

Department: Pervasive Healthcare
Editor: Gabriela Marcu, gmarcu@umich.edu

Common Shortcomings in Applying User-Centered Design for Digital Health

Lorraine R. Buis
University of Michigan

Jina Huh-Yoo
Drexel University

■ **USER-CENTERED DESIGN (UCD)** is the focus of many teams developing digital health innovations, yet principles are not always effectively employed. We have identified several common ways that UCD principles fall short at all stages of the design process and steps to overcome those pitfalls.

From connecting patients, providers, and caregivers, to remotely monitoring patient health outcomes, to aiding individuals self-managing their own conditions, technology is changing how we manage health. As technologies with potential application to healthcare have advanced, so has interest in pushing the envelope.

As experienced researchers of digital health solutions, we have been researching, publishing, and reviewing grants in this space and working with our own multidisciplinary teams of engineers, computer scientists, clinicians, and patients. We have learned many lessons from

our successes and failures, and those of others. On one hand, we have seen solutions change lives, but on the other, we have seen innovations make advancements in science and engineering but lack clinical utility. Sometimes these are true “hammers in search of nails,” where an innovation is inadequately applied to healthcare; other times they are misguided attempts at innovation, lacking proper understanding of clinical context.

Through this, we have observed and experienced several common challenges that determine the success of digital health projects. When these challenges arise, these are the projects that do not get funded, do not move forward, or end up sitting on a shelf. When reflecting back, despite widespread acknowledgement and understanding of user-centered design (UCD) principles in academia and industry, UCD methodologies are often overlooked, given short shrift, or pointedly ignored in the face of different constraints, including lack of time, money, resources, and personnel; they are also ignored because of ego, outright hubris, and the belief that we as innovators know exactly what is needed.

Digital Object Identifier 10.1109/MPRV.2020.2997615
Date of current version 30 July 2020.

No one is immune from skimping on the UCD process. Despite our own formal training, we also make missteps and regret not following our own advice. Some examples of common situations that lead to oversights include.

- Funding opportunities with short turnaround times, which may cause teams to guess about the types of solutions users need or want.
- Engineering labs that make quick progress on solutions with healthy volunteers before moving to feasibility testing in target populations, which often end up with technically innovative solutions that lack clinical utility.
- Lack of suitable resources (money, time, personnel, etc.), or access to clinicians and patients.
- Teams seasoned in working with a target population who want to develop new types of solutions without starting from the ground up.

The goal of this article is to point out the pitfalls that development teams face when working in the digital health space, structured through the lens of the UCD framework, so that the pitfalls can be avoided in the future and good products can be designed.

COMMON UCD CHALLENGES

Not Getting the Clinical Context Right

Getting the clinical context right is a common challenge experienced during the design of new innovations. Without adequate expertise, we have seen grant proposals focused on all stages of technology development get rejected because of the lack of adequate clinical expertise on the team, or lack of clinical utility. Just because something *can* be developed does not mean it *should* be developed, or that it is the *right* thing to develop. Having suitable clinical expertise on the team can help with the following.

- Finding the correct clinical domain.
- Finding the critical symptom, health-behavior, or health-outcome to target.
- Providing clinical perspective for collecting, interpreting, and monitoring data.

- Integrating the design with clinical workflow.
- Understanding feasible design in the clinical context.

Overcome the Pitfall: Assemble the Right Team

To get clinical context right, it is essential to have not just any clinical expertise, but to have the *right* clinical expertise. Building bridges between technical and clinical collaborators can be difficult. Universities with schools or colleges devoted to medicine, nursing, pharmacy, public health, or other allied health professions may have an advantage over universities that do not; however, collocation of technical and clinical departments on a campus does not mean that collaborations naturally emerge. It takes time and care to build trust and understanding, both of which are essential for productive interdisciplinary relationships. It is also not necessarily enough to have clinicians on your team who are experts in their clinical domain. Finding clinicians with experience working with developers, or who are excited to think about, and act on ways to transform current clinical practice, can be key to having a good, collaborative relationship for building digital health solutions. To determine whether you have the right clinical people on your team, ask yourself the following.

- Do my clinical team members work with patients who have the target health condition?
- Are my clinical team members experts in condition-specific pathophysiology and treatment?
- Do my clinical team members have knowledge of and experience working with the target population?
- Have my clinical team members conducted research with the condition and population in the past?
- Have my clinical team members developed digital health solutions before and do they have experience working with developers?

Not Getting the User Context Right

Failure to understand users' context is also commonplace. Even as those who are aware of UCD's fundamental principle—to understand users' needs and contexts, we often overestimate the desire that individuals have to understand and manage their health. We also overestimate

the lengths that users are willing to take to improve their health-related behaviors. For example, one common component of digital health solutions is tracking health outcomes. Technology provides opportunities to track data in ways that have never been possible before. We often make assumptions that people *want* to track data for health purposes, because there is an assumption that people *want* to change their behavior or improve their health. This is not always the case. Oftentimes, health-related behaviors are not something people engage in because people *want* to do them; rather they do so because they *have* to.

For instance, food logging is a common component of many digital health solutions; however, getting people to faithfully and accurately record dietary intake over time is hard. Despite evidence that modifying diet can lead to long-term health benefits, our research has taught us that food logging is typically seen by users as burdensome, boring, and unenjoyable. It sounds easy in theory, but is difficult in practice. Previous research has shown that when asked to log diet, many individuals batch enter and back-fill data instead of tracking in real, or near-real time as intended.¹ This can lead to inaccurate data regarding food, portions, or timing of meals, which may undermine behavior change.

Lack of understanding user beliefs and cultural context also speaks to technology use. Although we may think users will want to provide an endless stream of data that is collected in perpetuity, that is not a realistic ask. Some users may be willing to engage in the short-term, but not the long-term. Even with automated sensor-based tracking, burdens still exist with having to wear sensors and make sure data are flowing appropriately. For some, lack of sustained and faithful tracking occurs because of burden, but for others, the desire to not engage is related to situated social and cultural concerns, such as privacy and confidentiality.

User context can be biased through lack of experience working with target populations, or reliance on students or employees for formative development activities, instead of target end users. The solution we as digital health innovators think is useful for us is not always also useful for users.

Overcome the Pitfall: Get User Context Right

We should get to know the target end users *as we start* the project, not in hindsight. Leaving the walls of your office and finding your average user on the street takes time and effort, but is worth it to be more user-centered, and will likely result in better design. You can start this process by first asking yourself the following.

- What am I asking a user to do, and would I (or my family/friends) be willing to do that?
- How frequently am I asking a user to use my innovation, and would I (or my family/friends) be willing to do that?
- For how long am I asking a user to use my innovation, and would I (or my family/friends) be willing to use it for that long?
- How much of a burden am I placing on a user and is that comparable to the benefit they will get?
- What potential risks am I bringing to users by using my innovation?

Not Properly Identifying User Requirements

Even if we get the context right, we might fail to get the user and their requirements right. Creation of personas that guide development for different groups is a common starting point for design. These personas are archetypes of different types of users, often given names, faces, and a backstory, and are used to delineate tasks and goals that may be accomplished through the use of a product. Although these personas are great for capturing user task context, they may miss essential aspects of users themselves. We think we know the user, but we often do not.

For example, cell phone app development has exploded in parallel with widespread cell phone adoption, even among populations who have historically experienced barriers to adopting technology. However, in our work, we find that users often struggle with the devices they have. They struggle with downloading apps because they do not know their password, technical literacy is questionable, and pairing devices can be an incredible burden to overcome.

In addition to overestimating technical abilities, designers often overestimate users' understanding of their health. We have a lot of information about the information needs of

patients who are active in social media; however, this is a biased group of people who enjoy posting about their health online. Not all patients with Type 2 diabetes, for instance, will have as good of a handle on how their diet contributes to blood sugar fluctuations as we expect from seeing what is shared in online diabetes communities.

Furthermore, most use contexts involve multiple stakeholders who influence individuals' health behaviors. The roles of social networks, including caregivers, friends and family, and healthcare teams often go unnoticed, as innovators often focus on users themselves. In reality, the health of an individual is an enormous lesson in situated action as people are influenced by the context they live in, which can have profound effects on health behaviors. For example, if you are trying use an app to improve diet among pregnant adolescents, you must understand that teens often do not have control over the foods they have access to within the home. Likewise, those looking to create a care coordination app for dementia care need to understand that both informal and formal caregivers (including social workers, physicians, nurses, and nursing home administrators) all influence the health of a patient. As Orlikowsky's Technological Frames work argues,² these multiple stakeholders would have vastly different understandings of what technology adoption might mean for their work context, and unless the new technology solution addresses all of their needs, the adoption may fail.

Overcome the Pitfall: Get User Requirements Right

Although the role of personas is important for formative task-based design work, we must be careful not to reduce target users to archetypes that fail to grasp the essence of what users struggle with and need. Understanding the range of skills and abilities of users is critical. To ensure that we know what the realistic user requirements are, ask the following questions.

- What ranges of tech savviness do the target users have?
- Do target users have experiences using the technology platform my solution relies on?
- Is my target solution suitable for use by my friends/family?

- Do the target users understand enough about the specific health condition to lead them to understand why behavior change is beneficial?
- Even if they understand the benefits, do they have any economic, social, or cultural barriers that might hinder change?
- Have I considered who else may be influencing the behavior of the target users?

Failure to Design the Right Solution

Even if the context is well understood and users and their requirements are well defined, new innovations can fail in the design phase, particularly when it comes to envisioning and refining adequate solutions to a problem. Many projects fail because teams do not understand what the right kind of solution is, and they do not iterate until the solution evolves into something that meets the needs of all stakeholders. Technology vendors in the marketplace constantly develop technically innovative tools for collecting, compiling, and transmitting data from patient-side peripheral remote monitoring devices to providers, with the goal of revolutionizing care. Although these tools will likely be an essential component in healthcare in the future, our current healthcare system is not ready to use these tools clinically on a broad scale. Not only is our current health IT infrastructure not yet optimized to handle large-scale patient self-monitoring, but our workflow processes are not yet optimized to that model of care.

In our current model of care, physicians are limited in the time they can spend on individual patients. Working with clinicians can help ensure that proposed solutions can fit within the existing model of care. Furthermore, the better we can integrate solutions into current care environments, the more likely we can overcome the often touted 17-year uphill battle of making evidence-based changes to clinical practice.³

Overcome the Pitfall: Get the Design Right

We must take steps to make sure that proposed solutions are amenable and well positioned to be effective for the target population. Ways to ensure that we are on track include asking the following questions.

- What is the likelihood that my solution will be used by the appropriate people at the designated time?
- How will users incorporate this into their daily life?
- What do users need to change about their habits in order to use the solution as intended?

Flaws in Evaluation

Ideally, the team has worked closely with clinical collaborators and user stakeholders from the beginning, and iteratively refined the system according to UCD processes. However, even if good solutions have been designed, we have seen projects make missteps during the evaluation, which can sink a grant application, or prohibit a solution from advancing. This usually occurs when we select the wrong metrics for evaluation. These metrics, which are the criteria used to determine whether the project has succeeded, are often highly dependent on clinical and use contexts. For instance, we have seen evaluations that hinge on irrelevant or suboptimal metrics, or metrics that are so highly confounded that it is impossible to tell if a digital health solution worked.

Overcome the Pitfall: Get the Evaluation Right

We need to make sure that the metrics we use to ascertain success are the measures that will actually tell us if a digital health solution works. Ways to ensure that we are on track include asking the following questions.

- Do my evaluation metrics tell me critical information about the success of my product?
- Are my evaluation metrics rooted within the appropriate clinical context?
- Are my evaluation metrics the best ones for use in this context?

CONCLUSION

The UCD process is just one tool in our toolkit for achieving success; however, it is essential that careful application of the steps be made. We have seen many ways that good development teams have ignored parts of the UCD process, and we too have not been immune from failing to apply the process appropriately.

Sometimes, we get lucky and no serious harm befalls the design process, but more often than not, when a project does not pan out, hindsight can show us that failure to adequately engage in UCD was the catalyst. In reflecting on our years of digital health development, our lessons learned can be distilled down pretty easily. Within healthcare, providers, and especially nurses, are familiar with the “5 rights” of medication use, which include the “right patient, right drug, right time, right dose, and right route.” For UCD, it is “users are not like me.” These mantra together emphasize the need for a proper application of UCD principles for digital health development; the right clinical context, the right user context, the right user requirements, the right design, and the right evaluation.

ACKNOWLEDGMENTS

The authors would like to thank Lilly Pritula and Reema Kadri for help editing this manuscript, as well as Gabriela Marcu, PhD for guidance and support.

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Lorraine R. Buis is an assistant professor with the Department of Family Medicine and the School of Information, University of Michigan, Ann Arbor, MI, USA. Contact her at buisl@umich.edu.

Jina Huh-Yoo is an assistant professor of Human-Computer Interaction with the Department of Information Science in the College of Computing and Informatics, Drexel University, Philadelphia, PA, USA. Contact her at jh3767@drexel.edu.