Achieving Problem-Solution Fit in Digital Health Implementation

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Abstract

Digital health tools have the potential to address important health systems challenges, but they have had a variable impact when implemented in healthcare settings. What problem these tools can effectively address and the degree of uptake in a particular context are key challenges to implement and scale market-ready digital health technologies. Drawing on frameworks for service design, we take the perspective that people "hire" products or services to do a functional, social, or emotional job. To increase the likelihood of adoption, a digital tool should help users to do an important job. Methods like lean startup and value proposition design focus on discovering which customers they can best serve, and we adapt this approach to help implementation teams quickly and cheaply find a fit between a digital health solution and user jobs in a particular healthcare context. This involves iterative testing of hypotheses about a potential fit using low-fidelity prototypes or "minimally viable products". If initial tests do not support the hypotheses, the team can decide to pivot (change the target user, features of the digital health solution, the clinical model or desired outcome) or persevere (continue testing to confirm the result). We provide illustrative examples of how this method was used in implementation of a remote monitoring device for Chronic Obstructive Pulmonary Disease in a community hospital. This approach helps implementation teams empirically test assumptions about a particular fit before investing significant time, effort, and resources into a pilot study. Achieving fit between a digital health solution and user jobs does not guarantee user adoption or impact, but it brings a team closer to the point where it is worth investing in a more formal evaluation. Future work should seek to situate value proposition design and lean startup principles within a more comprehensive framework for digital health implementation that addresses organizational change.

Introduction

Implementing & Scaling Digital Health

Digital health solutions have the potential to improve access to care, the experience of care, health outcomes, and reduce cost. However, the evidence to date has been very mixed. Digital tools are often embedded in complex health services, which may affect their uptake and impact in ways that are hard to predict.[1–4] Implementation and scaling are often not considered during the design process for these tools, meaning there may not be an obvious clinical model to which a tool is best suited.[5] Digital tools often permit customization which offers flexibility in tailoring to the local context. This increases uncertainty for the implementation team as it becomes less clear which elements of the tool and accompanying clinical process are the "active ingredients.".[6,7] Iterative testing can help identify the core components of an intervention that can be efficiently replicated across settings. Furthermore, these tools interact with existing policies and organizational culture in ways that may limit or enhance their impact. As a result, there are three key areas of uncertainty when implementing and scaling digital health solutions in a particular healthcare setting:

1. **Adoption:** Will users adopt and interact with a digital health solution the way we expect?[8] (Note that "user" refers to any individual that may interface with the digital health solution, including patients, caregivers, and healthcare providers.)
2. **Mechanism of Action:** How do users interact with a digital health solution, and what outcomes can we expect? [6,9,10]
3. **Effectiveness:** How can we capture the changes in outcome in a rigorous evaluation?

Approaches like developmental evaluation address some of this uncertainty by providing general principles, whereas methods from the software and startup sectors provide clear methods for structured exploration of problem-solution fit at an early stage. However, their application has not been described in a context where there are many potential users with differing interests, and where the outcomes of interest go beyond user uptake or financial impact. We use the term digital health solution to describe an intervention that includes a digital health technology embedded in a clinical process (e.g. an intervention could include a mobile health app plus a structured exercise program).

User Adoption

User adoption does not ensure impact, but it is a necessary precursor to understanding the mechanism of action and measuring effectiveness in a given healthcare context. This is a key challenge, as shown in a systematic review by Kelders et al. which found that only 50% of participants adhered to web-based interventions.[11] There are a number of theories across different disciplines that seek to conceptualize user adoption of digital health solutions, such as Rogers' diffusion of innovation, Murray et al.'s normalization process theory, and Greenhalgh et al.'s phenomenological approach of "what matters to people".[12–15]

We draw on the management and service design literature to consider adoption from the perspective of "jobs to be done", which proposes that people "hire" products/services to do a functional, social, or emotional job.[14] Jobs are "what an individual really seeks to accomplish in a given circumstance."[16,17] For example, a digital health solution could enable a patient to access care more conveniently at home (*functional job*), boost a caregiver's confidence in caring for their loved one (*emotional job*), and improve a healthcare provider's relationship with their colleagues (*social job*).

So users adopt digital health solutions to: "address more jobs, switch to a more important job, go beyond functional jobs, get a job done incrementally better, or get a job done radically better."[18] Since user jobs are context-specific, it is particularly important to consider when implementing and scaling digital health solutions in a new healthcare context. We manage the uncertainty of user adoption by quickly identifying a suitable fit between a digital health solution and important user jobs in a particular healthcare context, which is described as problem-solution fit.[19]

Finding Fit

Approaches to problem-solution fit can be divided into push (a solution looking for a problem) and pull (pressing problem looking for a solution) strategies.[18] Push strategies are important in the implementation and scaling of market-ready digital health solutions in a new healthcare context. Current approaches for finding fit with push strategies include systematic reviews, stakeholder engagement, and pilot studies. However, these approaches to push strategies are not well suited when the contextual factors are crucial to success and the likelihood of getting it wrong the first time are very high.

Systematic reviews and stakeholder engagement help to gauge potential fit between a digital health solution and user jobs, but do not test the fit. Pilot studies typically test one possible fit between target group, digital solution, and clinical model to achieve an outcome. By the time a digital health solution has reached the pilot phase, the implementation team may have already invested a significant amount of time, effort, and resources in support of one particular fit, making it more difficult to change course. If the first attempt at a potential fit is likely to fail, then we require an iterative method to manage uncertainty by testing the fit quickly and cheaply prior to beginning a pilot.[20]

Value Proposition Design and Lean Startup

Startup companies in the software industry have developed a series of methods such as value proposition design (VPD) and lean startup to create products and services under conditions of extreme uncertainty, where there are no existing users, no established processes, and it is unclear if the proposed solution has any value.[20] VPD can be applied to push *and* pull strategies. It involves understanding target users by profiling their gains, pains, and jobs and how a product/service will create value for the user. Fit is achieved when a product/service is able to create gains, relieve pains, and help users to do important jobs.[18]

Lean startup involves an iterative process of user discovery, user validation, and pivots to achieve fit between a product or service and user needs. During the user discovery phase, minimally viable products (MVPs) are used to learn about the fit between a solution and user needs. MVPs can range from videos or pamphlets introducing the solution to prototypes with some functioning features. During the user validation phase, startup companies verify initial hypotheses by testing them on potential users. If the hypotheses do not hold true, then companies must pivot and decide to test a new fundamental business hypothesis. Pivots may involve changing the target user, the scope of the product/service features, or the user need that is addressed by the product/service.[21,22] There are few descriptions of lean startup in the medical literature, and they have not articulated the hypotheses and tests that led to their pivots.

[23] Drawing from VPD and lean startup principles, we describe a method for finding fit between a digital health solution and user jobs in a particular healthcare context.

Method

This method applies to the introduction of a market-ready digital health solution to a new healthcare context as a first-time implementation or to scale a promising solution. By market-ready, we mean that the digital health technology has the necessary regulatory clearances (e.g. FDA, Health Canada) and is currently on the market. Potential problem-solution fits are identified through literature review and stakeholder engagement. Best available evidence on similar digital health solutions as well as qualitative or mixed-methods studies of user perspective further assist in determining potential problem-solution fits. Stakeholder engagement informs an initial system understanding of the local context. It helps to incorporate perspectives of individuals who do not directly interface with the digital health solution, but have an important role in decisions around implementation (e.g. hospital administration).

Key uncertainties about a potential fit are stated as hypotheses that can be tested using low-fidelity prototypes or "minimally viable products". MVPs are used for quick tests on the ground to look for early signals as to whether the hypotheses are correct. Testing is most effective when it includes both quantitative and qualitative aspects to inform decision-making by the implementation team. If initial tests do not support the hypotheses, the team can decide to pivot (make a significant change) or persevere (continue testing to confirm the result). Pivots include changes to the target user group, user need, features of the digital health solution, the clinical model or desired outcome. The goal of hypothesis testing is not to identify the perfect parameters for a given digital health solution by controlling for all user-level variables. Instead, these tests aim to find large and obvious effects from small samples on key parameters of interest to inform changes. For example, if 4 out of 6 patients of the desired population indicate they do not want to use a technology because it is difficult to use, then this suggests that either a different approach to recruitment or changes to product design are needed for this group, or a different group should be targeted.

Illustrative Example

VPD and lean startup principles were applied in the introduction of a digital health tool for patients with chronic obstructive pulmonary disease (COPD) in a community hospital setting. The digital health tool included features for vital signs measurement (including a pulse oximeter), symptom surveys, medication & appointment reminders, and videoconferencing. A literature review was conducted to identify best available evidence on vital signs monitoring for COPD patients at home as well as mixed-methods studies to inform understanding of patient and caregiver jobs to be done. Stakeholder engagement was conducted using interviews to assess what constitutes value to hospital administration, frontline clinical staff, and patients in the local context.

Stakeholder engagement provided information about usual care for patients with COPD in this community, but also revealed the complexity of the local environment and the range of potential value propositions. Importantly, we quickly identified multiple user groups in the community who were candidates for the digital health solution (Table 1). Patient subgroups included those who were recently diagnosed with COPD, recently admitted with an exacerbation, or frequently readmitted with exacerbations. We learned of a patient subgroup that had previous exposure to a similar digital health solution and a subgroup that already owned pulse oximeters. We also identified different contexts in which users (patients, frontline clinical staff, and caregivers) might be recruited from, including inpatient wards, outpatient COPD clinic, and a pulmonary exercise rehab program. Furthermore, we identified patient populations that were not initially considered for the intervention, but might benefit from the digital health solution, including patients with severe asthma and interstitial lung disease.

We consulted broadly on potential user subgroups with frontline providers in inpatient, outpatient COPD clinic, primary care, and home & community care settings as well as hospital administration and a home care organization. Stakeholders from different care settings and roles had differing views about which patient subgroups would be most likely to adopt and benefit from the digital health solution. For instance, some stakeholders believed that patients admitted for an exacerbation would be motivated to adopt the technology and could be trained on the digital health tool during their hospital stay. Others believed that inpatients would not be in the right frame of mind to adopt a new technology and that outpatient recruitment would enable better continuity in patient recruitment and follow-up. In sum, stakeholder engagement was a hypothesis-generating activity that helped to elicit diverse, and sometimes contrasting, perspectives on user subgroups.

Table 1. Summary of potential user groups, user subgroups, and jobs to be done in the implementation of a vital signs self-monitoring platform in a community hospital setting. *Tested in hypothesis 1. **Tested in hypothesis 2.

User Groups	User Subgroups	Jobs to be done
Patients with COPD	***Care Setting*** Inpatient wards COPD clinic* Exercise rehab program** Primary care ***Stability*** Recently diagnosed with COPD Recently admitted with exacerbation Frequently admitted with exacerbation ***Experience with similar value proposition*** Already own a home pulse oximeter Previous exposure to a similar digital health solution	Identifying and self-managing exacerbations *(functional job)* Developing confidence in managing at home *(emotional job)* Transitioning home following admission for exacerbation *(functional/emotional job)* Connecting with peers living with COPD *(social job)*
Frontline clinical staff	***Care Setting*** Inpatient wards COPD clinic Exercise rehab program Primary care ***Professional role*** Respiratory therapist Physician	Providing unscheduled, emergency care to patients with an exacerbation at home *(functional job)* Timely coordination with colleagues *(functional/social job)* Ongoing contribution to improvements in patient care *(emotional/social job)*

Stakeholders were largely in agreement that an overarching goal should be to reduce COPD patient readmissions due to exacerbations. However, stakeholders also suggested a number of slightly different user jobs that might be addressed by the digital health solution. Potential jobs for patients with COPD in this community included identifying and self-managing exacerbations *(functional job)* and developing confidence in managing at home *(emotional job)*. For frontline clinical staff, jobs to be done included provision of unscheduled, emergency care to patients with an exacerbation at home *(functional job)* and timely coordination with colleagues *(functional/social job).* Again, stakeholder engagement highlighted both the opportunity and uncertainty that existed in implementing the digital health solution.

During the process of stakeholder engagement, we identified important constraints on digital health implementation imposed by the local context. Although the digital health tool was designed for remote patient monitoring and evidence in the literature is more robust for this application, stakeholders focused on using the tool for patient self-monitoring due to managerial concerns about organizational risk and impact on workflow. This organizational constraint limited the range of value propositions that could be explored.

Given the range of possible value propositions and the organizational constraints, we applied an iterative method to quickly identify a patient subgroup and job for which there might be a problem-solution fit. Insights from literature review and stakeholder engagement were used to generate an initial hypothesis about the fit between the vital signs self-monitoring platform and a COPD patient subgroup: patients with COPD at the outpatient COPD clinic would be interested in using the digital health platform to perform disease self-management at home.

We used a study recruitment flyer featuring images of the platform to test this hypothesis. Nine patients with COPD were approached at the outpatient COPD clinic while they were waiting for their appointment and introduced to the study with a standardized script. They were asked if they would be interested in participating in the study and to give a brief explanation for their preferences. Two patients said "yes", five patients said "no", and two were split answers between patients and caregivers. Those who said "no" cited that they were stable, could self-monitor independently, and perceived the platform to be burdensome. In both patient-caregiver pairs, the patient declined while the caregiver said yes. Given that only two out of nine patients responded positively, the hypothesis about the fit was not supported and a decision was made to target a subgroup of patients with COPD that might be more receptive.

Since the qualitative results from the first hypothesis test suggested that workload was a significant concern for the general patient population at the outpatient COPD clinic, the focus shifted to COPD patients at the exercise rehab program (hypothesis 2). Stakeholder engagement suggested that patients in the exercise rehab program may be more motivated to adopt a new platform and perform self-monitoring. Twelve patients with COPD were approached during the exercise rehab program and shown a study recruitment flyer. They were asked questions regarding recent exacerbations, measurements taken at home already, interest in participating in the study, and their rationale behind their interest or lack of interest. Eleven patients said "yes", one patient said "maybe". Nine who said "yes" indicated that they already had some interaction with monitoring technology (taken oxygen saturation themselves before, participated in a telehomecare program previously). Their "job to be done" was checking oxygen saturation to improve their health. The patient who said "maybe", wanted to ask his children for advice first. Ongoing tests and interviews are required to further understand patient motivations and the degree of engagement with the digital health platform, but early signals from these two hypothesis tests suggest a potential problem-solution fit for the patient subgroup at the exercise rehab program.

Discussion

Value Proposition Design and lean startup principles can be adapted to a healthcare context to manage the uncertainty of user adoption of digital health solutions, and quickly find fit between a given solution and a user need in the local context. The implementation team can change the target user or digital tool early in the implementation process before investing a significant amount of time, energy, and resources in one particular use case. VPD and lean startup are broadly applicable and aimed at a wide audience, which is appropriate for implementation teams that cut across sectors. The "jobs to be done" approach to user adoption treats digital health not as a technology alone, but as a series of new routines and assumptions to be embedded in everyday care processes. Achieving fit between a digital health solution and user jobs does not guarantee user adoption or impact, but it brings a team closer to the point where it is worth investing in a more formal evaluation.

However, the design of minimally viable products can be challenging with market-ready technologies in a healthcare context. This method rests on being able to make decisions to change course based on early signals. Healthcare has more stakeholders and is more complex than many other industries given its high degree of regulations and the high risks involved. Applying VPD & lean startup in traditional health research institutions requires close collaboration with Institutional Review Boards, since intervention development does not usually involve systematic data collection and experimentation, and it does not clearly constitute research. These processes allow for exploration of potential value propositions before the formal trial.

The illustrative examples presented here focused on achieving fit with patients as the users in a short time frame. Future work should demonstrate use of this method with other users as well, such as healthcare providers. To mitigate challenges with problem-solution fit, VPD and lean startup methods could be situated within a wider framework for designing new services with no current users that sit between quality improvement (incremental change in existing processes in a given context) and research (new knowledge that is generalizable). A more comprehensive framework should also address organizational change by integrating approaches such as developmental evaluation.[24]

Conclusion

Value proposition design and lean startup principles can be used by digital health implementation teams to explicitly, quickly, and cheaply test assumptions about the fit between a digital health solution and user jobs in a particular healthcare environment. This method enables implementation teams to manage the uncertainty of user adoption when introducing or scaling market-ready digital health solutions in a new healthcare context.

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