Chapter 12

The complexity of eHealth Implementation: A theoretical and practical perspective

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Introduction

As has become clear throughout this entire book, eHealth has added value for health, wellbeing and healthcare. However, in practice the success of eHealth has been argued as its potential is often not reached or seen, due to lack of evidence (see also Chapter 14) and low impact in healthcare. For example, the Dutch eHealth monitor provides a yearly overview of the current state of affairs in the Netherlands since 2013. Each year, one of the main conclusions is that eHealth has a lot of potential, but its uptake in practice is lagging behind (Krijgsman et al., 2016). Implementation of healthcare innovations is indeed widely acknowledged as a highly complex process, involving a variety of determinants on multiple levels (Glasgow, Phillips & Sanchez, 2014; Ross, Stevenson, Lau & Murray, 2016). Implementation is beyond the mere introduction of an app or a patient website. It requires systematic attention for the implications of technology mediated services for individuals, healthcare and the society at large.

On a global level, the WHO has concluded that for successful implementation a holistic view on health should be envisioned, addressing the organizational processes, structures, roles, standards, legislation as well as having consideration of human resources, education, reimbursement and the culture of those who will be utilizing the eHealth services – any of which can serve to derail initiatives if neglected (WHO, 2016).

This chapter first aims to explain and illustrate why eHealth implementation is a complex process and what theoretical approaches and models have been used to foster the implementation of eHealth. The second part of this chapter focuses on examples from practice and applied research on eHealth. After completing this chapter, you will be able to:

- explain the complexity of eHealth implementation
- name and explain differences in implementation approaches such as the RE-AIM Framework and the Diffusion of Innovation theory.
- critically analyze the applicability of existing implementation approaches, frameworks and models to practice.
- name and explain eHealth implementation principles related to development, financing, healthcare organizations, and technology.
- identify points of improvements for eHealth implementation from a theoretical and practical point of view.

The Complexity of Implementation

Implementation is often seen as a post development step to introduce a certain technology in practice, due to a rather narrow view on eHealth as a device to communicate content. In this view, implementation is merely focussed on acceptance and adoption of technology by an individual (see e.g., the Technology Acceptance Model in Chapter 11). Moreover, for many years, implementation has been out of scope in many eHealth research projects, resulting in many technologies that have not lived on after the end of these research projects. The general idea seemed to be that involving end-users in the development of these technologies would guarantee *adoption* and implementation. However, this has not been the case. Management and maintenance of an eHealth technology requires a budget and adequate infrastructure for support. To this end, *business models* (see Chapter 9), or the whole ecosystem of the eHealth technology (cf. Oinas-Kukkonen and Oinas-Kukkonen 2013), should be developed with diverse stakeholders (payers, providers, patients etc.) in mind and ideally jointly with them. The development of implementation models is not a post development activity but should be a central part of the development and perhaps even an ongoing process of discussing values to be realized from different perspectives of interest and innovation as we saw in Chapters 7 and 10.

eHealth has evolved from a device driven approach to a service driven infrastructure to change attitudes, behaviours or to innovate, even disrupt, healthcare. To be successful, implementation has to deal with issues as resources (e.g., time, staff, budget, investment policies), ethical concerns (privacy, security, ownership), governance (policy, accountability, responsibility etc.), and eSkills (capabilities, culture, etc.). Implementation of eHealth in healthcare is complex, just as we saw that healthcare itself is complex (Chapter 4).

Different implementation approaches

From the field of *implementation science* numerous models and frameworks have evolved that aim to understand the processes and driving factors involved in implementation, and to predict outcomes (e.g., Tabak, Khoong, Chambers & Brownson, 2012; Greenhalgh, Robert, Macfarlane, Bate & Kyriakidou, 2004; Moullin, Sabater-Hernandez, Fernandez-Llimos & Benrimoj, 2015; Fleuren, Wiefferink & Paulussen, 2004; Berwick et al., 2003; Durlak & DuPre, 2008; Grol, Wensing, Eccles & Davis, 2013). These models and frameworks range from technology acceptance models to models for the implementation of ecosystems to transform health and healthcare.

From the perspective of healthcare as clinical and medical based interventions, frameworks were introduced to implement these interventions using evidence from research findings. These frameworks express the acceptance and adoption of research findings in practice. In this view, implementation refers to a set of planned, intentional activities that aim to put into practice evidence-based practices in real-world services, with the goal to benefit end-users of these services (European Implementation Collaborative, n.d.). Many terms can be found in the

literature, varying from knowledge transfer, research translation, and innovation, which are used as synonyms (Grol, Wensing, Eccles & Davis, 2013).

A well-known example is the *RE-AIM Framework* by Glasgow, Vogt and Boles (1999), which originated as an aid for consistent reporting of research results of health promotion programs. The acronym RE-AIM refers to five steps in the process of translating research findings into practice: reach, *effectiveness*, *adoption*, implementation, and maintenance. As such, this framework is essentially a process theory describing the stages in intervention development, among which the stage of implementation. Although useful as a tool in planning and evaluation, RE-AIM does not provide an overview of causal factors that determine dissemination and implementation outcomes, nor is it specifically focused on technology-mediated interventions.

Another approach to implementation is based on Roger's Diffusion of Innovation theory (Rogers, 2010). Diffusion refers to the passive, unplanned spread of new practices, while dissemination is defined as the active spread of new knowledge or practices to a target population using planned strategies. In healthcare, the diffusion of innovation approach was introduced by the California Healthcare Foundation (2002) by Cain & Mittman. They identified 10 critical factors for implementation of new medical or information technology. These factors focus on the dynamics that govern the diffusion and adoption of complex interventions as introducing technology in a healthcare organization. Although a valuable approach to envision implementation, these factors refer to rules of thumb rather than giving guidance to an implementation process.

In 2004, Greenhalgh et al. published one of the most comprehensive and influential implementation frameworks, based on an exhaustive review of evidence. As the authors noted, this framework should primarily be considered as a memory aid that provides a unified conceptual terminology, rather than a prescriptive model with causal implications. Building on this work Damschroder and colleagues (2009) developed the *Consolidated Framework for Implementation Research (CFIR)*, an authoritative model widely used in healthcare. Updating the previous review of evidence by Greenhalgh et al., they organized a total of 39 determinants of implementation outcomes into 5 larger domains (see Box 1). Both Greenhalghs and Damschoders work can be seen as a continuation or extension of the Rogers approach on implementation of complex interventions. The value of this approach is the explication of organizational values and external values that influence the implementation of innovations in an organizational context. However, the costs, skills and the capacities of technology as an infrastructure to connect people and society are not addressed.

Box 1: CFIR: a diffusion of innovation approach to implementation

To illustrate this diffusion of innovation approach to implementation, the five domains of the CFIR, and underlying constructs, are briefly outlined here. The first domain contains the *characteristics of the innovation,* including well-known variables like relative advantage (will the new intervention have outcomes superior to current practice?), adaptability (the degree to

which the intervention may be adapted to the local context while maintaining the core components), trialability (can the implementation be easily undone, if warranted?), and complexity, originally identified by Rogers (2010) and adapted to healthcare by Cain & Mittman. Additional intervention characteristics included in this domain are the intervention source (an innovation perceived as originating from within the own organization is usually adopted more easily than when developed externally; and when coming from an external source, what is the perceived legitimacy of that source?), evidence strength and quality (stakeholders' perceptions of the evidence presented as support for the innovation), design quality and packaging (stakeholders' perceptions of how well the innovation is bundled, presented, and assembled), and cost (costs associated with acquiring, implementing, and executing the innovation).

The second domain is called the *outer setting* and represents with four constructs the economic, political, and social context within which the adopting organization is embedded. Patient needs and resources is the first construct, which should be known and accounted for as much as possible. This requires strong patient centredness of an organization and is generally seen as a predictor of successful implementation. Second, cosmopolitanism refers to the degree to which the implementing organization is actively involved in a broader network of other organizations, and is known to benefit implementation outcomes. Peer pressure, occurring when other similar and competing organizations already implemented the innovation, is a third construct that may drive implementation, in particular among late adopters. Finally, this domain includes external policies and incentives, often originating from national governmental bodies, or professional guidelines. An obvious example of this category is legislation regarding privacy and data integrity, or liability regulations, which may impede eHealth implementation.

Third, the *inner setting* refers to the organizational context in which the innovation is intended to take place, containing characteristics of the adopting organization that may impede or support effective implementation. This domain distinguishes five constructs. The first construct involves structural characteristics, referring to general aspects of an organization such as age, size, maturity, and the social architecture. The second construct are networks and communications within the organization. The nature and quality of both the social networks and the communication, both formally and informally, shape social capital and a sense of community within organizations will contribute to implementation effectiveness. Organizational culture, the relative stable set of norms, values, and assumptions held within the organization, is the third characteristic of the inner setting. The failure to change these cultural aspects in favor of an innovation is a barrier for implementation effectiveness. The fourth characteristic, implementation climate, has 6 underlying constructs: tension to change (perceived urgency to improve the current situation), compatibility (the fit between the innovation and existing individual norms, values, needs, and workflows and systems), relative priority (shared perception of how important the implementation is for the organization), incentives and rewards (both tangible and intangible), goals and feedback (on implementation progress to staff), and learning climate (practices and beliefs in the organization like supportive leadership, sufficient time and space to reflect and evaluate). Readiness for

implementation, defined as the tangible and immediate indicators of the commitment to the decision to implement an innovation, is the fifth characteristic of the inner setting. Here, three subconstructs are included: leadership engagement (involvement and accountability of leaders and managers), available resources (money, training, physical space, and time dedicated for implementation), and access to information and knowledge necessary for implementation.

Fourth, *characteristics of individuals* involved in adopting and using the innovation include a total of 5 constructs at the level of individual members of an organization, although these may also be aggregated to team level or other units. The individual constructs include knowledge and beliefs about the intervention (perceived value, attitude, skills), self-efficacy expectancies (belief in personal capabilities to achieve implementation), stage-of-change (the phase an individual is in, progressing from initial adoption to sustained use), identification with the organization (high commitment will promote effective implementation), and other personal attributes (such as ambiguity tolerance, motivation, learning styles).

And finally, the CFIR identifies the *process of implementation* as the fifth domain of relevant variables to consider, organized along four stages (planning, engaging, executing, reflecting/evaluating). As such, it acknowledges that an implementation process should be regarded as an intervention in itself.

A critical view on theory based implementation approaches

In the approaches discussed above, implementation is seen as a post design step, as a phase after the development of an eHealth technology has been completed. Implementation is seen as encompassing dissemination, which is then followed by the process of putting to use or integrating the new practices within a setting. Greenhalgh has described these three terms concisely as ‘letting it happen’ (*diffusion*), ‘helping it happen’ (*dissemination*), and ‘making it happen’ (*implementation*) (Greenhalgh et al, 2004). However, as has been pointed out earlier on in this book and will be seen later on in this chapter, implementation is far from a separate phase.

As noted above, the evidence underlying CFIR and other frameworks of implementation science relies for a large part on intervention research predating the internet and eHealth era. This raises the question to what extent these frameworks adequately reflect eHealth innovation. The recent reviews on eHealth implementation research by Ross et al. (2016) and Lau et al. (2016) found that some domains and underlying variables were of particular importance within the eHealth field,. At the same time, both these reviews also show that, for many of the factors within the five CFIR domains eHealth, specific evidence is still lacking or only emerging. For example, Ross et al. (2016) recommend future research on the involvement of patients as innovation participants, and the role of external change agents (stakeholders).

Furthermore, technology itself is out of scope in most existing implementation approaches, and even the business-side is not addressed, for example, via the development of value-based

business models for eHealth technology. In current eHealth interventions, stakeholder involvement and an implementation plan are required as part of the development process to overcome the tsunami of valueless apps. Implementation of eHealth has grown to a serious field of research aiming to understand and predict the success and failures of an eHealth intervention and technology. This is reflected by the foundation of the first specialized journal called Implementation Science in 2006 (Eccles & Mittman, 2006).

It now becomes apparent that many frameworks of implementation are available, but they all have difficulties grasping the complexity of eHealth implementation. In order to get a grasp of these complex set of activities, insight in practice is required. In the next section of the chapter, we will provide this insight via brief cases provided by people working with eHealth in practice, and connect them to findings from applied research on eHealth implementation. This chapter will end with a comparison between the theoretical and practical perspectives to highlight the main discrepancies and points for improvements in the domain of eHealth implementation.

Implementation: A Practical Perspective

In this second part of the chapter, we will provide insights in the complexity of implementation via brief cases provided by people working with eHealth in practice, and connect them to findings from applied research on eHealth implementation. This part is structured into four main categories: the development and implementation process, the healthcare context, technological intervention characteristics, and financing. It is important to note that this is not a substantiated, theory-grounded categorization; it is created by the authors of this chapter to provide structure and oversight. Furthermore, the illustrative cases are provided in boxes and are given by people working in different countries, institutions or companies and are meant to illustrate abstract issues, so they are not representative for the entire domain. The cases were collected among professionals with hands-on experience in eHealth innovation within the Netherlands, Germany, Finland, Canada, and Australia, and they represent a wide range of disciplines: social sciences such as health psychology, somatic healthcare, mental healthcare, health insurance, and IT. The 13 interviewees were recruited from the professional networks of authors and editors of this book. Data were collected with semi-structured interviews conducted by several authors of this chapter. The full list of participating experts is given at the end of this chapter.

The Development Process

An important goal of a development process is to make sure the technology fits the needs and preferences of the *context* and the *stakeholders* who will use, make decisions about adopting, or disseminate the technology in practice (see Chapter 7 & 8). The better this fit is, the easier it becomes to adopt the technology and to continue using it. A suboptimal development process might result in overlooking or not accounting for important barriers to implementation.

Involvement of stakeholders: how and when?

As was mentioned in multiple chapters in this book, involving stakeholders in the development process is essential. This definitely holds for determining the scope of a project and setting concrete goals for the to-be-developed technology early on in the process (Feldman, Schooley, & Bhavsar, 2014). Unfortunately, this is often skipped in practice. But even if stakeholders are involved in goal-setting, pitfalls might still arise in when and how to involve specific stakeholders, as is described by this case from forensic psychiatry, a domain in which patients are treated to reduce the chances of recidivism of an offense:

Case: Engaging stakeholders in eHealth development

In forensic psychiatry, it is always important to keep the reason for treatment clear on the table, which sometimes includes shameful, offense-related behaviours that the patients have to reflect on. Patients have a natural tendency to 'minimize' or ignore this sensitive core issue. A consequence of this, it could be that during the development of eHealth the goals of an eHealth intervention, as preferred by the patients, are not related to the offense-related core issue. For example, a patient who committed severe violence against his partner would rather focus on his youth traumas that he sees as the cause for his aggression, instead of the offense-related behaviour itself, which is a more sensitive subject to him. Hence, while co-creation is important, the dynamics between different stakeholders, such as patients and therapists, should be considered to keep the goals of an eHealth intervention effective.

Dirk Dijkslag, Transfore (The Netherlands)

Designing a technology can be a very difficult and time-consuming process and because of practical constraints such as money, time or a lack of knowledge, important activities such as accounting for the context are skipped. Also, technology is often not designed and tested well before implementation, which can result in, among other things, the overlooking of technological errors. Only when the system is already used in practice, these errors come to surface and can result in the termination of its use (Kushniruk, Bates, Bainbridge, Househ, & Borycki, 2013). Another design activity is the use of theories on behaviour change in the technology (see Chapter 2) to increase effectiveness and ease of use for the patient (Webb, Joseph, Yardley, & Michie, 2010). This often doesn't happen, and if *behaviour change techniques* (BCTs) are applied, they are often dated because developers are not responsive to new frameworks developed specifically for eHealth interventions (Mann, Quintiliani, Reddy, Kitos, & Weng, 2014). Another issue is that development often stops after the technology is seen as finished: an intervention is implemented in practice and "frozen" thereafter (Glasgow, Phillips, & Sanchez, 2014). Consequently, many flaws that come to surface only after implementation are not solved. Also, because of the rapid development of technology, systems can become outdated very quickly when they are not improved regularly.

But even when a development team has the best intentions, practical constraints can negatively impact an ideal development process. The case presented here concerns a rather practical pitfall for eHealth design that clearly addresses a planning issue:

Case: Timing is essential

As part of the development of a smoking cessation app a series of usability tests were held, which involved stakeholders from the target group, such as smokers or ex-smokers. The goal of these meetings was to have them try out the prototype version of the app and reflect on it. These meetings, involving both experts and users, usually have around 20 people, so they can be difficult to organize. Unfortunately, for one of these meetings the IT company developing the software couldn't deliver the prototype in time. The meeting was held anyway, using an older version (see Figure 1). Because of this, the feeling afterwards was that a lot of important information was missed because the planned version of the prototype wasn't available. As a result, for example, some features couldn't yet be evaluated at that point. Perhaps it would have been better to postpone that session, despite the consequences of that decision for the planning of the development process.

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As can be noted from the previous example, it is important to keep in mind that, even when the development should be conducted as prescribed by guidelines, methods and theories, in practice it is often not as straightforward as expected. A development process doesn't have a clear beginning and end, but is an interactive and muddled process that happens 'in many places at once' (Nielsen & Mathiassen, 2013).

Interdisciplinary development and added value for whom?

Involving many stakeholders from heterogeneous disciplines and with sometimes diverging interests within the development process is very challenging, but necessary (Feldman et al., 2014; Geissbuhler, 2013; Nielsen & Mathiassen, 2013; Van Limburg, Wentzel, Sanderman, & van Gemert-Pijnen, 2015). However, such a multidisciplinary, *participatory development* approach is rather novel, since many projects in healthcare are still monodisciplinary and expert-driven. The case below illustrates the importance of involving the right stakeholders:

Case: Stakeholder involvement during the whole process

It is important to reach the right stakeholders from the beginning, and making sure that all parties are willing to spend the time and effort that will be necessary. While full involvement in all phases is not usually required, actions can be made to keep all of them informed and participating at a certain degree. For example, for healthcare professionals any changes in their work procedures can be an 'added risk' for the patient. Because of this, most of the time they find it very hard to change their own methods, so their involvement is

key when developing a new way of working via eHealth. On the other side, the interests of a health insurance company are more into the total costs of healthcare for the patients, influenced by the regulations, so their involvement is rather important at the beginning because of what was previously mentioned.

Harry Nienhuis, Menzis (The Netherlands)

During eHealth design and implementation, health experts will have to collaborate closely with IT specialists such as soft- and hardware developers. The team members specifying the content and look and feel of the design, are often not able to actually create the hard- and software of the technology. This means that the involvement of IT professionals such as programmers is essential in eHealth development (Cantrell et al., 2015; Feldman et al., 2014; Mann, Quintiliani, Reddy, Kitos, & Weng, 2014). Often, non-IT team members believe that providing the soft- and hardware developers with a list of their demands suffices, but this is definitely not the case. Early involvement of IT developers is important to make sure everyone's on the same page (Feldman et al., 2014; Mann et al., 2014). To achieve this, good interdisciplinary teamwork is required, but this is far from easy. Collaborating with IT professionals requires specific skills, such as good communication; understanding each other's roles and skills; a clear, shared vision of the end product; flexibility; good management; and being open to gain new knowledge from other disciplines (Nancarrow et al., 2013). Clear communication is also required from the IT specialists. From the start, they have to be clear about technical matters that might not be known by the other members of the development team, such as costs, possibilities and constraints of the technology. An example from the perspective of an IT specialist involved in a project on Virtual Reality Exposure Therapy (VRET) for mental healthcare, further illustrates this:

Case: Interdisciplinary communication

VRET is a special kind of eHealth. It is a tool for treatment used in a therapy room together with the client and the therapist. The researchers or therapists who direct the development of content in the innovation have specific demands. For example, the researchers (therapists) are the ones that instruct to the developers the kind of virtual environments that have to be to be developed, the ones that are relevant for treatment of several diseases. We consider the feasibility of these requests according to the capacity of the current software and hardware and constantly communicate with the researchers while doing this. By following this approach, we have succeeded in developing complex and detailed interactive environments. It is also important to discuss the limitations in the financial requirements that are necessary to support development and implementation of innovations. It is important to focus on communication, providing clear information about the costs, validity and effectiveness of a VR technology.

Yme Canter Visscher, CleVR (The Netherlands)

Different stakeholders often have different motives, goals and values for a technology. Having a thorough understanding of and appreciation for these motivations is important, but these discussions with stakeholders are often lacking, or not well-communicated (van Limburg et al., 2015). It is also important to prioritize the values of different stakeholders and make choices based on this prioritization (Feldman et al., 2014), but this can be extremely complicated in the case of conflicting values. The case below further explains this:

Case: What's in it for each stakeholder?

We can usually distinguish two groups: the academic group and the industry or economic group. These two might have different interests or views regarding, for instance, the value of data, the expected outcome of the research, or how the cooperation should work. The academic groups are often focused on the development and dissemination of ideas or technologies, but might not invest so much into the implementation process and its sustainability on the long term. On the other side, the industry group might be focused on profiting from a prototype developed by academic researchers, but not care so much about the knowledge and process behind it. Therefore, conflicting opinions about the use of human resources, money or other conflicts could happen if the terms of cooperation are not made clear, for example via a written contract, before beginning a project.

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In order to optimally benefit from an interdisciplinary team, good management is required in which a broad range of stakeholders have clear roles and tasks (Feldman et al., 2014). However, a commonly made mistake is that developers tend to forget to include many different other stakeholders because they only identify the ones who they are acquainted with. Development teams need broad membership, crossing several disciplines, to make sure important perspectives are not overlooked (Mann et al., 2014).

Optimizing the development process

There are several ways to deal with implementation issues related to the development process. Since development and implementation are intertwined, it is of course important to conduct the development process in such a way that the chances on good implementation are increased. First of all, a systematic approach should be undertaken, which can be achieved via using a framework such as the *CeHRes Roadmap* (see Chapter 7). The Roadmap facilitates an *agile process* with continuous evaluation cycles to constantly check the fit with the context in a systematic way. It also ensures that stakeholders are involved in the development process via participatory development and by using methods from *human-centred design* (see Chapter 10).

The Healthcare Context

An eHealth techology has to seamlessly fit the context, not only for an optimal usage experience, but also for a smooth implementation process. Each healthcare context has specific demands and barriers that can hinder, block, but also facilitate this process. A hospital might have specific management structures to account for, consumer eHealth development involves dealing with rapidly evolving legal regulations regarding ethics, and eHealth in mental healthcare often has to account for therapists who are lacking in enthusiasm for the technology. eHealth developers constantly have to keep this context and its influence on implementation in mind.

Legislation, regulations, and ethics

When implementing eHealth, compliance to current legislation, regulations, and ethical protocols is essential. This includes issues like who is responsible for unintended patient safety risks due to technology-induced errors (Kushniruk, Bates, Bainbridge, Househ, & Borycki, 2013), or privacy concerns (Geissbuhler, 2013), for example regarding the privacy of patients online. The next case represents a dilemma involving the balance between safety and privacy concerns:

Case: When safety comes before privacy

Dealing online with patients with depression, our web based CBT-based platform every now and then required different actions to assess or continue to support the wellbeing of the program participants. The platform applied rigorous protocols about how to proceed in every possible scenario. However, in extreme cases sometimes decisions had to be made to, for example, take a more direct approach in reaching possibly suicidal patients that seemed to be at risk and could not be reached through the usual technology channels. This often was not completely consistent with the protocols, but was a match with the aim of our platform to look out for the wellbeing of our users and was appreciated in the end.

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Another, perhaps less obvious issue, is dealing with data after implementation. Developers should, already in the beginning, plan how they will store the data gathered by eHealth interventions, and who is the owner of this data. The following case shows what dealing with this issue may entail:

Case: What to do with data?

Long term storage, archiving and standardization regarding data collected by eHealth technology will be necessary. This also requires funding and regulations to be instituted, to allow next generations to make use of the data and knowledge. A decision between close and open access in the case of a technical device or technology could be significant when considering how to deal with data. Open access would mean it can be freely used by anyone

even in unrelated contexts or fields and sometimes even opposed to the main interests of the creators of such innovation. As long as another party complies with the conditions of use, such as citing the authors, they would not need explicit permission and can make legal use of the technology. But imagine, for instance, that data collected by these external parties is used in a harmful way, harming the privacy of the users. The name of the authors of this technology would then be openly linked to this. Therefore, sometimes even the obligation for a written permission can be appropriate and required.

Claus-Peter Rückemann, Westfälische Wilhelms-Universität Münster, WWU (Germany)

Chapter 1 of this book already pointed out some major ethical issues that should be accounted for during implementation. Practice shows that not all ethical issue are applicable to every eHealth technology, since a wearable might raise other ethical concerns than an online module for depression. This could require a case-by-case approach for ethical dilemmas, which is further explained by the following case:

Case: Don't skip, be practical

There is a feeling that, perhaps also due to time constraints, ethical implications are often not sufficiently addressed. A suggestion would be that practical approaches should be found to tackle this, such as hosting meetings with experts and stakeholders that review the ethical implications of a technology. Although more research is still needed for better strategies, a basic and practical way such as that one can be helpful.

Pasi Karppinen, Oulu University (Finland)

When implementing eHealth, it is essential to adhere to existing rules and regulations. An important issue, especially when considering the globalization of healthcare, is that different countries can have different legislations and written and unwritten rules. Kushniruk et al. (2013) explained that the Canadian healthcare system is fundamentally different from that of the United States on policy, financial, political, organizational, technological and cultural level, so there are differences in culture that are important to account for.

Healthcare versus technology

Healthcare and technology cannot be seen as separate areas, but are intertwined. Consequently, healthcare influences the way technology is designed, and technology can change the way healthcare is organized.

An example of the how the healthcare system impacts technology can be found in the adaptability of technology. *Adaptability* is defined as the degree to which an intervention can be tailored or refined to meet local needs, but without affecting the core components. Nielsen and Mathiassen (2013) developed a mobile technology to give healthcare workers in home health easy access to client data anywhere. After implementing the same technology in three

home care agencies, they observed that all agencies took a different approach in using the technology to make sure it fitted their own context. They perceived and used the technology differently: one agency used it as a coordination platform, the second one as a communication medium, and the third used it as a management tool. These differences in adaptability can partly by explained by underlying differences between these healthcare systems (Kushniruk et al., 2013). Adaptability of an eHealth innovation by users may be an intended feature that is purposefully built in within an intervention, but it may also occur unexpectedly when the intervention has been used for some time, as is clarified by this case:

Case: Target groups that adapt their intervention

For our web-based intervention we started off with six or seven depression programs tailored for different populations (e.g., teenage girls, single women, married males) which were written by different people and illustrated in a different way. However, we found out that patients dealt differently with this apparent level of individualization that we were first aiming for. At first, members of a certain population (e.g. single male) that were not included as a tailored branch would argue that there was no program available for them. Next, we found out that patients were exploring and connecting to content in other programs not originally tailored for them. Both teenage girls and elderly males could relate to a program aimed for middle-aged women. People identified with the contents that related to their disorders, rather than to the gender or predicament of the person.

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Technology also has the capability to influence healthcare. It can, for example, have positive consequences by increasing *efficiency*, for example by reducing meeting activities in home care (Nielsen & Mathiassen, 2013). Despite obvious benefits, implementation in this case proved difficult since care workers received the technology with scepticism, particularly because their routine changed when their morning meetings were cancelled (Nielsen & Mathiassen, 2013). Chances for success are highest when eHealth is compatible with the values, workflow, and routines among the adopting professionals (Geissbuhler, 2013). The case below illustrates how users may initially be quite resistant to change, but also that personal experience with the benefits may help to overcome such hesitation:

Case: Current workflows

Issues arose in the implementation of a decision-making tool aimed to support nurses in their daily tasks. At the beginning the technology caused a little bit of a slowdown in the process since, for example, taking notes by hand was faster on paper than doing it with an electronic device, and nurses were used to use that approach. However, one the main advantages was that they could keep a very useful record saved in the system. There was the case of a nurse that was not very fond of the tool. Still, after some time passed, this nurse experienced a difficulty while treating a patient that could have been addressed by the tool, so she became

aware of its added value afterwards. This made her approach the tool with a new perspective. In the end, this situation changed her attitude and eventually this nurse became a huge advocate for the technology. I recall her words: 'If I had used your tool I would've made the right decision'.

Accounting for the healthcare context

From the above, it becomes clear that healthcare systems are very complex (see Chapter 4), which means that you cannot merely introduce eHealth and expect that it will be used as intended. eHealth has to fit the complex context in which it will be used, which, as mentioned before, can be achieved via a good development process (see Chapter 7). To be more precise: conducting a good *contextual inquiry* lies the basis for this, since it enables the developers to get a thorough understanding of the context: they have to get the know the stakeholders, map their current behaviour, find out about existing protocols, etcetera (see Chapter 8). A good grasp of the context is a necessary precondition for a good fit between technology and healthcare.

Characteristics of the Technology

Many implementation issues arise from problems with technology. Multiple studies have shown that for the adoption of technology worldwide the main barriers were often technology-specific (Kruse, Kristof, Jones, Mitchell, & Martinez, 2016). Issues such as usability problems or malfunctioning can negatively impact the adoption and long-term use of eHealth in practice.

Possibilities of the hard- and software of technology

For technology to be used in practice, it has to be reliable and not cause frustration (Nielsen & Mathiassen, 2013). Some examples of these errors are a wrong patient file being selected and unclear log on and log off screens, leading to patient data going into the wrong patient record (Koppel et al., 2005). An example from practice, about technology that collected inaccurate data, illustrates the importance of a clear plan to deal with these issues:

Case: Anticipating technology errors

In a telemonitoring and coaching solution for patients suffering from heart failure, inaccurate values could sometimes be shown by the system to patients monitoring themselves. For example, a digital blood pressure monitor was provided but for patients with arrhythmia (irregular heart beat) it could still sometimes deliver odd results. While inaccurate measurements can happen, what was important was to account for this and have an action plan in order to avoid uncertainty for the patients. In this case, it was necessary to: First, for the healthcare providers and developers to establish an estimation of the error range based on preliminary or personalized data.

Second, have a way of finding out when this is happening and be aware of what would be the consequence of it, such as incorporating a personalized alarm system. Finally, to consider a way to control this or a plan to double check doubtful information, for example by creating a protocol to follow.

Robin Wesselink, University of Twente (The Netherlands)

When looking at the healthcare context, it is important that technologies match the activities and workflow of healthcare professionals. This also entails a match with existing technologies and systems that are being used. Ideally, only one system should be needed to prevent that professionals have to log in in different ways, need to access multiple systems to find information, manually transfer information into systems because they are not compatible, etcetera. It is important that eHealth interventions are compatible with each other, but this is often not the case. The next case describes how this problem within the mental health field can become a barrier for further innovation:

Case: implementation in a competitive field

With several eMental health providers in the field, each was developing interventions using their own eHealth platforms. These platforms contained multiple interventions, all in possession of one provider. This meant that when developing interventions, the technical boundaries of these platforms could restrict a project. Moreover, for healthcare institutions, who often have limited funding to invest in innovation, this meant being restricted after investing in one eHealth platform. Once they invested, there often were no more funds for new technologies. Consequently, institutions could only access interventions embedded in the same eHealth platform because other interventions are not compatible with the platform or the technical specifications (e.g., operative system, devices, etc.) that were obtained to make it work. Seeing this as counterproductive for eHealth implementation, we addressed this by focusing on doing things differently. As technological opportunities increased with time, it was decided to design everything to be platform-independent, as well as using open source programming, thus making it easier for people to use our interventions anywhere.

Brigitte Boon, Trimbos Instituut (The Netherlands)

Preventing issues with technology

It is apparent that the domain of eHealth is intertwined with and dependant on the possibilities of (new) technologies (see Chapter 3). A well-functioning technology is a necessary precondition for eHealth, but this is not a given. First of all, people have to be able to actually work with a technology, and flaws in its design have to be detected before actual implementation, which can be achieved by applying methods from *human-centred design* (see Chapter 10). Also, when technological errors arise during use in practice, and often they will, it is important to have people in your development team who can quickly resolve these kinds

of issues. These IT professionals are often important stakeholders and thus have to be involved as soon as possible (see Chapter 8).

Financing

Because of a lack of financing on the short and long term, many eHealth initiatives fail. An increasing number of eHealth interventions are being developed, yet many developers are unable to build on their ideas commercially because they lack the required business knowledge (Crutzen, 2012). This impedes large-scale implementation of potentially effective technologies. However, despite its importance, financial matters like the costs of eHealth programs are seldom reported in the literature (Sanchez et al., 2013). To ensure good implementation, it is essential to keep an eye on the financial context, from the beginning of the process.

Financing the technology

Many eHealth projects suffer from the "field of dreams" syndrome, in which a development team simply presupposes that users will show up spontaneously as soon as the technology is made available (van Limburg et al., 2015). This shows a lack of understanding of important implementation issues like reimbursement dynamics, how much money to ask for the technology, or consumers' willingness to pay for the service (Miron-Shatz, Shatz, Becker, Patel, & Eysenbach, 2014). These issues should be identified as soon as possible. As mentioned in Chapter 8 of this book, having a thorough understanding of the context at an early stage is paramount in eHealth development in general and also applies to the financial context, as is illustrated by this case:

Case: Follow the money

You really have to get to understand how the money flows, and take into account how that will influence the whole development process of your technology. You might have to ask yourself 'Who will pay for this?' and consider the possibility that, at the beginning, no one will. However, that is not necessarily a reason to not do it. In the end, you might have to connect your solution to other products or sources that might have a more immediate monetary value.

Jan Hendrik Croockewit, Nedap N.V. (The Netherlands)

Research has shown that government funding is important for successful eHealth implementation (King et al., 1994; Mann et al., 2014), as was illustrated by a study in which 66% of municipalities indicated that government funding had been of decisive importance for their decision to adopt an *mHealth intervention*. However, in a lot of cases, grant opportunities for eHealth are limited and highly competitive (Mann et al., 2014). The case

below illustrates how to cope with finding funding for an eHealth start-up, and shows that a long-term perspective is required:

Case: Perseverence is important

We have learned that our efforts have to be focused on good communication with possible funding parties, providing clear information about the costs, validity and effectiveness of our solution. For our platform this communication is happening on three fronts: with mental health clinics, health insurance companies, and the government. Unfortunately, these institutions are part of a system that often doesn't yet allow enough financial support for innovative eHealth technologies. This is a situation that has to be coped with on a higher level rather than something that can be changed by a single firm, so we are aware it might take years of efforts. Hence, together with research partners, we continuously aim to present a case that provides enough evidence about the economic value and advantages of our technology in order to convince potential funders of the importance of investing in eHealth platforms.

Pim Spoor & Oscar van Dijk, MedicineMen (The Netherlands)

Generating long-term value

The financial side of eHealth doesn't stop when funding to start development and implementation on the short term have been received. For long-term success, the technology should be financially sustainable (Geissbuhler, 2013). However, just as is the case with receiving funding, not much research on the economic sustainability of eHealth interventions has been conducted (Bengtsson & Ågerfalk, 2011). In practice, creating long-term value of eHealth is often a complex task, partly because all key-stakeholders have to agree on and commit to a plan to create this value, and this is often not the case as they can have conflicting values (Geissbuhler, 2013). Creating a plan to achieve this value requires some flexibility on the developers' side. For example, changes in topics like scalability have to be made along the way, as is made clear by this example.

Case: Size matters

A solution was developed to provide support to the psychosocial wellbeing of women with breast cancer in the Netherlands. However, we found that the size of the potential population of patients that could benefit from this was not enough to make a business case only when looking at the immediate context. We found that different approaches are sometimes required, such as creating public-private partnerships to develop interventions that could also be used in other countries, making a business case feasible.

Brigitte Boon, Trimbos Instituut (The Netherlands)

Another way of creating value is by not merely looking at value from a financial perspective. Value can also be defined in other terms, for example increased quality of care, or improved wellbeing of patients. Furthermore, the data that is collected by technologies can be extremely valuable, directly or for later use, even though at the moment the value of data is not enough to keep a technology sustainable. This is an important issue to keep in mind before, during and after implementation. The value of data is further explained by an information systems and natural sciences expert:

> Something important to consider is that the real value of data can only truly be established in the long term. For instance, by revisiting it with new research methods that reveal novel findings, or by accumulating it as part of a global knowledge base. Indeed, data is often the real value, not the application itself. This means for instance that data should at least be worth more than the costs that were required to compute it. That's the starting point, and even then, the real value might only be visible after years of use, depending on the context of the project of course. Consequently, in long-term projects, continuity between generations of researchers is important to consider because of this. A consistent idea of the value of data must be transmitted by the heads of research institutes or teams to the rest of professionals working with them. Long term storage, archiving and standardization regarding data will be necessary, allowing next generations to make use of the data and knowledge.
>
> Claus-Peter Rückemann, Westfälische Wilhelms-Universität Münster, WWU (Germany)

Dealing with financial issues

It can be concluded that it is important to account for financing of an eHealth technology from the start. Again, several methods can be used to achieve this, and an example that has been proven to be of added value for eHealth development is *business modelling* (see Chapter 9). It assists the development team in determining important matters for implementation such as the intended value of a technology, its customers, resources, cost structures and potential customers/users.

Future Directions

As we have seen in this chapter, both from a theoretical and practical perspective, is that implementation of eHealth technology is complex. It is not a post design step, but is interwoven with the development process. We have seen that many implementation models and theories exist, but that these have limitations in capturing this complexity; many still seem to consider implementation as a post-design phase; and they lack a focus on the financial and value side. A more recent framework on the sustainability of health technologies does suggest this '*value proposition'* as an important factor (Greenhalgh et al., 2017, see Box 2). Future research should reveal whether this new framework can assist in addressing the challenges to the implementation of complex eHealth technologies.

Box 2: The NASSS framework

The figure below presents the Nonadoption, Abandonment, Scale-up, Spread and Sustainability (NASSS) framework, developed Greenhalgh et al. (2017). As can be seen in this figure, not only the value proposition (with both the value for the demand-side, such as patients and healthcare providers; and for the supply-side, such as the developer of the technology) has a central role, but also the technology itself. Furthermore, the framework specifically focuses on the development process of eHealth technology and poses that technology is never finished. During implementation, it needs to be possible to adapt the technology to fit each specific setting and context. Lastly, the framework emphasises that implementation of eHealth technology is not only complex, but it also requires a lot of work.

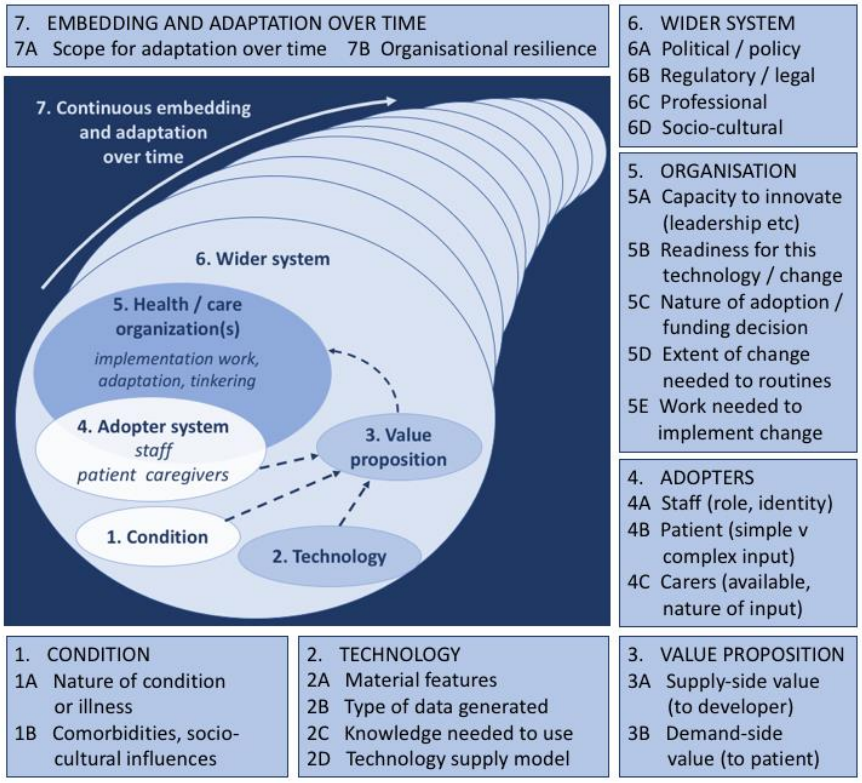

Figure 1. The NASS framework (Greenhalgh et al., 2017)

Summary

The take home messages of this chapter are:

- Successful implementation of eHealth innovations depends on multiple factors, at multiple levels, and is interwoven with the development process Although the majority of these factors apply to healthcare innovations in general, some factors are particularly relevant or even unique to the eHealth context, such as stakeholder involvement, interdisciplinary collaboration, and financial viability.

- Planning for implementation should be embedded in the full cycle of conceptualization, design, and dissemination of eHealth technologies, rather than regarded as a separate post-design phase. Within the eHealth field, above all, this is quintessential.
- Effectively planning a successful implementation of an eHealth innovation requires an agile and iterative, human-centred design approach that enables early stakeholder involvement, interdisciplinary collaboration, and business modeling. The CeHRes Roadmap as it is elaborated in the chapters of this book, provides the tools to create implementation-ready eHealth innovations.
- eHealth implementation goes beyond one organization and it often happens in many places at once and thus requires complex business models and value-driven implementation.
- Implementation deals with values; with the costs and benefits to maintain the eHealth technology, with deciding ownership and responsibilities for the eHealth technology.
- Implementation is also related to the vision on eHealth technology, some consider this as an innovation, some as a device or tool, and nowadays eHealth refers to a network of interconnected services. This all impacts the approach that is taken towards eHealth implementation.

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