Digital Personalized Health and Medicine
L.B. Pape-Haugaard et al. (Eds.)

Qualitative Evaluations of mHealth Interventions: Current Gaps and Future Directions

Meghan BRADWAY[1a,b] , and Kari LEIBOWITZ[c], Kathleen A. GARRISON[d], Lauren HOWE[e], Eirik ÅRSAND[a,f]
[a]*Norwegian Centre for E-Health Research, University Hospital of North Norway*
[b]*Department of Clinical Medicine, UiT- The Arctic University of Norway, Norway*
[c]*Department of Psychology, Stanford University, USA*
[d]*Department of Psychiatry, Yale School of Medicine, USA*
[e]*Department of Business Administration, University of Zurich, Switzerland*
[f]*Department of Computer Science, UiT- The Arctic University of Norway, Norway*

Abstract. Psycho-social factors are often addressed in behavioral health studies. While the purpose of many mHealth interventions is to facilitate behavior change, the focus is more prominently on the functionality and usability of the technology and less on the psycho-social factors that contribute to behavior change. Here we aim to identify the extent to which mHealth interventions for patient self- management address psychological factors. By understanding users' motivations, facilitators, and mindsets, we can better tailor mHealth interventions to promote behavior change.

Keywords. Self-management, apps, behavior change, psycho-social factors

1. Introduction

Mobile health (mHealth) technologies (e.g., smartphone apps or wearables), affect patients' self-management (SM), clinical care, and health research. Especially for those with chronic health conditions like diabetes, mHealth enables patients to gather relevant data such as information about blood glucose, diet, and physical activity to better understand their health and make decisions about diabetes SM. With this knowledge at their fingertips, patients are now encouraged to participate in their care by sharing mHealth data with their healthcare providers (HCPs). As patients do this, HCPs will need to adjust their approach to patient care and guidance, and health researchers need to understand how mHealth technologies impact the ways patients and providers work together.

The purpose of most health and mHealth interventions for lifestyle-related health issues, e.g. diabetes, is to facilitate health management and, if necessary, behavior change. Research on mHealth interventions has focused on user experiences, with some pre-post measures of health behavior change, e.g. frequency of blood glucose measurements. However, less attention is placed on users' environments, motivations, or interactions with others [1]. Both internal (e.g., self-efficacy, sense of control, mindsets about health) and external factors (e.g., social

[1] Corresponding Author: Meghan Bradway, E-mail: Meghan.Bradway@ehealthresearch.no.

connection, communication, and the patient-provider relationship) influence the process of health behavior change. If we do not address these factors within mHealth intervention studies, we will not be able to understand the comprehensive impact of such technologies.

We propose that it is critical to design research questions that capture psycho-social factors in behavior change. Therefore, we have assessed the prevalence of questions related to these concepts in mHealth intervention studies, thereby revealing current gaps and future directions.

2. Methods

We aimed to identify articles that were published after the release of the 2015 Guidance for Industry and Food and Drug Administration Staff regarding how to address mHealth technologies [2]. These articles would thereby reflect the most updated efforts to assess new mHealth technologies, including those that address these new guidelines. We reviewed studies published in English between Jan. 1, 2015 and Jan. 18, 2019, describing mHealth interventions for patient self-management of WHO's listed major chronic non- communicable diseases (NCD) [3], as well as chronic mental illnesses. We searched Medline, PubMed, Google Scholar, and ProQuest Research Library for combinations of "mobile application" or wearable, and self-management or self-efficacy, and patient. We focused on qualitative questions asked in the following methods: study-specific questionnaires, interviews, and focus groups. Methods that described the purpose of the inquiry, e.g. satisfaction, without listing the questions themselves, were also included. Questions asked to both patients and HCPs were then grouped under emergent themes and then overarching categories: user experiences and four major psycho-social theories of behavior change: behavior change intentions, facilitators/barriers, measures of behavior change.

3. Results

The search resulted in 31 articles. Twenty-four articles included qualitative questions (Figure 1).

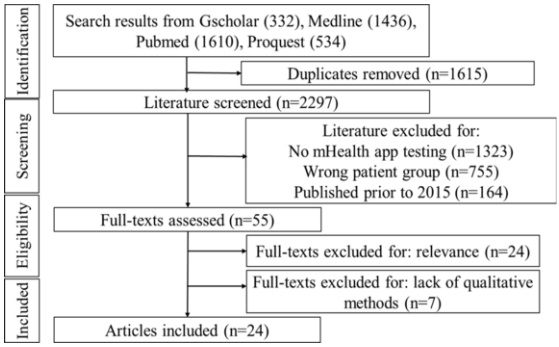

Figure 1 PRISMA diagram describing the selection of articles for data synthesis.

Emergent categories (n=18) were identified, and then grouped under broader categories (n=4).

We identified 204 questions and six articles that did not list their questions but, instead, described the topic of their inquiries. *User experience* was the most represented category (n=103 questions in n=13 articles, and n=5 articles addressing this category). Other inquiries focused on motivation, goals, and control [22], daily or SM habits [23, 24], confidence in future use [25] and focus on intention of use [26]. It is important to note that articles cited under a category may contain few questions that address that category, e.g. Fortuna et al. only included one question that addressed the category *Facilitators and barriers* [4]. Two of the seven articles that used interviews included questions that expanded upon previous feedback, e.g. "Anything else?", "What makes you say that?". While it was most common that patients were the target of inquiries (n=192 questions addressed to patients), three studies queried HCPs on satisfaction, experiences, and expectations (n=13 questions, n=1 interview).

Categories [Refs]	Sub-categories (n=questions)	Example questions or statements
User Experience [4-21]	• Experience (n=43) • Usability (n=24) • App description (n=19) • Usefulness/efficacy (n=5) • Satisfaction (n=8) • Suggested improvements (n=4) • Questions described, not listed (n=5 articles)	• What were the main issues/difficulties you were facing when using the system? • The app had a remind/alert functionality • Overall, I am satisfied with how easy it is to use the App • (Nurse) Viewing daily measurements allowed nurses to recommend treatments
Measures of behavior (SM), health, or lifestyle change [5, 6, 10, 12, 22-24]	• SM behaviors or tasks (n=14) • General health (n=7) • General life and habits (n=6) • Mood (n=2)	• The Fitbit helps me be more active • How did you feel this morning when you woke up? • How healthy do you think your diet is? • I often forget pills or take them late
Behavior change intentions [4, 5, 8, 10, 11, 15, 19, 22, 25, 26]	• Intentions (n=27) • Expectations (n=20) • Questions described, not listed (n=1 article)	• (Provider) How confident are you that you will use the data from HeartMapp for decision making on patient care? • How likely do you think this app will help you lead a healthier lifestyle for better control of your diabetes • How comfortable would you feel sharing the information on this app with a family member or close friend?
Facilitators and barriers to behavior change [4, 6, 15, 22, 25]	• Self-efficacy/ autonomy (n=11) • Needs were/were not met (n=9) • App would facilitate control over SM (n=3) • Motivation (n=2)	• I know what helps me stay motivated to care for my diabetes • I am able to turn my diabetes goals into a workable plan • I can ask for support for having and caring for my diabetes when I need it

4. Discussion

The number of questions related to *Behavior change intentions* and *Facilitators or barriers to behavior change* (n=72), compared to those about *User experience* and *Measures of change* (n=132), demonstrates the weight of inquiry in research toward the latter. While psycho-social factors influence the use of mHealth, this review shows that there are relatively few assessments of these forces in mHealth studies. For example, by inquiring about motivation as well as intention and external support, studies could provide a greater understanding of not just how much something has changed after a study, but also why. We need to understand the context, i.e. motivations, facilitators and mindsets, to which we are introducing mHealth interventions to understand what makes mHealth-use relevant and sustainable. Inherent factors within patients and HCPs, such as perceived roles and responsibility within chronic health care, influence how these users choose to –or not to- use an mHealth intervention. By including questions that address psycho-social factors, in addition to those that measure objective or quantitative pre-post factors, we can begin to explain when, how and why users choose to engage with mHealth in such ways that do –or do not- lead to sustainable health behavior change.

5. Conclusion

This review has demonstrated that while the qualitative questions asked in mHealth intervention studies do cover essential information, e.g. usability, there is a gap in our understanding of how and why users' choose to use mHealth interventions. By leveraging underutilized psycho-social factors, we can better understand the reasons for mHealth-use and study outcomes. Future studies could then tailor interventions to address end-user needs and more effectively optimize these technologies to facilitate health behavior change.

References

[1] T. Song, S. Qian, T. Cui, P. Yu. The Use of Theory in Mobile Health Interventions for Patient Self-Management of Chronic Diseases. *Studies in health technology and informatics.* **264** (2019): p. 1982-3.

[2] U.S. Food and Drug Administraion. Mobile Medical Applications. Guidance for Industry and Food and Drug Administration Staff. Rockville, MD, USA: U.S. Food & Drug Administration; 2015.

[3] Action Plan for the Prevention and Control of Noncommunicable Diseases in the WHO European Region 2016-2025. World Health Organization, http://www.euro.who.int/en/health- topics/noncommunicable-diseases/pages/policy/publications/action-plan-for-the-prevention-and- control-of-noncommunicable-diseases-in-the-who-european-region-20162025, Last access: 10.10.2019

[4] K.L Fortuna., et al. Adapting a Psychosocial Intervention for Smartphone Delivery to Middle-Aged and Older Adults with Serious Mental Illness. *Am J Geriatr Psychiatry.* **25**(8) (2017): p. 819-28.

[5] C. Velardo., et al. Digital health system for personalised COPD long-term management. *BMC Med Inform Decis Mak.* **17**(1) (2017) , 19.

[6] V.G de Garibay., et al. Utility of a mHealth App for Self-Management and Education of Cardiac Diseases in Spanish Urban and Rural Areas. *J Med Syst.* **40**(8) (2016): p. 186.

[7] Y.J Kim., et al. A Smartphone Application Significantly Improved Diabetes Self-Care Activities with High User Satisfaction. *Diabetes & metabolism journal.* **39**(3) (2015): p. 207-17.

[8] H. Kang, H.A Park. A Mobile App for Hypertension Management Based on Clinical Practice Guidelines: Development and Deployment. *JMIR mHealth and uHealth.* **4**(1) (2016): p. e12.

[9] N. Alnosayan, et al., Design and Usability of a Heart Failure mHealth System: A Pilot Study. *JMIR human factors*. **4**(1) (2017): p e9.
[10] Y.J Kim, et al., A Smartphone Application Significantly Improved Diabetes Self-Care Activities with High User Satisfaction. *Diabetes & metabolism journal.* **39**(3) (2015): p. 207-17.
[11] A. Miner, et al., Feasibility, acceptability, and potential efficacy of the PTSD Coach app: A pilot randomized controlled trial with community trauma survivors. *Psychological trauma : theory, research, practice and policy.* **8** (3) (2016): p. 384-92.
[12] M. Munster-Segev, O. Fuerst, S.A Kaplan, A. Cahn. Incorporation of a Stress Reducing Mobile App in the Care of Patients With Type 2 Diabetes: A Prospective Study. *JMIR mHealth and uHealth.* **5**(5) (2017): p. e75.
[13] E. Arsand, et al., Performance of the first combined smartwatch and smartphone diabetes diary application study. *Journal of diabetes science and technology.* **9**(3) (2015): p. 556-63.
[14] J.A Naslund, K.A Aschbrenner, S.J Bartels. Wearable Devices and Smartphones for Activity Tracking Among People with Serious Mental Illness. *Mental health and physical activity*. **10** (2016): p. 10-7.
[15] J.A Naslund, K.A Aschbrenner, L.K Barre, S.J Bartels. Feasibility of popular m-health technologies for activity tracking among individuals with serious mental illness. *Telemedicine journal and e- health : the official journal of the American Telemedicine Association.* **21**(3) (2015): p. 213-6.
[16] J.E Owen, et al., mHealth in the Wild: Using Novel Data to Examine the Reach, Use, and Impact of PTSD Coach. *JMIR mental health.* **2**(1) (2015): p. e7.
[17] R.M.C Masterson, et all., Review and Analysis of Existing Mobile Phone Apps to Support Heart Failure Symptom Monitoring and Self- Care Management Using the Mobile Application Rating Scale (MARS). *JMIR mHealth and uHealth.* **4**(2) (2016): p. e74.
[18] K. Possemato, et al., Using PTSD Coach in primary care with and without clinician support: a pilot randomized controlled trial. *General hospital psychiatry*. **38** (2016): p. 94-8.
[19] U. Sarkar, et al., Usability of Commercially Available Mobile Applications for Diverse Patients. *Journal of general internal medicine.* **31**(12) (2016): p. 1417-26.
[20] C.G Steele, et al., The Electronic Patient Reported Outcome Tool: Testing Usability and Feasibility of a Mobile App and Portal to Support Care for Patients With Complex Chronic Disease and Disability in Primary Care Settings. *JMIR mHealth and uHealth.* **4**(2) (2016): p. e58.
[21] A. Triantafyllidis, et al., A personalised mobile-based home monitoring system for heart failure: The SUPPORT-HF Study. *International journal of medical informatics*. **84**(10) (2015): p. 743-53.
[22] G Goh, et al, Short-term trajectories of use of a caloric-monitoring mobile phone app among patients with type 2 diabetes mellitus in a primary care setting. *Journal of medical Internet research.* **17**(2) (2015): p. e33.
[23] H. Holmen,et al., Stages of change for physical activity and dietary habits in persons with type 2 diabetes included in a mobile health intervention: the Norwegian study in RENEWING HEALTH. *BMJ open diabetes research & care.* **4**(1) (2016): p. e000193.
[24] J.Y Kim, N.E Wineinger, S.R Steinhubl. The Influence of Wireless Self-Monitoring Program on the Relationship Between Patient Activation and Health Behaviors, Medication Adherence, and Blood Pressure Levels in Hypertensive Patients: A Substudy of a Randomized Controlled Trial. *Journal of medical Internet research*. **18** (6) (2016): p. e116.
[25] P. Athilingam, et al., Features and usability assessment of a patient-centered mobile application (HeartMapp) for self-management of heart failure. *Applied nursing research: ANR*. **32** (2016): p. 156-63.
[26] H.S Park, H. Cho, H.S Kim. Development of Cell Phone Application for Blood Glucose Self- Monitoring Based on ISO/IEEE 11073 and HL7 CCD. *Healthcare informatics research.* **21**(2) (2015): p. 83-94.