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Design-Relevant Factors Affecting the Patient Experience in Digital Health: Preliminary Results of an Umbrella Systematic Review

Tingting Wang[a], Guido Giunti[ab], Marijke Melles[a], Richard Goossens[a]

[a] *Faculty of Industrial Design Engineering, Delft University of Technology, Delft, the Netherlands*
[b] *University of Oulu, Oulu, Finland*

Abstract

Since Covid-19, digital health interventions (DHIs) have been embraced as never before. The pandemic led to many new challenges, including the patient experience in digital health care delivery. In this literature study, we identified and synthesized factors that impact patient experience in digital health (dPEx), and reviewed the methods and strategies relevant to its design and implementation. We conducted an umbrella review including 15 reviews representing 543 studies. Four themes were identified that describe design-relevant factors that impact dPEx: individual context, content, technical issues, and design features. We propose a preliminary framework to explain the relationship between each factor and support user-centered design efforts. Further research is needed to identify which factors have the most impact.

Keywords:
Telemedicine; User-centered Design; Quality Improvement

Introduction

Research Background

Accelerated by COVID-19, there has been a significant increase in the adoption and use of technology that helps minimize hospital visits and risk of infection [1]. Remote consultations, are now 'in-place' for non-emergency situations, while digital health interventions (DHIs) help patients with a chronic disease monitor and manage their symptoms, and communicate with care providers through mobile devices, reducing the need for hospital visits [2]. Attitudes towards digital healthcare are changing because of this, resulting in a greater reliance on digital technologies [3].

However, it seems that the full potential of these technologies, especially regarding patient-centered care, remains unfulfilled [4]. While DHIs can empower patients and alter their overall healthcare experience [5, 6], some patients see it as a burden or as interfering with their relationship with care providers [2]. It is therefore important to further address these issues and improve the potential of DHIs by gaining a better understanding of the digital patient experience (dPEx) and how the design of new technologies affects dPEx [5, 7]. There is a need to identify facilitators of and barriers to influencing dPEx, and to design appropriate new interventions [8, 9].

Methods

Search Strategy and Screening Process

We performed an umbrella systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement methodology [10]. In an umbrella review, researchers compile and synthesize evidence from multiple reviews into one accessible document [11]. Scopus, PubMed, and Web of Science were searched for English language reviews, published after the year 2000. To be inclusive, we used the following broad interchangeable search terms in varying combinations.

Category 1= "patient experience" OR "health experience" OR "user experience" OR "customer experience" OR "client experience"; Category 2= "ehealth" OR "e-health" OR "mhealth" OR "m-health" OR "telehealth" OR "tele-health" OR "digital health" OR "virtual health" OR "remote health" OR "telemedicine" OR "telemonitoring" OR "teleconsultation"; Category 3= "patient digital experience" OR "digital patient experience" OR "e-patient experience" OR "epatient experience" OR "online patient experience". The final search strategy was ((category 1 AND category 2) OR category 3) AND (DOCTYPE (review)) AND (PUBYEAR > 2000) AND (LIMIT-TO (SRCTYPE, "journal")) AND (LIMIT-TO (LANGUAGE, "English")). We also added Google scholar to manually search for additional related references.

In the exclusion/inclusion process, two-round small random samples (20%) were independently reviewed by two reviewers (TW and GG) who evaluated the eligibility of the articles against the selection criteria. In order to ensure clarity of the selection criteria, inter-rater reliability was assessed using Fleiss-Cohen's Coefficient.

Data Extraction and Analysis

The collected articles were classified in 3 pre-categories which were produced and defined by the first author and refined by all co-authors based on the research questions and on an initial impression of the included papers. To reach agreement regarding categorization, group discussions were held in four iterations. This led to the selection of three categories: (1) Explanation: publications that discuss how patients experience and perceive DHIs; (2) Design Impact: publications that investigate barriers and/or facilitators affecting patient experience and that should be addressed by the DHI design, or that recommend design methods or strategies to facilitate positive patient experiences; and (3) Evaluation: publications that refer to methods used to evaluate the patient experience or studies presenting the results of these evaluations. Articles could be classified in more than one category. In this study, we present the preliminary findings of the second category: Design Impact.

All selected articles were imported into ATLAS Version 9.0.7(1857). First, we extracted the study characteristics: (1) authors and year of publication; (2) methods: review types and

protocols, data analysis, quality assessment, and included papers' amount; (3) DHIs: intervention features and technologies; and (4) population: specific populations and health issues. We then extracted design-relevant factors related to dPEx: potential design methods and implementation strategies for improving dPEx.

Data extraction and analysis was an iterative process using inductive thematic analysis based on the Barun and Clarke's six-phase method [12]. Four researchers were involved in the review process. TW and GG familiarized themselves with the data, quoted design-relevant influencing factors, generated initial codes, and then searched for themes among the codes. Frequently used terms in the included reviews, as well as some relevant theories (e.g., Behaviour Change Techniques) were used as inspiration to generate initial codes and themes. Other co-authors independently and randomly validated the initial results by comparing assigned codes to the original quotations. Any uncertainties about coding were resolved in group discussions.

Results

The search resulted in a total of 173 reviews of which 58 were duplicates. Of the resulting 115 articles, we screened titles and abstracts. Full-text articles (including 4 additional records collected through snowballing) were then explored for inclusion. Inter-rater reliability (IRR) was found to be more than acceptable; in the first round (n=23) for titles and abstracts review, the IRR was 0.88 (SE 0.07 CI 95% 0.74 – 1.03) and in the second round (n=12) for full-text review, the IRR was 0.80 (SE 0.13 CI 95% 0.54 – 1.05). Following the screening, 45 papers met the eligibility criteria; 15 of these were classified in the Design Impact category and were included in this study for data extraction.

Characteristics of Included Reviews

The 15 reviews were published between 2013 and 2020. Most were published in 2019 (n=4), and 2020 (n=6). Of the 15, 8 were systematic reviews, and the rest were scoping reviews (n=3), literature reviews (n=3), narrative reviews (n=2), integrative reviews (n=2), and an umbrella review (n=1). More than half (n=8) reported on a quality assessment. Six articles (n=6) focused on a specific target group: older adults (n=2), younger children (n=1), young adults (n=1), adults (n=1), and postpartum women (n=1). The other 9 articles focused on the general population. Investigated health issues included chronic disease (n=7; e.g., diabetes, chronic obstructive pulmonary disease, heart failure, cardiovascular disease, cancer, and hypertension), mental health problems (n=2; depression, anxiety), and lifestyle management (n=2), while in the remainder (n=6), specific health issues were not described. Note that some papers referred to more than one specific health issue. Interventions concerned communication (n=8), self-management (n=5), behaviour change (n=5), education (n=4), and self-monitoring (n=4).

The insights varied across the reviews and included themes, frameworks, models, a methodology and a checklist (see Table 1). Seven reviews presented themes to describe: (1) user experience or perspectives (n=4); (2) barriers and facilitators impacting patient experience or digital health adoption (n=2); (3) design features (n=1). Three reviews built frameworks, each with a different focus: human factors, aging barriers, or interactive design features. Two reviews generated models; one explaining the factors inhibiting and facilitating a positive patient experience, the other illustrating the relationship between stakeholders to recommend how to conceptualise and report interventions. One article proposed a design methodology based on qualitative methodologies for the development of health apps to attract and respond to end-users' needs. Another review produced a checklist of design features to enhance user engagement either for reference purposes or as an evaluation tool during the mHealth development process. Four reviews generated other types of insights such as the descriptive information about factors that impact the uptake of digital health (n=2), key tensions in the variation in uptake and sustainability of digital health and common intervention elements of interaction, or about how the user experience can be enhanced by specifically-designed hybrid recommender systems.

Table 1– Overview of insights relevant for the design of DHIs

Type of Insights	Examples of Insights	Papers
Themes (n=7)	[13] generated four themes of end-users' experience and perspectives of mHealth technology: (1) functionality (to support self-management and person-centered clinical encounters); (2) acceptance (technical usability, acceptability and feasibility); (3) the importance of co-design (intrapersonal, and extra-personal factors); (4) perceptions of benefit (self-efficiency, empowerment).	[2, 8, 13-17]
Framework (n=3)	[18] proposed four key points of human factors considerations for telemedicine design: (1) needs assessment (surveys & focus groups); (2) solution selection (feasibility & usability testing); (3) implementation (pilot test & phased approach); (4) monitor & sustain (observe & problem solve).	[18-20]
Model (n=2)	[2] produced a model including three themes of factors inhibiting and facilitating positive user experience: (1) disrupted lives (convenience, independence, burden); (2) personalised care (space, time, lacking the 'human factors'); (3) remote reassurance (active connection, passive connection, slipping through the net).	[2, 14]
Methodology (n=1)	[21] proposed a methodology consisting of four sessions for implementing user-centered health app design: (1) composing, preparing, and organizing contents (previous user experiences in mHealth, barriers to the adoption of mHealth, contents, and interface); (2) testing structure and usability (management and browsing, usability, perceived quality, security and privacy, self-management); (3) does the App match end-user needs? (acceptability, ergonomics, glanceability, comfort); (4) final tests, continuous improvement (proposals for improvement, usefulness, hardware limitations).	[21]

Checklist (n=1)	[17] listed seven design features and 29 corresponding specific implementations: (1) personalization (assessment, feedback, manipulation); (2) reinforcement (rewards, reminders); (3) communication (peer-to-peer communication, access to professionals); (4) navigation (easy to use, automation); (5) credibility; (6) message presentation (language, tone of voice, presentation design); (7) interface esthetic (attention grabbing, simple and consistent style).	[17]
Others (n=4)	[9] identified 7 interactive interventions' elements: (1) Education; (2) Self-monitoring; (3) Feedback/Tailored information; (4) Self-management training; (5) Personal exercise program; (6) Communication with health care provider; (7) Communication with fellow patients.	[9, 22-24]

Themes

Four main themes were identified to describe the design-relevant factors or methods that impact dPEx: individual context, DHI content, technical issues, and design features. The relationship between the themes and their sub-themes are presented in a preliminary framework (see Figure 1) summarizing our findings on design-relevant factors affecting DHIs' accessibility, usability, and acceptability.

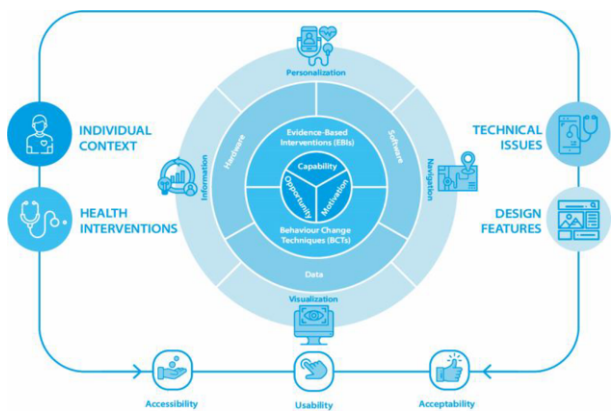

Figure 1– Preliminary framework explaining the design-relevant factors that impact patient digital health experiences

Theme 1: Individual Context

This theme describes how the patient experience is impacted by patients' individual context [2, 8, 9, 13-16, 18-21, 23, 24]. The three sub-themes follow the COM-B system framework for understanding behaviour [25]: capability, opportunity, and motivation.

- Capability

Capability refers to the psychological or physical ability of the patient to access digital health interventions. Eight reviews reported that capability-related factors impacted either patient experience or their uptake of using digital health interventions. Examples include medical conditions (e. g. aging barriers [20], postpartum status [8]), technical literacy [13-15, 23, 24], health literacy [15, 24], or language literacy [18].

- Opportunity

Opportunity refers to whether the physical and social environment enable the patient to be involved in DHIs. Nine articles [2, 8, 13, 15, 16, 18, 19, 23, 24] reported opportunity-related barriers or facilitators that influence DHIs' implementation, such as the cost of digital equipment [15], financial reimbursement [16, 23], a familiar and relaxing use environment [2], lack of time [8], cultural differences [19], social support [8, 15, 23, 24], and digital health policy or legislation [13, 23].

- Motivation

Motivation refers to the reflective and automatic mechanisms that activate or inhibit patients' DHIs' adherence or engagement. Ten reviews presented motivation-related factors that impact patient engagement in DHIs. For example, patients with a strong desire to lose weight or gain knowledge may have a higher motivation to use DHIs to manage their lifestyles [8], while lack of motivation or unwillingness to take action in response to remote instructions may inhibit usage [23]. Patient preference [8, 9, 15, 21, 23] is another factor influencing motivation; some studies reported on patients who prefer face-to-face interventions [15, 23]. In addition, patients perceived that benefits [13, 15] like obtained convenience or independence [2] will facilitate their positive user experience. Nine reviews [2, 8, 9, 15, 16, 18, 21, 23, 24] presented how patients' concerns or awareness about privacy, security and credibility can impact DHI adoption.

Theme 2: Content

DHIs' clinical-related content influences the patient experience [2, 8, 9, 13-17, 19, 21]. This theme includes two sub-themes: evidence-based interventions, and behavior change techniques.

- Evidence-Based Interventions (EBIs)

Without evidence-based items, doubts about the credibility, security and accuracy of interventions can impact users' DHI uptake [13, 15, 17, 21]. The content [8] and sustainability [9] of clinical interventions is greatly valued. In addition,

interventions need to be relevant to [14] the end-users' health conditions.

- Behavior Change Techniques (BCTs)

Five papers attached importance to BCTs [8, 13, 14, 17, 19]. Communication and social support are the most valued intervention features [2, 8, 9, 14-17, 19]. Active or passive connection between patients and providers can facilitate a positive user experience, while missed connection with care givers can lead to negative perceptions [2]. Some patients reported that they felt their communication with professionals was interfered by DHI [15]. Self-management [9, 13, 16, 19, 21], feedback and monitoring [8, 9, 14, 16], education or shaping knowledge [8, 9, 14, 16] were often mentioned in the reviews. Interventions supporting patient self-management can lead to a more positive user experience [13]. Moreover, reinforcement (rewards, reminders) [8, 14, 17], goals and planning [8, 14], training [13, 15], personalized exercise programs [9], repetition and substitution, natural consequences, association [14], and technical support behavior change [13] are BCTs that benefit patient experiences.

Theme 3: Technical Issues

Ten papers mentioned technical issues that impact dPEx [8, 9, 13-16, 18, 21-23]. This theme has three sub-themes: hardware, software, and data.

- Hardware

Problems with related hardware [9], extensive battery use [21], and mobility [15] can inhibit a positive user experience.

- Software

System integration or inter-operability [13, 15, 18, 23] , Internet connectivity [9, 23], ability to print, and email-related information [8], recommender systems [22], extensive memory use [21], techinical usability [8, 13, 14, 16, 21, 23] are software-related issues impacting patients' DHI uptake.

- Data

Lack of validation of technology [16], unreliable data [23], the requirement for manual data input, and transmission with delayed feedback [15] can influence patients' concerns about data privacy and security [16].

Theme 4: Design Features

This theme addresses the relationship between design features and dPEx. Nine reviews descibed varied design features [2, 8, 9, 13-15, 17, 19, 21] and eight mentioned design methods [13, 14, 16, 18, 19, 21, 23, 24].

- Personalized Design

Personalization was valued by eight papers [2, 8, 9, 13-15, 17, 21], suggesting that DHIs should be tailored to the end users' preferences and personal needs, as well as match their habits and daily routine [8, 15, 21]. Tailored assessment, information, and feedback are regarded as being important for patient experience.

- Information Design

The information delivered through digital health is shaped by clinical knowledge as well as by its design, for example, the message language and tone of voice [8, 17, 21].

- Navigation Design

The impact of navigation features was often-mentioned as contributing to dPEx, for example ease of use, extra instructions and tutorials [8, 17, 19, 21].

- Visual Design

Visualization [8, 15, 17, 19, 21] can impact patients' first impressions when using a DHI. An attention-grabbing, simple and consistent interface [17], layout (colors and images) [19], and message presentation [17] can all lead to a positive user experience.

In summary, our findings suggest that the factors impacting patient experience in digital health are varied and complex. The most common design method mentioned in our studies was user-centred design [14, 16, 18, 19, 21, 24]. Several authors suggested that multiple stakeholders should be involved in the design from the beginning, facilitating the designers' work as they need to understand end-user needs, and be aware of potential barriers to engaging in DHIs. User testing and usability assessment was emphasized as a means to investigate whether DHIs match end user needs. Updating digital health was valued, followed by Co-Design [13, 16, 18, 19, 21, 23]. Furthermore, human-computer interaction design [19], inclusive design [20], and multi-lifespan information system design approaches [23] were mentioned.

Discussion

This umbrella review contributes to our understanding of dPEx by presenting four themes of design-relevant factors that affect patients' digital health experiences. To our knowledge, one previous umbrella review investigated the topic of clinical and cost-effectiveness, patient experience, and telemedicine implementation, while only providing limited information on digital patient experience and neglecting a design perspective [15]. Our preliminary framework provides designers with an impression of which design-relevant factors impact dPEx and provides guidelines to addressing them in the design process.

The literature shows certain factors that can be either regarded as facilitators or barriers [2]. For example, well-designed DHI technical support could help patients manage their disease better and save time. However, given the technical nature of DHIs, some patients can perceive their relationship with providers as an interference.

A User-Centered Design (UCD) approach including designing core interaction features has the capacity to facilitate and enhance a positive user experience [19]. Only two papers [18, 21] gave detailed information describing how this can be achieved. Our preliminary framework can be of value to DHI designers in UCD efforts. The UCD approach emphasizes that users must be the primary drivers for design, implementation, and sustainability [18]. Our framework gives a central position to the users' capability, motivation, and opportunity .

Limitations: relevant original studies may have been excluded due to our focus on review papers. However, our approach on conducting an overarching review provides readers with a quick overview of relevant dPEx reviews. Another limitation

concerns the differences in data collection and analysis in the selected studies; these accounted for in an umbrella review.

Conclusion

We identified four themes of factors that influence dPEx: individual context, content, technical issues, and design features. We present a preliminary framework to help designers and developers understand the relationship between each factor and their impact on user experience design in digital health.

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Address for correspondence

Tingting Wang. Mail address: Landbergstraat 15, 2628 CE Delft, The Netherlands. Email: t.wang-8@tudelft.nl.