Implementation of health technology: Directions for research and practice

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Introduction

The success of health technologies in practice is highly dependent on the implementation approach. However, a lot of health technologies fail due to a lack of commitment and investment to introduce, maintain, and manage these technologies in a sustainable way (1). Implementation is often described as a complex process, involving a variety of factors that play a decisive role during the development process (2). To monitor and understand these factors, a holistic and multidisciplinary approach of implementation is demanded (3). Holistic because technologies are not just devices. Technologies create an infrastructure for the way of working, for new services and concepts on how to change and improve healthcare, how to align work practices with technologies, how to prepare healthcare workers to use technologies, how to engage stakeholders to invest in maintenance and how to assess the impact on healthcare? Multidisciplinary, only with knowledge and insights from different disciplines as social and behavioural sciences, engineering and business, user friendly, accessible, and affordable technologies can be realised. Therefore, implementation must deal with resources (e.g., time, staff, budget, investment policies), ethical concerns (privacy, security, regulations, ownership), governance (policy, accountability, responsibility etc.), and eSkills (capabilities, culture, etc.) (1, 2).

To better guide, monitor and understand the implementation, this paper describes and introduces directions for research and practice. A novel approach for implementation will be highlighted, and finally opportunities will be outlined for increasing knowledge on implementation.

Views on implementation

Implementation can be described as a process of several planned and guided activities to launch, introduce and maintain technologies in a certain context to innovate or improve healthcare. These activities deliver the evidence for adoption and upscaling a technology in healthcare practices.

Based on knowledge, insights from research and lessons learned from practice (2) several key principles for implementation can be announced:
Implementation is intertwined with development

Too often, implementation is seen as post-design activity that is planned and executed after the design of a technology is finished. However, current visions on technology development state that implementation plays an important role right from the start (2, 4, 5).

The development or redesign of a technology can be considered as the creation of an infrastructure for healthcare delivery to change or improve healthcare since it intervenes with existing care practices such as the division of labor, time, finance, legislation and regulations for using technology in a treatment or self-care process. Implementation starts with activities to get insights in the risks and factors that can influence the uptake and adoption. Therefore, systematic attention should be given to the implication for individuals, health care and society at large. Potential implementation issues such as limited resources (e.g., time, staff, and money), ethical (privacy, security, dependency, cultural diversity) or personal drawbacks (e.g., skills, motivation, and uncertainties) should be identified. These issues should also be accounted for in the subsequent cycles of development (prototyping, design and employment) (6). In this way, the well-known pitfalls of stakeholder disregard can be avoided.

Engaging stakeholders is crucial

Stakeholders should be identified and involved at start and during the development of a technology to ensure engagement and to achieve commitment about resources, capacities, and maintenance. Key stakeholders can be identified based on their role in the process of implementation and the level of strategic influence they have on short- or long-term success and failure of implementation (7–9). Stakeholders help to create the technology by means of being involved in activities like identifying the values to be realized with a technology and discussing critical issues for implementation.

Involving end users and stakeholders from different backgrounds, with different interests and strategic influence (political, medical, policy, commercial) is important for creating trust, commitment, ownership and for organizing the resources, finance, and capacities for the technology. Different stakeholders often have different motives, goals and values for a technology. Having a thorough understanding of and appreciation for these motivations is important, however these discussions with stakeholders are often lacking, or not well-communicated (2). It is also important to prioritize the values of different stakeholders and make choices based on this prioritization. Value proposition maps and business models are needed to implement the infrastructures for care delivery through technology (10). Such a business model should address the societal, medical, commercial, ethical and socio-cultural aspects of using technologies in healthcare (2, 11, 12).

Implementation needs continuous monitoring

To implement technologies in healthcare, continuous monitoring is needed to track and understand changes and impact on the healthcare system. Formative iterative data collections are relevant about real-time usage, adoption, and impact on care pathways, staff and costs. The iterative data collections provide evidence for implementation, via process methods combined with performance methods to establish cost-effectiveness, clinical outcomes and efficiency. For instance, methods to determine the effect of transferring hospital care to home care on health outcomes, or methods to estimate the differences technologies make in health care as compared to care as usual (13). Monitoring research should reach beyond the golden standard of randomized clinical trials. Robust methods are necessary to assess the full spectrum of potential benefits and risks a technology can have. For example, methods to track data about real-time use of a technology, like logfiles, user feedback systems, a risk assessment to understand the pros and cons for the organization of care and a business model to define the potentials for maintenance and upscaling care (14).

Governance is essential for sustainable implementation

Implementation is often an unofficial appointed task, no one is responsible for it. Lack of cooperation with managers of care organizations results in ad hoc planning and “reinventing the wheel”. Inappropriate planning, lack of commitment of staff, lack of resources induces an increase in workload and a negative attitude of staff towards digitalization of healthcare. Governance, referring to leadership, vision, policy and accountability is essential to create ownership and to invest in training and long-term data collections to understand the impact of technology on healthcare and society. Therefore, governance could facilitate participatory development discussing different perspectives of staff and management to create commitment, consensus and ownership and responsibilities for maintenance. Maintenance of technology is often underestimated, which can lead to obsolete technologies and in the end de-implementation.

Nowadays, new challenges are the validation and certifications of new and all existing health technologies under the new Medical Device Regulations (MDR) of which many aspects are still unknown (15). Careful planning is needed to
fulfil the regulatory demands for healthcare technologies, to
guarantee safety, security before the technologies go to the
EU-market. It will be important for managers of healthcare
organizations to understand the novel classification systems
for changing or updating the medical devices, for planning,
design, execution of impact assessments and for supporting
the development of a quality management system. Knowing
how other healthcare settings that have implemented similar
technology can be very helpful and efficient (16). This will
provide insights in interoperability and standardization, in
accordance with international interoperability standards, data
sharing, and local regulations (17).

The key principles reflect the complexity of implementation
and the need for a holistic approach towards sustainable health
technology implementation.

**Approaching a framework for implementation of health technology**

A numerous models and frameworks have evolved that aim
to understand the processes and driving factors involved in
implementation, and to predict outcomes (2, 4, 5). The
frameworks and models have different perspectives. For
example, frameworks like, RE-AIM Framework (18),
Consolidated Framework for Implementation Research (19)
were introduced to implement clinical and medical based
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. However, these
frameworks do not focus on the capacities and characteristics
of technology to change, innovate healthcare and how
technology could be integrated into workflow and care
pathways (2, 6).

Considering the aforementioned views on implementation,
a process driven development guideline is in preparation,
building on the CEHRES roadmap and business modelling (2,
6, 11, 12). The implementation guideline can be considered as
a maturity scan (20) to guide and to assess the process and
outcomes of implementation. The maturity scan entails 5
domains: users, stakeholders, organization, system (What are
the expectations, and requirements of the end users,
stakeholders, management of the organization and the
technical system surrounding the proposed innovation?); legal,
ethical, privacy aspects and regulations (What are the legal,
ethical and technical considerations regarding implementation
of a technology); business model (what are the expected cost/
benefits, resources, capacities to implement technology);
economic aspects (is a technology affordable, sustainable
considering stakeholders and market); effectiveness (is a
technology equally or more effective compared to current
practice). Each domain refers to several questions and
methods to assess the maturity of a certain domain. The end
scores visualizes (a spider plot) the status quo of
implementation and specifies what has to been done to
improve the implementation process (directions, and
methods). This scan will be further validated to develop a
holistic and multidisciplinary based implementation
approach (20).

**Increasing knowledge on health technology implementation**

The section focuses on implementation of health and
medical technologies. To maximise the impact of technology
on healthcare and society advanced methods are needed to
acquire qualitative and quantitative data to validate
technologies according to law- and regulations for medical
devices. I advocate a crossing border approach, as on the edge
of different disciplines new concepts for implementation and
methodologies will emerge. Therefore, I welcome
interdisciplinary and multidisciplinary research, to stimulate
the use of novel and comprehensive health technology
implementation assessments and advanced methods to engage
stakeholders, creating added value for patients, healthcare, and
society.

**Author contributions**

JvG-P, author contributed to the article and approved the
submitted version.

**Conflict of interest**

The author declares that the research was conducted in the
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References

1. Cresswell K, Sheikh A, Franklin BD, Krasuska M, Nguyen HT, Hinder S, et al. Theoretical and methodological considerations in evaluating large-scale health information technology change programmes. BMC Health Serv Res. (2020) 20(1):477. doi: 10.1186/s12913-020-05355-7

2. Van Gemert-Pijnen L, Kip J, Kelders SM, Sanderman R. EHealth research, theory, development and evaluation, a multidisciplinary approach. Enschede, the Netherlands: Routledge (2018).

3. https://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

4. Greenhalgh T, Wherton J, Papoutsi C, Lynch J, Hughes G, A’Court C, et al. Beyond adoption: a new framework for theorizing and evaluating nonadoption, abandonment, and challenges to the scale-up, spread, and sustainability of health and care technologies. J Med Internet Res. (2017) 19(11):e367. doi: 10.2196/jmir.8775

5. Bastoni S, Wrede C, da Silva MC, Sanderman R, Gaggioli A, Braakman-Jansen A, et al. Factors influencing implementation of eHealth technologies to support informal dementia care: umbrella review. JMIR Aging. (2021) 4(4):e30841. doi: 10.2196/30841

6. https://www.utwente.nl/en/bms/ehealth/cehres-roadmap-toolkit/cehres-phases

7. van Woezik AFG, Braakman-Jansen LMA, Kulyk O, van Gemert-Pijnen J. Tackling wicked problems in infection prevention and control: a reflection on co-creation with stakeholders. JMIR Res Protoc. (2015) 4(3):e104. doi: 10.2196/resprot.4519

11. van Limburg M, Wentzel J, Sanderman R, van Gemert-Pijnen L. Business modeling to implement an eHealth portal for infection control: a reflection on co-creation with stakeholders. JMR Res Protoc. (2015) 4(3):e104. doi: 10.2196/resprot.4519

12. Nieuwenhuis B. Value proposition design and business modelling. In: L Van Gemert-Pijnen, J Kip, SM Kelders, R Sanderman, editors. EHealth research, theory, development and evaluation, a multidisciplinary approach. Routledge (2018).

13. IJzerman MJ, Koffijberg H, Fenwick E, Krahn M. Emerging use of early health technology assessment in medical product development: a scoping review of the literature. PharmacoEconomics. (2017) 35(7):727–40. doi: 10.1007/s40273-017-0509-1

14. Cresswell K, Williams R, Sheikh A. Developing and applying a formative evaluation framework for health information technology implementations: qualitative investigation. J Med Internet Res. (2020) 22(6):e15068. doi: 10.2196/jmir.15068

15. Bianchini E, Mayer CC. Medical device regulation: should we care about it? Artery Res. (2022) 28:55–60. doi: 10.1007/s44200-022-00014-0

16. Cresswell K, Coleman J, Sae A, Williams R, Sheikh A, on behalf of the ePrescribing Programme Team, et al. Investigating and learning lessons from early experiences of implementing ePrescribing systems into NHS hospitals: a questionnaire study. PLoS One. (2013) 8:e53369. doi: 10.1371/journal.pone.0053369

17. https://health.ec.europa.eu/ehealth-digital-health-and-care/european-health-data-space_en

18. Glasgow RE, Harden SM, Gaglio B, Rabin B, Smith ML, Porter GC, et al. RE-AIM planning and evaluation framework: adapting to new science and practice with a 20-year review. Front Public Health. (2019) 7:64. doi: 10.3389/fpubh.2019.00064

19. Kirk MA, Kelley C, Yankey N, Birken SA, Abadie B, Damschroder L. A systematic review of the use of the consolidated framework for implementation research. Implement Sci. (2015) 11:72. doi: 10.1186/s13012-016-0437-z

20. https://www.utwente.nl/en/techmed/research/research-programmes/sht/