Outcomes of International Ehealth Implementations in Aged Care

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Abstract

This paper reports upon an investigation into the effectiveness of ehealth implementations in the aged care sector throughout the world. The purpose of the research was to better understand the link between goals and outcomes in the provision of geriatric ehealth services.

Telemedicine implies a limited service provided by doctors while ehealth means the application of information communication technology by a range of healthcare professionals. Ehealth has emerged as a means to facilitate geriatric care in the face of increased demand for services. It also has the potential to offer a number of benefits to older citizens, including increased quality of care.

Data collection was based an extensive search of electronic databases that indexed technology and medical journals, using terms established by two researchers trained in Information Systems. A review of the 647 primary articles identified, found 66 that met all the search criteria. These papers were then categorised using a framework from the geriatric ehealth literature (Nebeker, Hurdle & Bair, 2003), enabling the identification of Provider-Provider, Provider-Patient and Provider Decision-Support studies. Within these three perspectives the papers were classified according to the nature of the research undertaken, and the number of papers was recorded. Any positive outcomes or limitations reported in the sources were also collated for each category.

The results revealed that most of the papers were derived from Provider-Patient studies, with only very limited Provider-Provider or Provider Decision Support papers. Much of the Provider-Patient research focussed on teleconference implementations, often for particular health conditions. The limited result for Provider-Provider studies was surprising given the emphasis in the wider ehealth literature on the timely and current exchange of health data and information, including the adoption of Electronic Medical Records. Most of the Provider Decision Support studies considered individuals or groups with specific medical conditions. It was found that ehealth was generally accepted by patients and healthcare providers, and a range of mainly social and technical constraints was identified. However, the limited number of studies, the dominance of trials, the repetitiveness of the studies and the limited degree of innovation found failed to confirm any perceived "disconnect" between organisational goals and outcomes in ehealth aged care. Further studies need to be undertaken before the nature of the link between goals and outcomes in ehealth aged care can be established, along with the reasons that may account for any mismatch.

Introduction: Increasingly around the world, people live to a greater age than in preceding generations. Increased age often necessitates care involving a range of health services, which complicates the delivery of appropriate health services to the elderly. Ehealth has been identified as having potential to cope with the growing demand for complex health care needs by the elderly, where ehealth provides access to health information, support and services by the public, health workers and others, through electronic delivery, typically via the internet (Wyatt & Liu 2002). If it is accepted that the introduction of ehealth technologies across health care in general must be supported by evidence of their effectiveness (Rosenberg 1995), such evidence must also be demanded of ehealth in aged care.

This paper reports upon an investigation of the effectiveness of ehealth implementations in the aged care sector throughout the world, by examining the number, nature and outcomes of published academic studies in the area.

Background: Globally in both developed and less developed countries the aging population continues to grow (Kinsella & Phillips, 2005) as an increased proportion of citizens survive to an advanced age (Kinsella & Phillips, 2005; Buckwalter, Davis, Wakefield, Kienzle & Murray, 2002; Magnusson, Berthold, Chambers, Brito *et al.,* 1998). While this trend has been facilitated by improvements in medicine, it has also created a need for considerable resources to support the health and well being of those aged 65 and over. For older members of society the scope of professional medical services required can extend across a range of specialist areas, as:

> (t)he older patient often has multiple acute and chronic problems that require management by a variety of medical professions in a variety of settings. Proper care necessitates efficient gathering, integration and management of information by each professional in each setting (Nebeker, Hurdle & Bair, 2003:820).

It has been argued that advances in information communication technologies (ICT) have provided a cost effective means to service the increased demand on the health system (Bradley, Williams, Brownsell & Levy, 2002). This has given rise to the notion of ehealth or telehealth that implies care provided from a range of health professionals encompassing a number of applications, as opposed to telemedicine that is limited to services provided by doctors (Mashima, Birkmire-Peters, Syms, Holtel, Burgess & Peters, 2003). Access to timely shared patient information is crucial to the quality of care that can be provided by healthcare teams. Because of the complex nature of ehealth and the interaction of health carers, an essential element of ehealth is that of electronic medical records (EMR) (Stead, Kelly & Kolodner, 2005).

It has been claimed that the application of ehealth can improve the quality of life for frail older and disabled people by maintaining their independence while monitoring their specific health needs (Magnusson, Berthold, Chambers, Brito *et.al*., (1998). Since ehealth involves the use of computers and telecommunications it means that scope of the service can extend to patients regardless of the geographical location in which they live. It also offers the potential to eliminate the time, expense and inconvenience of travel especially for those living in remote communities (Macduff, West & Harvey, 2001). Consequently, it has been proposed that ehealth can improve the quality of life and health care of elderly people (Jennett, Affleck Hall, Hailey, Ohinmaa, Anderson, Thomas, Young, Lorenzetti & Scott, 2003), as 'services can be delivered in a manner that is timely and convenient' (Jones & Brennan, 2002: 293).

Despite the much discussed potential of ehealth (Smith, Bullers & Piland, 2000), in recent years doubts have been raised about its capacity to be effective in meeting the needs identified for it. For example, it has been suggested that a large number of ehealth initiatives have failed, so depriving people in need of the service offered through the implementations. Such failure has been largely attributed to many ehealth projects having been set up in isolation, and with little regard for their cost effectiveness (Macduff, West & Harvey, 2001). Because of the considerable financial commitment required for widespread ehealth implementations, such projects need to be evaluated to provide evidence of cost effectiveness. At the same time the quality and level of patient care provided through ehealth needs to be scrutinised to ensure the desired outcomes are being achieved.

The current research examined the nature of international research projects in ehealth in geriatric care environments. The purpose of the research was to investigate the evidence for the effectiveness of ehealth in this arena, given the predictions made for it. In this way an understanding was sought regarding the nature of any "disconnect" between planned goals and outcomes in the provision of geriatric ehealth services.

Method: A framework developed in one of the few reviews of ehealth in geriatrics was utilised for the current study. Nebeker, Hurdle & Bair., (2003) reviewed past and present implementations of medical informatics in three areas that they referred to as "trends": a.) Provider-Provider Interaction, b.) Provider-Patient Interaction and c.) Provider Decision-Support (p. 821). Nebeker Hurdle & Bair, (2003) argued that the first two categories are of particular importance in geriatrics.

The framework was used to categorise the studies into broad areas, and any positive outcomes and limitations reported were also analysed. A systematic review was undertaken of scholarly articles appearing in April 2005 in an extensive range of electronic databases that indexed both health science and ICT journals. The search terms, Geriatric* OR aged care OR nursing home AND ehealth OR "e-health" OR "health informatics" OR "medical informatics" OR telehealth OR telecare, were used by two researchers, after exploration of the results returned.

The following databases were searched:
- ProQuest (15 databases including technology and health articles dating from 1986–1987);
- Medline (the largest database of world health and medical journals)
- CINAHL (indexes nursing and allied health publications);
- The Cochrane Library (includes over 2000 international reviews of health interventions from 1993);
- Health and Medical Complete (over 380 health journals); and
- Australasian Medical (indexes 124 Australian medical journals and conference proceedings, starting from 1968).

The full text of published papers was used where available, or if unavailable, the abstract (Jennett *et.al.,* 2003). The use of abstracts for some papers was a limitation of the study. Citations, laboratory trials, utilisation of telephone technology only, review articles and non-empirical papers were excluded. Using the search terms, 10 articles were identified from ProQuest, 2 from the Cochrane Library, 52 from Medline, 583 from CINAHL and 0 from AMI, resulting in a total of 647 primary articles.

The 647 articles were then reviewed manually by two trained Information Systems researchers, who sought ehealth implementations in aged care. Of 66 papers identified that met all the search criteria, 3 were derived from ProQuest, 12 from Medline, 1 from the Cochrane Library and 50 from CINAHL. The papers were then classified into the three Nebeker, Hurdle & Bair, (2003) framework groups, then into more specific subcategories, according to the nature of the research. For each subcategory, the positive outcomes and limitations of the projects were collated from the information available through the databases. Frequencies of the number of papers published in each group and subcategory were recorded, along with the number of papers that reported upon trials.

Results and Discussion: As can be seen from Table 1, of the publications categorised as being in the Provider-Provider group of the framework, three papers reported upon training or the provision of information for providers. Just two of the papers focused on EMRs, while a single paper considered the use of ehealth for evaluating the home environment of elderly patients before their discharge from hospital.

It was surprising that only 6, or 9% of the total papers published that met the search criteria, fell within the Provider-Provider category, despite the emphasis in the literature on the potential of ICTs to improve the quality of health care though the timely and current transfer of health data and information. The positive outcomes reported from the analysis for Provider-Provider studies were few, while the limitations received more emphasis. This was particularly so for EMRs, even though the benefits of EMRs have been much discussed in the wider ehealth literature. However, based on

Table 1 Analysis of Nature of Provider-Provider Studies

Positive outcomes reported	Limitations reported
Training/ information needs for providers (3 papers)	
WWW can provide valuable information; Training access in rural areas; Effective for training.	Information overload; Unstructured nature of WWW; Focus more on personal & informational needs; Not a replacement for traditional methods.
Electronic Medical Records (2 papers)	
	Aged care EMRs & information management needs are unique, so models from acute care unsuitable; Benefits not demonstrated; ROI poor; These challenges will need to be overcome before effective implementation in industry; Trial only.
Evaluation of home environment before hospital discharge (1 paper)	
86% of problems noticed in on-site assessment detected.	Some problems not identified.

just two empirical studies found in the area, it appears that the constraints associated with the technology will limit their adoption in aged care. Although it may be possible to demonstrate effective use of EMRs in critical care, the models of use in that environment are not suitable for direct transfer to long term care (Catz, Bernardo, Phillips & Podolak 2003). Moreover, the projected poor Return on Investment (ROI) in the long term care environment (Catz, *et.al.,* 2003) will pose considerable challenges to the adoption of EMRs there.

Table 2 Analysis of Nature of Provider Decision Support Studies

Positive outcomes reported	Limitations reported
To inform care of group/individuals for a condition (7 papers)	
Improved diagnosis; Identified risk factors; Provided risk assessment; Enabled life expectancy prediction; More effective for prediction than existing methods.	Need to enter structured data; Data quality an issue; Integration problems with data download; Model inadequate to explain majority of occurrences.
Assessing telehealth needs (1 paper)	
Improved technology acceptance of elderly.	

Table 2 presents an analysis of the Provider Decision Support Studies (DSS). Again, only a limited number of studies in this area was found, with 8 or 12% of the total papers. The great majority of these studies reported upon ehealth to inform the care of either a group or individuals for a medical disease or condition. Some of the outcomes reported were very positive, including enabling more effective predictions than do existing methods, and improved diagnosis and risk assessment. The reported constraints of provider use of DSS were either technical in nature, or referred to the inadequacy of the model used.

Provider-Patient studies dominated the published research studies found, with 54 of the 66 papers, or 82% of the total. It can be seen from Table 3 that the subcategories in this group with the greatest number of papers were ehealth monitoring of elders at home (13 studies), ehealth for specific diseases or conditions (15 studies), investigations of a specific technology or system (12 studies) and ehealth for patient or carer training or information provision (10 studies). In some cases it was difficult to determine from the publications the precise nature of the ehealth technology in use, partly because of an inconsistency in use of ehealth terms, use of diverse terms for ehealth in different geographic regions and also because of the shift in meaning of the terms as the area has developed over time.   However, most of the Provider-Patient studies investigated a form of videoconference technology, and the studies tended to be repetitious and lacked innovation. The exception was for the subcategory that focused on a particular technology or system, where more variety and innovation were noted. The positive outcomes reported suggested acceptance of the technology by patients and providers, with equal or improved measurable outcomes for the patients.

Table 3 Analysis of Nature of Provider-Patient Studies

Positive outcomes reported	Limitations reported
Ehealth monitoring at home (13 papers)	
Patient control possible; Education & psychological support provided; Greater patient functional independence; More effective than traditional methods; Support elders in their own home; Reduces ER, hospital, nursing home admissions & hospital stays; Provides adapted technology to suit needs; Acceptance of approach seen.	Some technical & social challenges reported; Cost can be a constraint; Inadequate for disabled as human labour required; Devices need to be smaller and include volume control & voice activation; Hypothetical acceptance for others seen rather than personal adoption; Ethical issues raised including patient autonomy independence, security & privacy.
Ehealth and nursing homes (2 papers)	
Increased productivity; Cost savings; Well-accepted by both parties.	Not all homes chose to adopt technology; Not cost-effective until more homes use the service; Lack of ownership & planning; Nature of participants & their location can be problematic.
Ehealth for specific diseases/conditions (15 papers)	
Telemonitoring more effective for blood pressure control; Accepted by patients & staff; Efficient, lower cost than traditional method; Reduced congestive heart failure readmission rates; Increased communication; Feasible; Decreased hospital & ER admissions; Depression reduced, eating & sleeping better; Similar results to face-to-face assessments; Improved outcomes; Decreased home nursing visits; Demonstrated validity & reliability; Less patient travel.	Small numbers in trial; Availability of electric outlets in home an issue; Involves a cultural change & so needs preparation for its use; May not be suitable for those with overwhelming health problems; Frustration by patients that it's not used more often; Inability to touch or smell caused limitations; Technical considerations sometimes took precedence over patients; Increased volume of use would make it more cost-effective.
Focus on integration of nurses & ehealth (2 papers)	
Reduced costs & length of hospital stays; Patient satisfaction; May provide better access to doctor for those without a car.	Effectiveness for some conditions queried eg for skin complaints; Some technical problems noted.
Focus on a specific technology/system (12 papers)	
High acceptance; Promoted communication; Output helped identify deficits; Provided sufficient information for consultation; Seamless pre-hospital to hospital care enabled; Increased speed of treatment; Fewer congestive heart failure visits; Greater patient confidence; Human monitoring of alarms reduced; Reduced inappropriate referrals to medical provider; Satisfactory for health assessments.	Needs to be promoted; Familiarity, safety, transparency & interest need to be considered; In-home trials & technology improvements needed; Similar outcomes to telephone follow-up, but more expensive; Appliances did not always work appropriately; Some lack of awareness/acceptance of technology by patients & providers; False alerts; Wheeze & edema more likely to be missed in telehealth consultation; Abnormal fingernail colour misidentified by nurses; Use more indepth interviews to elicit symptoms in teleheath consultations.
Ehealth for patient/carer training or informational needs (10 papers)	
Less embarrassment & greater self-disclosure to computer program seen; Acceptance by elderly; Program increased carer resourcefulness, competence & knowledge; Increased patient understanding & confidence; Online & videoconference training effective; Greater depth of training, catered for broader needs & self-directed learning; Barriers were overcome when patients accessed current, local and relevant information; As acceptable & effective as conventional training; Increased treatment compliance; Less hospital/nursing home admissions & prescriptions; Web used for support, to find results of clinical trials.	More expensive & takes longer to produce than booklets, videotapes; Some patients commented on repetitiveness of program; Need for agreed standards on how to maintain & authenticate health & social web information; Further research needed to compare against conventional training; Increased patient empowerment & satisfaction.

Some technical and social limitations were reported, while it was noted that the systems will need greater uptake to be cost-effective. Several studies identified that ehealth technologies were less suitable for some applications, including use for skin complaints and detecting edemas.

A total of 43 of all the 66 studies found were trials, including a majority of papers in this Provider-Patient category. Many of the studies in this framework group involved trialling the use of videoconference or a closely related technology to elderly people in their homes.

Conclusion: A search was undertaken of an extensive range of databases that included the leading international medical and technology journals, seeking scholarly studies on ehealth in aged care, covering the period 1996 to 2004. As only 66 papers that met the search criteria were found, it can be seen that relatively few rigorous research studies have been reported upon in this area. When the studies were classified according their nature using a framework by Nebeker, Hurdle & Bair, (2003), Provider-Patient studies accounted for the great majority, with surprisingly few papers that derived from Provider-Provider or Provider Decision Support studies. However, in the wider ehealth arena, much discussion has taken place about the potential of Provider-Provider

implementations, such as EMRs, and Provider DSS applications, to bring benefits to patients. The analysis suggests that these uses of ehealth have not been implemented in aged care, or if they have, they may not have been evaluated rigorously. Furthermore, almost two-thirds of the studies published reported on trials, usually of very limited size. It may be difficult to achieve the same results obtained from a limited trial, when implementing large-scale applications of ehealth in aged care, where there are more variables to manage. Moreover, many of the Provider-Patient studies were repetitious implementations of video-conference technology, often to evaluate its utility, particularly for a particular disease or condition. Relatively few innovative implementations of ehealth in aged care were found. As a result of these findings, it is difficult to be confident about the cause of any perceived "disconnect" between organisational goals and outcomes for ehealth in aged care. Furthermore, from the analysis undertaken it is hard to find evidence that a gap exists between the goals and outcomes from ehealth in aged health.

Although there were indications that some ehealth implementations examined in aged care were effective, with their acceptance by many patients and providers, a range of limitations was also reported, including social and technical issues. In particular, one study noted that as long-term care and acute care environments have different information management needs, the EMR model that offers so much promise to acute care may not be transferable to the aged care sector, until the benefits can be demonstrated and the challenge of financing the implementations is overcome. However, it will not be possible to demonstrate convincing evidence of the benefits of ehealth to the aged care environment, until a greater number of rigorous research studies has been undertaken and reported. The perception of a 'disconnect' between the goals and outcomes of ehealth applications in aged care has not been derived from rigorous evaluation. This is not to indicate that the perception is inaccurate. Instead, it is simply too early in the use of ehealth for aged care to be able to support the claim from the results of rigorous published research. However, by the time this form of evidence is available, it is likely that the problem will be more difficult to overcome.

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