Successful Implementation of Technological Innovations in Health Care Organizations

Eveline J. M. Wouters, Thea C. M. Weijers, and Tracy L. Finch

Contents

Abstract

In order to accept and implement technology in a successful manner, not only determinants (acceptance barriers or facilitators) related to individual persons, for instance, health care providers as well as health care recipients, are important. Also interpersonal relationships on the work floor as well as the readiness and support of the organization itself are involved in the process of uptake of innovations. The Normalization Process Theory explains how this can be understood. The Technology Adoption Readiness Scale (TARS), developed based on this theory, offers a tool to diagnose the opportunities and challenges in health

E.J.M. Wouters (✉)
Institute of Allied Health Professions, Fontys University of Applied Sciences, Eindhoven, The Netherlands
e-mail: e.wouters@fontys.nl

T.C.M. Weijers
Fontys University of Applied Sciences, Eindhoven, The Netherlands

Royal Kentalis, Nijmegen, Sint-Michielsgestel, The Netherlands
e-mail: t.weijers@kentalis.nl

T.L. Finch
Institute of Health and Society, Newcastle University, Newcastle upon Tyne, UK
e-mail: tracy.finch@newcastle.ac.uk

J. van Hoof et al. (eds.), *Handbook of Smart Homes, Health Care and Well-Being*,
DOI 10.1007/978-3-319-01583-5_68

care organizations with respect to the implementation of certain technology- or eHealth applications. In order to guide the process of large scale implementation of technological innovations, also a pre implementation diagnosis is useful. This diagnosis, when provided by a "neutral party" has proved to be helpful for monitoring, guiding and thus supporting the implementation process of technological innovations in health care settings.

Keywords
Acceptance • Implementation • Normalization Process theory • Technology

Introduction

In general, technology offers many opportunities to support processes in health care. At the same time, although promising, technological innovations in chronic health care tend to diffuse at a slow pace (Sanders et al. 2012). Several reasons have been postulated for this slow uptake, such as lack of using a holistic framework for design of technology in health care (van Gemert-Pijnen et al. 2011), the disruptiveness of technology in the interaction with specific groups, e.g., older persons (Peek et al. 2014), but also lack of standards, ethical, clinical and technical aspects (Anderson 2007), resistance to change practice by health care professionals (Li et al. 2013), as well as lack of guidelines for practical implementation in health care organizations (Koch 2006). Even technology that has proved its merits in small scale pilots, has difficulties to be adopted on a large scale in health care (Christensen and Remler 2009; Sanders et al. 2012). This results in disappointing, highly inefficient, and costly investments. In this chapter, we first briefly focus on theory that explains factors that hinder or support implementation of technology within health care organizations. Next, we discuss current possibilities to disclose these factors and an instrument to analyze them, and finally, we describe how monitoring and talking over implementation strategy helps to improve adoption of technological innovations in health care organizations.

Normalization Process Theory

Several theories and models explain acceptance and adoption of technology in individuals, such as patients and health care professionals. Most often cited is the TAM (Technology Acceptance Model) (Davis 1989), and its augmented variants (Ketikidis et al. 2012; Venkatesh et al. 2003). Within organizations, not only personal acceptance is important. Also the context of the organization plays an important part in probability of innovations to succeed (Christensen and Remler 2009). In a large literature review, Lluch gave an overview of implementation barriers associated with management in organizations (Lluch 2011). The main themes described were related to the structure of health care organizational systems

(e.g., team coherence or lack of team coherence and changes in work processes), people policies (e.g., training or lack of training, support by the organization in time, money or other ways), accountability and liability issues, incentives (e.g., start-up costs), and information- and decision processes, which can lead to more work load (Li et al. 2013; Mair et al. 2012). These issues have to be properly realized by the organization managers and likewise addressed, in order to achieve successful implementation (Li et al. 2013; Lluch 2011; Mair et al. 2012).

In order to understand the implementation of complex innovations in health care, the Normalization Process Theory (May and Finch 2009) and its predecessor, the Normalization Process Model (NPM) (May 2006; May et al. 2007) is helpful. NPT is a middle-range theory of implementation that is derived from empirical observation and analysis of studies of interventions in clinical practice (May and Finch 2009; May et al. 2009) and includes factors found to be important by several researchers (Holden 2011; Koch 2006; Lluch 2011; Mair et al. 2012; Sanders et al. 2012). The NPT describes those determinants that have been found to influence promotion or inhibition of complex interventions, but it also offers a foundation on which the probability of successful implementation of complex interventions can be judged (May et al. 2011).

Practice

In order to be able to use NPT in health care practice, four main components have been distilled, related to the elements described by May (May et al. 2009). These constructs are dynamic (non-linear) and form the basis for development and evaluation of innovations in health care. The constructs are: *coherence* (does the technology make sense and do staff understand why and how it works?), *cognitive participation* (are people really involved and committed to make the innovation work?), *collective action* (how do people actually use the innovation in their daily work practice?) and *reflexive monitoring* (how do they appraise and evaluate the innovation?) (Murray et al. 2010, see Fig. 1). Of these, collective action will be further described in more detail, as it is the construct of NPT that is most central to understanding how a new technology is *enacted* during an implementation phase.

"Collective Action" is derived from the original Normalization Process Model (NPM) and represents a detailed understanding of what actually happens "in practice" when individuals are required to work in a different way (May et al. 2007). Successful enactment can be considered the goal of any innovation, whether technological or not. In this stage of implementation, working with the new innovation or technology is in some level of operation and is somehow part of the process of every day work practice (May and Finch 2009). If we want to understand what implementers actually have to do in order to achieve this goal (i.e., truly embedding the technological innovation in practice), then the components of Collective Action (reflecting the four original components of the NPM) offer insight. These components are: *interactional workability*, *relational integration*, *skillset workability* and *contextual integration* (May 2006).

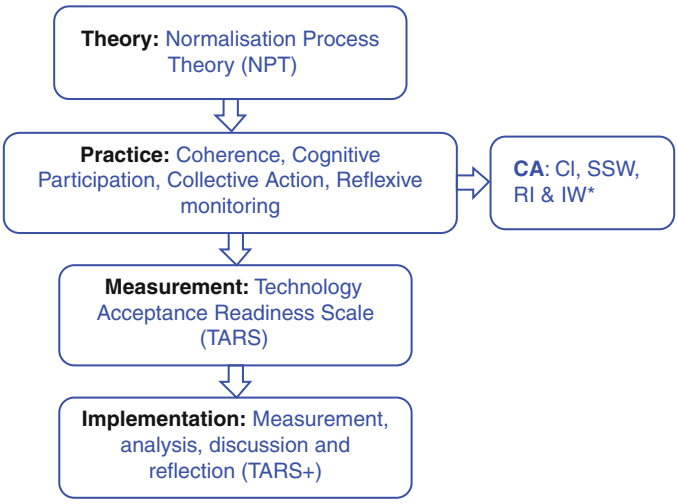

Fig. 1 Implementing technology into health care: from theory to practice

Of these four, *interactional workability* relates to how the technological innovation interferes with interactions between persons, especially between health care professionals and patients or residents, which is considered one of the most important values for professionals working in chronic health care (Murray et al. 2011; Nieboer et al. 2014). One good example (Nieboer et al. 2014) was that of a nurse who perceived the hoist not only to be useful in order to avoid her developing back problems. She experienced that it was also contributing the improvement of her relationship with residents: bed ridden persons who never had been at height level with herself, came at level when sitting in the hoist. For the first time she could "see them in the eyes" properly.

Relational integration refers to the impact that the new technology has on responsibilities between groups of professionals, feelings of trust and confidence, and how these might change as a result of the technology. If, for instance, there is no technical back up whenever technology fails, or if responsibilities in follow up of sensor alarms are not clear, this disrupts relational integration and causes a lot of stress and, consequently, non-adoption of the technology (Nieboer et al. 2014; Niemeijer et al. 2013). Similarly, in a comparative study by Murray et al. (2011), PACS (Picture Archiving and Communication System) was reported as promoting communication and trust between different professional groups because it enabled multiple users to view the same image from different locations. In contrast, a "choose and book" system for appointment making across primary and secondary care impacted negatively on relations between hospital consultants and general practitioners because it replaced personal contact that had previously been made between them in referring patients (Murray et al. 2011).

Skill set workability is about how the technological innovation might require changes in the original skills (and competencies) of work force. If, for instance, health care professionals have to do much more administration when using the technology, or if working with the technology requires high technological skills or lowers clinical autonomy, this is not at all helping implementation. Health care professionals have chosen their profession for certain reasons, related to certain core values (Nieboer et al. 2014), and interventions that interfere with these values are not easily accepted.

Finally, *contextual integration*, refers to how the technology is perceived to be in line with the goals, culture and mission of the organization. When there is trust that the technology supports the organizational goals and, vice versa, that the organization is supportive, for instance financial or otherwise, the implementation is more likely to succeed (Bush et al. 2009).

In summary, for technology to become normalized within a health care organization, it should enhance (or: not interfere with) personal relationships, be transparent as to responsibilities, fit in with skills, competencies and values of staff, and be in alignment with the goals of the organization. Organizations have to be aware of the importance of these factors and have to enact upon them in order to successfully implement new technology. In the next paragraphs, we will first describe the instrument derived from NPT that can help to measure (diagnose and monitor) the organizational "implementation proneness" with respect to technological innovations. Finally we will describe the experiences with the implementation of eHealth systems of several organizations, applying NPT and the four key constructs of collective action: interactional workability, relational integration, skill set workability and contextual integration.

Measurement of Technology Implementation

For organizations to be able to monitor implementation of new technology or eHealth systems on a level of scale, e.g., across sites, it is important to have a tool that offers insight into the dynamics brought about by the innovation, the individuals working with the innovation and the context of the organization in which the innovation is to be used (Proctor et al. 2011). For this purpose, a 30-item instrument was developed. The instrument is based on NPT and is called Technology Acceptance Readiness Scale (TARS) (Finch et al. 2012). With this instrument, the translation from theory to practice can be made measurable (see Fig. 1). In the UK, where it was developed, this resulted in a list of 30 items that included 27 items representing Collective Action, along with individual items to measure the three additional constructs of coherence, cognitive participation and reflexive monitoring that were added when the NPM was extended to Normalization Process Theory (Finch et al. 2012). Of questions on Collective Action, five are about interactional workability, seven about relational integration, six cover skill set workability and nine cover contextual integration. Ultimately, the TARS thus covers the full range of normalization of new technology within health care organizations

(Finch et al. 2012, 2013), but with greater emphasis on Collective Action (see Appendix). The tool is thus ideally suited to examining in detail the processes when a technology is in the stage of "implementation", but with some scope to address issues important to the wider processes of planning, implementing and evaluating as reflected in the extended NPT. The tool was pre-tested in two organizations, using two different eHealth systems (algorithm-based telephone triage, and hand-held digital devices to support community nursing practice). Also, for one organization the technology was relatively new (pilot), while in the other, it was already widely used. TARS was seen to be able to distinguish between levels of experience of the new technologies. It was also found that the overall ratings of level of "normalization" of the technologies that were retrieved from using the TARS were well related to participating health care professionals' reported perceptions of the routine use (or expectations thereabout). For example, in one of the e-Health settings, participants who rated the technology as "completely routine" (compared with "partially" or "not at all"), were significantly more likely to agree with positive statements about implementation factors, for example, about relational integration ("*I have confidence that using the eHealth system does not put patients at risk*"), contextual integration ("*This eHealth system fits in with the priorities and challenges of our organization*"), and interactional workability ("*The e-Health system is easy to use*"). Findings such as these from the TARS tool (Finch et al. 2012) were comparable with qualitative interview data from the same study (Murray et al. 2011) that reported participants' perceptions of barriers and facilitators.

Further Implementation into Practice

Inspired by NPT and its practical possibilities, as well as the strong recognition of acceptance and implementation barriers in the use of technology in chronic health care, the TARS was translated for application in The Netherlands. TARS was translated following the usual procedures (Koller et al. 2007). In two pairs of experts in technology implementation theory the items were translated into Dutch. The resulting two translations were compared and discussed until consensus was reached. One final translation resulted. Some items were also discussed with the author of the original instrument (Finch et al. 2012), who was able to trace back the team decision-making about specific items, and, if necessary, adapted. In the next step, the questionnaire was translated back into English by two linguists (English and Dutch). The final questionnaire was offered to ten health care professionals for comprehensibility. Only minor adaptations were necessary.

Consequently the questionnaire was used in five different organizations, of which the results of two are presented here. We replaced the general word "eHealth system" with the actual name of the technology used and the general word "organization" with the actual name of the organization, as intended for the original TARS instrument (Finch et al. 2012).

The TARS list was discussed with the first organization where it would be applied. This again led to some adaptations. Two questions were each split into

two separate questions and some questions that were of interest to this organization were added at the end of the questionnaire. Some of these questions (*do you think the implementation of the eHealth application is successful?; what grade would you give the eHealth application?*) proved useful and were retained to become part of the general questionnaire used later on.

During the translation process and the discussions on the right interpretation of the questions it became apparent that some questions and the answers to them could be interpreted in different ways. For instance, there was disagreement with the statement: "*the eHealth system is a different way of working.*" It was unclear for respondents if this meant "I am so used to the system that I no longer experience it as different" or did it mean "my way of working has not changed much as a result of the eHealth system." And if it means the latter, is that a good or a bad sign for implementation? In-depth interviews might have helped to understand the results better but are time consuming and difficult to plan. Instead we choose to use the presentation of the results to the professionals who had answered the questionnaire as discussion sessions to get a better insight both in their attitude to the eHealth system and their interpretation of the questionnaire.

The first organization where this Dutch version of TARS was applied was a care organization offering outpatient support. The eHealth system in question was video-communication in the interaction between client and professional, as part of a blended form of support. After experimenting with this system for over 2 years the organization had implemented it full scale in the outpatient support division. So there was a small group of professionals that had worked with the system for a longer period and a larger group that had worked with it for a shorter period.

The questionnaire was sent to all the professionals using the video com system ($N = 55$). In total 45 questionnaires were completed. Out of the 45 respondents 13 agreed that the videocom system had completely become part of the routine practice, and 32 thought that it had partly become that. In general the former group tended to be more positive about the eHealth system than the latter group, which can be seen as supporting validity of the questionnaire. We also found that the respondents that had been working with the system for a shorter period of time (<4 months) were overrepresented in the group who only judged the system partly routine. The results of this survey were discussed with the professionals in three regular team meetings. This proved to be a good approach. The professionals very openly discussed how in their opinion certain remarkable results should be interpreted. For example, 30% of the respondents had answered that they did not know whether the benefits of the eHealth system would outweigh the efforts. In the discussion they explained that they were well aware of the benefits but had no idea about the financial costs in particular, and that in fact they were not really interested in them. They relied on management to make such considerations.

In the second organization the TARS was used the set up was different. In this case the TARS questions had been part of a larger questionnaire on the use of a system for virtual projections in a care home, intended to physically activate the residents. The results were discussed within a network of professionals from different care organizations that were using or interested in using the same system. One of

the issues that were discussed was that the respondents had answered rather negatively on the questions related to relational integration. It became apparent that this could be related to a lack of coherence: people did not agree on the question whether this was an instrument for physiotherapy or for recreation.

The general results of the TARS were recognized as representative of their opinions on the implementation of the eHealth system in question. During evaluation, both staff and management also mentioned that the presentation of the questionnaire and the discussion of the results with a "neutral party" being the research team, offered a favorable and secure atmosphere to collectively improve aspects indicated as "weak" by TARS. Moreover, the aspects were not only discussed and appreciated, but also practical solutions were suggested in a collaborative manner, thus improving ownership of all parties involved. For example in one case a rather small group of respondents had answered that they did not understand their professional accountability. In the discussion both staff and managers became aware of the fact that indeed both responsibilities and accountability had not been properly regulated and protocols should be adjusted to the eHealth system. Staff and management thought this way of discussing the eHealth system should be repeated from time to time to improve the embedding of the eHealth system in routine practice. Management also suggested this way of working could be very useful when considering the implementation of new technology (i.e., pre-implementation measurement). So the discussion of the results of the survey with staff and management proved to be more than a way to understand the answers better. It was also an instrument to improve the coherence, to share views on the eHealth system and how to use it.

Next, work will be continued on the evaluation of this way of working: using this embedded TARS measurement (referred to as "TARS^{+}") (see Fig. 1). Also, the usability of TARS in pre-implementation stages is of interest and will be further developed and evaluated. Finally, in order to value this "TARS^{+}"-normalization process, it has to be evaluated in the long run, and compared to other implementation strategies.

Appendix TARS Items

1. **CA-CI** The ehealth system is adequately resourced financially
2. **CA-CI** Sufficient organizational effort has gone into supporting the ehealth system
3. **CA-CI** The ehealth system is a different way of working
4. **CA-CI** The rewards of using the ehealth system outweighs the effort
5. **CA-CI** Government policy initiatives are supportive of this ehealth system
6. **CA-CI** This ehealth system is technically and organisationally compatible with other systems and agencies that we are required to work with
7. **CA-CI** This ehealth system fits in with the priorities and challenges of our organisation
8. **CA-CI** This organisation has a culture that is supportive of change

9. **CA-CI** There is a culture in this organisation of involving staff in planning and development
10. **CA-SSW** Using the ehealth system makes me feel autonomous in my work
11. **CA-SSW** Using the ehealth system requires co-operation with other staff
12. **CA-SSW** The workload involved in using the ehealth system is manageable
13. **CA-SSW** In using the ehealth system, the allocation of work between individuals is appropriate
14. **CA-SSW** The skills I have are appropriate for using the ehealth system
15. **CA-SSW** The skills needed to use the ehealth system are easily learned
16. **CA-RI** I have confidence that using the ehealth system does not put patients at risk
17. **CA-RI** Using the ehealth system is an efficient use of time
18. **CA-RI** In using the ehealth system, responsibilities are divided between individuals appropriately
19. **CA-RI** In using the ehealth system, I understand my accountability for my work
20. **CA-RI** In using the ehealth system, I understand my liability for my practice
21. **CA-RI** Technical back-up in using the ehealth system is available if I need **it**
22. **CA-IW** I believe there is good evidence about the clinical effectiveness of using the ehealth system
23. **CA-IW** There is some flexibility in how the ehealth system can be used
24. **CA-IW** Using the ehealth system leads to positive outcomes for patients
25. **CA-IW** Using the ehealth system involves the right amount of time spent
26. **CA-IW** In using the ehealth system, the quality of professional and patient interaction is good
27. **CA-IW** The ehealth system is easy to use
28. **Coherence** The staff who work here have a shared understanding of what the system is for and how it is to be used
29. **Cognitive Participation** The staff here are committed to making the system work
30. **Reflexive Monitoring** There are ongoing mechanisms for monitoring and appraising

References

Anderson JG (2007) Social, ethical and legal barriers to e-health [Review]. Int J Med Inform 76(5–6):480–483. doi:10.1016/j.ijmedinf.2006.09.016

Bush M, Lederer AL, Li X, Palmisano J, Rao S (2009) The alignment of information systems with organizational objectives and strategies in health care. Int J Med Inform 78(7):446–456. doi:10.1016/j.ijmedinf.2009.02.004

Christensen MC, Remler D (2009) Information and communications technology in U.S. health care: why is adoption so slow and is slower better? [Research Support, Non-U.S. Gov't]. J Health Polit Policy Law 34(6):1011–1034. doi:10.1215/03616878-2009-034

Davis FD (1989) Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q 13:319–339

Finch TL, Mair FS, O'Donnell C, Murray E, May CR (2012) From theory to 'measurement' in complex interventions: methodological lessons from the development of an e-health

normalisation instrument [Comparative Study Research Support, Non-U.S. Gov't]. BMC Med Res Methodol 12:69. doi:10.1186/1471-2288-12-69

Finch TL, Rapley T, Girling M, Mair FS, Murray E, Treweek S, . . . May CR (2013) Improving the normalization of complex interventions: measure development based on normalization process theory (NoMAD): study protocol [Research Support, Non-U.S. Gov't]. Implement Sci 8:43. doi:10.1186/1748-5908-8-43

Holden RJ (2011) What stands in the way of technology-mediated patient safety improvements?: a study of facilitators and barriers to physicians' use of electronic health records [Research Support, N.I.H., Extramural]. J Patient Saf 7(4):193–203. doi:10.1097/PTS.0b013e3182388cfa

Ketikidis P, Dimitrovski T, Lazuras L, Bath PA (2012) Acceptance of health information technology in health professionals: an application of the revised technology acceptance model. Health Informatics J 18(2):124–134. doi:10.1177/1460458211435425

Koch S (2006) Home telehealth–current state and future trends [Research Support, Non-U.S. Gov't review]. Int J Med Inform 75(8):565–576. doi:10.1016/j.ijmedinf.2005.09.002

Koller M, Aaronson NK, Blazeby J, Bottomley A, Dewolf L, Fayers P, . . . West K (2007) Translation procedures for standardised quality of life questionnaires: The European Organisation for Research and Treatment of Cancer (EORTC) approach [Evaluation Studies]. Eur J Cancer 43(12):1810–1820. doi:10.1016/j.ejca.2007.05.029

Li J, Talaei-Khoei A, Seale H, Ray P, MacIntyre CR (2013) Health care provider adoption of eHealth: systematic literature review. Interact J Med Res 2(1), e7. doi:10.2196/ijmr.2468

Lluch M (2011) Healthcare professionals' organisational barriers to health information technologies-a literature review [Review]. Int J Med Inform 80(12):849–862. doi:10.1016/j.ijmedinf.2011.09.005

Mair FS, May C, O'Donnell C, Finch T, Sullivan F, Murray E (2012) Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review [Research Support, Non-U.S. Gov't review]. Bull World Health Organ 90(5):357–364. doi:10.2471/BLT.11.099424

May C (2006) A rational model for assessing and evaluating complex interventions in health care [Evaluation Studies Research Support, Non-U.S. Gov't]. BMC Health Serv Res 6:86. doi:10.1186/1472-6963-6-86

May C, Finch T (2009) Implementing, embedding, and integrating practices: an outline of normalization process theory. Sociology 43:535

May C, Finch T, Mair F, Ballini L, Dowrick C, Eccles M, . . . Heaven B (2007) Understanding the implementation of complex interventions in health care: the normalization process model [Research Support, N.I.H., Extramural Research Support, Non-U.S. Gov't]. BMC Health Serv Res 7:148. doi:10.1186/1472-6963-7-148

May CR, Mair F, Finch T, MacFarlane A, Dowrick C, Treweek S, . . . Montori VM (2009) Development of a theory of implementation and integration: normalization process theory. Implement Sci 4:29. doi:10.1186/1748-5908-4-29

May C, Finch T, Ballini L, MacFarlane A, Mair F, Murray E, . . . Rapley T (2011) Evaluating complex interventions and health technologies using normalization process theory: development of a simplified approach and web-enabled toolkit. BMC Heal Serv Res 11(1):245

Murray E, Treweek S, Pope C, MacFarlane A, Ballini L, Dowrick C, . . . May C (2010) Normalisation process theory: a framework for developing, evaluating and implementing complex interventions [Research Support, Non-U.S. Gov't]. BMC Med 8:63. doi:10.1186/1741-7015-8-63

Murray E, Burns J, May C, Finch T, O'Donnell C, Wallace P, Mair F (2011) Why is it difficult to implement e-health initiatives? A qualitative study [Research Support, N.I.H., Extramural]. Implement Sci 6:6. doi:10.1186/1748-5908-6-6

Nieboer ME, van Hoof J, van Hout AM, Aarts S, Wouters EJM (2014) Professional values, technology and future health care: the view of health care professionals in The Netherlands. Technol Soc 39:10–17

Niemeijer A, Frederiks B, Depla M, Eefsting J, Hertogh C (2013) The place of surveillance technology in residential care for people with intellectual disabilities: is there an ideal model of application. J Intellect Disabil Res 57(3):201–215. doi:10.1111/j.1365-2788.2011.01526.x

Peek STM, Wouters EJM, van Hoof J, Luijkx KG, Boeije HR, Vrijhoef HJM (2014) Factors influencing acceptance of technology for aging in place: a systematic review. Int J Med Inform 83(4):235–248

Proctor E, Silmere H, Raghavan R, Hovmand P, Aarons G, Bunger A, . . . Hensley M (2011) Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda [Research Support, N.I.H., Extramural]. Adm Policy Ment Health 38(2):65–76. doi:10.1007/s10488-010-0319-7

Sanders C, Rogers A, Bowen R, Bower P, Hirani S, Cartwright M, . . . Newman SP (2012) Exploring barriers to participation and adoption of telehealth and telecare within the whole system demonstrator trial: a qualitative study [Randomized Controlled Trial Research Support, Non-U.S. Gov't]. BMC Health Serv Res 12:220. doi:10.1186/1472-6963-12-220

Van Gemert-Pijnen JE, Nijland N, van Limburg M, Ossebaard HC, Kelders SM, Eysenbach G, Seydel ER (2011) A holistic framework to improve the uptake and impact of eHealth technologies [Review]. J Med Internet Res 13(4), e111. doi:10.2196/jmir.1672

Venkatesh V, Morris MG, Davis GB, Davis FD (2003) User acceptance of information technology: toward a unified view. MIS Q 27:425–478