

Evaluation Strategies for Telehealth Implementations

Anthony Maeder and Nathan Poultney

School of Health Sciences
Flinders University
Adelaide, Australia

anthony.maeder@flinders.edu.au, pou0005@uni.flinders.edu.au

Abstract—Telehealth implementations are often inadequately evaluated, due to selective focus of interest and limited analysis of individual factors. This paper provides an appraisal of some generic approaches to evaluating telehealth implementations, based on a survey of contributions in the literature. Some strengths and limitations of existing approaches are identified. Adoption of a framework-based strategy is advocated, with the option of combining evaluation measures for different aspects of implementations in a hybrid structure.

Keywords—telehealth; evaluation; framework

I. INTRODUCTION

Early work in telehealth was poorly served by inadequate evaluation efforts. There are several reasons for this deficiency. Emphasis was often placed on the novelty of the technology or organisational aspects of the intervention, leading to evaluation of these aspects in preference to others more relevant to health impacts, and using associated evaluation methods which were often unfamiliar in clinical settings. A widespread simplistic initial view of telehealth as the utilisation of one of only a few different IT delivery mechanisms (such as video or image transfer), which could be analysed separately from any human or organisational aspects, has reinforced this viewpoint. Health benefits and health economics gains are typically realised only after a lengthy period of time, beyond the extent of projects which delivered the intervention, and so their inclusion in evaluations has often been seen as inconvenient or infeasible. On the other hand, participant experience and satisfaction is relatively easy to assess, and so many early evaluations incorporated that as a significant component of their coverage. This trend of emphasizing user experience and satisfaction has continued - for example in many recent mHealth trials [1] - which has tended to defocus evaluations from the resultant health effects or benefits.

As noted by Bashshur et al. [2]), a dilemma exists as to whether to evaluate a telehealth intervention as if it were a typical health intervention coincidentally delivered by telehealth technology, or whether to treat it as a special type of intervention for the purpose of evaluation, because it relies on telehealth. These two modes of perception of the intervention have led to the development of different families of models for evaluations. A related issue arising is whether conventional evaluation methods for health interventions generally are applicable to telehealth interventions, as the first model above

would imply, or whether specific evaluation methods should be developed for telehealth, in line with the second model. In reality, telehealth interventions are seldom evaluated without substantial interest in the telehealth aspects, so the second model has tended to dominate evaluation approaches. We will summarise a range of such ‘direct’ approaches in the next section, and then introduce the concept of ‘framework’ approaches in the following section. We will conclude with a discussion of the limitations and advantages across the range of approaches surveyed.

II. DIRECT APPROACHES

Direct approaches to evaluation may be defined as those methods which focus on a single category of factors, or a set of closely associated categories drawn from a unifying model, for evaluation purposes. Initial formal contributions of this type proposed approaches concentrating on case-specific aspects of interest [3] which permitted choice of emphasis on clinical, usage or technical aspects. Scott et al. [4] proposed adoption of a timeline as a unifying aspect in an implementation based model, with evaluation components for needs, integrated research process, and findings. This approach made allowance for human, social, cultural, economic, and political factors.

Cost and workload aspects were identified as important, warranting careful development of appropriate analysis methods [5] and have subsequently been the focus areas for many studies. A further important area targeted was psychosocial aspects related to users [6], such as usability and satisfaction. Emphasis was also placed on the efficacy of diagnostic and management decisions [7] and associated impacts on access and outcomes in telehealth services [8]. Finally, technical aspects of implementations were seen as a part of evaluation [9], in the areas of information capture and display, and information transmission (including statistical analysis and visual quality).

The notion of inferred causality linking the intervention characteristics with observed effects which were ascribed to telehealth in evaluations was described by Bashshur et al. [2]. The influence of medical care process models for unifying the effects of client and provider behaviours and explaining participation effects and clinical outcomes was advocated by Heinzlmann et al. [10]. These two alignments suggest that one strategy for conducting evaluations is to focus predominantly on the clinical aspects, which Brear [11] has

typified as determining clinical benefits, causal influences from technical, people and organisational factors, and cost-effectiveness in terms of obtaining the benefits (see Fig 1).

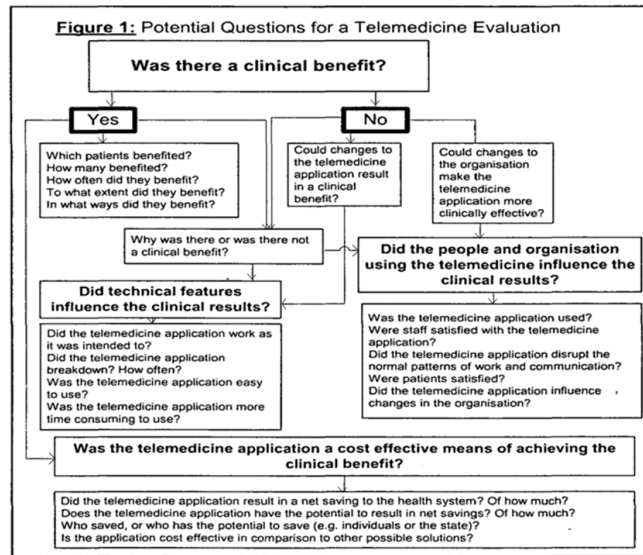


Fig. 1: Clinically focussed evaluation (Brear, [11])

Alternatively, approaches to evaluation may be derived through synthesis, by identifying key groupings of evaluation elements from reviews of studies of a number of comparable interventions. Ekeland et al. [12] reviewed a wide range of studies offering evidence of clinical effectiveness and itemised major evaluation elements as behavioural, cost/economic, health, organisational, perception/satisfaction, quality of life, safety, social, technology, Deshpande et al. [13] reviewed store-and-forward interventions and summarised the main evaluation elements in four categories: health outcomes, process of care, resource utilization and user satisfaction. Wade et al. [14] considered economic analyses of telehealth services, and determined that evaluation elements could be grouped as costs and effects, technology, and organisational aspects.

III. FRAMEWORK APPROACHES

Evaluation frameworks have been developed to provide a higher level contextual setting for selection, or aggregation, of the above diverse elements. We define an evaluation framework here as consisting of a structured collection of a wide range of evaluation categories associated with different evaluation questions or objectives, from which an evaluator might choose those most pertinent to the intervention. A strong argument in favour of framework approaches is that ad hoc choices of evaluation elements can lead to biased selection (or alternatively omission) of measures which are strongly correlated with the success (or failure) of interventions [15].

An early framework approach by Hebert [16] proposed three domains of focus for evaluation: structure, process and outcomes. This structure allowed diverse components to be incorporated in a study consistently e.g. health technology

assessment criteria with health services performance measures. Bashshur et al. [2] advanced a refined version of this approach with high level sequential structuring of evaluation aspects in four phases: evaluability assessment to identify what could or could not be evaluated based on the description and scope of the intervention project, documentation evaluation (including artifacts such as software) for the intervention design and implementation, then applying formative or process evaluation for the change and acceptance associated with deployment of the intervention in a clinical service, and finally summative or outcome evaluation applicable to health and economic benefits.

Taxonomies of telehealth have been useful mechanisms for identifying and grouping elements which may be candidates for evaluation, in different circumstances of telehealth instances. Tulu et al. [17] defined a structural taxonomy based on the components that must be used in the realization of a service, namely application purpose, application area, environmental setting, communication infrastructure, and delivery options. More recently, Bashshur et al. [18] developed a more top-down approach via conceptualisation as a three dimensional space describing intersection sets of functionality, application and technology elements (see Fig 2). Nepal et al. [19] proposed a framework of broader coverage, including six aspects for evaluation: health domains, health services, delivery technologies, communication infrastructure, environment setting, and socioeconomic analysis.

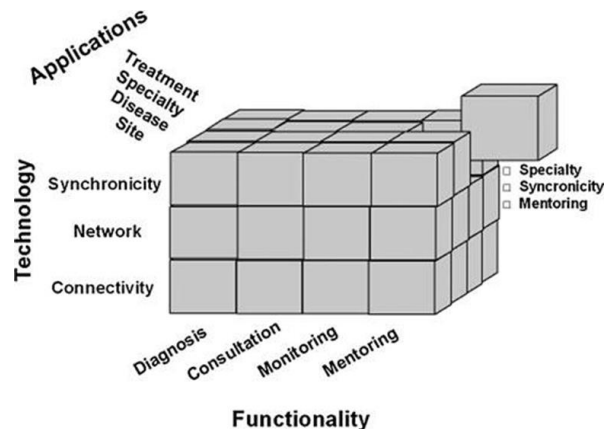


Fig. 2: Top-down telehealth taxonomy (Bashshur et al., [18]).

Alternative approaches to evaluation frameworks have emerged recently in an attempt to provide greater inclusivity and flexibility, as those described above tend to focus on abstract concepts to define them. Van Dyk [20] reviewed possible areas for evaluation based on technology development models, and advocated a multi-dimensional space associated with technology maturity principles and systems lifecycle concepts (see Fig 3). The associated framework [21] has a wide coverage of systems aspects through its “maturity categories” dimension, while enabling various clinical considerations to be included via the “telemedicine process” dimension.

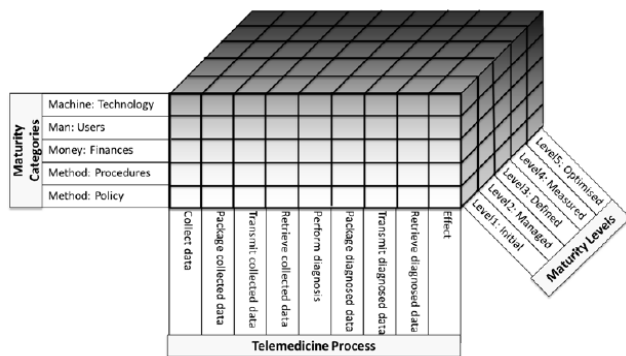


Fig. 3: Telehealth maturity-based evaluation model (van Dyk, [21])

Recently an evaluation framework appropriate to Australian telehealth circumstances was proposed by Dattakumar et al. [22], informed by an extensive literature review of telehealth interventions and service evaluations. The resulting structure contained four dimensions encapsulating key domains for evaluation: Patient, Clinician, Organisation, and Technology. This approach was seen as a means of aligning evaluation with organisational learning models and health system performance indicators. This framework was intended to be broad-based in its applications and offer the potential to be strongly aligned with strategic national directions (Maeder et al 2014).

IV. DISCUSSION

This paper has presented a view that for telehealth interventions it is difficult to treat evaluation components independently from one another, and to perform evaluation in isolation from the broader context of usage. Nevertheless, typical telehealth evaluations tend to have focussed on selected areas which include costs and resources, organisational and social aspects, and clinical benefits, rather than comprehensive coverage. Attempts to identify various sets of criteria, models and frameworks for evaluation have been described in the literature, without achieving widespread consensus. These have been based around such disparate views as the inherent sequential characterization of a telehealth intervention over time, or the taxonomic analysis of telehealth along system functionality lines, or the mapping of the intervention to a multidimensional maturity model space.

It has been argued that there is an overarching need to take a holistic approach and integrate different elements of evaluation to understand characteristics of the overall system of interest which is enabled by telehealth. Framework based evaluation strategies offer a more comprehensive and systematic approach to achieve this end than piecemeal selection of individual evaluation factors [24]. Such frameworks as those discussed above offer comprehensive coverage and useful mechanisms for description of evaluation instances (especially those pertinent to large scale projects or services), but add conceptual complexity that cannot be easily navigated for simpler telehealth implementations. This situation can make it difficult to select an appropriate

framework for a given study, due to the uniformity of evaluation resolution implicit in the extensive nature of a framework. For instance, if a telehealth intervention relies on previously proven usability and user acceptance aspects, but addresses a new clinical area in which its effectiveness is not known, it may be difficult to downrate one and uprate the other in the evaluation process.

A promising approach to achieve selective blending of frameworks in order to achieve the desired emphasis on different factors has recently been suggested [25], involving hybridisation of multiple frameworks. In this approach, A multidimensional meta-framework is synthesized by defining one dimension as varying across frameworks, while the other dimensions specify the areas of priority for evaluation (e.g. in the above example, human factors and clinical impact). Factors for evaluation can be drawn from the intersection of the various framework entries, in each priority area. This version of a framework based approach allows flexibility of choice of framework without compromising the depth available for specific factors. However, it requires mapping of frameworks to be undertaken for which no formal methodology currently exists.

REFERENCES

- [1] J.A. Ginige, A.J. Maeder and V. Long,, "Evaluating success of mobile health projects in the developing world." *Studies in Health Technology and Informatics*, vol. 206, Rotterdam: IOS Press, 2014, p. 7-19.
- [2] R. Bashshur, G. Shannon, and H. Sapci, "Telemedicine evaluation." *Telemedicine and e-Health* vol. 11, no. 3, pp. 296-316, 2005.
- [3] R.L. Bashshur, "On the definition and evaluation of telemedicine," *Telemedicine Journal* vol. 1, no. 1, pp. 19-30, 1995.
- [4] R.E. Scott, K. Coates, and G.F. McCarthy, "The value of an evaluation framework for telehealth initiatives," *Studies in Health Technology and Informatics*, no. 64, Rotterdam: IOS Press, 1999, pp. 39-45.
- [5] R. Wootton and M.A. Hebert, "What constitutes success in telehealth?" *Journal of Telemedicine and Telecare* vol. 7, suppl. 2, pp. 3-7, 2001.
- [6] B.H. Stamm and D.A. Perednia. "Evaluating psychosocial aspects of telemedicine and telehealth systems," *Professional Psychology: Research and Practice* vol. 31, no. 2 p. 184, 2000.
- [7] W. Hersch, M. Helfand, J. Wallace, D. Kraemer, P. Patterson, S. Shapiro, and M. Greenlick, "A systematic review of the efficacy of telemedicine for making diagnostic and management decisions," *Journal of Telemedicine and Telecare* vol. 8, no. 4, pp. 197-209, 2002.
- [8] W.R. Hersch, D.H. Hickham, S.M. Severance, T.L. Dana, K. Pyle Krages, and M. Helfand, "Diagnosis, access and outcomes: update of a systematic review of telemedicine services," *Journal of Telemedicine and Telecare* vol. 12, suppl. 2, pp. 3-31, 2006.
- [9] M. Clarke and C.A. Thiyagarajan, "A systematic review of technical evaluation in telemedicine systems," *Telemedicine and e-Health* vol. 14, no. 2, pp. 170-183, 2008.
- [10] P.J. Heinzlmann, C.M. Williams, N.E. Lugn, and J.C. Kvedar, "Clinical outcomes associated with Telemedicine/Telehealth," *Telemedicine and eHealth* vol. 11, no. 3, pp. 329-347, 2005.
- [11] M. Brear, "Evaluating telemedicine: lessons and challenges," *The HIM Journal* vol. 35, no. 2, pp. 23-31, 2006.
- [12] A.G. Ekeland, A.S. Bowes, and S. Flottorp, "Effectiveness of telemedicine: a systematic review of reviews," *International Journal of Medical Informatics* vol. 79, no. 11, pp. 736-771, 2010.
- [13] A. Deshpande, S. Khojja, J. Lorca, A. McKibbin, C. Rizo, D. Husereau, and A.J. Jadad, "Asynchronous telehealth: a scoping review of analytic studies," *Open Medicine* vol. 3, no. 2, pp. 69-91, 2009.

- [14] V.A. Wade, J. Kanon, A.G. Elshaug, and J.E. Hiller, "A systematic review of economic analyses of telehealth services using real time video communication," *BMC Health Services Research* vol. 10, p. 233, 2010.
- [15] D.E. Jackson and S.I. McClean, "Trends in telemedicine assessment indicate neglect of key criteria for predicting success," *Journal of Health Organisation and Management* vol. 26, no. 4, pp. 508-523, 2012.
- [16] M. Hebert, "Telehealth success: evaluation framework development," *Studies in Health Technology and Informatics* no. 2, Rotterdam: IOS Press, 2001, pp. 1145-1149.
- [17] B. Tulu, S. Chatterjee, and M. Maheshwari, "Telemedicine taxonomy: a classification tool," *Telemedicine and e-Health* 13, no. 3, pp. 349-358, 2007.
- [18] R. Bashshur, G. Shannon, E. Krupinski, and J. Grigsby, "The taxonomy of telemedicine," *Telemedicine and e-Health* 17, no. 6, pp. 484-494, 2011.
- [19] S. Nepal, J. Li, J. Jang-Jaccard, and L. Alem, "A Framework for Telehealth Program Evaluation," *Telemedicine and e-Health* vol. 20, no. 4, pp. 393-404, 2014.
- [20] L. Van Dyk, "A Review of Telehealth Service Implementation Frameworks." *International Journal of Environmental Research and Public Health* vol. 11, no. 2, pp. 1279-1298, 2014.
- [21] L. Van Dyk and C. Schutte, "Development of a maturity model for telemedicine," *South African Journal of Industrial Engineering* vol. 23, no. 2, pp. 61-72, 2012.
- [22] A. Dattakumar, K. Gray, S. Jury, B. Biggs, A. Maeder, D. Noble, A. Borda, T. Schulz, and H. Gasko, "A unified approach for the evaluation of telehealth implementations in Australia," *Institute for a Broadband-Enabled Society, University of Melbourne*, 2013.
- [23] A. Maeder, K. Gray, A. Borda, N. Poultney, and J. Basilakis, "Achieving greater consistency in telehealth project evaluations to improve organisational learning," *Studies in Health Technology and Informatics* no. 209, Rotterdam: IOS Press, 2014, pp. 84-94.
- [24] S. Agboola, T.M. Hale, C. Masters, J. Kvedar, and K. Jethwani, "Real-World" Practical Evaluation Strategies: A Review of Telehealth Evaluation," *JMIR Research Protocols* 3, no. 4, p. e75, 2014.
- [25] N. Poultney, A. Maeder, and J. Basilakis, "Evaluation study of Australian telehealth projects," *Australasian Workshop on Health Informatics and Knowledge Management* 2015, pp. 63-68, 2015.