an educational perspective it is great as far as teaching people how to use it, it is just so easy to teach people how to use"

"Personally I think ILMA has got the advantages of being able to be done a lot quicker so intubating through an ILMA you can do a hell of a lot quicker"

The inclusion of the ILMA for those practitioners with AAM qualification was said to provide an advantage especially as an airway rescue device, as one respondent stated,

"I believe all intensive care paramedics should be intubating, so those people have got both options they can fall back on, for the intensive care paramedic it is really intubate through it as an adjunct to traditional intubation"

They view of the ILMA being a simpler device to use and thus suited to lower clinical levels than the laryngoscope, is supported by this comment from one respondent,

"with the paramedics they should perhaps have the ILMA with the ability to tube through that"

During the interviews the respondents did report a degree of satisfaction with the ILMA training program, which was related to the ease of use of the ILMA, as one respondent has confirmed,

"…at the time when you finished with that day session you would feel you could do it, it looked pretty simple and the rules were simple and the application was simple.."

There appears to be a drift from paramedics valuing the hospital environment and the extended learning experience to valuing content of the new program for theoretical knowledge and skill development. This change maybe due to the device which was used, the ILMA.

4.4.2 Paramedic choice and ease of use

When there is a choice to perform a skill, in this case tracheal intubation, using two different tools or techniques it is unsure what influences that choice. In June 2008 the UK Joint Royal Colleges Ambulance Liaison Committee recommended "*Tracheal intubation should be developed as a specialist skill for selected providers*" (Committee 2008). This recommendation makes no mention of the technique or device used and as such lacks a degree of currency with the variety of devices now available for paramedics to use to accomplish tracheal intubation.

Paramedics recommend ILMA tracheal intubation is a skill which should be within their scope of practice. Most reported the attending paramedic should decide which method of tracheal intubation should be used first and we assume this would be based on the patient's characteristics and their clinical circumstances, which is supported by their report that the ILMA should be used first in specific patient presentations.

The majority (19/35) believed the paramedic should choose the method of tracheal intubation when given the choice between the laryngoscope and the ILMA. Only two participants reported the ILMA should be the first method of paramedic tracheal intubation compared to 40% indicating the laryngoscope.

The majority of Paramedics did agree for the ILMA to be used for specific clinical presentations. As one respondent reported,

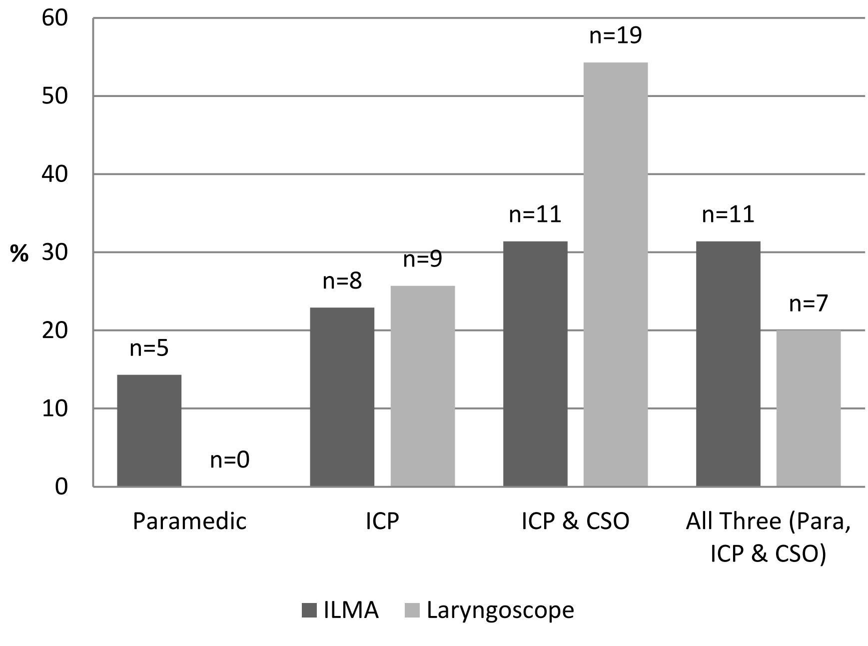
"I think they both have their place someone not trained in intubation with a laryngoscope yes I think it is something they should be able to do, but having laryngoscopic intubation you have a choice of either one and

then in certain situations well, intubation is the way to go but just the ILMA has a place"

Paramedics have declared laryngoscopic tracheal intubation should primarily be performed by the higher clinical skill levels, for example Intensive Care Paramedic and Clinical Support Officers, which supports the statements that tracheal intubation is a relatively difficult skill to perform.

Five respondents in this study were not AAM qualified (Paramedic level). The higher clinical skill levels of ICP and CSO were the clinical skill levels judged as most appropriate to perform laryngoscopic tracheal intubation. The paramedic respondents believed ILMA tracheal intubation should be performed by all clinical skill levels, the respondents strongly reported "all three" skill levels should be able to perform tracheal intubation using the ILMA along with the higher clinical levels of "ICP and CSO".

Figure 11: Which skill level should perform tracheal intubation?



Key: Para = Paramedic, ICP = Intensive Care Paramedic, CSO = Clinical Support Officer.

The notion of paramedics having a choice of airway management device is a paradigm shift, as to date almost all of paramedic airway practice has involved adherence to a strict protocols. These protocols detail a standardised one approach for all patients and all airway management situations, which can be viewed as restrictive practice. Emergency Physicians and Anaesthetics have guidelines but their prime decision on how to managing a patient’s airway is determined by the patient’s characteristics and the presenting clinical context, which they then choose the best airway tool and technique to use.

Notably the paramedics did report the lower skill level of Paramedic could perform tracheal intubation using the ILMA but not when using the laryngoscope, these responses are most likely those paramedics not AAM qualified.

Competence in performing ILMA tracheal intubation was indicated to be easier to achieve than laryngoscopic tracheal intubation, by 14% of respondents indicating the lower clinical practice level of paramedic could perform and ILMA tracheal intubation plus the 31% indicating it should be performed by “all three levels” which includes the lower paramedic level. There was a higher result for ILMA tracheal intubation (31%) to be performed by all three skill levels than if laryngoscopic tracheal intubation should be performed by all three levels (20%).

This restriction of laryngoscopic tracheal intubation has been reported (Gerbeaux 2005; Bledsoe 2006; Thomas, Abo et al. 2007; Committee 2008) and they justify this approach based upon the requirements needed to maintain competence in this difficult infrequently performed out of hospital skill. This restraint of laryngoscopic tracheal intubation does not appear to be relevant to the easier and less difficult tracheal intubation using the ILMA, where there appears to be a wider acceptance and less complex training required (Reardon and Martel 2001; Caponas 2002; Pandit, MacLachlan et al. 2002; Tentillier, Heydenreich et al. 2007) which is supported in this study.

The confidence of achieving tracheal intubation success by the paramedics who were AAM qualified was increased by having another technique to achieve the same outcome. This does indicate a lack of confidence in performing the current method of laryngoscopic tracheal intubation, which must be considered in light of the current skills maintenance program. The inclusion of a secondary device, the ILMA, may improve confidence and thus reduce the frequency of skills practice requirements, as mentioned by this paramedic,

"I felt that I was happy to have another skill that was increasing my level of competence, competence is probably not a good word but my level of intervention is probably a better way of putting it"

The AAM qualified paramedics did indicate the ILMA provided a sense of reassurance for the situations when there was a difficult intubation and the potential of failure with the laryngoscope was increased. A paramedic stated,

"Yes it is a good basis for AAM and those who could do AAM saw the ILMA as a backup for the ones that are grade 3's and 4's[14]"

The ILMA was reported by respondents as an important airway adjunct for paramedic practice, as testified,
"I still see a primary role in the more difficult intubations with an ILMA"

And another respondent pronounced,

"I would go for the ILMA first because you have a better chance of getting it in, in the case of not being able to intubate via laryngoscopy I would obviously fall back onto that (ILMA)"

Despite the strong traditional paramedic culture of laryngoscopic tracheal intubation being held in high reverence, following the introduction of the ILMA with a major change in educational methodology, paramedics reported this new approach has an important role in future paramedic practice.

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[14] Classifications of the vision obtained with the mouth wide open, Mallampati class 3 and 4 are the most restricted view allowing one to observe the immediate oral cavity only.

The participants did report a high level of confidence in using the ILMA, but they also reported a perception of it being not as quick or easy to use as the laryngoscope, conclusions which appear contradictory. During the PILMAT trial, where the ILMA was used by paramedics as part of their daily practice, analysis of the times which paramedic crews spent ‘on scene’ implementing AAM procedures (commonly tracheal intubation) did demonstrate when the ILMA was used the ambulance scene times were shorter.

4.4.3 Success rates and scene times

One measure of competency commonly used in tracheal intubation practice is by evaluating success rates. Tracheal Intubation success rate refers to successful performance on the skill where the outcome of placing the tracheal tube into the trachea is achieved. During the PILMAT trial, ILMA tracheal intubation was shown to have a similar success rate as the traditional laryngoscopic tracheal intubation. The overall laryngoscopic tracheal intubation success rate was 91% (n42/46) and the overall ILMA tracheal intubation success rate was 92% (n48/52).

Records of the 83 laryngoscopic tracheal intubations undertaken by paramedics in the Tasmanian Ambulance Service prior to the introduction of the ILMA during 2005 and 2006 showed 17/83 (20.5%) of the patients presented with a view of the vocal cords which was stated as ‘not seen’ with over 70% of these patients paramedics stated as ‘very difficult’ to perform tracheal intubation. In the group of patients where there was a good view of the vocal cords there still was a high number (19%) where the paramedic stated performing tracheal intubation to involve ‘moderate difficulty’. Just over half (47/83) of the patients provided a good view of the vocal cords.

Table 20: View of the vocal cords and laryngoscopic tracheal intubation difficulty by paramedics 2005 – 2006

Vocal cord view	Tracheal intubation	Unsuccessful
Good, 56.6% (47/83)		
Straightforward	78.7% (37/47)	2.7% (1/37)
Moderate difficulty	19.1% (9/47)	0.0% (0/0)
Not Recorded	2.1% (1/47)	0.0% (0/0)
Poor, 22.9% (19/83)		
Straightforward	15.8% (3/19)	0.0% (0/0)
Moderate difficulty	63.2% (12/19)	8.3% (1/12)
Very difficult	21.1% (4/19)	0.0% (0/0)
Not seen, 20.5% (17/83)		
Straightforward	0.0% (0)	0.0% (0/0)
Moderate difficulty	29.4% (5/17)	40.0% (2/5)
Very difficult	70.6% (12/17)	8.3% (1/12)

These results indicate a high overall success rate and a significant number of patients where the vocal cord view was less than ideal which also appears to correlate to the degree of difficulty in performing tracheal intubation.

The ILMA was a new device, taught in a very different format and the paramedics had less experience than with the laryngoscope. In the PILMAT trial a proportion of the ILMA tracheal intubations were performed by paramedics not qualified in AAM. These non-AAM qualified paramedics achieved a 100% tracheal intubation success rate when using the ILMA, in comparison the AAM trained paramedics had an 88% success rate with tracheal intubation via the ILMA. During the PILMAT trial the paramedics were 1.7 times more likely to be successful with their first attempt at tracheal intubation when using the ILMA than when using the laryngoscope. All successful ILMA tracheal intubations were achieved by the second attempt, which was the recommended maximum number of attempts during the PILMAT trial.

During the PILMAT trial, when performing laryngoscopic tracheal intubation, paramedics were successful 62% with their first attempt, and when performing ILMA tracheal intubation they had a higher first attempt success rate of 85%. After their second attempt the success rate for laryngoscopic tracheal intubation increased to 86% and the success rate for ILMA tracheal intubation after the second attempt rose to 100%. The higher success rate on the initial tracheal intubation attempt when using the ILMA may be due to a number of factors which was not evaluated during the PILMAT trial.

The ILMA has been developed to specifically manage the difficult tracheal intubation (Agro, Brimacombe et al. 1998; Limited 2001; Martel, Reardon et al. 2001; Reardon and Martel 2001; Waltl, Melischek et al. 2001; Caponas 2002) situation and the management of this patient presentation by paramedics has relied more on the skill and experience of the individual paramedic rather than on having the appropriate tools to achieve adequate ventilation. An experienced ICP during the study was confronted with one of the most challenging and difficult airways, in a remote location and was very relieved to have the ILMA which allowed effective tracheal intubation and subsequent ventilation, something they thought much easier and with less risk to the patient than their normal practice allowed.

The scene times are recorded electronically by paramedics activating a button when arriving and departing the scene. The only incidents included in this analysis were ones where the paramedic made a tracheal intubation attempt, using either the laryngoscope or the ILMA, and the patient was transported to hospital, i.e. care was not terminated at the incident scene. The analysis of the ambulance scene times during the PILMAT trial showed when paramedics used the Laryngoscope for tracheal intubation there was a mean scene time increase of 4.8 minutes over when the ILMA was used. The mean scene time when the ILMA was used for tracheal intubation was 28.9 minutes and when the laryngoscope was used the mean scene time was 33.7 minutes.

Figure 12: Scene times for patients requiring tracheal intubation during PILMAT in 10 minute slices.

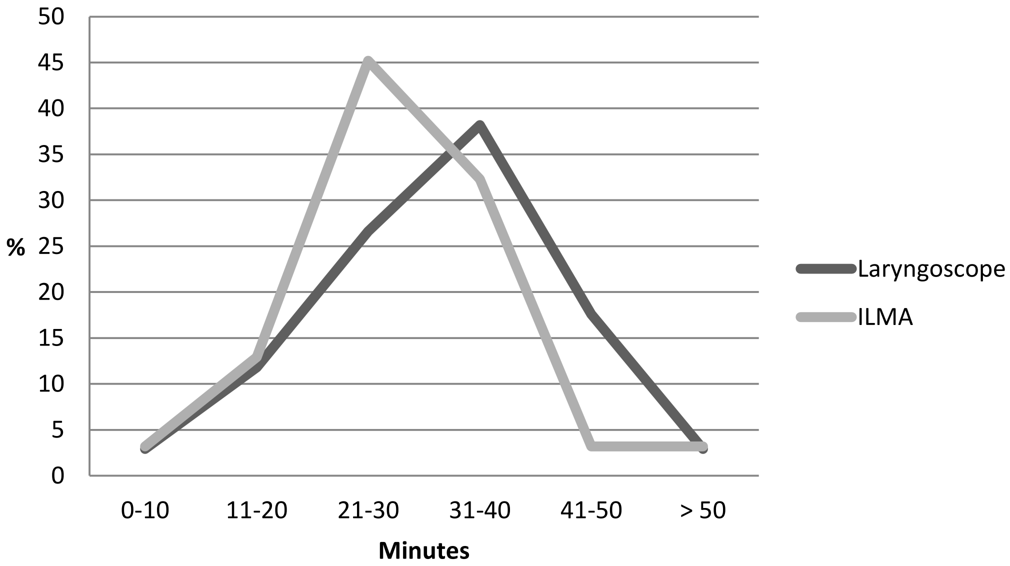


Figure 12 shows the peak number of incidents scene times when the ILMA was used for tracheal intubation was in the 21-30 minute time bracket (45%) whereas the peak of incidents scene time when the laryngoscope was used for tracheal intubation was in the 31-40 minute time bracket (38%). This clearly shows, without analysing other confounding factors, paramedic tracheal intubation using the ILMA leads to a shorter scene time then when using the laryngoscope. This supports evidence presented on the use of the ILMA in-hospital by Martel et al (Martel, Reardon et al. 2001), where ILMA use by Emergency Physicians was found to achieve ventilation in less than 15 seconds and tracheal intubation in less than one minute.

This demonstrates the paramedics were confident to use the new tracheal intubation device, the ILMA, but the perceptions of their performance indicted they felt they were not as competent as with the tradition laryngoscopic method. Analysis of paramedics actual performance indicated aspects which suggest they were more competent when using the ILMA than when using the laryngoscope. This discrepancy between confidence and competency has been reported in a number of studies (Stewart, O'Halloran et al. 2000; Morgan and Cleave-Hogg 2002;

Barnsley, Lyon et al. 2004; Cottrell, Thammasitiboon et al. 2008). Competence is said to be linked closely to the person's opinion of their previous experience at performing the task, whereas Stewart et al (Stewart, O'Halloran et al. 2000) defines confidence as the individual's willingness to undertake the skill. This disconnect between confidence and competence was also reported by Morgan et al (Morgan and Cleave-Hogg 2002) in relation to performance of standard anaesthetic scenarios which also incorporated operator experience.

Relating these concepts to the use of the ILMA, the paramedics were willing to use the ILMA (confidence) and their competence was based on either their initial use or the training which was undertaken. Therefore the initial use of a new device or performance of a skill can have a substantial effect on their perceived level of competence and level of confidence which is also true of the educational processes "the educational process makes a difference to students' level of confidence" Cottrell et al (Cottrell, Thammasitiboon et al. 2008).

Studies have commented the ILMA is easy to use (Burgoyne and Cyna 2001; Mason 2001; Pandit, MacLachlan et al. 2002; Timmermann, Russo et al. 2007) and therefore when given the choice paramedics are expected to choose it rather than the laryngoscope, but there are other factors such as the training process which may influence choice. This complexity is only one of the criteria proposed by Roger's innovation of diffusion theory which has an influence on the uptake of a new device or procedure.

4.5 Training strategies

The structure and methods chosen for a specific training purpose can be influenced by a number of factors; many of these factors are not concerned with the desired learning outcomes but often dictated by organisational limitations. Any negative influence caused by the organisational constraints on achieving the desired learning outcomes can be reduced by ensuring the most appropriate training methodology is implemented to cope with these demands. Ambulance Service training can often be driven by the organisational demands, either financial or logistical, with little compensation provided by engagement of the most appropriate methodology.

The inaugural Tasmanian paramedic AAM training program exclusively utilised in theatre real patient training for two main reasons, firstly it provided a degree of control by the medical experts in the field, Anaesthetists, and secondly within the Tasmanian Ambulance Service there was no educational or performance experience in this specialist area. Taking the time to investigate other AAM training methodologies and reviewing the AAM training practices of other ambulance services both nationally and internationally may have changed this initial AAM training structure that at the time was considered appropriate.

The degree and appropriateness of the training a student is exposed to will have a major influence on the success and final level of confidence they possess. The two training programs compared in this study had not only very different durations but also considerable differences in their methodologies. The traditional laryngoscopic-based tracheal intubation training had an almost exclusive focus on in- theatre real patient training as opposed to the newer ILMA tracheal intubation training which for its training methodology had its focus exclusively on the use of simulation using AAM specific manikins.

4.5.1 Structure and Processes

ILMA tracheal intubation training has been reported by paramedics to require a shorter and less complex course than the typical laryngoscopic training course. After having completed the ILMA training program and the majority had used the ILMA in a clinical situation, 74% of respondents stated it requires less training than the laryngoscopic tracheal intubation program, and 23% paramedics disagreed that the ILMA required less training. The ILMA training consisted of two main components: a review of knowledge and then a skill based practical component of approximately four hours which involved numerous successful ILMA tracheal intubations using a manikin.

In further evaluation of the traditional AAM training program the paramedics reported a high degree of acceptance for all of the course components.

Table 21: Frequency of response to the question "The following elements are essential for paramedic laryngoscopic tracheal intubation training?"

	Agree	Disagree	Missing	p value
Precourse theory	100.0% (35/35)	0.0% (0/35)	0.0% (0/35)	*
In theatre training	94.3% (33/35)	5.7% (2/35)	0.0% (0/35)	*
Guidance by Anaesthetist	85.7% (30/35)	14.3% (5/35)	0.0% (0/35)	.000
Manikin training	94.3% (33/35)	2.9% (1/35)	2.9% (1/35)	*
CSO classroom training	85.7% (30/35)	14.3% (5/35)	0.0% (0/35)	.000

Note: p values relate to chi-square analysis performed without missing category in each variable.
* p value not possible due to insufficient data and therefore <5 distribution in categories.

The components contained in the traditional AAM primarily laryngoscopic course were:

1) precourse theory; which not only reviewed previous knowledge but also introduced new knowledge and concepts which the student could study and become familiar with some days and often weeks before attending the course,
2) in theatre training; where a period of several days was spent attempting to obtain as much experience as possible in both general and advanced airway skills in the hospital theatre environment on live patients,
3) guidance by an anaesthetist; which was somewhat unstructured, if the student was lucky they spent a full day or two with the same anaesthetist and received direction and feedback, whereas other times were spent wandering between theatres in an attempt to 'chase' the AAM skills and thus no connection with the anaesthetist,
4) manikin training; where short periods of time was spent alone practicing the AAM skills, and
5) CSO classroom training; a more formal training experience where the CSO would teach, support and provide feedback on the

performance of specific AAM skills using a manikin-based simulation.

All the components of the laryngoscopic tracheal intubation training program were deemed of high importance. The in-service (CSO classroom training) and in-theatre components were reported to be of comparable importance although not the most essential in the laryngoscopic tracheal intubation training program.

The new ILMA training program was developed without having any reference to the conventional laryngoscopic tracheal intubation training program. The ILMA training program was deliberately based on the premise of having strong foundational knowledge through the detailed precourse theory and exclusively using manikins for skill achievement and competency in contrast to the established in-theatre real patient training component.

The survey respondents, who were AAM qualified and had participated in the laryngoscopic tracheal intubation training program, were asked to rate, based on their experience, which of the laryngoscopic tracheal intubation training program components they believed essential for ILMA tracheal intubation training.

The precourse theory, in theatre training and manikin training were all deemed highly essential for paramedic laryngoscopic tracheal intubation training. Guidance by the anaesthetist was rated as the least essential component (49%) for ILMA tracheal intubation training. The in theatre component was rated as more essential than the anaesthetist. Instead the paramedics preferred the pre-course theory, manikin and CSO in-service components. This is a major change in training methodology which may be attributed to the reported ease of use of the device (ILMA) or the paramedics' previous confidence and experience obtained from the laryngoscopic tracheal intubation training program.

Table 22: Frequency of response to the Question "The following elements are essential for paramedic ILMA tracheal intubation training?"

	Agree	Disagree	Missing	p value
Precourse theory	94.3% (33/35)	5.7% (2/35)	0.0% (0/35)	*
In theatre training	62.9% (22/35)	34.2% (12/35)	2.9% (1/35)	.086
Guidance by Anaesthetist	48.5% (17/35)	48.5% (17/35)	2.9% (1/35)	1.000
Manikin training	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
CSO classroom training	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

With the medical supervision (in-theatre and guidance by anaesthetists) components reported as least essential for ILMA tracheal intubation training, other training components become critical. The most essential components for an ILMA tracheal intubation training program has been reported to be the manikin training (97%) and the CSO classroom training. This change in emphasis from the in theatre tracheal intubation training, which has posed a number of logistical difficulties, to the more controlled efficient manikin-based simulation training has been supported by the paramedic intubation success rates when using the ILMA. The PILMAT trial which exclusively used manikin training, concluded "*intubation via the ILMA was as successful as conventional laryngoscopic intubation*" (McCall, Reeves et al. 2008).

In an attempt to remove the influence of previous AAM training, especially laryngoscopic tracheal intubation, the reported ILMA tracheal intubation components considered essential were evaluated from the five respondents who were not AAM qualified and had only used the ILMA for tracheal intubation.

The five non-AAM qualified respondents reported all components essential except for the guidance by an anaesthetist. There is clearly a difference in what paramedics consider the essential tracheal intubation training components between the two devices: the laryngoscope and the ILMA. These variations may have a substantial effect not only on the ability to achieve more effective training outcomes but also on the decision on which level of practitioner may be suited to having these skills as part of their clinical practice. It is evident in this small study; tracheal intubation via the ILMA can be successfully implemented into paramedic practice without an extensive in-hospital training component.

Table 23: Frequency of response to the Question "The following elements are essential for paramedic ILMA tracheal intubation training?"

	Agree	Disagree	Missing	p value
Precourse theory	100% (5/5)	0% (0/5)	0% (0/5)	*
In theatre training	100% (5/5)	0% (0/5)	0% (0/5)	*
Guidance by Anaesthetist	40% (2/5)	60% (3/5)	0% (0/5)	*
Manikin training	100% (5/5)	0% (0/5)	0% (0/5)	*
CSO classroom training	100% (5/5)	0% (0/5)	0% (0/5)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

1. This data was from the 5 respondents who were not AAM qualified

The preferred training components across both training programs didn't differ except for the in-theatre (ILMA 64.3%, laryngoscope 95.5%) and guidance by anaesthetist (ILMA 46.4%, laryngoscope 95.5%) components. Using the traditional AAM training program as a comparison and having completed the new ILMA training program, paramedics were able to compare the components of each training course. The two main differences, manikin/simulation training and in-theatre training, were main components for the interviews.

A crosstab analysis showed in theatre training (ILMA tracheal intubation 64.3%, laryngoscopic tracheal intubation 95.5%, p.031) and guidance by anaesthetist (ILMA tracheal intubation 46.4%, laryngoscopic tracheal intubation 95.5%, p.022) are less significant training components for confidence in ILMA tracheal intubation. This contributed nothing further to the data analysis.

Table 24, Tracheal intubation confidence for the different training components when using both devices.

	confidence in ILMA tracheal intubation		confidence in Laryngoscopic tracheal intubation	
	yes	p-value	yes	p-value
Precourse theory				
yes	96.4% (27/28)		100.0% (22/22)	
no	3.6% (1/28)	.204	0.0% (0/22)	–
In theatre training				
yes	64.3% (18/28)		95.5% (21/22)	
no	35.7% (10/28)	.031	4.5% (1/22)	0.749
Guidance by Anaesthetist				
yes	46.4% (13/28)		95.5% (21/22)	
no	53.6% (15/28)	.022	4.5% (1/22)	0.022
Manikin training				
yes	100.0% (28/28)		95.2% (20/21)	
no	0.0% (0/28)	.019	4.8% (1/21)	0.869
CSO classroom training				
yes	100.0% (28/28)		86.4% (19/22)	
no	0.0% (0/28)	.019	13.6% (3/22)	0.679

1. There were 28 complete responses to the crosstab of ILMA tracheal intubation confidence and the training components and 22 complete responses to laryngoscope tracheal intubation confidence and the training components.

The in-theatre training was reported as essential (n33, 95%) but during the interviews a number of shortfalls were identified with this training component, one respondent reported:

".. because you can't get enough real people and also you can't get the complicated intubation"

The learning curve for paramedic tracheal intubation has been shown in a study by Wang et al (Wang, Seitz et al. 2004) to be the best in the out of hospital and ICU settings. The learning curve for paramedic tracheal intubation in the theatre environment was lower despite providing the greatest opportunity by way of patient numbers for skill practice. During the interviews a number of comments were made regarding the in theatre training environment, commonly statements regarding the decreasing practice of tracheal intubation and competition with other medical trainees were cited as consistent problems with in theatre paramedic AAM training.

The initial Tasmanian AAM training program specified a minimum number of laryngoscopic tracheal intubation attempts (30) were to be achieved during the in theatre training component in order to successfully complete the program. The majority (33/35) of respondents in this survey did indicate the in theatre training for laryngoscopic tracheal intubation highly essential with the guidance provided by anaesthetists slightly lower. This suggests the live patient experience for laryngoscopic tracheal intubation a critical component of the training process and the anaesthetists' involvement of slightly lesser importance. This also may indicate the guidance by an anaesthetist critical during the first attempts until the paramedic has experienced success and received adequate feedback to provide a suitable level of confidence, after which the paramedic relies less on the anaesthetist guidance but continues to value the live experience.

The desire to experience ILMA use on a live patient, as evidenced by the reported level of in theatre training, was supported during the interviews. One respondent stated,

"To feel the ILMA going into a real person once or twice in theatre, that's all it would take I feel and that's based on experience since then, that I would be more confident going on doing it the first time"

The notion of having to experience laryngoscopic tracheal intubation before being able to truly appreciate a blind tracheal intubation technique (ILMA) was only a recommendation made by paramedics who were AAM qualified. Performing tracheal intubation is the only time when paramedics have traditionally been able to view inside the human body, potentially adding to the exclusiveness which many AAM qualified paramedics feel. Therefore for the AAM qualified paramedics to suggest laryngoscopic tracheal intubation is a prerequisite for ILMA tracheal intubation may be an attempt to maintain their superiority. The AAM qualified paramedics, who had viewed the anatomy of the upper airway by using a laryngoscope, believed they were better equipped to provide alternative methods of airway management especially when introducing new techniques such as the ILMA, as one AAM qualified paramedic declared,

"If you don't need a laryngoscope and you just go in with an ILMA there is going to be some doubts in your mind what you are dealing with, you don't truly appreciate the oropharynx"

4.5.2 The ILMA training program structure

The ILMA tracheal intubation training program was very different to what paramedics in Tasmania had previously experienced. The major differences being the exclusive use of manikins for the training as opposed to the traditional in theatre live patient training and the much shorter ILMA training programs duration.

Table 25: Frequency of responses to the question 'The following components of the ILMA training program were most beneficial?'

	Agree	Disagree	Missing	p value
Precourse theory	88.6% (31/35)	11.4% (4/35)	0.0% (0/35)	*
Course structure	68.6% (24/35)	28.5% (10/35)	2.9% (1/35)	.016
Time for learning	77.1% (27/35)	22.9% (8/35)	0.0% (0/35)	.001
Information	91.4% (32/35)	8.6% (3/35)	0.0% (0/35)	*
Instructors ability	94.3% (33/35)	5.7% (2./35)	0.0% (0/35)	*
Preparation	82.8% (29/35)	14.3% (5/35)	2.9% (1/35)	.000
Providing confidence	88.6% (31/35)	11.4% (4/35)	0.0% (0/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

The paramedics were asked which of the training components they believed most beneficial. Providing confidence and the preparatory component of the ILMA training program, i.e. precourse theory work, was reported as two of the most beneficial components. The most beneficial components of the ILMA training program were the instructor's ability (94%) and the information provided.

The course structure and time for learning were deemed to be the least beneficial features. These two results are expected when considering the information provided about the benefit of a short in-theatre component and the desire for more manikin practice immediately after the training program. The two major differences to course structure from the traditional

AAM training program was firstly the exclusive use of manikins, and secondly the significant reduction in duration.

The exclusive use of manikins with the students not having the opportunity to learn on real patients has been commented upon, they prefer to experience one or two skill performances on a real patient after their manikin training and before performing the skill in their routine out of hospital practice.

The time difference between the two programs, the traditional AAM program and the ILMA training program, was significant. The traditional AAM training program at the time of this study, had a minimum of 120 hours practical experience with the majority occurring in the theatre environment whereas the ILMA training program was limited to a formal approximately four hour manikin training session followed by individuals self-directed manikin practice.

Table 26: Frequency of responses to the question “The following activities are critical for the success of an ILMA tracheal intubation training program?”

	Agree	Disagree	Missing	p value
Organisation	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
Educational resources	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
Acceptance by hospital staff	77.1% (27/35)	22.9% (8/35)	0.0% (0/35)	.001
Feedback on performance	94.3% (33/35)	5.7% (2/35)	0.0% (0/35)	*
Direction	88.6% (31/35)	5.7% (2/35)	5.7% (2/35)	*
Learning support	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

Over 94% (33/35) of respondents indicated the feedback provided on their performance and the learning support they were provided was critical to their success in the ILMA training programme. This supports the literature and in addition the organisation and educational resources components were reported as equally valued. The participants have reported the course planning factors of organisation and resources critical along with the training styles of learning support and feedback.

The ILMA program provided feedback, direction and learning support in relation to paramedic performance which involved manikin and in-service training but did not include an in-theatre component. The paramedics were not influenced by hospital staff views on the value of ILMA tracheal intubation. One possible explanation for this was their perception that their training of ILMA tracheal intubation could successfully occur without the hospital component. The lower influence which acceptance by hospital staff had on participants reported success of the ILMA training program may be due to the ILMA not being used in the receiving Emergency Departments and therefore a disconnection from the paramedics used of the new device.

4.5.3 In-theatre training

There are a number of reported difficulties in paramedic tracheal intubation training which is conducted in hospital and particular in the theatre environment. Having a clinically significant training program, such as AAM, exclusively employ only one training mode or setting can provide a limited training experience and potentially a questionable level of competency.

The in-theatre training and guidance by an Anaesthetist were reported to be more essential for laryngoscopic tracheal intubation training than for ILMA tracheal intubation.

Table 27: Frequency of responses to question 'The following activities are essential for a paramedics' tracheal intubation training?'

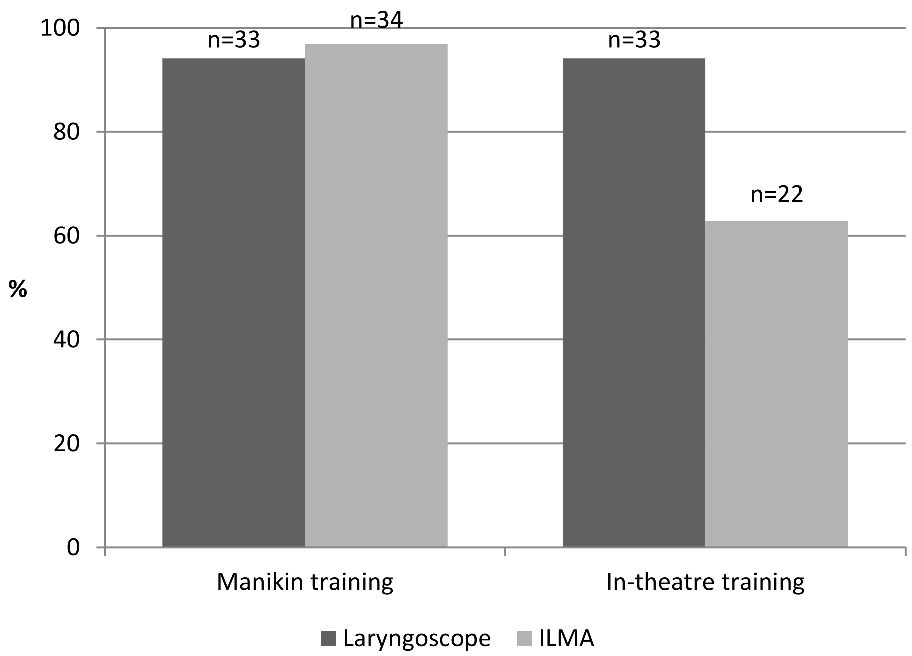
	Agree	Disagree	Missing	p value
In theatre for ILMA tracheal intubation	62.8% (22/35)	34.3% (12/35)	2.9% (1/35)	.086
In theatre for laryngoscopic tracheal intubation	94.3% (33/35)	5.7% (2./35)	0.0% (0/35)	*
Anaesthetist for ILMA tracheal intubation	48.5% (17/35)	48.5% (17/35)	2.9% (1/35)	1.000
Anaesthetist for laryngoscopic tracheal intubation	85.7% (30/35)	14.3% (5/35)	0.0% (0/35)	.000

* p value not possible due to insufficient data and therefore <5 distribution in categories.

The in-theatre training component was reported essential for laryngoscopic tracheal intubation training by 94% of the respondents as opposed to only 63% deemed it essential for ILMA tracheal intubation training. As laryngoscopic tracheal intubation relies upon the paramedic viewing the upper airway around the larynx, having an extended practical training component in the controlled live patient setting is expected to provide appropriate experience and subsequently confidence in performing the skill. ILMA tracheal intubation does not require visualising the upper airway and may be this is why less priority is placed on the in theatre training component.

The guidance by anaesthetist for laryngoscopic tracheal intubation was stated to be essential by 86% of respondents and by only 49% of the respondents for ILMA tracheal intubation. Although in-hospital tracheal intubation training provides experience with live patients, as opposed to manikins, it is questionable whether using this environment exclusively can provide the paramedic with the feedback and learning support they require to improve their confidence.

Figure 13: Perceived need between paramedic in-theatre and manikin training



The paramedics indicated there was a similar need for manikin training for both Laryngoscopic and ILMA tracheal intubation training. But when asked their need for in-theatre training there was a difference with the laryngoscopic in-theatre training stated as essential by 94% of respondents and in-theatre ILMA training as listed essentially by only 63% of respondents.

The in-theatre training experience requires structure and is dependent on the support of all the theatre staff and not only the anaesthetist. In many AAM Paramedic programs consultation and agreement for in theatre training experience is organised with the senior Anaesthetist and some of their colleagues but far too often other staff and in particular the nursing staff are not involved in these discussions or developments. This often leads to Paramedics showing up for theatre training and few if any on duty theatre staff on the day aware of their requirements, this immediately builds a uneasy relationship between the theatre staff and the paramedic. It must be remembered these staff are often very busy and to have another priority in their work environment and with no notice and little information, the paramedic just adds responsibilities to their daily work duties. As one respondent reported in relation to their in-theatre experience,

"there were problems, personalities, a lack of interest, no one is really driving the program ……………… putting you on the edge and not making it a truly good learning environment and that is one of the problems"

The anesthetist is a key person in the theatre training environment and especially so for paramedics. They are the medical specialist who has the overall responsibility for airway management and normally a representative from their college sits on the relevant ambulance committee which authorizes paramedic clinical practice. The majority are supportive and many are not against paramedic AAM practice but are very concerned about the AAM training process, quality assurance and the ability of paramedics to maintain competence in a difficult infrequently performed skill. A paramedic indicated,

"with the anesthetists there are more pro ambulance and they go out of their way to try and help"

The theatre environment, like most medical care settings, has needed to change in response to patient and health care reforms. Many years ago, when many of the paramedic AAM programs commenced, it was common in theatre for all patients to require tracheal intubation, now this is not the case with a large number of patients who have been fully prepared for theatre requiring minimally invasive airway management. The more common use of the LMA has significantly decreased the tracheal intubation learning opportunity for all health care students. For this reason, the theatre environment is reported not to be the most suited environment for learning tracheal intubation as the frequency of performing this skill has declined and competition for theatre opportunities has increased (Johnston, Seitz et al. 2008). Paramedics confirmed,

"they are having trouble getting patients as there is a lot of competition to do it and that the anesthetists themselves are not actually doing a lot of intubations"

And another reported,
"they (anaesthetists) are using LMAs, and so that is reducing our potential for training"

Paramedics must compete with a wide range of other health care students who are all vying for this ever decreasing learning opportunity. This competition often causes further confusion as students roam from operating theatre to operating theatre searching for the patients who requires their skills. This decreasing opportunity is a major factor in the restructuring of many AAM training programs, decreasing their reliance on in-theatre live patient tracheal intubation training experiences. It is yet to be seen if these restructured programs adequately meet the students learning needs and provide safe AAM practice.

The paramedics have expressed the in-theatre training experience as a critical component of any AAM training program, but the degree is suggested to vary according to the technique employed. Reductions in-theatre tracheal intubation training must be adequately supplemented with other appropriate training methodologies, the most common of which will be varying degrees of simulation using appropriate manikins.

4.5.4 Manikin training

For a number of reasons, real life may not always the best method of training, the training which was undertaken to be skilled in the use of the ILMA was reported to be achievable using manikins alone. The participants reported the use of manikins an essential component of AAM training for both the laryngoscope and ILMA tracheal intubation. The respondents reported little variation in their value of manikin and CSO classroom (in-service) training as essential components of an AAM training program.

Table 28: Frequency of response to questions 'The following activities are essential for tracheal intubation training?'

	Agree	Disagree	Missing	p value
Manikin training for ILMA tracheal intubation	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
Manikin training for Laryngoscopic tracheal intubation	94.3% (33/35)	2.9% (1/35)	2.9% (1/35)	*
CSO classroom training for ILMA tracheal intubation	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
CSO classroom training for Laryngoscopic tracheal intubation	85.7% (30/35)	14.3% (5/35)	0.0% (0/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

In relation to the ILMA tracheal intubation training the manikin (97%) and the CSO classroom (97%) training components both reported as the highest in-service training components. When asked about the laryngoscopic tracheal intubation in-service training component, the respondents did indicate a difference between manikin and CSO classroom training components. The manikin in-service training component was reported by 94% of respondents and the CSO classroom component by 86% of respondents as essential. This is slightly different to the respondents' perceptions when being trained to use the ILMA, where a great requirement was placed on both of these in-service training components.

In both training programs the importance of manikin training was reported as highly essential, in the laryngoscopic program 94% agree and with ILMA program 97% agree the manikin training component to be essential. The CSO classroom training component was again rate highly with its importance in the laryngoscopic tracheal intubation training reported as somewhat of less importance than in the ILMA tracheal intubation program.

The respondents did report a preference in learning AAM skills by undertaking the procedures on patients. The manikins are reported to be unable to provide the degree of 'feel' and realism that can be experienced when performing the skill on a live patient. The respondents reported this experience is only required to be short, as stated by one paramedic,

"the manikins were great they teach you the procedure and that initial skills stuff but I just think at the end of the day there is a feel to putting these in someone and it is nice to experience that and it would literally be once or twice to feel that. I have done LMAs in theatre and it's similar but there is a difference in how they work and feel"

Many health care skills training programs initially use simulation to introduce a skill and provide repeated practice opportunity for the student until their levels of confidence and competence are at a satisfactory level to perform the skill on a live patient. This approach also assists greatly with the logistical matchup between increasing student numbers and decreasing live patient opportunity. The concept of patient safety is assured and the students' initial learning is greatly assisted by the more controlled and less stressful environment. One respondent maintained,

"it is impractical to go out and do it on a real person, you can do it on manikins until you are happy with the skill but when it comes to doing your

first real one of those it is different again and it would be nice to experience it on a real person (in-theatre) before you had to do it"

As another respondent spelled out,

"I think we can do a lot of work on the manikins and top it up with a few until the person themselves and the anesthetist feels happy they can do this procedure on a real person. I think it does translate across reasonably well (manikin to person) I think at the end of the day in my view there is a feel with both procedures and its best to experience it (in theatre) before going out there and doing it"

The introduction of a new and somewhat unfamiliar procedure or device, such as the ILMA, can be easily taught and practiced on manikins but finding the opportunity for learning on a live patient can be problematic. The ILMA for example, although internationally recommended as an airway management tool for anesthetists was rarely used and by some anesthetists not known about. This means training coordinators must clearly convey the required learning outcomes and at times select individual anesthetists to achieve the required training outcomes.

During the interviews, the Paramedics reported a variety of comments regarding the use of manikins to conduct AAM training. Many supported and expressed value in using manikins especially in the early stages of learning, for example:

"the manikins were great they teach you the procedure and the initial skill"

Another reported, the manikins were very effective for ILMA training:

"With the ILMA I think you can get by with just manikin training"

The respondents supported manikins for their initial ILMA training with direction and support from CSOs and then having the manikins available to practice on as required until confidence is at a level to continue the training process. The confidence expressed in exclusively using manikins for ILMA tracheal intubation training supports an approach of self-directed learning and ease of use towards ILMA tracheal intubation training. A participant testified,

"there is training with a CSO over a day or two of manikin work going through all the general procedures the failed procedure the difficult procedures, that's part of the process people go away and do more practice themselves for a while on manikins, and at the moment the manikins are readily available for people, so we need people to be able to access these manikins to make their own practice more easily than now."

One comment frequently expressed by those interviewed was the desire to have regular accessibility to manikins for their self-directed learning. The use of manikins did provoke comments on areas where they were not considered totally appropriate. The respondents did express limits to the use of manikins and some difficulties which their use presents. One of the common concerns mentioned was in relation to the authenticity of the manikins, which in the PILMAT study there was only one type of low fidelity manikin used. One respondent stated,

"I think initially the manikin training is quite good but the manikins are not realistic enough"

To use manikins in any training program is not just a simple process of purchasing the manikins and having them available, it requires a significant degree of planning to ensure not only the type of manikin is appropriate but also its functionality gels within the appropriate structure of the curriculum. There is an increasing variety of manikins all of which provided varying degrees of both functionality and also patient realism. As identified in the quote below to provide effective training the organisation must ensure the use of appropriate manikins, this often necessitates critical manikin evaluations by suitably qualified training personnel. A paramedic commented,

"it depends on the manikin if you are lucky enough to be putting it into a mega code or Simman the insertion is more realistic but still unless it is properly lubed up before hand and so on it is still not entirely realistic, if you are unlucky enough to put it into an intubation head, like that black intubation head, forget it because it is not realistic and it is not useful"

Another limitation reported when using manikins was the often unnatural feel of the manikin and not being able to experience the true feeling of placing the device (ILMA) into a real person. Some interviewees did express this as an advantage, being introduced to the skill and having the ability to practice in a simulated environment much less stressful than having to initially learn the skill on a live patient with all the added pressures of a time critical environment. But they did suggest after the initial training and obtaining a degree of confidence using manikins performing the skill on a live patient would greatly enhance their level of confidence. As one paramedic identified,

"the manikins were great they teach you the procedure and that initial skills stuff but I just think at the end of the day there is a feel to putting these in someone and it is nice to experience that and it would literally be once or twice to feel that."

There was an area in which the manikin training provided a major advantage over real patient training, this was reported as an ability to increase the degree of skill difficulty in parallel with the increase in trainee confidence and learning increased. This ability not only to control the training experience but also to tailor the training requirements to the individual student's development was expressed as a major advantage for the use of manikins during the training program. There is an extensive range of manikins which are capable of allowing the training and practice of AAM skills. One respondent declared,

"manikins that are, you are able to control and make more difficult would be good and we can do that now with simman. So you can stiffen up the neck and do other things, the more of that sort of stuff you can do whether it is for the ILMA or anything else the better off you are going to be in confidence and just experience with difficulties and learning to deal with them that is a good thing."

The ability to plan and script the training tasks required by the student is one advantage not possible when using live patient training, either in the in-hospital or in the out of hospital environment. The relatively controlled in hospital environment is seen as not providing the comprehensive AAM training environment for which it has been traditionally used, many comment on the diverse environmental differences between these two training settings, in hospital and out of hospital. In relation to building confidence in both the routine aspects of AAM skills and experience in managing both the frequent and in frequent airway difficulties the use of appropriate manikins is seen as the best training method. Another paramedic declared,

"…you go into theatre for a week and not see anyone who has got any airway difficulties anyway. So I suppose from that perspective there are definite advantages to having different manikins."

One method proposed which would provide variety in the AAM manikin experience is not only to vary the degree of individual manikin difficulty but also to utilise a number of manikins from different manufacturers. The use of a variety of manikins not only provides greater learner experience but also reduces the effect of "learning" which is often attributed to skills training using single devices in a simulated environment.

Although a controlled environment, commonly using a manikin, is valued during initial tracheal intubation skill training, live patient experience preferably (in theatre) has been valued once confidence reaches a specific point before the culmination of training by supervised out of hospital practice. It was reported during the interviews, the value of live patient experience in the relatively controlled theatre environment after initial manikin training is advantageous. The literature supports the important role the use of manikins has for tracheal intubation training, "*ETI insertion success was lower without mannequin practice*" (Rumball, Macdonald et al. 2004).

The use of manikins during AAM training is now routine and their importance has increased at times in response to difficulties experienced in finding opportunity for in-theatre AAM training experience.

4.5.5 Frequency of skill updates

Laryngoscopic Tracheal Intubation

Another of the issues raised in the literature is the ability of paramedics to successfully practice tracheal intubation, and the ambulance industry's ability to ensure regular practice where live patient encounters are insufficient to maintain confidence and/or competence. The maintenance of skills through regular practice is one area determined by ambulance operational logistics, often a lower priority is given to paramedic competency. As in most fields, education is the first expense to be reduced in times of budget constraint. The majority of respondents reported they would like more frequent laryngoscopic tracheal intubation practice, and believed they required to practice laryngoscopic tracheal intubation every eight weeks.

Table 29: Frequency of responses to question 'How frequently have you practiced and how frequently would you like to practice laryngoscopic tracheal intubation?'*

	Did practice	Would like to practice
1 – 8 weeks	20.0% (6/30)	40.0% (12/30)
2 – 3 months	20.0% (6/30)	26.7% (8/30)
3 – 6 months	16.7% (5/30)	26.7% (8/30)
>6 months	23.3% (7/30)	6.6% (2/30)
Never	20.0% (6/30)	0.0% (0/30)
Missing n (%)	0.0% (0/30)	0.0% (0/30)

1. AAM qualified paramedics only

Most paramedics reported considerable time periods between practising laryngoscopic tracheal intubation, although some did report frequent practice. Most respondents actually practiced greater than every 6 months with 20% of paramedics reporting their practice of laryngoscopic tracheal intubation either "1-8 weeks", "2-3 months" or had never practiced.

Table 30: Frequency of response to question 'The following activities are essential for rural paramedic to maintain competency in laryngoscopic tracheal intubation?'

	Agree	Disagree	Missing	p value
Precourse theory	77.1% (27/35)	20.0% (7/35)	2.9% (1/35)	.001
In theatre training	80.0% (28/35)	20.0% (7/35)	0.0% (0/35)	.000
Guidance by Anaesthetist	62.9% (22/35)	37.1% (13/35)	0.0% (0/35)	.128
Manikin training	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
CSO classroom training	85.7% (30/35)	11.4% (4/35)	2.9% (1/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

They also reported in-service training to have the next most essential components. Respondents reported CSO classroom training (86%) to be the second most essential training element to maintain competency in laryngoscopic tracheal intubation. The least essential component reported as essential to maintain laryngoscopic tracheal intubation was "Guidance by Anaesthetist" despite it being agreed to by 63% of the respondents.

There was a difference with in-theatre training and guidance by an anaesthetist, 80% felt in-theatre training essential for maintaining laryngoscopic tracheal intubation competency as opposed to 45% believing in theatre training is essential for maintaining ILMA tracheal intubation competency. When maintaining laryngoscopic tracheal intubation 63% felt guidance by an anaesthetist essential in contrast to only 37% believing it is essential to maintain competency in ILMA tracheal intubation. The in-theatre components were judged least essential to maintain both skills, the ILMA training program did not contain any in-theatre training component.

ILMA tracheal intubation

Most respondents reported significant time periods between their practices of ILMA tracheal intubation, similar to those reported for practicing laryngoscopic tracheal intubation. As the ILMA was reported in this study not to be easier to use but easier to learn, the level of self-reported competency and frequency to practice was less. The inclusion of the ILMA into general paramedic practice levels was reported to produce an issue with the maintenance of skills.

Table 31: Frequency of response to the questions "During the past 12 months, how frequently have you practiced ILMA tracheal intubation?" and "How frequently would you like to practice ILMA tracheal intubation?"

	Did practice	Would like to practice
1 – 8 weeks	11.4% (4/35)	25.7% (9/35)
2 – 3 months	11.4% (4/35)	40.0% (14/35)
3 – 6 months	34.3% (12/35)	28.6% (10/35)
>6 months	22.9% (8/35)	5.7% (2./35)
Never	17.1% (6/35)	0.0% (0/35)
Missing	2.9% (1/35)	0.0% (0/35)

Paramedics report the practice of ILMA tracheal intubation should occur on a frequent basis. Sixty six percent of respondents' stated ILMA tracheal intubation should be practised at least every three months with 40% of respondents indicating every two to three months with only a few actually practicing in this time interval. Only 5% of respondents reported regardless of which device practice frequency could exceed six months, a process which may be desired but not formally instigated in any Australian paramedic service to date.

The respondents identified the period required between practice was less for ILMA tracheal intubation than for laryngoscopic tracheal intubation. Paramedics consider maintaining competency in tracheal intubation requires a different focus between the laryngoscope and the ILMA. Precourse theory and manikin training were both considered essential to maintaining laryngoscopic and ILMA tracheal intubation competency.

Table 32: Frequency of responses to the question 'The following activities are essential for a paramedic to maintain competency in ILMA tracheal intubation?'

	Agree	Disagree	Missing	p value
Precourse theory	74.3% (26/35)	25.7% (9/35)	0.0% (0/35)	.004
In theatre training	45.7% (16/35)	51.4% (18/35)	2.9% (1/35)	.732
Guidance by Anaesthetist	37.1% (13/35)	60.0% (21/35)	2.9% (1/35)	.170
Manikin training	97.1% (34/35)	2.9% (1/35)	0.0% (0/35)	*
CSO classroom training	91.4% (32/35)	8.6% (3/35)	0.0% (0/35)	*

* p value not possible due to insufficient data and therefore <5 distribution in categories.

The manikin training was clearly stated to be the most beneficial component to maintain competency in ILMA tracheal intubation. The in-service CSO classroom training was considered to be only slightly less essential.

The in-theatre components guidance by anaesthetist and in theatre experience were reported as significantly less essential to maintain ILMA tracheal intubation competence than maintaining laryngoscopic tracheal intubation. The in theatre training and guidance provided by an Anaesthetist were judged the least essential. In comparison to laryngoscopic tracheal intubation (77%) maintaining competency in ILMA tracheal intubation by in-theatre experience (46%) was seen as much less essential.

There is a reported low frequency of paramedic practice in tracheal intubation, some state it is inadequate to maintain competence in the skill (Gerbeaux 2005; Bledsoe 2006; Deakin, King et al. 2009). The practice requirements differed between laryngoscopic and ILMA tracheal intubation. An increased frequency in practising laryngoscopic tracheal intubation was expressed as required to maintain competence whereas less frequency for practicing ILMA tracheal intubation was identified. This less frequency of practice identifies the increased levels of confidence and competence the rural paramedic has and the ILMA as a device which is easier to learn and use.

This brings into question the value of tracheal intubation as a core paramedic skill. There may be a direct link between confidence and training and so the course structure in laryngoscopic tracheal intubation was examined in more detail.

Contrary to the actual practice undertaken most reported their desire for practice to be a shorter interval. A high proportion (12/30) of participants stated they would like to practice laryngoscopic tracheal intubation every "*1 – 8 weeks*" with half this number actually practicing this frequently. One paramedic recalls their feelings after an extended period without practice,

"I have just had 8 weeks of not being at work, I would feel after that time that I should go and practice on a manikin those procedures so I feel I can keep it up for a few weeks if I am getting a bit of a run of it, but if I have a couple of months break then I really feel as though I need to practice"

This frequency of practice is reflected in the literature which supports the paramedics reported belief that to maintain competency in laryngoscopic tracheal intubation a regular ongoing skills practice regime is required. Reportedly there are insufficient patients encountered in practice to maintain the skill, so the reliance on a well structural formal skills maintenance program was considered essential. One respondent stated, *"we don't necessarily get enough practical cases on-road to maintain those (AAM) skills"*

Based on the same elements as the initial training required for laryngoscopic tracheal intubation, the paramedics were asked to consider the training elements essential to maintain their competency in this skill. The majority of paramedics reported the main educational component required to maintain competency in laryngoscopic tracheal intubation was manikin training (97%).

The respondents reported the lack of frequent skill performance during their practice was insufficient to maintain competency. There were many comments during the interviews when discussing maintaining the AAM skills which highlighted the advantages of using in-service training, as one paramedic described,

"I think along with everything else we do there should be some formal reaccreditation process that we do, time wise you would not want it to go more than 2 years

The time period required between a formal maintenance of skills process was reported, with most stating a period between 6 to 12 months ideal, which is supported in the frequency of practice reported to be required by most in the above Table 32. The frequency required to maintain competency was defined by one paramedic,

"some sort of revision at the outside annually and probably six monthly, when you come in and do even if it's just a half day workshop or something like that, just to make sure you haven't got into any bad habits and that your skills are still where they should be"

And another stated,
"Personally I think there should be an annual reaccreditation"

The format and process of the traditional Ambulance Tasmania AAM skills maintenance program was a mixture of manikin and live patient experience. The value of performing the AAM skills in-theatre to maintain the skill was stated as valuable especially in combination with manikin practice. This approach does complicate the difficulty of finding adequate time and live patient experiences in theatre, which may dictate more reliance on manikin and simulation as explained by a paramedic,

"you need to do a couple in theatre and a couple on a manikin but if I haven't got any (out of hospital) .. then they might say I have to do 10 in theatre and 10 on a manikin and it needs to be a structured process but it should have manikin exposure as well as real person exposure"

A higher proportion of participants (12/35) actually practiced ILMA tracheal intubation every "*3-6 months*". In relation to the frequency of practice, one paramedic suggested,

"I think there should be some sort of revision at the outside annually and probably six monthly"

Wang et al (Wang, Seitz et al. 2004) suggests low skill performance numbers is insufficient practice to maintain competence and thus confidence because tracheal intubation success was found to be closely associated with tracheal intubation experience. Garza et al (Garza, Gratton et al. 2003) discovered in their retrospective study, there was significant correlation between the number of tracheal intubation attempts and success, and there was no correlation between months of general experience and tracheal intubation success. Furthermore, the American Heart Association (AHA 2010) recognises paramedics require "regular field experience", which is defined as six to 12 tracheal intubations per year to maintain competence. Another paramedic recounted, the lack of skill use during their normal out of hospital practice,

"with adults we are only averaging 6 a year one every 2 months and last year it dropped down to 2 and this year it's started off already with no tubes"

The difference in the respondents' level of confidence was also reflected in their desired frequency of practice between the two devices, the laryngoscope and ILMA. They stated more frequent practice was required for laryngoscopic tracheal intubation than ILMA tracheal intubation. The recognised correlation between the number of live patient encounters and frequency of practice is often ignored when a new procedure is implemented. By increasing the number of practitioners able to perform tracheal intubation you dilute individual practitioner's exposure to performing the skill in the workplace, which must be supported by a robust skills maintenance program in order to maintain competence. This was expressed by one respondent,

"if you brought it back to paramedic level then you have another tier you have to share them (tracheal intubations) around to the point where they get confident or you have a fantastic off line training"

Similar to paramedics' beliefs in maintaining competence in laryngoscopic tracheal intubation, paramedics believe manikin and in-service training by far the most essential training components which can be used to maintain competence in ILMA tracheal intubation.

The respondents reported when using the ILMA the frequency of practice could be less than for the laryngoscopic tracheal intubation whilst still maintaining confidence. As one respondent reported,

"with the ILMA I think you could go for an extended period and still feel reasonably confident"

After the initial training in ILMA tracheal intubation the respondents reported further practice within the immediate two or three months after the completion of the training would provide an increase in confidence, as conveyed by one respondent,

"Perhaps I would have liked to have had some sort of refresher, you know, you did your initial training, you go out, you use it for a month or two months whatever, then come back in and just go through it again"

The effect an extended period between practice has was expressed by one respondent,

“some people who didn’t get to put any in initially and then a few months pass by and they lose confidence in the skill because they haven’t practiced it, yeah so probably just a little bit of follow up training, a month or two months afterwards”

The requirements for the maintenance of competence and confidence changes according to the individual’s period between their initial training and first performance of the skill. If the average live patient exposure is low across the practitioner population the frequency of skill practice should be greater. This will put additional pressure on the logistical requirements of any skills maintenance program and should be considered when deciding on the implementation of a new skill or device.

4.6 Summary

The research questions being answered in this study are:

1. What are paramedics’ attitudes towards the ILMA as a device for AAM in comparison with other standard devices?
2. What are the key factors that influence paramedics’ attitudes towards the introduction and use of the ILMA?
3. What factors impact on paramedics’ self-reported confidence and competence in using the ILMA?
4. How can AAM educational practices better respond to the introduction of new innovations such as the ILMA?

Tracheal intubation is an essential paramedic skill and the laryngoscope has been the conventional device used by paramedics to perform tracheal intubation, other devices and techniques are now available to achieve the comparable outcomes. The implementation of a new tracheal intubation technique with drastically different educational strategies does provide a high degree of confidence and equivocal levels of competency in tracheal intubation. The introduction of the ILMA was widely accepted by paramedics and resulted in increased confidence and competency.

The paramedics reported and confirmed the ILMA is a device which is easy to learn and use and has a role in their management of a patients' airway and for this reason rural paramedics stated it could be used by skill levels not traditionally authorised for tracheal intubation. The performance and confidence of tracheal intubation in specific patient cohorts judged as difficult is low and is improved by using the ILMA.

Although paramedic confidence in performing tracheal intubation may be achieved by simulation it might be vital to provide a blended educational approach for paramedics to maintain tracheal intubation competence. The influence that different educational strategies and environments have on paramedic confidence and competence when learning AAM has been revealed with the hospital theatre playing a less important role than traditionally thought. The AAM devices and procedures being taught appears to influence the best training methodology, with the use of simulation and other critical educational theories requiring modification to ensure the paramedic receives the training in the most effective and efficient manner.

The use of simulation in health education is increasing and paramedic AAM training has effectively utilised simulation, a brief experience in theatre has been shown to increase paramedic tracheal intubation confidence when used strategically after simulation when the paramedics' competence and confidence has reached a specific level.

These findings will be examined in more detail in the following Discussion chapter.

Chapter 5 Diffusing ILMA innovation in paramedicine

5.1 Introduction

As chapter four showed, the findings of this study suggest that Paramedic tracheal intubation using the ILMA is as successful as using the laryngoscope and requires less training. This suggests paramedics and intensive care paramedics can successfully use the ILMA for routine and advanced airway management, however, the degree to which the field of paramedicine takes up the innovation of ILMA for AAM will be mediated by a number of factors. Section one of this chapter frames ILMA use for AAM as a diffusion of innovation by drawing upon Rogers (2003) writings about diffusion of innovation theory. The value of this theoretically framed discussion is that it contributes to understandings about the social processes by which new practices of AAM can be introduced to paramedicine through developing ILMA confidence and competence and commitment to quality and safe out of hospital airway management. A central tenet of the theory of diffusion of innovation is the recognition that the sequential decision making process used by paramedics can be influenced by many AAM training elements as well as emphasising the various personal characteristics of the learner, which are critical components of any training program.

Chapter four also shows that paramedics are confident and competent in using ILMA tracheal intubation and are committed to using the device as a viable, safe and effective strategy for tracheal intubation in out of hospital settings. According to Rogers “diffusion of innovation” theory (Rogers 2003) the social system in the organisation provides a major influence on how readily a new practice is accepted and adopted. As such the study findings suggest the new practice of ILMA use is compatible with the individual’s values, beliefs and experiences which enhances the rate at which the new innovation may be adopted.

In recognition of this finding, section two of this chapter, draws upon the study findings and key pedagogical theories to develop a model of introducing change into paramedic AAM practice. It is a model that identifies current educational strategies and makes suggestions on a method of ensuring successful change.

5.2 Framing ILMA use for AAM as a diffusion of innovation

The diffusion of innovation process proposed by Rogers (Rogers 2003) indicates there are five sequential decision making stages which a new item or process moves through when being adopted. They are: knowledge, persuasion, decision, implementation and confirmation.

5.2.1 Developing paramedics knowledge acquisition of the ILMA for AAM

Tasmanian paramedics have been involved in activities designed to develop their knowledge and skills for safely and effectively using the ILMA device. As the introduction chapter showed, Tasmanian paramedics were invited to participate in the 2005 PILMAT trial. Designed to introduce ILMA for paramedic tracheal intubation, this short manikin based training program can be understood as the first stage of the diffusion of innovation (Rogers 2003). Here the opportunity to discover knowledge on the advantage, how this device suits the paramedics' needs and the simplicity of using the ILMA for paramedic AAM practice was provided. In other words, paramedics were exposed to new information about the purpose and function of the ILMA in relation to out of hospital AAM.

The PILMAT trial spanned eighteen months and incorporated analysis of the efficiency and effectiveness of paramedics' use of the ILMA by examining the logistics, clinical and situational aspects for every out of hospital ILMA use. While the trial provided useful evidence that paramedics had acquired the knowledge and skills requisite for ILMA, it was limited for understanding paramedics' confidence, competence and commitment to using the device in out of hospital AAM situations. The diffusion of innovation process outlined by Rogers (Rogers 2003) suggest that knowledge acquisition is merely the first of five sequential decision making stages in which individuals opt to adopt or reject a new item or process. The findings of this study provide indepth understanding of the second stage diffusion of innovation stage, which is persuasion.

5.2.2 Persuading paramedics to incorporate the ILMA as standard practice

Despite their reported commitment to the ILMA device, the findings of this study reflect the growing evidence base that paramedics have a strong affinity toward laryngoscopic tracheal intubation (Thomas, Abo et al. 2007) and report this as a skill which is essential for their out of hospital practice. One explanation for this strong affinity towards laryngoscope intubation is an increased level of prestige predominantly due to the culture and history of paramedic practice. Nevertheless, the study findings also show that Tasmanian paramedics are amenable to other methods and devices to achieve successful tracheal intubation. These findings suggest that paramedics are open to new possibilities for approaching tracheal intubation for emergency airway management. In other words, they are open to the possibility of being persuaded to change the practices they have come to know and accept as the most efficient and reliable practice. Rogers (Rogers 2003) argues that when an organisation introduces a new practice individuals will consider its value and decide whether it represents a superior alternative to their current practice.

Chapter four shows paramedics recognised the ILMA as a necessary item for inclusion into the scope of their practice and they were aware they could achieve a similar tracheal intubation success rate as with the traditional laryngoscopic tracheal intubation. The majority of the participants in this study had experience in tracheal intubation which would make the inclusion of the ILMA as an alternative device easier as the context of the procedure is already established. The rural paramedics involved in the ILMA study (PILMAT) had no experience in using the standard LMA, as a supra-glottic airway device was not in use in Ambulance Tasmania[15] at the time. This meant they were unfamiliar with all aspects of ILMA use including its role, effectiveness and usability. After they were introduced to the ILMA and trained in its use they believed it was a device which has a role in providing out of hospital airway care and should be used by paramedics. After using the ILMA in their practice in various patient care situations ranging from using it as an intermediate airway through to using it to perform tracheal intubation in some of the most challenging emergency care situations, they reported the ILMA has a function in the management of the difficult tracheal intubation situation and it should be used by paramedics in specific clinical presentations. These findings reflect the various factors that converge as complexities inherent in persuading individuals to adopt or not adopt new innovation. Rogers (Rogers 2003) places particular emphasis on the adult learner during the persuasion stage whereby recognition of the need to change is isolated as an important component of the persuasion process. In other words, the finding that paramedics themselves recognise their current laryngoscopic tracheal intubation practice must change is encouraging for the field because this is a crucial step in their likely commitment to enforcing those changes to their practice.

The study findings also show there are a number of additional complexities, such as the prestige of laryngoscopic tracheal intubation and its normal status for use in tracheal intubation by the health care system, the unpredictability of patient presentations whereby the initial patient experience could involve straightforward or a difficult tracheal intubation and a significant number of paramedics had many years' of AAM experience, that influence paramedics decisions about ILMA use for AAM. Indeed, Rogers (Rogers 2003) argues there are various social factors that may extend the persuasion phase when diffusing innovation. These are important considerations for the field of paramedicine because the

[15] At the time of the study known as the Tasmanian Ambulance Service

complexity and importance of achieving social change to the extent that the ILMA use becomes a system norm need to be considered by training providers to effectively advance the remaining elements that determine adoption of the new activity. As discussed in the methods chapter Rogers identifies these as relative advantage, compatibility, complexity, trialability and observability.

When introducing new devices such as the ILMA or procedures for AAM the training program should be developed in ways that enable paramedics to be actively involved in the decisions to adopt or not adopt the new device and its associated procedures. These sentiments are reflected in many adult learner theories (Kolb, Knowles) that posit learners who see the relevance of the learning are often more willing and able to apply it soon after the training program. The ILMA training program reinforced the relevance during the pre-course review phase by allowing the learner to recall the critical aspects of their knowledge and skills which enlightened them to the natural advancement in their practice which was to use the ILMA for tracheal intubation. Learners who present at a training program with no introductory process will require a greater time period to reflect on their experiences, place the next learning into context, and progress through the decision making phases. According to Rogers (2003) these are ‘knowledge’, ‘persuasion’ and ‘decision’.

For ILMA paramedic training providers it is important this is not regarded as a simple and linear process. Instead, Rogers (2003) identifies four types of innovation decision making processes:

Optional - where it relies on the individual choice and is independent of others within the social structure.

Collective – where there is a decision made by a consensus of the social members and all conform once the decision is made.

Authority - the decision is made by a few in power with the individual having minimal influence on the decision but provides the fastest rate of adoption.

Contingent - where two or more decisions are required and the final choice is made after an earlier decision has been made.

The paramedics reported they had increased confidence and comparable levels of success in the use of the ILMA despite indicating it was not easier or quicker to use than the laryngoscope for tracheal intubation. This is despite their statement that to use the ILMA for tracheal intubation requires less training. Roger’s model (Roger’s 2003) indicates complexity as a characteristic of an innovation which influences the period required for persuasion and requires careful consideration in the process of persuasion as it does not only relate to the device but the accompanying process and procedure.

The complexity and compatibility characteristics of the persuasion phase have been expressed by a number of factors in this study which may not easily be associated to one or the other criteria. These factors at times appear opposing and strengthen the influence the social structure and values have on the persuasion phase. For example, the paramedics reported they believed laryngoscopic tracheal intubation to be quicker than when they undertook ILMA tracheal intubation, but the scene times reflect the opposite where the paramedics spent more time on scene when performing laryngoscopic tracheal intubation.

When paramedics have a decreased confidence level in a skill such as laryngoscopic tracheal intubation the inclusion of a new device which they are confident to use and perceive of value because it provides an alternative will produce a positive influence on their acceptance of the new device. According to Roger’s (Rogers 2003) diffusion of innovation theory the advantage provided by the new skill, ILMA tracheal intubation, is only required to be a perceived advantage to have a positive influence. The requirement to provide detailed objective advantages of a new skill is not necessary in order to influence the new skills acceptance. Furthermore, Roger’s theory suggests the uncertainty a technological change makes to the system norms can be lessened by a number of measures prior to the official use of the technology in normal practice.

These represent one of the key social processes that will influence whether the ILMA innovation will become a system norm in paramedicine measures correspond to classroom activities and use of simulation often employed during AAM education programs. The provision of knowledge to commence cognition about the relative advantage, compatibility and complexity commences the persuasion phase and other measures which assist when the innovation is a device is the ability to trial and experiment. These are important considerations for paramedic curriculum designers because Roger's (2003) theory states this provision of knowledge will decrease the uncertainty and lead to the learner having an increased level of acceptance as they begin along a path of persuasion. Roger's (2003) theory states the ability for a new technique or procedure to be trialled on a limited basis causing uncertainty to be decreased and the learning to be enhanced by use in normal practice is a beneficial aspect and may improve acceptance.

When critical clinical skills, such as AAM are introduced to paramedicine, the use of manikins and simulation can develop to a specific performance point where further increases in performance can best be achieved by workplace implementation. Here, learning by doing as described by Rogers (2003) becomes a fundamental component of the ILMA training program.

The acceptance of the innovation and the rate of adoption during the persuasion phase is known to be influenced by the characteristics of the individual or individuals who are providing the knowledge and conducting any training. During the persuasion phase the involvement of 'champions' key respected paramedics who would provide an important communication channel for the users is a factor which can increase the rate of adoption. The social change is more rapid when the presenter has similar values and expectations to the learner a term Roger's identifies as homophily. There is increased homophily when AAM training is conducted by paramedic educators in a classroom or during simulation then training provided by specialists in a foreign environment such as the theatre setting. The greater desire for manikin and in service training components may reflect the notion of homophily as described by Rogers (2003) Diffusion of Innovation theory.

According to Rogers (Rogers 2003) diffusion of innovation theory the phases contained within the “innovation decision making” process of persuasion and decision which rely upon occurring in greater detail once the skill or procedure is taken into the workplace require the opportunity for performance to occur. If performance of the new skill or procedure is delayed then not only with the learning curve commence its decline but the evidence required for the learner to make these critical decisions on the adoption of the new skill or procedure will be hindered or possibly shelved causing a barrier not only to the current but also to future implementation. This process is in line with Roger’s concept of trialability which increases the rate at which the innovation may be adopted by allowing the learner to undertake deeper and more relevant learning by using the device.

All learners will have a different time periods which they require in order to make a judgement on the value of the new skill or procedure. There will be early adopters who rapidly decrease uncertainty and are critical in the dissemination of their subjective evaluation to their peers which aids their adoption and on the other end of the categories of learners will be the traditionalists which in Rogers (Rogers 2003) and in adopter categories are known as ‘laggards’. The laggards are the last to accept and make the decision that the new skill or procedure is appropriate, they are often the learners who are removed from the regular communication channels and require the most evidence before they accept. There is a risk that the rural paramedic due to their disconnection from the mainstream peer communication processes may have a tendance to become laggards and providing mechanisms to overcome the communication difficulties may assist in the adoption of the new skill or procedure.

5.2.3 Educational considerations of ILMA innovation into paramedic AAM

Knowledge

There are a number of components which ensure a successful training program. The primarily theory preparatory requirement ensured the participant had a specified level of knowledge prior to entry which not only ensured they had a contemporary level of knowledge but also provided a strong platform on which to develop the new knowledge and skills. The preparatory components in both the AAM and ILMA programs were expressed as the most beneficial elements.

The effective preparation of any course participant prior to attendance ensures not only a common base on which to commence the training but also can be expected to minimise the duration of the training as information included in the preparation is not required to be covered during the actual course. This again may contribute to insuring the duration of the training programs which require paramedics to be taken away from their workplace is kept to an appropriate length.

This prior knowledge is an important component of the adult learning theory proposed by Malcolm Knowles (Shysh 2000) where his theory assumed adult learning to be linked to their previous accumulated knowledge and experience. This learning theory also proposes that learning is enhanced when it is applied and the student can see an immediate application for the new knowledge or skills. The pre-course theory in this program contextualised the students' previous knowledge and experience which allowed them to have insight into how the new knowledge and skill (ILMA tracheal intubation) has application and relevance to their clinical practice.

The rural paramedics felt their confidence started to develop whilst undertaking the preparatory pre requisite coursework. In both the AAM and ILMA programs the pre-coursework consisted of a comprehensive review of the foundational knowledge and its clinical application in relation to the topic. The students were provided a study guide and an amount of reference material which they individually worked through prior to undertaking an examination paper which they were required to pass. If confidence begins to develop at this early stage it is unknown what the critical period is between undertaking this preparatory work and commencement in the actual training program. The preparatory content only included a review of knowledge the paramedic already had, any claims that this might suggest a course may be shortened by placing new content in such a preparatory programme is not confirmed here and would need to be studied further.

Participation in the ILMA training program was voluntary and as such those attending have demonstrated a level of motivation which is explained in Roger's (Rogers 2003) theory as a preliminary stage whereby there is recognition of a need which when it originates from the individual is stronger than when imposed as a requirement from authority. This drive most likely occurred due to two factors: firstly the nature of the skills, as tracheal intubation is held in such high regard by paramedics, and secondly, due to the perceived difficulty in achieving and maintaining laryngoscopic tracheal intubation the paramedics were inspired about a possible alternative. Adult learning theory and the social cognitive theory (Bijl and Shortridge-Baggett 2001) both recognize the value of internal motivation where the learner is driven by their own desires for success and their personal goals.

Airway management is a cornerstone of paramedic practice which many paramedics maintain a strong desire to perform at the highest possible level. While undertaking the preparatory coursework the paramedics were engaging in the knowledge and skills which they already possessed with the aim of increasing their knowledge and skills. A component identified in the social cognitive theory's self-efficacy model (Bijl and Shortridge-Baggett 2001) is the physical state of the learner where their excitement and enthusiasm provides a condition of arousal which has a positive impact on their learning.

Roger's (2003) theory places importance on knowledge in the decision to adopt. The preparatory knowledge review provided a stimulus and motivation for the learners to attend the training program. They could value the importance of AAM and were open to alternatives.

The use of manikins for training

The use of manikins for tracheal intubation training was also reported essential when learning laryngoscopic tracheal intubation. The use of manikins in AAM training has increased over the past decades from organisational pressures related to decreasing the training period and the reduction in availability of time within the theatre environment for paramedics. The increase in manikin fidelity and their availability has led to increased use but the true purpose and degree to which they can be utilised in AAM training is yet to be fully reported.

The ability to involve the various staff which normally come together to provide out of hospital patient care in the training environment of a new skill assists with the adoption of the skill because it realistically places the skill in the work environment and as according to Rogers (2003) diffusion of innovation theory enables a more valid judgement of the compatibility of the new skill to existing practice. This also enables a component of adult learning as detailed by Knowles (Shysh 2000), the practice of applied learning, to be undertaken which he states is a core component which enhance adults learning.

In-service training provided by specific education staff was seen as essential to the ILMA training program. This can be seen to be closely integrated to the use of manikins as this is the method which in-service training is conducted. Paramedic training in general involves a large degree of in-service training and as such is a training method with which they are familiar, therefore being comfortable with the process and surroundings would provide a degree of reassurance which may influence their confidence and may improve the learning experience. This reinforced the position stated by Bandura (Bijl and Shortridge-Baggett 2001) in the self-efficacy theory.

The training experience provided by the effective use of manikins was determined to be one of the most essential components of the ILMA training program. Simulation and the use of manikins have previously been reported as effective methods of teaching paramedic tracheal intubation and this can be extended to using the ILMA. Manikins which enable tracheal intubation training are used by most EMS services in Australia and are commonly used for the training of other less complex airway management devices such as the LMA.

In hospital training

The training of paramedics in hospital theatres has always been a major component of many AAM programs and this environment has been traditionally viewed as the ultimate location for paramedics to learn and practice the skill of tracheal intubation in an environment which affords a greater degree of control than the out of hospital emergency situation. This belief has been supported in relation to laryngoscopic tracheal intubation but it was not considered a priority for paramedic training in ILMA tracheal intubation. It can be said that traditionally paramedic AAM training occurred in the theatre environment because of two necessities. Firstly it is considered a more controlled setting than in the out of hospital area for real patient experience and secondly the guidance provided by the anaesthetist was considered optimal for the skill set. With the advancement of manikins and specific simulation facilities and the increasing development of the EMS learning environment, including special educators, these initial philosophies are no longer as critical.

An aspect of the in theatre training which has been alluded to was the unfamiliar environment the theatre is to the paramedic student. An important aspect identified by Rogers diffusion of innovation theory (Rogers 2003) is whilst in the phase of being persuaded to adopt the new skill having communication with a trainer who has similar: beliefs, education and socioeconomic status, referred to as homophily, improves the effectiveness of learning. The paramedics learning in the theatre environment by anaesthetists who are not homophilous makes communication difficult and thus distracts from effective learning.

Bandura's social cognitive theory (Bijl and Shortridge-Baggett 2001) likewise identifies there are a number of environmental factors which influence learning. The paramedics in theatre although performing tracheal intubation were often utilising different procedures and techniques and were commonly assisted by either a nurse or the anaesthetist. These unfamiliar environmental factors hindered the paramedic in performing tracheal intubation as would be expected in the out of hospital environment which according to the social cognitive theory hinders learning.

One of the components of the ILMA training program which was reported as critical to its success was the feedback received by the paramedics whilst training using the manikins and simulation. The importance of learners receiving feedback and the influence it has on their continual development was reported by McGaghie (Issenberg and McGaghie 2002). Feedback is required to be given in context and to be focused, the paramedic educator who is very familiar with the context and the individual paramedic managing a simulation may provide more appropriate feedback than the anaesthetist who has a lack of out of hospital experience and is time poor.

Communication and thus feedback is more effective when it is provided by someone with similar status within the society, educational levels and beliefs according to Roger's model (2003). This identifies the paramedic in service educator from within the same social construct more effective to provide feedback than any staff in the theatre environment. Homophily communication from within a workgroup can provide more acceptable and targeted feedback which is more readily accepted by the learner. A similar component is explained in the social cognitive theory where verbal persuasion is identified as a major element of learning and this can obviously be more related to a paramedics practice when provided by and individual from the same working environment.

The paramedics reported they felt a degree of learning support was critical to the successful ILMA training program and this may account for why the in theatre component was not valued as much. A specific training facility such as a paramedic education classroom is more conducive to supporting learning than a busy theatre environment. The principal learning activities are therefore better suited to a specific learning environment, e.g. a paramedic AAM simulation area, which may be supplemented by secondary associated learning activities or experiences, e.g. the in theatre environment, but the value of these secondary learning activities requires individual appraisal to ensure they are utilised to their best benefit and not relied upon.

If teaching ILMA tracheal intubation requires less or a significant reduction in the time spent in the theatre environment it places the use of the ILMA for tracheal intubation by paramedics at a significant advantage over their exclusive use of the laryngoscope. The many EMS organisations who currently have AAM programs which use the laryngoscope can be confident the introduction of a secondary or alternative tracheal intubation device such as the ILMA need not require paramedics to spend time excessive training in a hospital theatre.

Learning in an environment such as in a theatre, where there are few and infrequent opportunities to perform tracheal intubation, means it will take an extended time to reach a plateau where performance is considered suitable and therefore a flatter learning curve. In comparison to when using a manikin where there can be repeated performances in a short time period which provides suitable performance sooner via a steeper learning curve.

This supports the pilot ILMA tracheal intubation training program with comparable success rates to laryngoscopic tracheal intubation, which included no in hospital training component and exclusively used manikins to teach and assess competency. One might wish to argue on this basis that an in hospital training component is not required for paramedic AAM education but this requires further research especially as during the interviews the paramedics expressed a desire to perform tracheal intubation on a patient to supplement their manikin experience.

Time in the theatre environment was considered more essential when learning laryngoscopic tracheal intubation than when learning ILMA tracheal intubation in this study. Theatre time has been a major component of AAM training in many EMS systems and its importance in learning to use the laryngoscope has been supported. When learning to perform ILMA tracheal intubation the time in theatre was considered less essential and was more aligned with experiencing the 'feel' of the ILMA in a real patient after exclusive manikin training and not so much with learning how to use the ILMA. With the decreasing availability of theatre time for paramedic AAM and its logistical struggles the introduction of a device like the ILMA which may have less requirements for time in theatre requires careful consideration by EMS services.

As the diffusion of innovation theory is a social change model there is a requirement for key people to act as change agents who communicate the new skill in a manner which would decrease uncertainty leading to an increase in the perceived advantage of the new skill which increases the likelihood of it being accepted. The key people who act as change agents are most likely to be found within the normal paramedic work environment and finding a change agent in the theatre environment is unlikely, if one is within the theatre environment it is unlikely they will have any substantial contact with each paramedic.

Guidance by anaesthetist

The environment plays a critical role in learning and must be conducive to providing the learner a suitable setting in which to achieve their goals whilst receiving the appropriate rewards and not being hindered in their learning activities. The hospital theatre is an environment which is not an ideal paramedic learning environment when considering these requirements. The major differences in the tracheal intubation training requirements between using the laryngoscope and the ILMA was the in-hospital components, actual training in theatre was deemed less essential and the guidance provided by an anaesthetist was considered substantially less essential for ILMA training.

Although in theatre training and guidance by anaesthetists was rated as less essential than the other components of AAM training it was still reported essential for laryngoscopic tracheal intubation training but much lower for ILMA tracheal intubation training. It could perhaps be argued because the paramedics training in ILMA tracheal intubation only involved simulation and not in theatre experience this provided them with the confidence that this skill can be adequately taught in this manner, whereas the laryngoscopic tracheal intubation has always been taught with a major in theatre component therefore they believe from experience this is the best training strategy. An area for further study is to evaluate any change in laryngoscopic tracheal intubation training outcomes from a reduction or removal of in theatre training for laryngoscopic tracheal intubation.

Rogers (2003) discusses the ease with which learning occurs and the great benefits provided when the learners and trainers have a strong degree of homophily. Communication which is an essential component of learning occurs with greater ease and is more effective when both parties have similar goals, educational levels, workplace desires and outcomes. The divide between anaesthetists and paramedics in relation to airway management could not be greater; the anaesthetist an in-hospital highly trained, experienced and regular airway management practitioner as opposed to the paramedic an out-of-hospital limited experienced infrequent provider of AAM. Paramedics are aware of this divide and the unease it provides when they attend theatre to experience or learn tracheal intubation under the guidance of an anaesthetist. Therefore providing the increased desire to learn tracheal intubation through the use of manikins and simulation where the trainer/teacher is much more homophilous to the paramedic and communication in both directions can be more effective.

The increasing difficulties being experienced by having paramedics attend theatre in order to learn tracheal intubation may not be such a major issue if tracheal intubation using the ILMA has demonstrated this component of the AAM training program does not have to be relied upon in order to achieve successful learning outcomes. A reduction in theatre time for paramedic AAM training is likely to evolve due to workforce factors, a lack of in theatre tracheal intubation and competition for training experiences by other health professionals (Barnsley, Lyon et al. 2004; Wang, Seitz et al. 2004) and therefore if paramedics can find a viable alternative even if it reduces the paramedic demand on theatres then this will provide benefits to both workplaces.

The routine use of theatre time to learn the majority of the skill of tracheal intubation has been replaced by manikin and simulation as was the case in the PILMAT trial, this has a number of benefits some mentioned above such as communication and others such as the rate at which the learning takes place. Theatre experiences are very much performed in a time critical environment and spasmodic with large periods where practice is not possible. The use of manikins/simulation enables infinite control by the teacher of the pace at which the learning occurs as opposed to the theatre environment where the experience is governed by the workplace and learning is not considered a major component of its operation.

It is unsure why paramedics felt the guidance provided by an anaesthetist was required less when learning ILMA tracheal intubation, perhaps it adds to the notion that the ILMA is easy to use and as mentioned during the interviews paramedics felt practice on a patient towards the end of training program is why the in theatre component was of value. The stated benefits in using manikins and simulation for training (Owen and Plummer 2002) has been supported but the value of performing tracheal intubation on a live person in order to ‘feel’ what it was really like was stated to increase confidence. This need may have been expressed because of the type of manikins used during the ILMA training program, low fidelity torso only AAM task specific manikins. The ‘feel’ stated as necessary by the paramedics may have been achieved using high fidelity manikins.

Learning Curves

The complexity of a new skill or procedure can influence the learner in other ways. The self-efficacy theory described by Bandura (Bijl and Shortridge-Baggett 2001), identifies one of the key components to learning is regular successful performance which increases efficiency and progresses the learner along the steeper section of the learning curve. This repeated successful performance also provides a shield to the learner so that a single failed performance will have little or no effect on the learning curve or performance. Therefore initial success in the workplace is related to ensuring the learner has progressed sufficiently along the learning curve to protect their performance when the failure occurs. This study has shown the paramedics although achieving a high level of confidence during the short manikin training process was insufficient for some of the learners to be protected for their first failed performance with the resulting decrease in confidence.

The learners who experienced further successful performance during their initial use in the workplace continued their progress along the learning curve and increased their self-efficacy to a point where the first failed performance had little effect on performance or subsequent confidence. The PILMAT trial identified learners who experienced failure in their initial workplace performance and thereafter a loss of confidence and increased uncertainty, to prevent or minimise this may require either of the following approaches;

1. Provide adequate skill performance during training to ensure appropriate progression along the learning curve which increases self-efficacy sufficiently that a failed performance will have minimal of no effect. The PILMAT trail had a short manikin-based learning program

which did provide a high level of confidence but it was unknown if this was sufficient to shield the majority of paramedics from their initial skill failure,

2. Where the new procedure, skill or item can have a staged introduction into the workplace to enable initial use which has low chance of failure until progression along the learning curve is sufficient, and then allow the skill to be used in the more difficult and challenging situations. This did not occur in the PILMAT trail where ILMA tracheal intubation was authorised initially in any adult situation from the simplest to the most difficult, where the most difficult could have been their first use of the ILMA. Staging the exposure where the learners experienced ILMA tracheal intubation on routine straightforward incidents to begin with which would have continued their progress along the learning curve whilst increasing their rate of adoption to then after set performance criteria to be allowed to perform ILMA tracheal intubation on any patient presentation may have been a better approach.

5.2.4 Compatibility of the ILMA innovation with current AAM practice

Despite tracheal intubation being a core skill of paramedic practice there are other issues to consider which may be viewed as not compatible and affect the acceptance of a new skill or procedure. Rogers (2003) defined compatibility as the degree to which a new device is seen as consistent with the existing workplace values, experience and needs of those involved. The alignment of an innovation to the established workplace increases the chance of it being accepted.

If paramedics regard the ILMA device as being compatible with the current workforces experiences, desires and ideals Rogers theory suggests it will be more readily acknowledged as being desirable and have an increased rate of adoption. These is little doubt from the expressed desires of the PILMAT participants and published articles that tracheal intubation matches with the needs and values of paramedic out of hospital care. The process of achieving successful tracheal intubation involves a number of steps starting with the preparation of the patient and various items of equipment through to securing the tracheal tube once successful performance has been verified. The mechanism by which the tracheal tube is placed into the trachea is only one step in this process and by thereby replacing the laryngoscope with the ILMA changes one component which remains compatible with all the other steps in the process. Therefore ILMA tracheal intubation is viewed as being compatible with not only the workforce values but also the current procures and processes which increases its level of acceptance.

Blind tracheal intubation

The blind technique employed by ILMA tracheal intubation is not compatible with current AAM practices. Throughout the history of paramedic AAM, tracheal intubation has been achieved by direct observation of the internal laryngeal structures allowing the visual passing of the tracheal tube through the vocal cords into the trachea. This visual approach is the commonest technique used to perform tracheal intubation in all health fields. The in-hospital management of difficult tracheal intubations where alternative devices are employed, such as a fibre scope, still allow the operator to visualise placement of the tracheal tube. Recent new developments in airway tools as alternatives to the laryngoscope still allow the operator to observe placement of tracheal tube through the vocal cords. Therefore the visual approach to performing tracheal intubation has been and remains the prime method for both the in-hospital and out of hospital performance of tracheal intubation.

As the direct visual approach to tracheal intubation is the most frequent method for paramedics to perform tracheal intubation, and in many EMS the only method, it presents an inherent difficulty where in many patients their vocal cords will either not be seen at all or present a poor view due to anatomical variances. Techniques which allow tracheal intubation without the burden of having to directly observe the vocal cords may present an advantage over laryngoscopic tracheal intubation.

In hospital there are options which can assist in the visualisation of the vocal cords, such as using a fiberoptic device inserted into the airway which can be used to visualise the entire upper airway.

Tracheal intubation using the ILMA is a 'blind technique' which means the operator is not required to view the larynx or vocal cords in order to insert a tracheal tube. The ILMA has been designed with special features which allow this blind technique to be successful:

- A rigid handle which allows manoeuvring of the distal opening of the ILMA to align with the airway opening;
- The epiglottic elevator bar which moves the epiglottis[16] out of the way when the tracheal tube is being passed;
- The slope of the distal airway tube to act as a ramp directing the tracheal tube towards the lower airways;
- A specially designed compatible tracheal tube which has depth marks allowing the operator to approximate the location of the distal end of the tube and thus fault find if there is any resistance felt to advancement of the tube;

Despite these features this blind technique is a complete change to the way paramedics have been performing tracheal intubation since the skill was first introduced. Those paramedics who had been performing laryngoscopic tracheal intubation, the majority of participants, are expected to have anxious feelings about this radical change to the way in which they have been taught and experienced tracheal intubation. This change in technique and anxiety has been reflected in a reported lack of confidence in the blind technique despite the comparable tracheal intubation success rate between their use of the laryngoscope and ILMA. This move from being able to visualise the vocal cords and a perceived sense of control to a blind technique which may have invoked a sense of loss of control would not be felt in a positive way by the adult learner who

[16] Epiglottis – a small trap-door structure at the opening of the airway which closes during swallowing and at other times to protect the lungs. A major visual obstruction to tracheal intubation which requires to be moved in order to allow successful passage of the tracheal tube.

had a very limited experiential learning process during the ILMA training program.

Roger’s (2003) diffusion of innovation theory which he states is based upon a social change process clearly identifies a beginning stage where there is a degree of uncertainty. This uncertainty is said to be caused by the new alternative and the individuals perception of there probable success which leads to an uncomfortable state. As the only previous paramedic method of performing tracheal intubation was to view the vocal cords using a laryngoscope the introduction of a blind tracheal intubation technique would be expected to cause a high degree of uncertainty and invoke an unnerving feeling. This discomfort caused by a radically different approach to an established skill should be recognized as a cause of the learning curve being flatter and potentially requiring an extended time period of trialability or observation in order to achieve acceptable performance. This may also trigger a more deliberate and comprehensive use of manikins and simulation when clinical skills are involved.

Laryngoscopic tracheal intubation requires interruption to ventilation and oxygenation which may be prolonged unnecessarily due to the operators’ level of competence, when considering this skill has been cited as a “difficult skill” to perform by those who are infrequent users of the skill, such as paramedics. When performing tracheal intubation via the ILMA ventilation and oxygenation can be continued uninterrupted throughout the procedure, this provides obvious benefits to the critical patient's status and also places less pressure on the operator to perform tracheal intubation in the most rapid timeframe. For this reason performing ILMA tracheal intubation appears to be a less rushed and anxious procedure than when observing laryngoscopic tracheal intubation.

It has also been reported it takes a specific level of muscular strength in order to successfully use a laryngoscope in all types of patients. Timmermann et al (Timmermann, Russo et al. 2006) in their study of medical students comparing the laryngoscope to ILMA tracheal intubation reported the male medical students were more successful in using the laryngoscope whereas there were no identified differences between male and female medical students when using the ILMA. One of the reasons why laryngoscopic tracheal intubation is difficult maybe due to the strength required of the operator. Use of the ILMA requires much less effort and dexterity with no requirement to displace the upper airway as is the case when using the laryngoscope.

The complexity of ILMA tracheal intubation.

During the PILMAT study involving a revised training program and the use of the ILMA for tracheal intubation by paramedics the tracheal intubation success rate was comparable to the laryngoscopic success rate in the same EMS system. As Rogers (2003) highlights one of the major initial factors which can influence the individuals' acceptance of the new device is its complexity and the degree of uncertainty it causes to the individual. The ILMA training program was of shorter duration and only involving manikins and the level of confidence was higher which indicates ILMA tracheal intubation was viewed as less complex and providing less uncertainty to the paramedic.

There are a number of features explained in Roger's diffusion of innovation theory (Rogers 2003) which support the paramedics becoming confident in the use of the ILMA. An important component of the new skill or procedure being introduced is its level of complexity, if the users perceive the performance of ILMA tracheal intubation to be simple to understand and perform then it will be adopted more rapidly and likewise confidence levels will rise earlier. The ILMA has been reported as easy to use which reflects a level of understanding in its use and performance as being less complex.

ILMA easy to learn and use

The ILMA was stated to be easy to teach and use and the training requirements were less problematic. Roger's diffusion of innovation theory identifies several factors which contribute to the ease to which a new procedure, skill of device is accepted; the degree of advantage it provides, its compatibility with current values and needs and the simplicity in relation to understanding and operation.

The paramedic workforces' desire for tracheal intubation as part of their practice and the esteem in which it is held provides a very strong advantage to any form of tracheal intubation being accepted. This acceptance is not required to be based on objective advantages but may be due to the individuals perception of the social prestige or satisfaction which the new procedure, skill or device brings. This study identified this strongest in the small group of PILMAT participants who had no previous experience or training in AAM and were motivated enough to achieve a 100% ILMA tracheal intubation success rate.

Roger's diffusion of innovation theory (2003) places importance on the complexity of the new skill or procedure as being a factor which influences its adoption. In patient scenarios where tracheal intubation is difficult to perform the paramedics may feel an increased confidence because use of the ILMA to perform tracheal intubation is realised as less complex. The difficult airway situations the ILMA was developed to manage have included situations which are commonly experienced by paramedics. The obese patient presents great difficulty when performing laryngoscopic tracheal intubation. The increase in the incidence of obesity means paramedics will be confronted with these types of patients more often and must have the resources to be able to provide effective ventilation. The ILMA is easy to use in the obese patient (Combes, Sauvat et al. 2005) and no other paramedic airway specifically caters for this type of patient and their unique characteristics.

The ILMA has been reported in the many studies conducted away from the out of hospital field as being easy to use and has taken on a critical role in achieving tracheal intubation in the difficult to intubate patient. This study supported these findings and found the ILMA to be readily accepted and used by paramedics in their routine practice which supports the statements regarding its ease of use. The paramedics felt the laryngoscope was easier or quicker to use than the ILMA despite data indicating this may not be true and their confidence being lower. This may reflect the close association and experience paramedics have with the laryngoscope for tracheal intubation and it could perhaps be argued that the established practice of laryngoscopic tracheal intubation provides a strong experience of success which may require a time period greater than the PILMAT trial for paramedics to conclude the decision making process as described by Rogers (2003). An entrenched and successful skill which is held in such high regard appears to require an extended period of trialability in order for the participants to conclude the decision making process, as opposed to a more routine skill which holds little prestige.

The judgement made by the paramedics that ILMA tracheal intubation could be performed by a skill level which does not currently perform laryngoscopic tracheal intubation suggests ILMA tracheal intubation is easier to perform as has been reported, but the skill is less complex therefore more readily adopted and the learning curve is much shorter and steeper thereby increasing the level of self-efficacy.

Reducing the complexity of a procedure which has a low frequency of use by the introduction of a new tool must increase the rate of adoption by its influence on the prime areas related to the adoption as proposed by Rogers: relative advantage, compatibility and complexity.

The decision that ILMA tracheal intubation can be performed by lower clinical practice levels may have been influenced by a number of factors;

1. Training environment; as proposed in Bandura's social cognitive theory (Bijl and Shortridge-Baggett 2001) the environment has a major impact on the learner. The PILMAT trial utilised an exclusive manikin-based training approach which occurred within the paramedics' normal workplace without them having to contend with learning in the foreign hospital theatre environment.

2. Trainers; as Rogers identifies in the diffusion of innovation theory (Rogers 2003) communication and training is more effective when conducted by people who are homophilous. The PILMAT trial used

trainers who were from within the normal paramedic workgroups thereby ensuring increased level of effectiveness and communication by being homophily.

3. AAM experience; andragogy, the adult learning theory portrayed by Knowles (Shysh 2000) indicates the accumulated experience of the adult learner provides both context and relevance for new learning. This study showed the majority of participants in the PILMAT trial were AAM qualified and thus had some degree of experienced in performing tracheal intubation. This experience would have provided strong evidence on which to base a decision regarding the value and requirements for ILMA tracheal intubation.

The paramedics in the PILMAT trial who were not AAM qualified and had no experience with tracheal intubation, although a small group they achieved a 100% ILMA tracheal intubation success rate which may be attributed to a number of the factors mentioned above. This indicates the non-intensive care trained paramedic is able to successfully perform tracheal intubation using the ILMA and raises the ongoing dilemma of EMS providers to determine the appropriate skill set for both intensive care and non-intensive care qualified paramedics. This may not be an easy decision as there are many factors to consider when introducing new procedures, skills or techniques to ensure not only the proper training is conducted but also the innovation is adopted in the most efficient manner.

Difficult tracheal intubations

Bandura's self-efficacy theory (Bijl and Shortridge-Baggett 2001) identifies four critical areas which are key to learning and performance: repeated success, physical state of the operator, vicarious experience and verbal persuasion. These areas may be achievable during formal training but the paramedic often working alone or with less qualified assistants is unable to have exposure to vicarious experience or receive the immediate feedback and cues required for verbal persuasion during their normal practice. During the interviews a number of paramedics stated a desire to have regular access to manikins to practice and also for trainers to make ‘visits’ to their stations where feedback on performance can be received which is indicates the importance of feedback and the notion of verbal persuasion.

During the PILMAT trial this request for practice and feedback would have been during the period of persuasion in the innovation decision-making process as identified by Roger’s theory (Rogers 2003). With a shortened training period and limited practice opportunities it can be expected the ‘persuasion’ and ‘decision’ periods, as identified in Rogers theory, may be extended. It is not unreasonable to expect that learners will require varying time periods before these individual decisions are made, which is explained by the adopter categories explained by Rogers. How training programs accommodate these varying periods of persuasion and decision making are often not considered, some of the measures which should be developed are:

1. During the initial training phase, normally conducted in the classroom environment, emphasis is required on ensuring the learner can identify the advantages the new procedure, skill or item provides.
2. During the initial training when the knowledge phase is being conducted the learner requires to have explained and explore how the new procedure, skill or item fits in with their existing practice. This requires a comprehensive examination of the social values, experiences and requirements of the learners work group and their current workplace. This is the area which can be assisted by any precourse activities which review or reinforce current practices as identified in this study and seen as valuable during the PILMAT trial.
3. Don’t over complicate the new procedure, skill or item provide information at the level which the learner will find easy to understand and relate to.
4. Appropriate time and level of practice in the training environment where observation and feedback are critical components. This is ideally concluded by trainers within a similar workgroup to the learners, trainers who have a similar clinical education level, views and not a too dissimilar

status will achieve the best results in the learners. In the PILMAT trial the trainers were currently employed well known paramedics who had progressed through the decision making process to the point where they had decided the importance of the new device (ILMA) and thus were the early adopters in that process.

5. Providing the best suited environment for the learning to occur is especially important during the period of skills practice; the classroom, skills laboratory, simulation centre or workplace are all suited to different learning situations as are specialist areas for exposure such as hospital theatres. This study has highlighted a final component of tracheal intubation training is desirable in the hospital theatre environment but also the critical importance which should be placed on an appropriately structured manikin based tracheal intubation training program.

6. Initial practice in the workplace requires the appropriate level of support and at times supervision depending on the complexity of the new procedure, skill or item. There are a number of factors which may influence how and to what level this support and supervision is required. A newly introduced skill which has a steep learning curve and in which the learners achieved a level of performance in the training environment which is close to the plateau of the learning curve and there exists a low level of uncertainty will require limited support and minimal supervision in the workplace during initial use. This study showed during the PILMAT trial the confidence levels of the learners where high after the classroom training component although there remained some uncertainty and the learners expressed a desire to have increased support during the initial use of the ILMA.

7. Developing and implementing good communications channels during the training process which are assisted by the use of change agents and ‘champions’. Communication is not only critical during the learning phase but also to provide commentary on the success or otherwise of the new procedure, skill or item during the initial use in the workplace which enhances the persuasion and decision making phases of the innovation decision-making processes thereby increasing the rate of adoption. During the PILMAT trial key paramedics were used in a

supportive and training role as champions to provide a level of workplace communication which the results show were insufficient to reach all the rural paramedics. Regular newsletters reinforcing the new skill and providing information on individual paramedics experience in using the ILMA were distributed during the PILMAT trial but were insufficient to provide the practical support required by the rural paramedics. The rural paramedics strongly suggested further manikin practice in their workplace with feedback from trainers was desired to assist their adoption of the skill.

The ILMA introduction may have been perceived as less complex but the paramedics still expressed a desire to have an opportunity to ‘play’ or use the device in order to enhance their learning and confidence, as stated by one during the interviews *“the actual training was fine be me personally should have grabbed the ILMA a few more times and had a few more practices with it”*.

5.3 A model for diffusing ILMA innovation for AAM management in paramedicine

Roger’s diffusion of innovation (Rogers 2003) proposes that experimental use of a new device on a limited basis will increase the rate at which the device is adopted. The trialability of a new device, procedure or skill as proposed by Rogers introduces another aspect to learning that of ‘learning by doing’. Being able to use a new device in the workplace when it is under the concept of a trial indicates to the learner the decision making process has not been completed and they are a part of that collective decision making process, this engages the learner to use the new device, procedure or skill because they feel involved and have a degree of influence on their work. Trialability may involve use in a simulated environment or the workplace.

The PILMAT process was undertaken as a trial for the participating paramedics to examine the use of an alternative tracheal intubation device and technique. The ability to provide the existing AAM qualified paramedics with the opportunity to trial the ILMA is suggested by Rogers

(Rogers 2003) as providing the user with a decreased sense of uncertainty which ultimately speeds up their decision to either accept or reject the new device, referred to as the persuasion phase. Paramedic practice is an area in which the trial of new devices, procedures or a skill presents some unique challenges; one of the principal challenges is the mobile nature of the paramedic workforce. In the usual operational mode where two paramedics are working as a team in an ambulance vehicle places a restriction on the ability to provide appropriate supervision during the initial use of a new device, procedure or skill. With an infrequently performed skill such as tracheal intubation to have a requirement for a clinical mentor to supervise the initial learners' performances would be a major impost.

5.3.1 Training using manikins

The use of manikins for clinical training has increased over the past decades (Good 2003; Gaba 2004; Barsuk, Ziv et al. 2005; Bradley 2006) and has involved their use in a variety of areas similar to the other health professions. Manikins are used to train paramedics in many aspects of their work from elementary skill acquisition through to the critical and specialist areas such as rescue and AAM. Most paramedic laryngoscopic tracheal intubation training involves varying periods of training using two primary facilities, the hospital theatre and simulation using manikins. The hospital theatre involves real patients and provides the trainee with experience in performing the skill on people, although over a number of tracheal intubation experiences this will provide anatomical variety it falls short of providing experience in many of the environmental difficulties faced by paramedics performing tracheal intubation in their workplace.

The use of manikins provides the learner with the ability for repetitive performance of a skill which not only will improve confidence in but advances the students' performance along the learning curve (Good 2003). Learning curve theory proposes that initial performance will not be efficient and by repeating the skill many times will improve performance and therefore manikins provide the ideal method for repetitive practice.

During the initial performances there may be a high level of failure which may have clinical implications if performed on a patient, whereas if using a manikin the expected early failures in the learning curve pose no potential patient risk. Tracheal intubation practice in theatre is normally restricted to very few or infrequent skill performance which has the effect of extending the learning curve in relation to the time it takes to achieve a satisfactory level of performance.

The use of manikins for tracheal intubation training does have the restriction of the trainee becoming familiar with only one anatomical variance, although a number of manikins now have the ability to slightly alter the anatomy, it is highly recommended a variety of different manikins are used for AAM training. Manikins can be placed in locations and positions which more realistically reflect the situations in which paramedics may be required to perform tracheal intubation. In a vehicle, a confined space and in dark and wet environments are locations where manikins can be placed to simulate the settings where paramedics may have to perform tracheal intubation. These cannot be experienced in the theatre environment.

This ability to place manikins in a more realistic out of hospital environment is supported by Rogers diffusion of innovation theory (Rogers 2003) where it is stated one of the characteristics for a new skill to be accepted is its perceived advantage which is greatly enhanced by the ability to place manikins in a credible situation. The social cognitive theory (Bijl and Shortridge-Baggett 2001) makes strong ties between the personal, behavioural and environmental factors which learning is based upon. The use of manikins to provide a more realistic paramedic tracheal intubation scenario must therefore improve the opportunity for learning.

The use of manikins allows the paramedic to perform repeated successful practice of the skill which leads to increased efficiency and provides a protective barrier whereby a performance failure will not have any major influence on performance. This is a component of the self-efficacy theory (Bijl and Shortridge-Baggett 2001) which if not provided places the paramedic at risk of an overall declining performance if a failure is experienced.

The diffusion of innovation theory (Rogers 2003) describes if the paramedic has the opportunity during the off-the-job training process to raise their learning curve of the skill or technique to a level which decreases uncertainty and affords a degree of influence towards acceptance of the new skill or procedure this will provide increased confidence which has been demonstrated during the PILMAT trial.

Malcolm Knowles's adult learning theory (Shysh 2000) explains an adult learner has an increased desire for applied learning, the ability to immediately employ the learning in their workplace. With infrequently performed skills such as tracheal intubation the learner may not have the opportunity to perform the skill upon their return to the workplace and this will have a negative effect on their learning and future use of the skill. With this in mind the rural paramedic being trained in an infrequently performed critical skill would value initial experience in an urban environment to ensure their learning curve has developed sufficiently to allow for a failure of the skill not to affect their performance.

5.3.2 The Social Element of the ILMA's Introduction.

Roger's (2003) diffusion of innovation theory identifies another key influence on the endorsement of a new skill or procedure by a group of learners is the ability to observe the skill and to the results visible. Rogers explains if the results of using the new skill can be seen and discussed by others in the social group then it will be more likely to be accepted and in a shorter time period. Introduction and initial use of the ILMA caused a great deal of discussion between the peer-to-peer networks as those waiting to use the new device wished to know how it performed and confirmation of its value. Because of the uncontrollable nature of out of hospital practice there were some initial uses which were not successful but many which were successful. The majority of the initial successful implementations not only developed the individuals performance but through observability and communication channels assisted in the confidence and use by those who initially had a failed performance or were hesitant.

Training was undertaken in the PILMAT trial mostly in small groups, where during practice those who were hesitant could observe others 'having a go'. This hesitance to 'wait and see' was also evident when the ILMA was taken initially into the workplace. Initial use of the ILMA in the workplace presented a great deal of discussion, mainly because it was such a major move away from the very traditional and entrenched AAM practice.

The paramedic use of the ILMA normally occurred in critically ill or injured patients where it was common practice to have a second crew to assist which provided not only support of the paramedic using the ILMLA but allowed others to observe successful performance and provide areas for discussion after the case had been completed. Therefore having or implementing suitably effective communication opportunities whether formal or informal during the period where observation and persuasion is being made by the learner is another element which will assist when the new skill or procedure is introduced into the workplace.

As the paramedics using the ILMA were dispersed around the State and due to shift work meant as a single group they never gathered together. A regular newsletter was distributed which provided results of ILMA tracheal intubation in the workplace. This dissemination of information including the results made the implementation observable and stimulated further discussion and according to Roger's (Rogers 2003) improves the persuasion to embrace the new device.

5.4 Summary

This study involves examining rural paramedic AAM training in particular their perceived confidence and competence and if these change on completion of a much shorter manikin based training program. These areas are also examined with the introduction of a new tracheal intubation device, ILMA, which challenges the strongly held traditional method.

The addition of a new device or procedure can be and involve a significant change to the workplace and its successful accomplishment can depend upon a number of critical factors. Roger's (Rogers 2003) diffusion of innovation theory identifies a sequential model from: acquiring knowledge, being persuaded, making a decision, implementation and confirmation, which implementation of innovations move through. . This study involves the examination of the inclusion of a new AAM device (ILMA) and procedure (ILMA tracheal intubation) which was being trialled in the workplace and was identified to be in the 'persuasion' phase according to Roger's model. This training and inclusion of the new device and procedure which preceded this study was the PILMAT trial.

The persuasion phase of Roger's model (Rogers 2003) includes components which have influence on the rate or even if the new device or procedure will be implemented, they are: relative advantage, compatibility, complexity, trialability and observability.

The relative advantage provided by the addition of ILMA tracheal intubation into paramedic practice was determined to be extensive. The ease of use and training along with the benefits in managing the difficult airway provided benefits well in excess of current practice, but despite these advantages the paramedics indicated their traditional laryngoscopic method of tracheal intubation to be easier and quicker. This was not supported when the tracheal intubation success rates and scene times were compared between the two devices.

The traditional in theatre training ground for paramedic AAM skills has recently been questioned from a number of different aspects. The opportunity for skill practice, appropriateness of the environment, scheduling and homophily are concerns which have been raised. The PILMAT trial did not include any training time in theatre and exclusively used manikins to teach the use of the new device and the procedures, this use of manikins and reduced reliance on in theatre training was viewed as a positive approach.

Paramedic tracheal intubation has been performed in most Australian States and Territories form a number of years and is viewed as a core paramedic skill. There are many aspects of the introduction of the ILMA use and training, which are similar and therefore compatible with the current workplace practices but careful consideration needs to be placed on the methods of introducing an innovation for it to be adopted in the shortest period.

The use of the ILMA has been reported in many articles as being simple and easy to use. There exists the common hesitation when something new is introduced but the speed at which the new device is embraced and implemented into routine practice is influenced by its complexity, according to Roger's (Rogers 2003). The short training program followed by the successful use of the ILMA by paramedics in the PILMAT trial is evidence of its lack of complexity.

The ability to trial a new item or procedure and undertake a degree of safe experimentation is proposed by Rogers (Rogers 2003) to have an influence on the decision to adopt. Because of the variety and uncontrolled nature of paramedic work they can take a new device or procedure into the workplace and learn by doing, this was seen in the comments from the interviews in this study where the notion of using the ILMA to see how it works was expressed.

The use of manikins and simulation does also provide an environment where paramedics can safely trial new device and procedures until they have a degree of confidence where they can progress to the workplace. Despite the PILMAT trial involving very short manikin training time most of the paramedics were confident to trial the ILMA. This may be attributed to the simulated training environment in contrast to the theatre environment where 'experimenting' and 'playing' is inappropriate and to the ease of use of the ILMA.

Roger’s (2003) suggests a new device or procedure when introduced which has its use exposed and invokes peer communication within the workplace will lead to a increased rate of adoption than one which is hidden. The PILMAT trial invoked a great deal of interest and peer discussion because of the change to a traditional practice.

The paramedics involved in this study confirmed a number of the principles proposed by Roger’s in his diffusion of innovation model (Rogers 2003) they experienced during the PILMAT trial. They experienced the introduction of an innovation in an unfamiliar methodology which they have expressed caused a number of benefits but also caused some trepidation and has shed light on the introduction of new devices or practices into the paramedic workforce.

Chapter 6 Conclusion

6.1 Introduction

Paramedic Practice is an emerging profession which has the responsibility of providing emergency care to all types of patient conditions in all out of hospital environments. This diverse scope of practice holds AAM as one of the mainstays of providing competent potentially lifesaving care to acutely ill or injured people. One of the prime and critically important skills within AAM practice is laryngoscopic tracheal intubation. It is an area of knowledge and skill which is held in extremely high regard by paramedics and is difficult to perform. It is well acknowledged that paramedic competency in tracheal intubation is difficult to maintain because of the infrequency of which it is performed (Bledsoe 2006).

Paramedic tracheal intubation is an area of practice at the advanced Intensive Care Paramedic level which has come under scrutiny from medical professionals because of perceived poor levels of performance and errors. This study supports that paramedics consider tracheal intubation to be an essential skill to provide effective airway management in their day to day practice. Recognition this area of AAM is encountered on an infrequent basis has led to claims that paramedic confidence and competence in tracheal intubation decreases, which can potentially lead to poor patient outcomes. A poor patient outcome for a person requiring emergency intervention for effective airway management essentially translates to fatality. The effect the common forms of tracheal intubation training have on confidence during both the initial training in tracheal intubation and its ongoing maintenance of was therefore the key focus of this study.

The changing service delivery requirements of health care providers has shifted the original AAM training and practice philosophies which now must be matched with the needs of today's patient demographics and health service outcomes. Paramedic laryngoscopic tracheal intubation training and practice presents barriers in its traditional format and a change in both areas may be timely. The ILMA has been shown to be easy to use, a valuable alternative to the laryngoscope and has a number of advantages which are suited to the paramedics' field of AAM practice. Tasmanian Ambulance Service Paramedics embraced with enthusiasm the opportunity to learn and use an alternative tracheal intubation technique.

The purpose of the research is to offer insight into qualitative factors that affect the implementation of the Intubating Laryngeal Mask Airway into the Advanced Airway Management practices of paramedics. The five attributes identified by Rogers (Rogers 2003) in his Diffusion of Innovation theory: relative advantage, compatibility, complexity, trialability and observability, have been involved in different degree in the introduction of the ILMA. The introduction of the ILMA demonstrated enthusiasm amongst paramedics which has to varying degrees unknowingly meet the five innovation attributes as described by Rogers. Relative advantage, complexity and a trial were the main criteria described by the paramedics as influencing their uptake of the ILMA. The examination of this introduced practice has identified the special characteristics of paramedic practice in relation to a clinical change specifically related to AAM practice.

6.2 Strengths of this research

A study by a paramedic researcher which developed a research design that allowed the paramedics' voice to be captured is the main strength of this study. The strength of the targeted study design allows for a rigours account of paramedics' experience of their engagement in simulation training in order to acquire the knowledge and skills of tracheal intubation to be described. Another strength of the research design was the inclusion of a comprehensive theoretical framework which drew upon Rogers writings on the diffusion of innovation (Rogers 2003). This framework strengthened the study by allowing theoretical informed interpretations of the findings. This elevates the strength and rigour of the findings beyond the level of descriptions and interpretations to allow for in depth interpretation and theoretical explanation.

The exclusive use of manikins to train paramedics in ILMA tracheal intubation prior to performance in the out of hospital setting was the uniqueness of the PILMAT study which this research follows. The manikin training conducted by the paramedics was short and supported by extensive preparatory theory which provided them with confidence levels similar to those obtained by the previous extensive in theatre training component. This manikin training was the shortest of any known tracheal intubation training programs used to authorise tracheal intubation practice using a new device, the ILMA.

The Diffusion of Innovation theory provides a number of critical attributes which influences the uptake of a new device/technique, one such area is the innovations compatibility to the current individual's values and needs. The restriction of tracheal intubation amongst paramedics and the reliance on one device/technique provided opportunity for the introduction of a new device to support current practicing AAM paramedics and for those paramedics not authorised to perform AAM.

A strong reliance on the traditional laryngoscopic method of tracheal intubation by paramedics was revealed in this study. There may be many reasons why this reliance is so strong and a future study to discover the reasons why would provide information which would allow suitable changes to clinical practice strategies in the future to be adopted.

Traditionally the training of paramedics in tracheal intubation has centred on achieving confidence and competence by spending varying time periods in theatre practicing under the direction of an anaesthetist. This approach is becoming difficult to achieve and discovering the paramedics' attitudes to all aspects of AAM training and using Rogers Diffusion of Innovation theory (Rogers 2003) allows the evaluation of the best approaches to introducing change into paramedic AAM.

This is the first time we are aware, where paramedics have been examined about their confidence in carrying out AAM skills and its relationship to the training program undertaken and their levels of experience. The many published articles on the difficulty of tracheal intubation and the poor performance of this skill by paramedics have largely been generated from outside the paramedic discipline and the opinion and attitude of the paramedic body has been unheard. This study using a questionnaire and key person interviews has obtained the paramedic perspective on an area of practice which is often debated throughout the medical community.

The findings of this study have implications for EMS educators, managers and those providing clinical governance to out of hospital paramedic practice. Paramedic AAM in particular tracheal intubation is an infrequently performed skill which many paramedics have less than ideal confidence to perform. While EMS educators can use information from this study to insure the development of appropriate implementation and training methodologies, EMS managers need to investigate optimal methods of providing clinical exposure to this skill, either real or simulated, which maintain both operator confidence and competence.

This research was a brief look at paramedic tracheal intubation confidence and competence, the implementation of the ILMA for tracheal intubation and the training strategies used for paramedic AAM training. Further study of paramedic tracheal intubation using the ILMA over extended time periods would provide a more complete picture of the suitability of this skill to be included as a core paramedic skill.

The influences on implementing a modification to clinical practice which involves characteristics unique to each change needs to be considered to ensure the change to practice and adoption of any new device occurs in the shortest time period. All modifications to current practice involve a social change which must be forefront in the mind of those responsible for the introduction of new AAM practices.

6.3 Summary of study findings

The main findings to emerge from this study were: infrequent tracheal intubation performance reduces paramedic confidence, the ILMA is a viable alternative for paramedic tracheal intubation and the key components of AAM education include the use of manikins for simulation.

6.3.1 Infrequent tracheal intubation reduces paramedic confidence in AAM

Paramedics believe the infrequent performance of tracheal intubation in the out of hospital environment to be inadequate to maintain their confidence and competence. They argue that more frequent practice is required to maintain confidence at a level which enables them to provide safe and effective AAM.

Paramedic confidence was higher when using the ILMA for tracheal intubation than the laryngoscope for the experienced paramedic AAM practitioners. The results suggest paramedic confidence in tracheal intubation can be achieved using an alternative device using manikins for training. The participants in this study reported a lack of confidence in performing tracheal intubation which is expected to be common throughout this specialist workforce and therefore paramedics' maintaining exclusive use of the laryngoscope for tracheal intubation may not be enabling best practice to be achieved.

Although the paramedics reported an increase in confidence when using the ILMA for tracheal intubation they did not support it being used as the prime device but rather to be used as a second option for clinical situations considered difficult or as a backup device when the laryngoscopic tracheal intubation attempt failed.

6.3.2 ILMA as a viable alternative to the laryngoscope

In this study paramedics used the ILMA as their first option to perform tracheal intubation with the laryngoscope there as a secondary method if they were unsuccessful with the ILMA. Increased take up of the ILMA device is also being seen across other health professions. For example, medical Doctors are increasing using the ILMA to perform tracheal intubation in the patient with a difficult to manage airway or in the uncontrolled out of hospital environment with success. The paramedics in this study had an increased success rate of performing tracheal intubation when they used the ILMA and the time they were on the scene of the incident was also reduced. This finding is consistent with emerging evidence that shows the ILMA to be easy to learn with a steep learning curve and simple and quick to use when performing tracheal intubation. The paramedics stated the ILMA provides an alternative device but not a replacement to performing laryngoscopic tracheal intubation and this finding is consistent with that reported by the PILMAT trial. Many EMS agencies where paramedics perform tracheal intubation have relied totally on the laryngoscope as the only tool to perform tracheal intubation with lesser levels of airway protection provided if this technique fails.

6.3.3 Innovative education technologies and AAM training

Paramedics have reported the supervised in theatre experience when learning tracheal intubation has less influence of their confidence than do the other common training methods. There are numerous structures to achieve paramedic AAM education with almost all programs utilising varying degrees of simulation and time in theatre with patients. In this study, the paramedics experience with simulation to learn about ILMA tracheal intubation was examined. It was found the use of manikins and simulation was judged as more influential on their levels of confidence and competence in their initial tracheal intubation training than the hospital theatre environment and direction by an anaesthetist. This suggests the traditional apprenticeship style of training used to prepare paramedics for tracheal intubation may not be the most effective approach, in this study a training method utilising a blended methodology was supported by the paramedics. The use of blended methodologies for teaching and learning paramedic tracheal intubation which focus on achieving competency would potentially improve the performance of paramedics in this area. The use of hospital based opportunities, simulation and experiential learning have been proposed as important components of learning tracheal intubation which will prepare and maintain paramedics' tracheal intubation confidence and competence.

The increased confidence coupled with the easier to achieve training program and the comparable success rate to laryngoscopic tracheal intubation indicates the ILMA is a device which is well suited to a role within paramedic practice and out of hospital AAM. A number of studies have described the success of using manikins to teach paramedic tracheal intubation using both the traditional laryngoscope and the relatively new ILMA methods. The use of simulation has been increasing in medical education for a variety of reasons and it has been used in teaching paramedics tracheal intubation often to supplement the in theatre experience, It has been reported in the literature that Anaesthetists and Emergency Physicians have had great success in using the ILMA in their field of work.

6.4 Original contributions this study makes.

6.4.1 Contributions to theoretical explanation of paramedic tracheal intubation

The clinical field of paramedic practice is one which is very dynamic regularly involving change with the introduction of new devices, procedures and skills which coupled with the service demands places logistical pressures on EMS providers. When planning for the introduction of a new device, procedure or skill, careful evaluation of the new item along with the workplace is required as this will influence the best methodology to be used for its introduction. The process described by

Rogers (Rogers 2003) diffusion of innovation's persuasion phase which can have a substantial influence on the rate of adoption should be used to evaluate the best method of introducing a new clinical device/technique.

Without doubt the most essential component of introducing a new device, procedure or skill is in the planning, determining the process to ensure paramedics are confident, competent and safe to use the new item in their scope of practice. This planning should be undertaken in a formal manner and dependant on the innovation can range from a short appraisal involving one or two staff to taking a number of weeks and involving many staff. The degree of planning is dependent upon a number of important factors, as proposed by Rogers (Rogers 2003) the important factors are: the culture of the workplace, how well the new item will integrate into the existing scope of practice and the complexity of the new item.

The critical segments as identified by Rogers which should be used when new devices/techniques are introduced are: 1) identification of the advantage it provides, 2) ensuring compatibility with current practice, 3) reducing its complexity, 4) enabling the ability for the item to be trialled, and 5) ensuring the results are open and discussed. Careful consideration of these steps will ensure the innovation is adopted in the easiest and most rapid manner. In order for these steps to commence there is a requirement to disseminate knowledge about the new device/technique in order for the social system where it is to be introduced to begin the first step of deciding on the advantage it brings.

Recommendation 1

The diffusion of an innovation into a discipline of expert practitioners with tradition skills is required to consider a number of factors to ensure its introduction and integration into practice and is not rejected.

Practitioners need to understand the rationale of the new item and why it has been decided to be include it into their practice. Understanding and acceptance of the innovation commences the process whereby the paramedic will identify its value and become a willing participant in the change process. On many occasions this will be self-evident, especially when clinical equipment, skills and medications are involved, as the paramedics often have advocated for their inclusion. This acceptance can become a critical factor when new procedures are being introduced where the paramedic undervalues the importance of the new item and requires a detailed explanation of its role and function.

Recommendation 2

EMS agencies should identify key personnel to develop a strategy for the introduction of a new device, procedure or skill. The planning should involve the development of a process for the introduction and training of staff after careful consideration of the steps in the persuasion phase of Rogers Diffusion of Innovation model and the social change implications.

6.4.2 Contributions to paramedic tracheal intubation practice

The ILMA is a device which in hospital practitioners have included in their airway management practices because it is easy to use and a remedy for situations where tracheal intubation is difficult. This study has shown paramedics in their routine out of hospital practice find the ILMA easy to use and have a similar tracheal intubation success rate to their established laryngoscopic method. The paramedics confidence in using the ILMA was obtained by implementation of a short manikin based training program. Non Intensive Care Paramedics can be successfully trained to perform tracheal intubation using the ILMA.

Recommendation 3

EMS providers seeking a rescue or secondary method of performing tracheal intubation to ensure patient safety and quality provision of both airway and patient care should examine or trial the ILMA as it provides a safe easy to learn method of tracheal

intubation and easier to maintain confidence and competence levels whilst preserving a high success rate.

6.4.3 Contributions to paramedic tracheal intubation education programs

Simulation

Simulation involves many formats and can be provided from the simplest role playing which requires no resources to the intensive requirements of immersive simulation. Simulation is the critical initial stages of the learning curve where confidence and competence begins and its duration will obviously be dependent upon the complexity of the new item. The implementation of an adequate simulation experience should not be overlooked as it does ensure the learning curve is developed to a point where practice can be considered efficient and safe to perform in the workplace. For this reason the use of simulation should ensure it commences at a simplistic level involving just the new item and then develop to include the workplace environment which can be tailored to specific difficulties which are likely to be encountered, thereby further increasing the learning curve.

Simulation needs to involve a variety of experiences and especially as the paramedics display increased confidence and competence the variety and complexity of the simulated experiences can be increased and any cognitive abilities which are required to successfully use the new item in practice be experienced and developed. When employing simulation in specialist areas careful consideration of homophily should be evaluated to assist the learning and increase the rate of adoption.

The simulation process should follow recognised processes where the learner is exposed to appropriate levels of practice, feedback and review. Low fidelity low cost AAM task trainer manikins now allow EMS agencies to purchase multiple numbers which enable the paramedic to experience a variety of airway formats and have improved access to increase their experiences.

In theatre experience

Despite the initial use of simulation to develop ILMA tracheal intubation confidence and competence to a performance level which can ensure safe practice the paramedics expressed the advantage of transitioning from the simulated environment to the controlled theatre patient environment prior to having to perform the skill in an out of hospital emergency situation. After achieving confidence and competence using simulation the paramedics voiced these areas would improve if a small number of experiences with patients in the theatre environment was undertaken. They felt the experience of performing tracheal intubation on ‘real patients’ would provide a substantial boost in their confidence.

Supervised practice

A period of supervised practice in the new skill is a critical component of developing the individual’s learning curve. Feedback and support from a supervisor who has a similar level of practice and background enhances the student’s development and accelerates the learning curve. The blend of manikin and in-theatre training can be confidently structured to provide successful learning outcomes in any AAM training program where the emphasis can be reduced on the in-theatre experience.

Recommendation 4

Paramedic education developers can implement a blended approach to the initial training of AAM with the appropriate structure to include manikin, simulation and in theatre experience which is valued by paramedics and can provide the appropriate levels of confidence and competence.

6.5 Limitations of this research

As with many studies this research is not without a number of limitations.

A major limitation of this study is the small numbers of paramedics involved and those who responded to the survey. Although the total paramedic population involved in the original PILMAT trial was sent the survey the response rate of 40% provides the opportunity for a bias to occur in the data. Examination of the questionnaire respondents' demographics indicated the non-response bias not to be considerable because these demographic characteristics closely resembled the population.

At the time of the data collection there was no formal AAM skills maintenance or ongoing education program for the paramedics involved and this may have had an influence on their level of confidence and competence. The AAM experience obtained from clinical practice varies considerably as discovered during the PILMAT trial, where a number of paramedics had the opportunity to use the ILMA more than five times where others did not use in the routine practice. The frequency of practice has an effect on confidence and competence and the data collected during this study originated from a population of paramedics where their only performance of AAM skills was achieved through their routine clinical practice without any form of training except when the ILMA was introduced.

Alternatively, approximately 12 to 18 months prior to the questionnaire this paramedic group had been involved in the PILMAT trial where a review of AAM practice and training with the ILMA had been completed which may have had a degree of influence on their AAM confidence and competence. Even so this was 12 months prior and during this period clinical experience in AAM was very diverse.

The culture within the Tasmanian Ambulance Service at the time of the data collection may have influenced the participants' responses. It was stated at the time of the PILMAT trial AAM training had slowed and paramedics were eager to practice these skills and were open to alternatives. As the participants had not been subjected to a formal AAM skills maintenance process and therefore may have not received any training or feedback on their tracheal intubation practice for some time this may have increased their enthusiasm to learn and use a new AAM device.

This study was conducted in a small government run ambulance service with limited paramedic AAM exposure and no specialist training for rural paramedics. Therefore the paramedics working in the rural areas of this ambulance service are expected to have varying attitudes, knowledge and skill levels to full appreciate the role and function of a rural based paramedic service. When questioned on specific areas related to rural practice their response is purely based on the individual's experience, which may have varied, and not on any formal training undertaken in rural paramedic practice.

Due to the dispersed paramedic population in this study from both rural and urban centres, the results cannot be immediately transferred to either urban or rural paramedic practice. This study utilised a questionnaire and key person interviews which captured the opinions of Ambulance Tasmanian paramedics at a specific point in time and due to the dynamic nature of out of hospital practice their expressed views relate to that point in time only and therefore cannot be used to indicate a point of view today. The ILMA continues to be used by paramedics in Ambulance Tasmania and therefore they now have a substantially increased level of experience in its use and it is likely their attitudes, confidence and competence would be different today.

6.6 Summary

Tracheal intubation is a necessary skill for the effective delivery of an out of hospital EMS. The low frequency of laryngoscopic tracheal intubation performance by paramedics has a detrimental effect of their confidence and competence and to ensure patient safety measures must be taken to prevent this performance decline. Changes to AAM education methods and its format can restrict this decline and provide processes suited to the paramedics needs.

Paramedic AAM has been slow to respond to the changes which have occurred to in hospital airway management. New methods and devices for tracheal intubation are available which are easier to use and must be evaluated for inclusion to the paramedic AAM scope of practice.

Roger's diffusion of innovation theory provides a framework by which innovations and changes can be introduced into AAM practice in the most effective manner decreasing the risk of rejection and prolonged time periods required for change.

In summary this study has highlighted the concerns with paramedic AAM practice and how the paramedic industry can improve confidence and competence in this area by examining their reliance on a single method of tracheal intubation and the training processes which are used. Expectations that EMS paramedics can provide safe and effective AAM needs to be ensured.

The current focus on the laryngoscopic method of tracheal intubation may be limiting performance and the safe practice of tracheal intubation. The prestige of tracheal intubation within the paramedic workforce appears to have no basis and may lead to a lack of openness to their true performance in this area. EMS managers need to examine models of practice which provide not only the communities expectations but also a sustainable level of practice especially in relation to an infrequently performed difficult skill like tracheal intubation.

It is time for paramedic AAM training to effectively utilise the blended methods available to maximal advantage and transition from an apprenticeship style to a true educational model which includes the appropriate level of cognitive processing to ensure the relative uncontrolled out of hospital AAM practice is optimised.

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Appendix 1: Ambulance Tasmania tracheal intubation protocol 2007

2. Primary Emergency Indications

Adult and paediatric patients (> 12 months).

The following guidelines should be used in making the decision about whether an unconscious patient should be intubated, to enable intubation without consultation in most cases.

- Respiratory Arrest not easily managed by bag/mask ventilation.
- Respiratory arrest > 15 minutes from hospital.
- Cardiac arrest.
- Spontaneously breathing patient with difficulty in maintaining airway.
- Persistent hypoxia (SpO_2 < 85%) not responding to other treatment and > 15 minutes from hospital.
- Deeply unconscious patient (GCS 3 – 4) and > 15 minutes from hospital.
- Patient has aspirated vomitus.

Intubation should **not** be attempted in the following situations:

- Spontaneously breathing patient with easily maintained airway.
- Respiratory arrest easily managed by bag/mask ventilation and < 15 minutes from hospital.
- **Paediatric intubation if unable to visualise vocal cords.**
- Conscious, confused or lightly unconscious patient who physically opposes attempts at intubation with hands, head turning, mouth closing or strong gagging.
- Cardiopulmonary arrest with shockable rhythm before attempting defibrillation.
- Opiate drug overdose before attempting treatment with naloxone.
- If resuscitation is futile, i.e. patient in late stage of terminal illness, patient with untreated cardiopulmonary arrest of > 30 minutes.

Appendix 2: PILMAT data collection form

Tasmanian Ambulance Service **Airway Management Form**

INCIDENT: Date: / / Number: ________ **TNR:** **Y N**

REGION: **NW N S** **OFFICERS NAME:** ____________________________

PATIENT NAME: ________________________________ **Sex: M F** **Age:** ________

Airway Skills Performed:

- lateral / side position
- head extension
- jaw thrust
- triple airway manoeuvre
- oropharyngeal airway
- nasopharyngeal airway
- suction
- laryngoscopy
- used Magill's forceps
- ILMA No. SN AMF ____________
- endotracheal intubation, via
  - laryngoscopy
  - ILMA
- tube type: **S R ILMA**
- tube size ________
- tube changed due to incorrect size
- \# of attempts: **1 2 3 >3**

Intubation: successful unsuccessful

- straightforward
- moderately difficult
- very difficult

Vocal Cords: *(ETI only)*

- good view
- poor view
- not seen

Aids Used: *(ETI only)*

- introducer
- bougie
- cricoid pressure
- Magill's forceps

Environment:

- in ambulance
- restricted space
- limited head access
- inside building
- inside vehicle
- outside
- other

Attempts:	successful	
1	**Y**	**N**
2	**Y**	**N**
3	**Y**	**N**
4	**Y**	**N**

if attempts FAILED, indicate the secondary (rescue) airway used:

- Bag-Valve-Mask
- ILMA
- Cricothyriod Puncture

ILMA & ETT Placement Checks:	Tracheal	Oesophageal	Indeterminate	Not assessed
ETT seen to **pass through cords**				
Bulb aspiration (ODD)				
Bilateral chest **movement**				
Equal **air entry**				
Silent epigastrium				
EasyCap	**C**	**A**	**B**	

Who determined the final placement (location) of ETT?

- Paramedic performing intubation
- Another officer at the scene
- Receiving hospital Medical Officer
- General Practitioner at the scene
- Receiving flight paramedic
- Other: ____________________

Name

Observations	*pre*	*airway skill/s*	*post*
HEART RATE			
SYSTOLIC BP			
RESPIRATORY RATE			
O2 SATURATION			
GCS			
ECG			

Effective Airway **Y N** Effective Ventilation **Y N**

Clinical evidence of **Airway Obstruction**

- Stridor
- Poor air entry (ausc)
- Poor chest expansion
- Difficult ventilation

Other Skills / Procedures Performed:

- inline immobilisation
- sedation required
- cricothyroid puncture
- needle thoracentesis
- extubation
- IPPV ease of ventilation

easy 1 2 3 4 5 hard

Complications

- failed intubation attempt, due to:
  - Patient anatomy
  - Inadequate view of cords
  - Orofacial Trauma
  - Equipment failure
  - Inadequate patient relaxation
- blood on the ETT or ILMA
- oesophageal intubation
  - delayed detection
  - unrecognised
- tube dislodgement
- other

Clinical Suspicion of **Aspiration** **H M N**

TASMANIAN AMBULANCE SERVICE

When the form is completed, please:

1 Fax this form to: **6229 5197**

When you have used an ILMA, please:

2 SMS* **0407 872 664**

(* date & incident number)

3 Place this form with the **ARF**

Is patient in cardiac arrest on intubation?	**Y**	**N**
Is patient a victim of trauma?	**Y**	**N**
Is the patient under 18 years old?	**Y**	**N**

Key - ILMA - intubating laryngeal mask
ETI - endotracheal intubation

Appendix 3: Literature Review Methodology

Process

This chapter provides details of the strategies used for the literature search and the various sources of information used in this study. The literature search involved undertaking the following key processes:

- Identification of the appropriate key words;
- Search of online databases for relevant articles;
- An additional search using the key authors identified during the original search;
- Review of the articles references to identify other potential research;
- Use of the bibliography software Endnote to record and organise the articles;
- Refine and refresh the literature search.

Strategies and Keywords

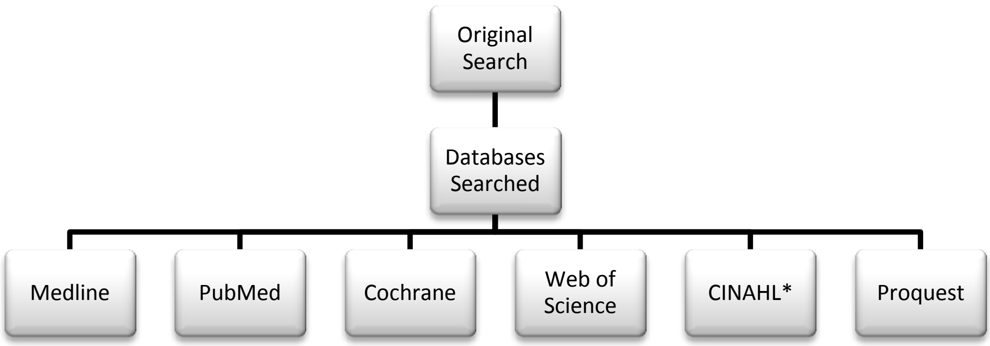
The literature search was conducted using the selected key words (page 59) and limited by articles and studies in the English language and published since 1995. The searches were conducted according to chart 1, page 55.

The literature search was conducted using the research questions as a basis to develop key words to be used in the search of specific literature databases. The research questions were refined into search questions to enable the development of clear key words to use during the database searches. In table 3 the list of key words can be found and their relationship to the specific research questions.

Table 1, Literature search strategy with reference to the research questions.

Search Questions	Research Question	Key Words
What models of AAM education exist?	2	Paramedic education Skills training Endotracheal intubation training AAM Manikin training Simulation training Airway skills training Laryngoscopic intubation
What is the evidence of paramedic tracheal intubation?	1, 2	Paramedic endotracheal intubation Paramedic AAM Prehospital tracheal intubation
What evidence is there on tracheal intubation using the ILMA?	1	ILMA ILMA tracheal intubation Endotracheal intubation
What is the evidence of paramedic skills training?	2	Skills training Paramedic AAM training Paramedic education
What is the evidence on operator confidence and competence using different skills training models?	1, 2	Confidence Competence Skills training Paramedic training models
What evidence exists on the skills development from novice to expert?	2	Novice Expert Skills training
What evidence are there on skills maintenance theories?	2	Skills maintenance Skill decay Learning curves

Figure 1: Process used in Literature search.



* Cumulative Index to Nursing and Allied Health Literature

The above databases were chosen as the most common clinical sources of information and often used to find current clinical information.

The above databases where searched using the following search terms:

Skills training
Manikin training
Simulation training
Airway skills training
Skills maintenance
Skill decay
Learning curves

AAM
Endotracheal intubation
Endotracheal intubation training
Paramedic AAM
Paramedic AAM training
Paramedic education
Paramedic training models
Laryngoscopic intubation
Paramedic endotracheal intubation

Prehospital tracheal intubation

ILMA
ILMA tracheal intubation

Confidence
Competence
Novice
Expert

Articles were selected for a more detailed appraisal with subsequent inclusion into the literature review and were initially sorted into the following broad subject groupings, according to their prime focus being related to:

1. The Intubating Laryngeal mask Airway
2. Paramedic Practice
3. Clinical Education
4. Tracheal intubation

Details on the themes within each of these groups are:

1. The Intubating Laryngeal Mask Airway: this group included general information on the ILMA and primarily studies which had been undertaken in the hospital setting and predominately in hospital theatres. As this device was relatively new the theme for these studies focused on its use as an airway tool in specific clinical presentations and its comparison when used for tracheal intubation to the traditional laryngoscopic method. These studies involved both its use on actual patients and manikins to study the educational requirements and clinical application of the intubating laryngeal mask airway.

2. Paramedic Practice (AAM and rural): articles or studies in this group were limited, with the majority concerned with evaluating paramedic tracheal intubation performance by the analysis of success rates. There were few articles involving paramedic use of the intubating laryngeal mask airway and those which were found almost solely involved its use on manikins in a classroom teaching environment. There were some articles comparing paramedic airway care between various devices including performing tracheal intubation. Many of these articles were authored by medical officers with very few articles found which had paramedics as authors.

There were few articles published on rural paramedic practice. Recently published articles were concerned with the differences and uniqueness of rural paramedic practice, with few discussing the specific clinical training or skills required in this working environment.

3. Clinical Education: this group of articles included studies involving both the clinical education setting in relation to the procedures mentioned above and the concepts involved in clinical education, especially those looking at skills training and operator competence and confidence. This collection includes articles involving Advanced Airway Management education by all providers of health care.

4. Tracheal intubation: articles under this heading included all devices and techniques involved in out of hospital tracheal intubation and specifically in-hospital tracheal intubation involving use of the intubating laryngeal mask airway. There were many articles concerning use of the standard laryngeal mask airway and these were included only if there was a comparison to the laryngoscope, the intubating laryngeal mask airway or its use by paramedics.

After the initial sorting into the above four subject areas further sub groupings within three of the areas occurred in order to further define the content of the literature, the first initial group, ILMA including the LMA was retained as the first literature group.

Table 2: The further literature sub groupings consisted of:

Initial Groupings	Final Groupings	Number of Articles
1. ILMA	ILMA and LMA	28
2. Paramedic	Paramedic AAM (tracheal intubation)	43
	Rural Paramedic Practice	#
3. Education	Simulation	36
	Confidence	8
	Competence	22
4. Tracheal intubation	General AAM training	17
	AAM skills maintenance	7

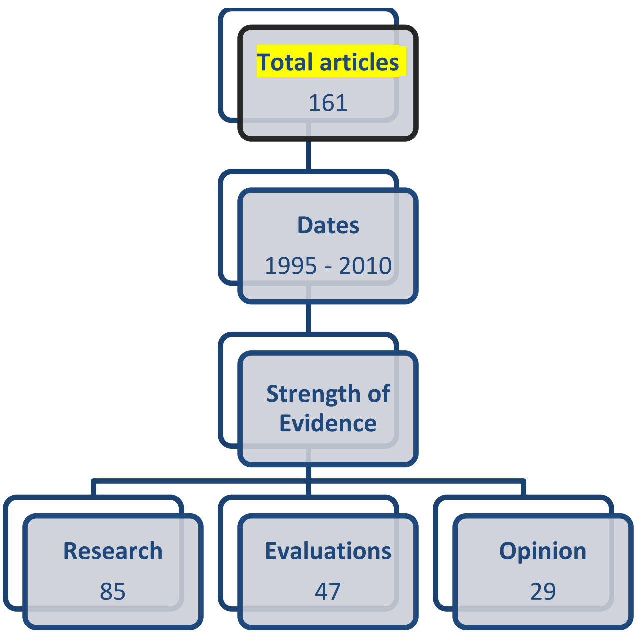
These subgroups were used as the final literature categories.

Summary of Articles

The majority of the articles found during the literature search had a strong bias towards paramedic AAM, simulation and use of the LMA and the ILMA, with the vast majority involving research conducted either in the University or hospital settings. The perception of paramedics was significantly lacking in all topics and types of journal articles. Many of the articles specifically related to paramedic practice but did not include the paramedic viewpoint thereby focusing the discussion from the observers' perspective excluding the critical dialog from the actual paramedic practitioners.

The following chart is a summary of the articles in relation to the total number, the date ranges they came from and the type of articles in relation to their strength of evidence. The strength of evidence is based on well-known levels of evidence which indicate the rigor undertaken during the study and the degree of validity which can be placed on the conclusions. The lowest ‘opinion’ group represents literature which is an individuals or groups view on the topic normally based on experience and having no research data presented. The middle ‘evaluations’ group are articles which involve the assessment of a device or technique without any comparison, or the simple application of a device or technique often involving manikins. The higher ‘research’ group of articles involves the analysis of devices or techniques using a detailed research methodology and data which is analysed using recognised statistical processes.

Figure 2, Overall summary of literature types.



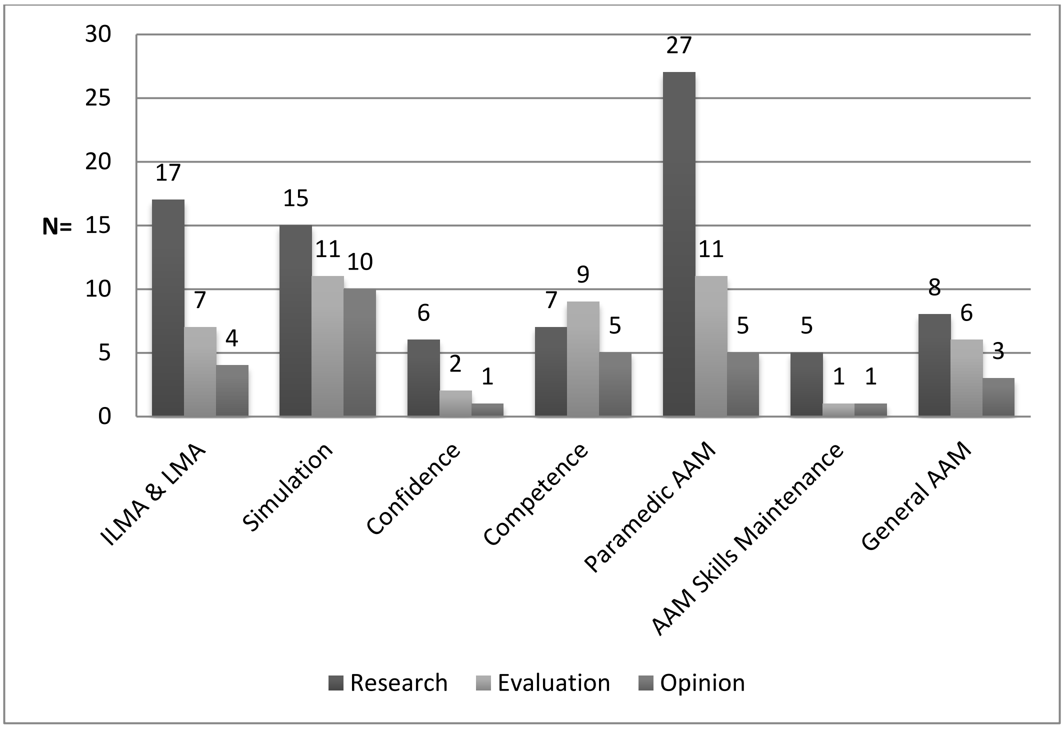
On further scrutiny of the articles it was discovered they came from a range of areas, see table 4, with the majority on the topics originating from individual professions. The vast majority of literature on the LMA and ILMA originated expectedly from the hospital anaesthetic department with only one from a paramedic author. The majority of literature on paramedic AAM came from hospital emergency department authors with only two from the paramedic profession. The topics of confidence and competence had literature which predominantly originated from research conducted by universities.

Table 3: Journal articles summary, by author

Area (number of articles)	Paramedic	Nursing	University	Hospital Anaesthetic Dept.	Hospital Emergency Dept.	Other
ILMA & LMA (28)	1	0	0	20	6	1 meta-analysis
Simulation (36)	1	5	10	17	2	1
Confidence (8)	0	1	5	1	1	0
Competence (22)	0	3	12	4	2	1 Accreditation body
Paramedic AAM (43)	2 (recommendations)	0	5	6	28	2 Case review & guideline
AAM Skills Maintenance (7)	0	0	1	0	6	0
General AAM (17)	0	0	1	9	7	0
Total (161)	4	9	34	57	52	5

The literature was further examined and divided by type according to the topic, see table 5. The greatest number of articles was research conducted on paramedic AAM, but as mentioned previously this was conducted principally by hospital emergency and anaesthetic department personnel. This may be due to these areas having the overarching lead of paramedic AAM training and practice. The LMA and ILMA had the next highest number of articles involving research with the same hospital departments featuring as the authors. The literature concerning opinion was low across all areas with opinion on simulation having the most number of articles.

Figure 3, Journal article summary by type



Appendix 4: Advantages in using simulators (Owen and Plummer 2002**)**

1. **No risk** to the patient while teaching the basics – during the initial learning phase where there is an increased risk of failure and complications the use of manikins ensures patients are not exposed to these risks.

2. Students can **practice as often as required** – the availability of patients is always a logistical issue with any patient training sessions, when using manikins they are available at any time for students to perform the skill or skills as many times as required.

3. **Multiple attempts** can be made in quick succession – when using patients there is only the opportunity to perform the procedure or skill successfully once, when using a manikin there is the opportunity to perform the procedure or skill many times.

4. **Practice can be scheduled** – use of manikins can mean the practice or training process can be planned to suit the individual student or the requirements of the training program. Even in the relatively controlled setting of the hospital theatre there is the potential for the patient to be unexpectedly difficult or challenging which will potentially mean performing the skill will be removed from the student.

5. **Errors can be allowed** – the emergence of the patient safety movement in health care has correctly highlighted the unacceptably high rate of medical errors inflicted on patients. This increased awareness has brought into question the philosophy of training on patients, even with informed consent the pressure and demands of performing critical invasive skills on patients provides the student with unnecessary pressure and an inappropriate learning environment. The use of manikins can allow students to perform errors without jeopardising patient safety or adding emotional pressure to the students.

6. Procedure can be **undertaken slowly or stopped** – the use of simulation or a manikin to learn time critical skills, such as tracheal intubation, is the only method where the procedure can be paused and discussed or even stopped if there is performance below what is expected. This infinite control of the learning cannot be conducted when using patients.

7. **Different situations** can be created – when performing skills or procedures on patients the learning situation is restricted and dictated by the patient's physical and pathological status. A manikin can not only have the clinical parameters altered but also can be placed in situations and environments chosen to suit the individual student or training program requirements.

8. **Different techniques and equipment** can be tried – using a manikin allows the student to evaluate various techniques or different types of equipment to achieve the desired outcome. The performance of skills on patients is normally dictated by the clinical and physical requirements of the patient, implementing the best option for each individual patient, which may not be what the student requires.

9. **Difficulty can be increased** incrementally – the experience provided by patients is restricted to their individual situation whereas when using a manikin, which has the capabilities, physical and clinical parameters can be altered and specifically increased to suit the students development. This increase can be performed during a single performance or incrementally over many performances. This ability provides a significant enhancement to the learning process and outcomes.

10. **Environment can be controlled** – when managing patients in the non-acute setting there can be some degree of control exerted on the learning environment. Tracheal intubation is a skill performed in a critical environment when performed in the theatre setting, but commonly in the emergency department and out-of-hospital settings it is performed under emergency conditions. Manikins can be placed in the desired environment and the parameters in that environment can be fully controlled.

11. Students appreciate having some experience and being able to **become confident** prior to attempting the skill on a patient – when performing skills on a manikin where there is none of the additional time and performance pressures, it provides a learning environment which can be tailored to the students' needs and to ensure the required level of confidence is obtained prior to performing the skill on a patient. Performing critical skills on patients even in the relatively controlled theatre environment does produce anxiety in the student.

Appendix 5: PILMAT: invitation, interview sheet and consent

Title of Study: ***A Prospective Cross-Sectional trial in the use of the ILMA in the Pre-hospital Management of Critically Ill Patients.***

Study Investigators:

Dr Marcus Skinner, Director, Anaesthesia and Intensive Care, NWRH, Burnie
Dr Mark Reeves, Deputy Director, Department of Anaesthesia, NWRH, Burnie
Dr Corinne Ginifer, Director of Emergency Medicine Training, NWRH, Burnie
A/Professor Paul Myles, Department of Anaesthesia, Alfred Hospital, Melbourne
Mr Noel Dalwood, Superintendent Clinical Practice, Tasmanian Ambulance Service, Hobart

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Invitation Summary

You are invited to participate in a research study about the use of the Intubating Laryngeal Mask Airway (ILMA) in the pre-hospital field. You are invited because you are a qualified pre-hospital practitioner, and your participation is voluntary.

If you agree to participate, you will be trained in the use of the ILMA and approved to use this device on subjects who meet specific clinical criteria. This research will provide alternative airway care for subjects. You will be required to carry out normal airway assessment techniques to determine if an ILMA is suitable to be used, and when the device is used you will be required to provide anonymous feedback both on the ILMA and your opinion of its use.

If you decide not to participate in this research it will not affect any of your current or future work activities or opportunities.

What is the purpose of the study?

The purpose of this study is to assess the use of the ILMA by pre-hospital emergency care providers and its effect on patients.

What will my participation involve?

If you agree to participate, you will be trained in the use of the ILMA and approved to use this device on subjects who meet specific clinical criteria. If you are trained in advanced airway management (AAM) you will also be able to perform *blind endotracheal intubation* via the ILMA.

Your participation will last approximately 12 months and may require some skills maintenance training.

You will be required to provide anonymous clinical data and your opinions on various aspects of the ILMA and its use. This data will be obtained from a form, completed by you after each ILMA use similar to the current 'Intubation Record', for clinical and demographic information and a telephone interview for your opinions.

Are there any risks?

There are no risks for you and no increased risk for the subjects.

Are there any benefits?

No direct benefit is guaranteed to you from participating in this study. Your participation in this research may benefit other people in the future by helping us to learn more about the use of the ILMA in the pre-hospital field. The only gain you may experience is that you have another device to assist with airway maintenance and ventilation during the study and the experience you gain from using the ILMA.

Are there any costs?

Your participation in this study will not involve your spending any money. This information session and possibly the interview (approximately 3 – 5 minutes) after each use of the ILMA may occur during your time off duty. When ever possible the interviews will be conducted whilst you are on duty.

Are there any alternatives?

You do not have to participate in this study to attend AAM training or any other advanced clinical level training.

Will I be paid for my participation in this study?

No, your participation in this study will occur during your normal hours of employment.

Will there be compensation for injury?

Your normal work cover for any injury will apply during your involvement in this study.

If I decide to start the study, can I change my mind?

Your decision to participate in this research is entirely voluntary. You may choose not to participate. If you do decide to participate, you may change your mind at any time. You will be told of any new or significant findings which may affect your willingness to continue. Your decision of whether or not to participate in this study will not affect your employment in the Tasmanian Ambulance Service.

Will my confidentiality be protected?

The researchers might use information learned from this study in scientific journal articles or in presentations. None of this information will identify you personally.

The data obtained from this study will be kept secure in locked premises and coded which will not involve any of your personal details.

What if I have questions?

If you have any questions about this research, please contact the Project Officer, Michael McCall, on 0407 872 664 or at the Hobart Ambulance Station. If you have any questions about your rights as a research subject, contact Executive Officer of the Human Research Ethics Committee (Tasmania) network, Amanda McAully (6226 2763).

Authorisation to participate in the research study:

I have read the information in this consent form, reviewed any questions, and I voluntarily agree to participate in this study. I have received a copy of this consent form.

______________________________ ____________________

Name & Signature of Subject **Date**

______________________________ ____________________

Name & Signature of Person Obtaining Consent **Date**

Appendix 6 – Questionnaire

Introduction of the 'Intubating Laryngeal Mask Airway'

into rural ambulance paramedic practice.

QUESTIONNAIRE

This survey seeks information of your opinion on Advanced Airway Management (AAM) and your use of the Intubating Laryngeal Mask Airway (ILMA). Please read each question carefully and indicate your answer clearly with a circle.

Throughout this questionnaire the term 'Paramedic' refers to the highest ambulance clinician often referred to as an Intensive Care Paramedic (ICP).

1.0 General Demographics

Questions 1.1 to 1.7 concern your general work details; please circle the most appropriate answer to provide information regarding your clinical employment situation.

1.1	Please indicate your current skill level?	□ *AO* (1) □ *Paramedic* (2) □ *CSO* (3) □ *Other* (4) ___________
1.2	What year did you qualify in AAM?	*Year:* _________ □ Not Qualified, (2)
1.3	Did you complete your initial AAM training in the Tasmanian Ambulance Service?	□ *Yes* (1) □ *No* (2) □ *N/A*
1.4	Do you have additional AAM qualifications or experience?	□ no (1) □ nurse (2) □ medical officer (3) □ other___________
1.5	Since qualifying as a paramedic, the majority of your work has been at an?	□ *Urban station* (1) □ *Branch station* (2)
1.6	Where do you work now?	□ *Urban station* (1) □ *Branch station* (2)
1.7	Have you intubated a patient using the ILMA?	□ *Yes* (1) □ *No* (2)

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2.0 Confidence

Questions 2.1 to 2.9 seek answers which reflect your confidence in performing AAM skills. Please circle the most appropriate answer.

I am very confident to perform the following skills:

		Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
2.1	Laryngoscopic tracheal intubation	1	2	3	4	5
2.2	ILMA tracheal intubation	1	2	3	4	5
2.3	Paediatric tracheal intubation	1	2	3	4	5
2.4	Cricothyroid puncture	1	2	3	4	5
2.5	Tracheal intubation of an adult head injury with GCS of 5	1	2	3	4	5
2.6	Confirming tracheal tube position	1	2	3	4	5
2.7	Manage the 'difficult airway'	1	2	3	4	5
2.8	Manage the 'cant intubate cant ventilate' patient	1	2	3	4	5
2.9	ILMA insertion	1	2	3	4	5

3.0 Advanced Skills

Questions 3.1 to 3.9 concern your opinion on the skills required to be performed by a paramedic. Please circle the most appropriate answer.

The following are essential skills to performing the role of a paramedic?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
3.1 Defibrillation	1	2	3	4	5
3.2 IV Cannulation	1	2	3	4	5
3.3 Chest Decompression	1	2	3	4	5
3.4 Tracheal Intubation	1	2	3	4	5
3.5 External Cardiac Compression	1	2	3	4	5
3.6 Cricothyroid Puncture	1	2	3	4	5
3.7 Rapid Sequence Intubation (RSI)	1	2	3	4	5
3.8 Intraosseous Cannulation	1	2	3	4	5
3.9 External Cardiac Pacing	1	2	3	4	5

LARYNGOSCOPIC TRACHEAL INTUBATION

Questions 4.0 to 7.1 are about your view on the training and use of the laryngoscope for tracheal intubation. Please circle the most appropriate answer.

4.0 The following activities are essential for rural paramedic laryngoscopic tracheal intubation training?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
4.1 Pre course theory	1	2	3	4	5
4.2 In theatre training	1	2	3	4	5
4.3 Guidance by Anaesthetist	1	2	3	4	5
4.4 Mannequin training	1	2	3	4	5
4.5 CSO classroom training	1	2	3	4	5

5.0 The following activities are essential for a rural paramedic to maintain competency in laryngoscopic tracheal intubation?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
5.1 Pre course theory	1	2	3	4	5
5.2 In theatre training	1	2	3	4	5
5.3 Guidance by Anaesthetist	1	2	3	4	5
5.4 Mannequin training	1	2	3	4	5
5.5 CSO classroom training	1	2	3	4	5

6.0 How confident are you using the laryngoscope for trachea intubation in the following situations?

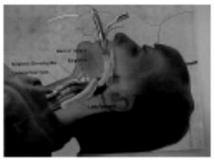
	not at all				very
6.1 A multi trauma patient who has inadequate breathing and a poor airway?	1	2	3	4	5
6.2 A patient suspected of an unstable cervical spine?	1	2	3	4	5
6.3 A patient in cardiac arrest?	1	2	3	4	5
6.4 An unconscious non-traumatic patient?	1	2	3	4	5

7.1 Which skill level should perform tracheal intubation using the laryngoscope in TAS?

☐ QAO 1 ☐ PARA 2 ☐ CSO 3

You may mark more than one answer.

QAO = Qualified Ambulance Officer, PARA = Paramedic, CSO = Clinical Support Officer



ILMA TRACHEAL INTUBATION

Questions 8.0 to 13.1 are about your view on the training and use of the ILMA for tracheal intubation. Please circle the most appropriate answer.

8.0 The following activities are essential for rural paramedic ILMA tracheal intubation training?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
8.1 Pre course theory	1	2	3	4	5
8.2 In theatre training	1	2	3	4	5
8.3 Guidance by Anaesthetist	1	2	3	4	5
8.4 Mannequin training	1	2	3	4	5
8.5 CSO classroom training	1	2	3	4	5

9.0 The following activities are essential for a rural paramedic to maintain competency in ILMA tracheal intubation?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
9.1 Pre course theory	1	2	3	4	5
9.2 In theatre training	1	2	3	4	5
9.3 Guidance by Anaesthetist	1	2	3	4	5
9.4 Mannequin training	1	2	3	4	5
9.5 CSO classroom training	1	2	3	4	5

10.0 The following are critical to the success of an ILMA training program?

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
10.1 Organisation of the program	1	2	3	4	5
10.2 Educational Resources	1	2	3	4	5
10.3 Acceptance by hospital staff	1	2	3	4	5
10.4 Feedback on performance	1	2	3	4	5
10.5 Direction	1	2	3	4	5
10.6 Learning support	1	2	3	4	5
10.7 Other, please indicate:	1	2	3	4	5

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11.0 The following components of the ILMA training program were most beneficial:

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
11.1 Pre course theory	1	2	3	4	5
11.2 Course structure	1	2	3	4	5
11.3 Time for learning	1	2	3	4	5
11.4 Information	1	2	3	4	5
11.5 Instructors ability	1	2	3	4	5
11.6 Preparation	1	2	3	4	5
11.7 Providing confidence	1	2	3	4	5

12.0 How confident are you using the ILMA for tracheal intubation in the following situations?

	not at all				very
12.1 A multi trauma patient who has inadequate breathing and a poor airway?	1	2	3	4	5
12.2 A patient suspected of an unstable cervical spine?	1	2	3	4	5
12.3 A patient in cardiac arrest?	1	2	3	4	5
12.4 An unconscious non-traumatic patient?	1	2	3	4	5

13.1 Which skill level should perform tracheal intubation using the ILMA in TAS? ☐ QAO 1 ☐ PARA 2 ☐ CSO 3

You may mark more than one answer.

Key QAO = Qualified Ambulance Officer, PARA = Paramedic, CSO = Clinical Support Officer

14.0 Skills Maintenance

Questions 14.1 to 14.4 are about your AAM skills maintenance. Please circle the most appropriate answer.

	never	1 – 8 weeks	2 – 3 monthly	3 – 6 monthly	>6 months
14.1 During the past 12 months, how frequently have you practiced laryngoscopic tracheal intubation?	1	2	3	4	5
14.2 How frequently would you like to practice laryngoscopic tracheal intubation?	1	2	3	4	5
14.3 During the past 12 months, how frequently have you practiced ILMA tracheal intubation?	1	2	3	4	5
14.4 How frequently would you like to practice ILMA tracheal intubation?	1	2	3	4	5

Questions 15.1 to 15.6 seek your opinion on the importance and necessity of viewing the vocal cords during tracheal intubation. Please circle the most appropriate answer.

15.0 When performing tracheal intubation:

	not at all				very
15.1 How important to you is visualising the vocal cords?	1	2	3	4	5
15.2 Are the 'tube placement checks' adequate in comparison to seeing the tube through the cords?	1	2	3	4	5

	not at all				very
15.3 How confident do you feel when performing 'blind' tracheal intubation?	1	2	3	4	5
15.4 How confident did you feel prior to your first out-of-hospital laryngoscopic intubation?	1	2	3	4	5
15.5 How confident did you feel prior to your first out-of-hospital ILMA intubation?	1	2	3	4	5
15.6 Did the ability to visualise the vocal cords influence you choice of intubation technique (ILMA vs. laryngoscope)?	1	2	3	4	5

16.0 Summary

Questions 16.0 to 18.0 ask general information on your opinion of ILMA use out-of-hospital.

Please circle the most appropriate answer.

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
16.1 My initial impression was the ILMA was not required for tracheal intubation	1	2	3	4	5
16.2 I now think the ILMA has an important role in tracheal intubation	1	2	3	4	5
16.3 My experience with laryngoscopic tracheal intubation influenced my use of the ILMA	1	2	3	4	5
16.4 The receiving hospital staff being unfamiliar with the ILMA influenced my use of it	1	2	3	4	5

17.0 In comparison to the laryngoscope, using the ILMA to perform tracheal intubation is:

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
17.1 Easier	1	2	3	4	5
17.2 Quicker	1	2	3	4	5
17.3 Requires less training	1	2	3	4	5
17.4 The ILMA should be a part of ambulance practice?	1	2	3	4	5

Circle your answer

18.0 Which method of tracheal intubation do you believe should be the first option by paramedics?	**ILMA**	**Laryngoscope**	**Officers Choice**

	Strongly Disagree	Disagree	Unsure	Agree	Strongly Agree
18.1 The ILMA should be first choice for specific clinical presentations?	1	2	3	4	5

Please specify: ____

Thank you for the time you have spent in completing this survey, please place the completed survey in one of the reply paid envelopes supplied and place it in the post.

If you are willing to be interviewed regarding your use of the ILMA please complete the following page and mail it the smaller reply paid envelope.

Many Thanks

Mike McCall

Appendix 7 – Interview structure

ILMA Interview Schedule:

These interview questions will contribute to the information included in the project – ‘Introduction of the Intubating Laryngeal Mask Airway into rural ambulance paramedic practice’.

The interview will be digitally recorded and transcribed.

After an appropriate introduction the following proposed questions will be presented:

Primary Opening Question

Tell me about your experience using the ILMA?

Secondary Questions (if not covered in the initial broad question)

ILMA Training

- ☐ What was your overall impression of the ILMA training program?
    - What components worked well?
    - What areas could be improved?
- ☐ Did this training provide you with enough confidence to use the ILMA?
- ☐ Do you have any other suggestions which may improve training in the ILMA?

ILMA Use

- ☐ Describe some instances where you used the ILMA on-road?
    - What were the positive aspects of using the ILMA?
    - What were the negative aspects of using the ILMA?
- ☐ What is your overall impression of the ILMA?
    - Do you think the ILMA has a role in out-of-hospital airway management?
- ☐ Compare tracheal intubation using the ILMA and the laryngoscope?

AAM

- ☐ What skills should be taught during AAM training?
- ☐ What is the role of AAM in paramedic patient care?
- ☐ Who, when and where should be trained in AAM?
- ☐ What is the ideal AAM training program?

Skills Maintenance

- ☐ What is your impression of the current AAM skills maintenance process?
    - What are the factors affecting the success of the current skills maintenance process?
- ☐ What process would allow you to maintain your AAM skills?
- ☐ How does the maintenance of tracheal intubation using the laryngoscope compare to using the ILMA?