

Scaling-Up Digital Innovations in Healthcare: Expert Commentary on Success Factors and Barriers

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Abstract

Healthcare delivery is undergoing a rapid change from traditional processes towards the use of digital health interventions and personalized medicine. Hospitals and health care providers are introducing hospital information systems, electronic health records, and telemedicine solutions to create more efficient workflows in and beyond institutions. Patients are choosing among a wide range of digital health tools provided by wearables and mobile phone applications to support their self-management, health and well-being. The question of how sustainable digital health scale-up can be successfully achieved is not yet sufficiently resolved. This paper identifies and discusses success factors and barriers for scaling-up digital health innovations. The results discussed in this paper were gathered by 13 scientists and representatives of public bodies and patient organizations during the 1st International Workshop on Best Practices for Scaling-Up Digital Innovations in Healthcare – Scale-IT-up!, co-located with the BIOSTEC 2020 conference held in Valletta, Malta. The resulting success factors and barriers are explored in the context of prior research and implications for future work.

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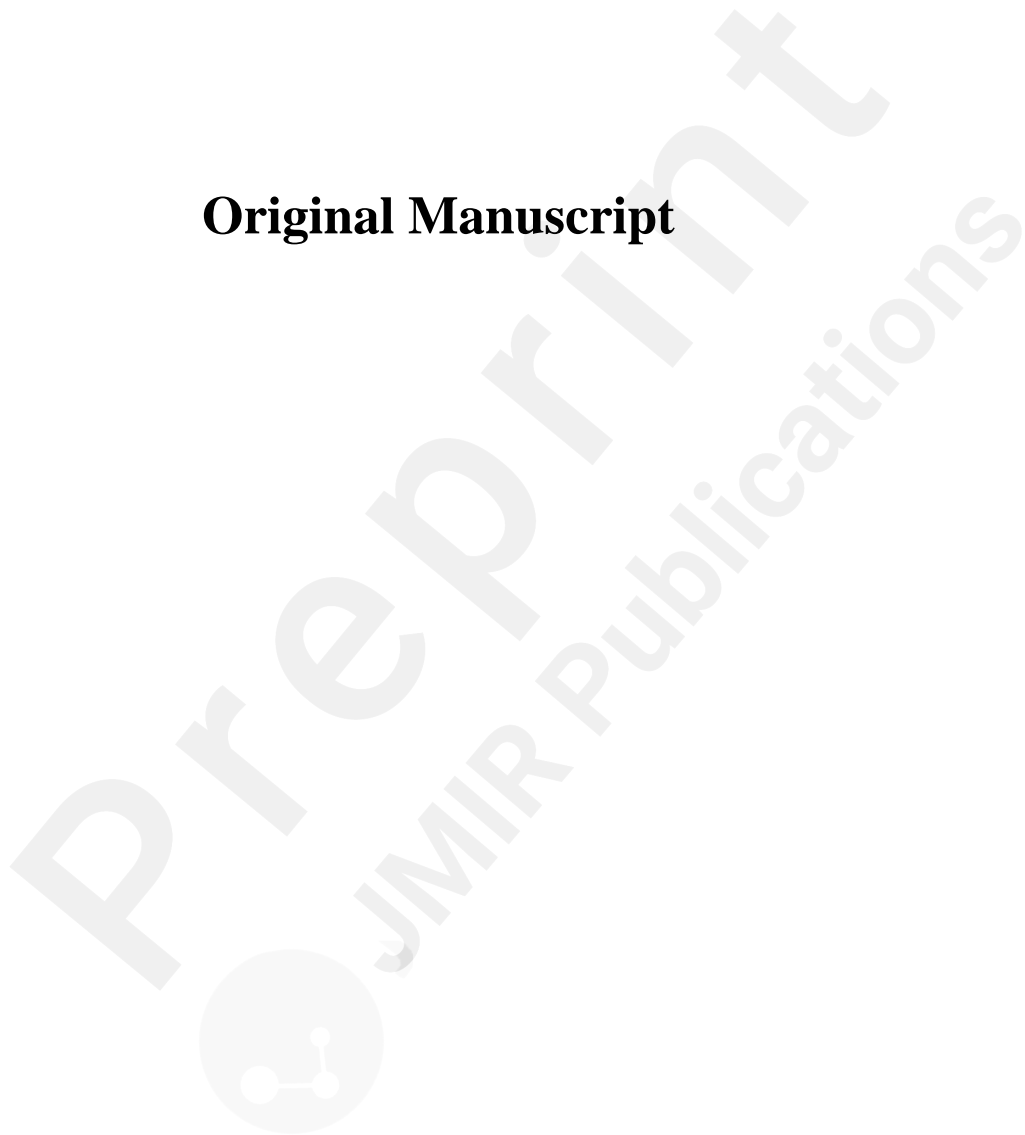
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Viewpoint

Scaling-Up Digital Innovations in Healthcare: Expert Commentary on Success Factors and Barriers

Abstract:

Healthcare delivery is undergoing a rapid change from traditional processes towards the use of digital health interventions and personalized medicine. Hospitals and health care providers are introducing hospital information systems, electronic health records, and telemedicine solutions to create more efficient workflows in and beyond institutions. Patients are choosing among a wide range of digital health tools provided by wearables and mobile phone applications to support their self-management, health and well-being. The question of how sustainable digital health scale-up can be successfully achieved is not yet sufficiently resolved. This paper identifies and discusses success factors and barriers for scaling-up digital health innovations. The results discussed in this paper were gathered by 13 scientists and representatives of public bodies and patient organizations during the 1st International Workshop on Best Practices for Scaling-Up Digital Innovations in Healthcare – Scale-IT-up!, co-located with the BIOSTEC 2020 conference held in Valletta, Malta. The resulting success factors and barriers are explored in the context of prior research and implications for future work.

Introduction

Healthcare delivery is undergoing a rapid change from traditional processes towards the use of digital health applications [1-3] and with it precision medicine [4] and precision health [5]. Hospitals and health care providers introduce hospital information systems [6, 7], electronic health records [8-10] and telemedicine solutions for more efficient workflows within and beyond institutions [11, 12]. People may choose between a wide range of digital health services provided by wearables and mobile phone applications supporting their self-management, health and well-being [13]. These may increasingly employ digital biomarkers to sense states of vulnerability [14, 15]; text- or voice-based conversational agents for intervention delivery [16-18]; or a mixture of human and digital support via blended treatments [19, 20]. Such types of digital health services may be able to intervene with the right type of support, at the right time, whilst bearing in mind contextual factors offering a distinct contribution outside of human delivered care [21]. The basic infrastructure created by existing services is growing, even though this currently does not lead to better adoption of these services. The question of how sustainable digital health diffusion can be successfully achieved is not sufficiently solved yet. This paper goes one step further towards resolving this issue by identifying and discussing barriers and success factors for scaling-up digital health innovations.

Workshop context

Barriers and success factors for scaling-up digital health innovations were identified and discussed in the context of a conference workshop. The workshop participants were both junior and senior scientists and representatives from a non-governmental organisation and a home-care-provider. The participants came from diverse countries with a background in public health, implementation science, information systems research, and computer science. Many of the participants have several years of experience with the design and implementation of digital health interventions. All participants were brought together at the “1st International Workshop

on Best Practices for Scaling-Up Digital Innovations in Healthcare – Scale-IT-up!”. The workshop was held at the BIOSTEC conference in Valletta, Malta, on the 25th of February 2020. The workshop was organized in three sessions, where five papers were presented [22-26]. Two keynote speeches on digital health innovations were given by Lisa A. Marsch, from the Dartmouth College in the U.S., and Diane Whitehouse, from the European Health Telematics Association (EHTEL) in Belgium, who both have extensive experience in scaling-up digital health innovations. For example, Dr. Marsch co-developed the most empirically-supported digital behavioral therapy for substance use disorders: it became the very first “prescription digital therapeutic” approved in the U.S. by the Food and Drug Administration [27-29]. Diane Whitehouse, as principal eHealth consultant in EHTEL, has followed a range of scaling-up projects. Examples include one related to telemedicine [30] and another to integrated care [31]. Based on this experience, both keynotes presented insights from various international initiatives and projects. With the agreement of the speakers, the presentations and keynotes were made available to the general public¹. Each presentation provided a different focus on what drives successful scaling-up of digital health innovations: for example, how financial incentives need to be defined to motivate patients to adopt digital health innovations successfully. Based on the input of all the presenters, the last workshop session included a discussion on best practices and challenges while scaling-up digital health innovations with all 13 speakers and workshop participants. This last workshop session forms the basis for the method used to identify the relevant set of success factors and barriers.

Method

The participants in the last workshop session were split into two groups. Both groups undertook a two-round group process, with discussions on barriers and success factors. In the first round, the groups identified either success factors or barriers of scaling-up digital health innovations. This identification was carried out according to the brainwriting technique [32], whereby each participant wrote down success factors or barriers individually. This process enabled each participant to take their time and to be equally involved in the process. Afterwards, each participant presented and explained their list of success factors or barriers to the group so that the ideas could be consolidated and clustered. This process took 20 minutes, before group members switched to the other topic (i.e., from success factors to barriers, and vice versa). The two leaders of the success factors and the barrier table remained in position to inform the other group members about the results.

In the second round, the other group was informed about the results of the first round and could extend and revise these findings. Finally, all participants were given the final results, which were discussed and consolidated until a group consensus between all 13 participants was reached.

Results

In total, 36 success factors and 33 barriers were identified. To align the success factors and barriers identified in the workshop session with prior research, factors were grouped in categories classified by DeLone and McLean [33] as success factors, and Kowatsch et al. [3] as both success factors and barriers.

The success factors listed in Table 1 (below) relate to different levels of influence, and the range of issues covered was diverse: from regulatory and leadership considerations to technical factors (e.g. information quality, interoperability or business model) and factors related to the innovation itself (e.g. modularization regarding upscaling) to aspects involving individual end-

¹ <https://vimeo.com/channels/1542084>

users and their context (e.g. culture, social support). The connection between the stakeholders involved in digital health innovations was highlighted as being important, represented by interdisciplinary co-creation.

Table 1. Identified success factors for scaling up digital health innovations and alignment with prior work. Note: *Category adopted from DeLone and McLean [33], **Category adopted from Kowatsch et al. [3], ***Category based on conclusions from the workshop.

Success Factor	Description
Regulatory issues**	A method for approval of market-entry Legislative change
Leadership***	Continuous dialogue between academia, industry, government and other stakeholders to facilitate policy-relevant research and increase scaling-up of science based best-practices Visionary leadership Care management
Information quality*	Open source Continuous clinical validation of digital innovations Information disclosure Evidence-based intervention components Access to patient data, software, etc.
Interoperability**	Complemented and extended healthcare service delivery and research (does not compete with or disrupt workflow) Early steps on interoperability Integration in existing workflows
Business model***	Appropriate incentives Financially viable business model Business model in mind at an early stage Added value
Standards**	Alignment to existing standards Usage of existing infrastructure Utilization of existing infrastructure and organizations
Culture**	Organizational change Capacity building Awareness raising Prioritization of trustworthy digital health
Social support**	Build trust Recommendation of the digital health innovation by physicians
Innovation process***	Minimum viable product and small iterations Adoption, iteration, refinement and removal of elements that do not add value Modularization regarding upscaling Flexibility in innovation process User-centred design and evaluation at every stage
Interdisciplinary co-creation***	Patient inclusion Collaboration between medical experts, computer scientists, business experts, etc. Continuous dialogue between academia, industry, government and other stakeholders to facilitate policy-relevant research and increase scaling-up of scientifically validated best-practices Employee involvement Engagement of diverse stakeholders/stakeholder engagement

A similarly diverse picture can also be seen with the barriers identified (see Table 2). The

barriers are e.g. related to funding, reimbursement and regulatory issues, and technical factors associated with usability, integration or interoperability. Many categories, however, are strongly linked to the individual end-users and their context, e.g. individual characteristics or resources of end-users, negative associations, culture, and regional infrastructure. Also for the barriers, missing cooperation or goals (in planning, responsibility and methodology) were named as being hindering. The characteristics inherent in innovation were also named a few times. Participants referred to a lack of trust when transferring existing solutions to new contexts (the “not invented here” dilemma, also referring to solutions being rejected due to a wish for pushing own solutions instead). Also, a too high pace of innovations (leading to a piecemeal approach, not paying heed to past success/failures in other settings when designing new approaches) was named.

The results show that both success factors and barriers for digital health innovations exist on the micro, meso, macro, and the technology/innovation level. On the micro level – the level of individual end users – user-centred design and patient involvement can serve as success factors. On the contrary, lack of motivation, missing co-creation or stakeholder engagement can easily be barriers. Actors on the meso level can support digital health innovations by raising awareness or building capacity, while different infrastructure or missing leadership in projects (both changeable on this level) can be hindering. Regulatory issues (as example for macro level aspects) can easily be success factors or barriers at the same time. Easily approving market entry of new solutions can be supportive, whereas legal regulations and the health systems innovativeness can be barriers. The same is true for technical aspects, respectively aspects regarding the innovation itself, like interoperability measures or the innovation process. Interoperability measures can hinder the innovation if not sufficiently taken into account but can also support actively the innovation’s success. Flexibility and modularization in the innovation process can also support the innovation’s success while the pressure of change and the risk of innovations is hindering in some cases. Finally, we could see that a holistic approach involving all levels and stakeholders is necessary. Knowledge in silos or a missing common goal are clearly a barrier to digital health innovations. At the same time, interdisciplinary co-creation between academic, industrial, governmental and other stakeholders was experienced as a driving factor supporting successful scaling-up.

Table 2. Identified barriers for scaling up digital health innovations and alignment / cross-validation with prior work. Note: **Category adopted from Kowatsch et al. [3], ***Category based on conclusions from the workshop.

Barrier	Description
Funding**	Missing funding
Reimbursement**	Reimbursement is not guaranteed
Regulatory issues**	Legal regulations
	Liability issues
	High regulatory barriers
	Health system is not innovation friendly
Guidelines**	Unclear/not defined process to innovate
Usability of technology**	Lack of ease of use
	Complexity is too high
	No user-centred design
Integration**	Integration issues
Interoperability**	Incompatibility of existing processes and innovation
	Closed systems/missing interoperability

Individual characteristics of end user**	Lack of motivation to change/adapt Trust issues
Individual resources of end users**	Additional work for medical staff
Negative associations**	Physicians perceive digital health innovations as a threat/substitution
Culture**	Culture
Regional infrastructure**	Infrastructure available is different
Cooperation**	Missing co-creation (medical, IT and business staff) Gap between technology developers/researchers and healthcare practice Missing broad stakeholder engagement Knowledge in silos Missing common goal
Planning**	The aim of research is not a successful implementation No suitable business model for preventive interventions
Responsibilities**	Missing leadership in projects
Methodology**	Selection bias
Benefits**	Missing value proposition for patients
Innovation characteristics***	Who pays the risk of innovation? Too high pace of technology inventions Need for speed (rapidity/pressure of change) The "not invented here" dilemma

Summary

The workshop intention was to match existing theoretical insights on success factors and barriers of digital health innovations with the practical experience the workshop participants had from both practice- and research-based (empirical and applied) perspectives. This experience was then grouped into categories to reach a single consolidated list of success factors and barriers.

The categories of success factors and barriers have shown that successful scaling-up of digital health innovations is influenced by actors and aspects on different levels, on the micro, meso, macro, and technology/innovation level. This shows that actors on all these levels can positively influence the success of digital health innovations.

Prior work [3] covers diverse categories of influencing factors on digital health innovations, such as individual characteristics of the end users, the disease targeted, expectations or regulatory issues and funding. While most of these categories were mirrored by the results of our workshop, some categories were not named at all. For example the disease, social interaction, or expectations, which are part of previous work [3] were not mentioned by the workshop participants. Others, such as standards or social support, were only named as success factors, even though they also represent barriers according to Kowatsch et al. However, other aspects arose, which could not be matched to existing categories, namely the characteristics and the process of innovations, the business model, leadership and interdisciplinary co-creation.

Future research should especially focus on these findings. It needs to be elaborated further if the discrepancy between the findings of our workshop and prior literature show different perspectives in the perception of success factors and barriers for digital health innovations between research and practice. Also, future research should corroborate our findings with larger groups of experts to see how they hold or vary per medical sub-industry. We suggest that the development of digital health applications for smartphones may be different from the development of hospital information systems.

The findings reported are mainly limited by the size of the expert group involved in the workshop. It could have been too small or not representative enough since the group was

composed mainly of researchers. Nevertheless, the experts involved combined extensive experience in (digital) health care.

To summarise the findings and discussions from the workshop, five conclusions for the scaling-up of digital health innovations can be highlighted. First, digital health interventions can help to drive data quality, outreach to communities, and manage disease transmission/progression. Second, to reach these aims, a general cultural shift is needed when seeing digital interventions as viable instruments in healthcare along with classic pharmaceutical, surgical or other therapeutic measures. Third, technological developments and interoperability appear to be success factors supporting digital health interventions rather than acting as hindrances. This latter finding is rather surprising, since lack of interoperability has often been named as barrier in prior work [34, 35]. However, also the European Commission calls for a more extensive focus on interoperability so as to facilitate increasing use of digital health technologies [36]. Fourth, when scaling-up digital health innovations, it is important to ensure the involvement of all stakeholders, people from different professions, and especially patients. Only with a joint effort on the part of all stakeholders can digital health interventions succeed. Fifth, the innovation process itself also plays a crucial role, especially in relation to culture and leadership. The innovation process should be partitioned into different stages, within each further research should examine how to best fulfil each stage. Innovation processes should also be considered in reimbursement models for digital health innovations to ensure that new technologies, such as digital pills, have a chance to be tested in real-world settings. When working on all the five aspects, we believe that the scaling up of digital health interventions can be strongly supported and help bringing healthcare services to new levels.

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Conflicts of Interest

Author LAM is affiliated with Pear Therapeutics, Inc., HealthSim, LLC, and Square2 Systems, Inc. Conflicts of interest are extensively managed by her academic institution, Dartmouth College. GWT, JO and TK are affiliated with the Center for Digital Health Interventions (www.c4dhi.org), a joint initiative of the Department of Management, Technology and Economics at ETH Zurich and the Institute of Technology Management at the University of St. Gallen, which is funded in part by the Swiss health insurer CSS. TK is also cofounder of Pathmate Technologies, a university spin-off company that creates and delivers digital clinical pathways. However, Pathmate Technologies is not involved in this article.

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