Evaluation Study of Australian Telehealth Projects

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Abstract

This paper provides an overview of selected telehealth projects involving pilot or trial implementations, undertaken in Australia in the period since 2000, which have undergone substantial formal evaluations reported in the peer reviewed scientific literature. Barriers and enablers reported for these telehealth projects are identified and the evaluation aspects are presented using a recently proposed generalised evaluation framework.

Keywords: telehealth, evaluation, pilot, trial, technology adoption.

1 Introduction

Telehealth is the delivery of health services and information remotely via telecommunications. The uses of telehealth are numerous and not limited to specific areas of health. However, the evaluation of the success of health services delivery using telehealth depends closely on the particular implementation and so there is no single standardized evaluation approach. When implementations are undertaken, often at great expense and effort, yet are not properly evaluated, many of the learnings can be lost.

This research study sought to analyse exemplary cases of telehealth projects involving pilot and trial implementations of telehealth-delivered services undertaken within Australia, which have been evaluated in some detail and have shown clinical benefits, cost benefits or both. This exercise is timely because the Australian government has recently invested in a number of large telehealth implementation projects which are intended to be nationally scalable and sustainable in the long term.

Our study aimed to identify those aspects of telehealth projects which were evaluated, and determine the extent to which these aspects were regarded as providing substantial evidence for telehealth adoption within Australia. We mapped these aspects to a recently proposed evaluation framework and we also identified barriers and enablers that were reported for telehealth implementations. It is argued that this information would inform the conducting of future large scale telehealth project evaluations.

2 Telehealth Evaluation

Telehealth lacks a well-accepted framework for conducting evaluation of implementations. Various models have been suggested as generic approaches for evaluation in eHealth such as the GEP-HI model (Nykänen et al 2011), but these tend to ignore the substantial human-in-the-loop aspects central to telehealth service delivery. Clinical and economic impacts are difficult to analyse when many telehealth implementations are discontinued beyond pilot phase, or are undertaken on a single site, or provide care to a minimal number of patients. These characteristics limit the power of typical statistical analysis that can be performed.

Early work by Scott et al (1999) proposed a Telehealth Integrated research Model (TIRM) which adopted a timeline-based approach from needs assessment through integrated research to post-study assessment. It allowed for consideration of human, social, cultural, economic, and political factors associated with healthcare. This approach was targeted at strategy and policy makers, rather than at systems developers and service implementors.

Hebert (2001) proposed a conceptual evaluation framework based on quality criteria defined by structure-outcome-process variables in a telehealth context. This included in its scope: health technology assessment studies, with consideration of cost elements and alternatives to Telehealth; application of performance measures, including outcomes, summaries and operational considerations; and programme evaluation for use of the technology to provide a service. Variables for evaluation would address identified "success" factors such as technical acceptability of the system, cost/benefit/effectiveness, organizational support, satisfaction, recruitment and retention, client outcomes such as quality of life, acceptance by consumers and providers.

The Telemedicine Evaluation model, a more recent contribution by Brear (2006), adopted an outcomes-orientated telehealth evaluation approach. The primary focus was to evaluate the clinical impact of a telehealth service, with the operational context of the service and cost effectiveness in mind. The approach was framed in terms of typical evaluation study questions following a systems analysis style (see Figure 1). A limitation of this approach is that longer term factors leading to scalability and sustainability are not easily incorporated.

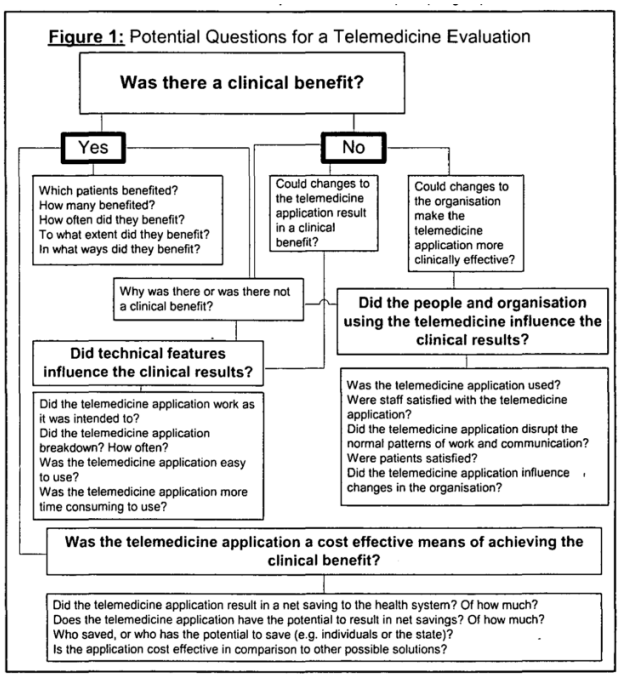

Figure 1: Telemedicine Evaluation model (Brear, 2006)

Another approach to telehealth evaluation is the use of a modified technology maturity model (van Dyk and Schutte 2012). Adopting a systematic view of a telehealth service, the maturity model allows for measuring the capabilities of a service and perceived sustainability in a more open-ended fashion, beyond the pilot phase. This Telemedicine Maturity Model (TMMM) utilises a three dimensional approach to describe evaluation alignments with Maturity Categories, Telemedicine Process and Maturity Levels (see Figure 2).

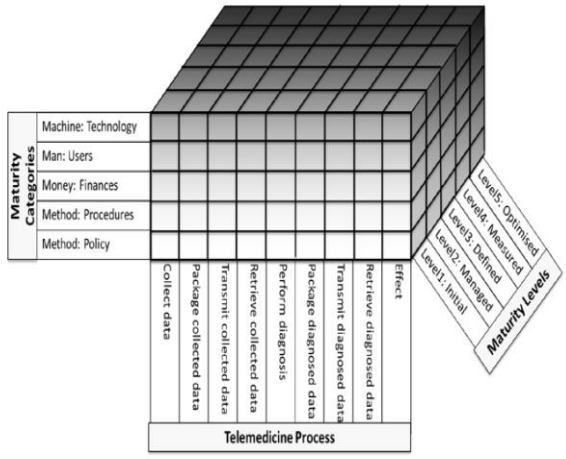

Figure 2: Telemedicine Maturity Model (van Dyk and Schutte, 2012)

The main benefit of the TMMM approach is the strictly structured, systematic approach it provides to the evaluation of the delivery of a telehealth service. However, a drawback is the inflexibility to adapt or change its components to fit any arbitrary telehealth service. A telehealth service that does not follow the same sequence of steps in the process levels in the maturity model may not fit the model, leaving steps undefined that would be essential to certain services.

Recently a framework appropriate to Australian circumstances has been proposed by the Institute for a Broadband-Enabled Society (IBES) (Dattakumar et al 2013). This model is based on learnings from an extensive literature review of telehealth service evaluations. The resulting structure contains four separate layers in key areas for evaluation: Patient, Clinician, Organisation, and Technology. This framework is intended to be broad-based in its applications and offer the potential to be strongly aligned with strategic national directions.

3 Study Methodology

We wished to consider only peer reviewed scientific literature publications on Australian telehealth projects which reported formal evaluations. We initially constructed a list of publications by conducting a search for the period 2000-2013 using the combination of search terms ("Australia") AND ("pilot" OR "trial" OR "evaluation") AND ("telehealth" OR "telemedicine" OR "telecare"), and including hyphenated variants.

We applied this search to PubMed as well as a range of different literature search databases available through our university library. The search period was limited to publications appearing between the years 2000 and 2013 inclusive, to ensure the currency of the findings. The most prolific result from these searches was obtained from PubMed (477 papers), with Scopus next (237 papers). All search results were aggregated and duplicates were eliminated to obtain the final search results (504 papers).

Next we read the abstracts of the remaining papers to determine whether they were within the scope of our study. This was determined by the following criteria:

- A pilot or trial of a telehealth implementation was involved,
- The trial related to a specific clinical area and was aimed at achieving clinical benefits,
- A formal evaluation component was included, based on an established methodology and applied on a sufficiently large scale.

Using these criteria we identified 55 papers which described projects that we deemed to be worthy of further analysis. Each of these papers was read in full and the details reported were summarized. We organized the papers according to the clinical area and type of health service being delivered by telehealth, and scored the relevance of the papers to our study using Brear's (2006) criteria:

- Was there a resulting clinical benefit?
- Did People, Organisational or Technical aspects influence the clinical result?
- Was the Telehealth Application a cost beneficial way to achieve they clinical result?

From this set of papers we extracted one exemplar for each clinical area that had been represented in the set of 55 relevant papers, based on the strength of evidence it provided. By discarding papers on projects of smaller scale or using less stringent evaluation methodology, we

expected to avoid marginal effects and concentrate our analysis on more significant findings. Finally we obtained a set of 15 distinctive exemplar papers, which are summarized in Table 1.

4 Results Discussion

The results in Table 1 cover a wide range of clinical areas including:

- Diseases e.g. diabetes, hepatitis, ear and eye.
- Trauma e.g. burns, wounds, emergency.
- Disability e.g. speech, psychiatry.
- Public health e.g. mental and sexual health.

Nevertheless they are not a comprehensive set of all the areas that were addressed by Telehealth projects, which included others such as aged care, rehabilitation, oncology, paediatrics. It was not expected that this study would cover all areas as the inclusion criteria were aimed at finding "good" exemplars with significant evaluation results, from which generally applicable findings could be deduced.

The range of evaluation methodologies covered was also quite narrow, ranging from randomised controlled trials, to mixed methods and surveys, to feasibility studies. Again, we were not intending to cover examples of all methods, but rather seeking to examine sound cases with clear outcomes. The size of studies also varied widely, from 10 to 558 subjects, but often this was due to the nature of the clinical area, which would not conducive to a larger scale of deployment (e.g. cystic fibrosis).

Consideration of the details presented in each of the selected papers can lead to some points of common experience, indicating aspects of telehealth projects which may therefore be preferred elements for evaluation. We will discuss these from the negative and positive impact perspectives, identifying barriers and enablers for telehealth adoption and success.

4.1 Barriers to Telehealth Adoption

Fewer common barriers were established than enablers, perhaps because most projects concentrated on establishing the success of their outcomes. A clear barrier factor was the lack of clinician uptake and support of telehealth initiatives. For example, general practitioners were found to be less likely to adopt telehealth than clinicians in private or public hospitals: it was reported that they are hesitant to 'try new things' despite trial successes (Smith et al 2012).

Broadband infrastructure and equipment costs can be a barrier to telehealth adoption. Some locations (in particular remote or rural areas) may have poor broadband infrastructure or no broadband access at all. Specialised equipment may not be available in some remote areas and may be too expensive to purchase. Where telehealth is being utilised, high speed internet is vital to those methods in particular for data heavy operations such as videoconferencing (Saurman et al 2011).

For some telehealth services, appropriately trained staff are required in remote locations to ensure the correct data is captured/recorded and forwarded on (store-and-forward approach) to clinicians. Telehealth training locally may also be necessary for more complex systems and to ensure clinician competence (Pa et al 2010).

Uptake of telepsychiatry is slow in Australia despite being widely reported as a successful example of telehealth at an international scale. A lack of funding for services is a major issue faced in this area, despite established savings due to service delivery cost reductions (Smith et al 2012).

Some patients are hesitant towards using telehealth as they feel there is little or no personal connection with their clinician. Others such as migrants with LOTE backgrounds are disadvantaged if translation and cultural support services are not available. These issues are particularly disadvantageous to telepsychiatry or speech pathology (Carey et al 2010). On the other hand, some of these patients value the increased detachment and privacy experienced during their telehealth encounters (Bird et al 2010).

4.2 Enablers of Telehealth Adoption

Rural and remote areas of Australia greatly benefit from the use of telehealth services, as it cuts down on patient travel costs and reduces stress involved while providing the same if not superior clinical and cost benefit to those involved. Telehealth is of greater convenience to remote populations that would otherwise have to travel to larger towns or cities in some cases to receive the medical care they require (Herrington et al 2013).

Telehealth has made a great difference to improving the health of the Aboriginal and Torres Strait Islander population. This is evident from pilot trials alone (Sanatamaria et al 2004, Elliott et al 2010).

Accessibility and availability of treatments is a concern telehealth addresses. This is the case in the treatment of chronic stuttering. The Camperdown Program (Carey et al 2010) found that across 40 participants there was no significant difference between treatments provided face-to-face or by telehealth.

Videoconferencing has also been successfully utilised in the area of monitoring patients that with debilitating conditions such as cystic fibrosis (Cox et al 2013), or with serious treatable diseases such as hepatitis C (Nazareth et al 2013). As with the case of speech pathology, differences in assessments and decisions between face-to-face consultations and videoconferencing were not detected. It was found that telehealth greatly improves the self-management of type 2 diabetes using a telephone-linked care (TLC) programme (Bird et al 2010).

The method of videoconferencing for patient-clinician interaction allows for a more interactive and personal consultation when distance and travel are an issue (Herrington et al 2013, Waite et al 2010, See et al 2005). Telephone consultations and videoconferencing were found to be viable methods of allowing people to consult a clinician about private health matters such as sexual health. Simple use of SMS has also been found to greatly improve clinical attendance of scheduled appointments. Privacy is the primary concern for people (in particular young adults) to choose such modalities (Gold et al 2010).

Paper	Area of Health	Study/Trial Summary	Sample Size (patients)	Evaluation/Analysis Methodology
Bird et al 2010	Diabetes	Care and monitoring via automated telephone system	340 people	Randomised Controlled Trial
Carey et al 2010	Speech Pathology	Stuttering treatment via videoconferencing	40 people	Randomised Controlled Non-inferiority Trial
Cox et al 2013	Cystic Fibrosis	Physiological measurements via videoconferencing	10 people	Feasibility Study
Elliott et al 2010	Chronic eye and ear diseases	Screening patients in a vehicle and uploading results to clinicians remotely	442 people	Feasibility Study
Gold et al 2010	Sexual Health	Sexual health promotion through SMS to young adults to increase their likelihood of safe sex and regular checkups	43 people	Evaluation Focus Groups
Herrington et al 2013	Emergency Care	Telemedicine (primarily videoconferencing) assisting clinicians in remote diagnosis and care	25 sites (locations)	Feasibility Study
McWilliams et al 2007	Paediatric Burns	Clinical reviews of paediatric burns via videoconferencing	30 people	Survey
Nazareth et al 2013	Hepatitis C	Patients in remote or rural areas were reviewed and treated for hepatitis C via videoconferencing	35 people	Feasibility Study and Survey
Pa et al 2010	Diabetic Foot Ulcers	Store-and-forward approach used to report on the status of diabetic foot ulcers	8 people	Survey
Santamaria et al 2004	Wound Care	Store-and-forward approach to wound care	93 people	Randomised Controlled Trial
Saurman et al 2011	Mental Health	24-hour mental health specialists available via videoconferencing to rural and remote populations	558 people	Mixed Methods Evaluation
See et al 2005	Dermatology	Dermatology diagnosis and treatment through the use of digital images, e-mail, fax	46 people	Feasibility Study
Smith et al 2012	Psychiatry	Examination of the costs involved with telepsychiatry	N/A	Retrospective Review
Wade et al 2002	Tuberculosis Medication	Monitoring tuberculosis treatment via videoconferencing	128 people	Mixed Methods Evaluation
Waite et al 2010	Literacy	The assessment of children's literacy via videoconferencing compared to face-to-face consultations	20 people	Randomised Controlled Trial

Table 1: Selected exemplar projects

Videoconferencing has been successfully and widely used in the area of psychiatry. Telepsychiatry has been noted as successful and cost efficient however there is low uptake in the adoption of telepsychiatry practice (Saurman et al 2011, Smith et al 2012). The possibilities of telehealth are not strictly limited to medical care, telehealth has been applied to the assessment of literacy skills in children (Waite et al 2010).

Store-and-forward approaches to patient information and data transfer allow for effective data management and time efficient information sharing. The store-and-forward method has been trialled in areas such as managing diabetic foot ulcers with successful outcomes (Pa et al 2010).

Telehealth has been shown in some trials to offer significant cost benefit over using more conservative methods of care, such as in telepsychiatry (Saurman et al 2011, Smith et al 2012). The telehealth based paediatric burns service at the Princess Margaret Hospital conducted 297 clinical reviews via videoconferencing and estimated cost savings at close to $1000 per session (McWilliams et al 2007). The monitoring of medication adherence for patients with tuberculosis has also been discovered to be cost effective through the use of videoconferencing when compared to traditional methods of a drive-around service (Wade et al 2012).

5 Evaluation Framework

The above discussion has identified a set of aspects associated with barriers and enablers for Telehealth, summarised in Table 2. These aspects may be used as a basis for further evaluation exercises in future Telehealth projects, with the advantage that there is at least one benchmark study with which they could be compared. However, it is likely there are other aspects which have

not been identified due to the limited scope of the exemplars.

Barriers	Enablers
Clinician unwillingness for change and adoption	Videoconferencing accessibility and usability, improved attendance
Broadband infrastructure or equipment costs	Clinical and cost impacts for remote areas, disabled and indigenous health
Staff training for effective use	Reduced travel costs and stress
Lack of funding for setup and maintenance, and reimbursement	Store-and-forward approach to data management and sharing
Patient personal reactions to use of teleheath	Transferrable evidence of clinical and cost benefits

Table 2: Major barriers and enablers for telehealth implementations.

The question arises whether these identified aspects could be expressed in a broader continuum so that at least a set of comparable or related aspects could be identified to enrich an evaluation. We addressed this need by making use of the recently proposed IBES Australian generic telehealth evaluation framework (Dattakumar et al 2013). The IBES framework provides four component areas essential to the function of a Telehealth system:

- Patient factors: control of the care involvement
- Clinical factors: quality of care and outcomes
- Organisation factors: efficiency, sustainability
- Technology factors: capability, capacity.

The barrier and enabler aspects we identified can be associated with the above factors. The framework allows aggregation of all aspects considered, and methods applied, in evaluation studies to describe each factor or component area in detail, and thereby compare different projects. Our association of the identified aspects from this study with the four component areas in the evaluation framework is shown in Table 3.

Framework Factor	Aspects identified in Study
Patient	Reduced travel costs and stress (E); Patient personal reactions to use of teleheath (B)
Clinical	Clinician willingness for change and adoption (B); Clinical and cost impacts for remote areas, disabled and indigenous health (E);
Organisation	Staff training for effective use (B); Lack of funding for setup and maintenance, and reimbursement (B); Store-and-forward approach to data management and sharing (E); Transferrable evidence of clinical and cost benefits (E)
Technology	Videoconferencing accessibility and usability, improved attendance (E); Broadband infrastructure or equipment costs (B)

Table 3: Association of study findings with evaluation framework (B = barrier; E = enabler).

Adopting an approach to evaluation based on the generic framework appears to be consistent with our study findings, in that there is a close match to one of the four component areas in each case. Further analysis of other telehealth projects not considered here may therefore benefit from adoption of a similar bottom-up process as we have used, or a top-down process using aggregated information from related framework based studies.

6 Conclusion

This paper has described a literature based study to identify good exemplars of Telehealth projects where evaluation studies have been conducted, and has summarised the findings of 15 such studies in terms of their identification of barriers and enablers to telehealth implementation adoption and deployment. The findings were subsequently mapped to a recently proposed generic evaluation framework to demonstrate that conclusions were reached in valid areas for further use in future studies.

The work reported here was limited by the choice and application of the methodology for identifying and assessing Australian telehealth projects from the peer reviewed literature. More exemplars could have been included, and a wider search scope could have been set. This form of limitation, which would affect any such study, would be avoided if an Australian repository of telehealth projects were to be established, Advantage would be gained by having the ability to find evaluation aspects of comparable projects easily and unambiguously. Furthermore, the use of a framework such as the one applied here, would considerably simplify and regularise the approaches taken in evaluating Telehealth projects in the future.

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