The International Journal of Design in Society
ISSN: 2325-1328 (Print), ISSN: 2325-1360 (Online)
Volume 17, Issue 2, 2023
https://doi.org/10.18848/2325-1328/CGP/v17i02/17-42

Exploring Digital Self-Triage Design in Healthcare Center Smartphone Applications for Anxiety: A Design Critique

Dimitrios Gkouskos, Halmstad University, Sweden
Susanne Lindberg, Halmstad University, Sweden
Oliver Weberg, Halmstad University, Sweden

Received: 04/05/2023; ***Accepted***: 09/21/2023; ***Published***: 10/24/2023

Abstract: Mental health issues are on the rise, and more healthcare resources are needed to address existing needs. The digitalization of mental health care can enable easier access to much-needed treatment. Still, little is known about how to successfully design digitalized health care, especially from a human–computer interaction perspective, even though digital mental healthcare options are currently available for healthcare seekers. The purpose of this article is to explore how currently available digital care apps are designed, outline design strategies used, and identify opportunities for improvement. In this article, we use design patterns from five digital healthcare center mobile applications in a design critique approach to explore digitalized self-triage journeys that are available to users in Sweden. We showcase the diverse design solutions through pre-patterns identified from digitalized self-triage steps of prelogin, selecting your health issue, answering questions, and filing a case. We then discuss identified design challenges in relation to (1) calibrating appropriate expectations, (2) health literacy requirements, (3) transparency of information, and (4) expected risk-taking behaviors. We end with implications for future design-oriented research to complement clinical, financial, and technological perspectives on digital mental healthcare centers and implications that can improve the design of digital self-triage for mental health applications.

Keywords: *Digital Triage, Digital Self-triage, Digital Mental Health Care, Design Patterns for Digital Mental Health Care, Design Patterns for Anxiety Care, Design Critique*

Introduction

Mental health issues among young people have been increasing internationally (Bor et al. 2014). A 2018 survey by the Swedish government "Swedish eHealth Agency" (ehälsomyndigheten) revealed that 17 percent of all people living in Sweden have experienced mental health issues, with younger people being the most affected: 33 percent of women and 19 percent of men between the ages of 16–29 years were reported to have reduced mental health (2021). Anxiety is a particularly prevalent mental health issue among young people. Statistics from the Swedish Healthcare Agency show that 43 percent of the Swedish population between 16 and 84 years of age experience anxiety symptoms and 57 percent of the group that experiences anxiety symptoms is between 16 and 29 years old (Statistics for Mental Health for Young Adults in Sweden 2023).

The digitalization of mental health care is purported to extend the available human resources of healthcare systems and enable the diagnosis and treatment of more patients than previously possible. The Swedish government has a "Vision 2025 e-Health" initiative ("Vision

E-Halsa" 2016) with the aim of Sweden being the best in the world in healthcare digitalization by 2025, underlining the significance and projected growth of healthcare digitalization efforts in Sweden. One type of healthcare digitalization is digital healthcare centers, and they are steadily becoming more available worldwide. Such centers have been available to the Swedish public since the early 2010s, offering health care for physical and mental issues through digital channels. The Swedish Association of Local Authorities and Regions (Sveriges Kommuner och Regioner in Swedish) reports that during 2020, 11 percent of all primary care visits in Sweden were carried out digitally and that this is a 100 percent increase from 2019 (Den digitala utomlänsvården ökar 2021). The total number of healthcare visits in the same period has not increased significantly, meaning that patients are likely replacing physical visits with digital healthcare visits.

Providing digital health care is no simple task. Considering that healthcare regulations have routinely lagged behind technological advances and business ventures, digital health care is still relatively uncharted territory where research-backed knowledge is lacking. This includes a Human-Computer Interaction (HCI) perspective where some healthcare providers see technology as disruptive to an already extensive healthcare workload (Kujala et al. 2020). While efforts have been made to include medical professionals in the development of healthcare technology (Martikainen, Kaipio, and Lääveri 2020), patient perspectives are rarer. Yet, digital healthcare applications are widely available and frequently used (Chambers et al. 2019), especially by young adults. Young adults seeking health care are more likely to participate in their own care by using digital triage services, or online symptom checkers, as a first step in their healthcare-seeking journeys (Kujala et al. 2020). Digital triage tools are used to assess the severity and nature of symptoms to guide mental healthcare seekers (hereby referred to as users) to appropriate care; recent research (Hartley et al. 2020) shows that finding the proper care is one of the most challenging steps for users, and digitalizing the first step in finding care creates additional challenges.

Triage is an essential step in enabling healthcare providers to scale up efficiency and treatment quality (Lai et al. 2020). Digitalizing the triage process converts a sensitive human-to-human (typically healthcare seeker to nurse) interaction to a complex HCI (Morse et al. 2020), creating a challenging problem for technologists, caregivers, and designers to solve. Since no standardized triage digitalization guidelines exist, there is great diversity in the solutions to the many design challenges that exist within triage digitalization, and there is limited research that explores the design of digital triage from an HCI perspective. This has left designers of digital triage without guidance on the design of systems that affect patients and healthcare professionals.

In this study, we use the concept of design patterns in a design critique approach (Blevis et al. 2007) to examine the diversity that exists in the interaction design of digital triage solutions in the most popular, commercially available digital care services for anxiety health care in Sweden. There are several other expert evaluation methods based on applications of cognitive theory to design, such as the GOMS (goals, operators, methods, selection rules) and

KLM (keystroke-level modeling. These types of methods do not take learning by exploration into consideration, even though learning by exploration is typical of first-time users (Polson et al. 1992). Further, methods such as GOMS produce in-depth evaluations but are focused on routine task performance (John et al. 2002) and limited in terms of providing direction for future designs (John and Kieras 1996). A design critique analysis through design patterns enables a holistic view of first-time use that is necessary to capture the complexity of digital self-triage and gives direction for future design solutions (Borchers 2001). In comparison, another popular expert evaluation method, cognitive walkthrough, requires the use of well-defined user tasks for the evaluation (Polson et al. 1992). Since design critique both allows the evaluation of all stages of use and does not require knowledge of specific user tasks, it is a suitable method to understand digital self-triage services. By analyzing and comparing the design solutions found in popular commercial healthcare applications, we identify pre-patterns and set the stage by identifying missing knowledge needed to establish design knowledge and provide a direction for future research work to improve the design of digital triage applications for anxiety in young adults.

Aim

In this article, we aim to answer the research question:

> What design challenges and solutions can be identified in the digital self-triage stage of commercially available digital healthcare applications when seeking healthcare for anxiety?

It is important to highlight that the focus of this study is on the design of the healthcare applications from an HCI perspective, meant to complement, and not replace, other necessary perspectives in digitalizing health care, such as a user-centered perspective or a clinical perspective.

Related Work

In this section, we present an overview of HCI research in digital health care, HCI research on digital self-triage, and relevant literature on design patterns and pre-patterns; these concepts will then be used in the analysis of digital self-triage design in commercially available applications.

HCI Research in Digital Health Care

Blandford (2019) has summarized the impact of HCI in health care as limited due to the slow uptake of new technology. Digital healthcare technologies have been used to enable remote health care in a variety of ways, from videoconferencing between the healthcare professional and patient (Liaw et al. 2019) to online triage tools (Pols 2012; Park et al. 2021) and clinical decision support systems (Ren et al. 2020; Yang, Steinfeld, and Zimmerman 2019). Due to its

nature, digital health care requires that patients participate in their own health care. This participatory mindset is represented through a multitude of publications (for more on this, see these review papers—Halvorsen et al. 2020; Bombard et al. 2018; Vahdat et al. 2014). Some studies underline the importance of knowledge and access to information that enables participation in health care (Oldenburg and Griskewicz 2016; Gkouskos and Burgos 2017).

The complexity of healthcare systems and a change-resistant culture with a long tradition of paternalistic practices (Halvorsen et al. 2020) make designing patient-focused technology for healthcare contexts challenging. Digital health care adds a remote component further increasing the expectations placed on patients in terms of ability, information access, and health literacy. Digital health care often requires increased technological and healthcare competence from healthcare seekers compared to a physical healthcare visit where expert healthcare staff are present. HCI is oftentimes left to solve the puzzle of mediating a functioning and clinically validated healthcare visit over a digital channel.

HCI research on the digitalization of health care spans a variety of areas. One prominent area is that of clinical decision support systems, sometimes powered by artificial intelligence (AI) technology. Here, HCI is used to enable and even empower healthcare professionals in making correct decisions during their healthcare work. One example included healthcare professionals in designing technology that is intentionally designed to be unremarkable so as to fit into existing healthcare practice in a complex setting where decisions are made on whether patients should be eligible for a high-risk surgical procedure (Yang, Steinfeld, and Zimmerman 2019). Similarly, researchers highlight the importance of including healthcare professionals in the design of an intelligent decision support tool in an occupational context (Ren et al. 2020). Another area of HCI in health care is that of user acceptance (Gambino, Kim, and Sundar 2019; Mitzner et al. 2013; Nadal et al. 2022), where the focus is on designing healthcare-oriented technologies that are accepted by users. A third focus area for HCI in health care is enabling groups with specific health issues to use technology for support, with some examples found in technology that supports people with cognitive or sensory impairments (Yoo, Odom, and Berger 2021) and people with dementia (Hendriks, Slegers, and Duysburgh 2015).

In summary, existing HCI-oriented healthcare research focuses on empowering healthcare professionals in dispensing health care and enabling patients with diagnosed healthcare issues to manage their health or getting healthcare seekers to accept technology as part of their healthcare journeys. In the following section, we focus on digital triage and relevant research on digitalizing the self-triage part of mental healthcare journeys.

Digital Self-Triage

Triage is often the first step of a healthcare-seeking journey where the healthcare seeker is assessed and receives guidance on if, where, and how to receive appropriate health care. Digital self-triage is used in healthcare settings to increase the efficiency of the healthcare system by offloading the triage task from a nurse or other healthcare professional, turning

triage into a self-help task. The resulting digital service is known by different names, including "online symptom checker" (Kujala et al. 2020), "digital triage" (Lai et al. 2020), and "self-diagnosing digital platforms" (Aboueid et al. 2019). In this article, we use the phrase "digital self-triage" to refer to the first unmanned step that users take in using a digital application or online service to select an illness, answer questions, and file a case, with the aim to meet a healthcare professional.

Digital self-triage is often performed using structured questions that put together an anamnesis or an account of one's symptoms. Digitally, this is usually done through the selection and description of symptoms, then forwarded to the healthcare professional who initiates contact during working hours (Eldh et al. 2020). Based on the input of the healthcare seeker, a nurse may ask more questions or refer prospective patients to appropriate personnel, such as a physician (Eldh et al. 2020). Some digital self-triage solutions use AI, such as chatbots that facilitate the anamnesis process, or as decision support by recommending further steps for the healthcare professional (Lai et al. 2020).

The introduction of digital self-triage systems is a promising possibility for healthcare seekers but has potential adverse effects on users and healthcare staff; it requires the rework of established healthcare processes and routines and in some cases can create more complexity (Eldh et al. 2020). Digital access to health care is becoming increasingly expected, particularly by young adults (Eldh et al. 2020), and is a way to automate the triage task, enabling healthcare staff to focus on other tasks. Digital self-triage has also been shown to have been essential in reducing the infection risk for healthcare professionals and in increasing the efficiency of health care during the COVID-19 pandemic (Lai et al. 2020).

As digital self-triage systems are a new type of technology, there is a lack of established knowledge and best practices from HCI, clinical, ethical, and other relevant perspectives, and therefore, guidelines and regulations are lacking for this technology (Aboueid et al. 2019). Several relevant publications, mostly from the field of medical informatics, present first-impression accounts of digital self-triage systems from the perspectives of healthcare staff and patients, with cautiously promising results in terms of accuracy and a strong focus on the need for further research to evaluate the medical accuracy, evidence-based outcomes, and fit of this technology in existing healthcare systems (Morse et al. 2020; Kujala et al. 2020; Meyer et al. 2020). An HCI design perspective is unfortunately lacking in the existing body of work, even though there are many digital self-triage services currently commercially available to prospective users.

The studies that do exist highlight issues that have a significant impact on the design requirements of digital self-triage services. Self-triage often requires advanced health literacy from users (Aboueid et al. 2019; Eldh et al. 2020) as the technology can present them with multiple possible diagnoses and even ask users questions that require medical knowledge. Furthermore, there is friction between digital self-triage systems and traditional healthcare service routines, indicating that the design of these systems may not take into consideration established ways of working in health care (Eldh et al. 2020). A key identified pain point is

the hand-off of self-triage results, often in the form of extensive text, resulting in the digital technology being viewed as a generator of extra work, with one more communication channel to handle for healthcare staff (Kujala et al. 2020).

Design Patterns

Design patterns are short summaries of abstracted design knowledge, created with the purpose of communicating viable solutions to common design problems (Alexander 1977). Additionally, patterns can be used during the design process to include users in design (Dearden et al. 2002) as well as in design education (Wania 2019). First introduced within the context of architecture (Alexander 1977), design patterns have since been adopted and adapted within a range of subjects, such as software engineering and HCI.

While design patterns are widely used and considered more impactful than, for example, heuristics in some situations (Koukouletsos et al. 2009), they lack a common structure and established methods for identification. Several attempts have been made to formalize design patterns; nevertheless, many of these attempts conclude that clarity should always trump formal correctness (Borchers 2001; van Welie, van der Veer, and Eliëns 2001). The structure of a design pattern should, at minimum, include (1) a *context* in which the design pattern is used, (2) the *problem* that the pattern intends to solve, (3) *examples* of how this problem can be solved, and (4) a *description* and rationale behind the solution (van Welie, van der Veer, and Eliëns 2001). Furthermore, the identification of design patterns should be based on practice, and they also tend to be validated through demonstrated successful use (Dearden and Finlay 2006) or peer review (Chung et al. 2004).

It is not uncommon that design patterns are the outcome of a design research process; however, it is more common for the outcome of a design research process to be summarized as one or more pre-patterns, which can be formulated into full design patterns with further research (Zimmerman, Forlizzi, and Evenson 2007). The concept of pre-patterns was established and was meant to be a way to communicate emerging design knowledge that has yet not been fully established, for example, due to the immaturity of the context of use for the design (Chung et al. 2004). While pre-patterns are meant to evolve and possibly be replaced by other patterns with further research (Chung et al. 2004), they have also been shown to be of importance throughout the design process, even during the early stages of design as a communication and problem-solving tool (Saponas et al. 2006).

Design Patterns in Health Care

Design patterns are increasingly used in healthcare contexts with the rise of healthcare-oriented HCI research in recent years. For example, one study presents two pre-patterns for pervasive health care, identified through a value-sensitive design process (Detweiler and Hindriks 2012). These pre-patterns indicate the values that should be present in the design of pervasive computing for health care, such as preventing isolation.

Much of the existing interaction design pattern work in health care is targeted at healthcare professionals and their use of technology in health care. When looking into medical decision support tools, researchers (Yang, Zimmerman, and Steinfeld 2015) found that few design patterns and little design research exist in this space. Some recent research has investigated developing design patterns for explainable AI in clinical decision support systems (Schoonderwoerd et al. 2021). Lindberg et al. (2014) presented six design patterns for the design of digital peer support for children cured of cancer. The patterns emphasize how social interaction among children can be designed in a sensitive context. More recently, Ligthart et al. presented three design patterns for an interactive storytelling robot for children used as a stress-reducing intervention (Ligthart, Neerincx, and Hindriks 2020). The patterns enable the child to make decisions about the story by conversing with the robot, reenacting parts of the story with the robot, and recording sound effects, all to increase the child's agency and engagement with the social robot.

Blandford discusses the central role of HCI in the wider spread of healthcare technologies and, as such, calls for more research on design patterns within the healthcare context (Blandford 2019). Nevertheless, there have also been cases where the healthcare context has been found to be too complex to be possible to summarize in general design patterns (Kirchner et al. 2021; Bardzell et al. 2019).

Method

This study consists of an analysis of five commercially available digital healthcare applications that include digital self-triage. Because digital healthcare applications are both common and frequently used (Chambers et al. 2019), yet there is little research on the design of these applications, this study focuses on understanding the most popular commercial design solutions as design exemplars of digital self-triage solutions. The analysis uses an adaptation of the design critique method (Blevis et al. 2007; Alabood et al. 2023) to create knowledge from the study of five design exemplars as ultimate particulars (Wiberg and Stolterman 2014) that are available and used by hundreds of thousands of people. "The ultimate particular is the actual final manifested outcome and as such, a result of an intentional design process. A digital artifact or an information system implemented in a specific organization is an ultimate particular" (Stolterman 2008, 5). Design critique was deemed to be a suitable method for the study of ultimate particulars since it allows a close look at specific implemented design solutions rather than descriptions of the design from the perspective of particular users.

The Research Team

As this study is a design critique, it is important to frame the positionality of the researchers in relation to the field of technology design for mental health. The design critique team consisted of three researchers, all of whom have experience working with researching technology design for mental health. The first author has two years of previous experience

working for a digital mental health company as a senior design researcher and another three years of experience working in academia as a design researcher within the domain of mental health digitalization. The second author has seven years' experience with design research in sensitive design situations. The third author has three years of experience teaching and researching the design of digital products and services.

Application Selection

The five most popular digital healthcare applications in Sweden according to rankings on the App Store and Google Play in March 2023 were chosen for analysis. The selection criteria for applications were that (a) the application should be available on Apple and Android smartphone platforms; (b) the application should treat patients nationwide in Sweden; (c) the application should include digital self-triage as part of the services offered; and (d) the application should offer both physical and mental healthcare services, similar to a primary care health center. Five smartphone applications meeting the aforementioned selection criteria have been included in this study.

Table 1: The Five Digital Healthcare Centers We Selected with Their App Store Rankings as of March 16, 2023

Digital App Name	*AppStore Rank, March 2023*	*Google Play Store Rank, March 2023*
Capio Go	5	5
Doktor.Se	2	2
Doktor24	4	3
Kry	1	1
Min Doktor	3	4

It is worth noting that the same five applications were among the top five that met our criteria in both the Apple AppStore and the Google Play store, though the ranking varied. All five applications are private healthcare centers, contracted through Swedish public health care. Digital healthcare center services provided by the public sector were not included in this study as they did not meet the criteria of being available nationally, since they are limited to specific Swedish regions.

Analysis Method

We base the analysis of the digital healthcare applications on the concept of design critique as described by Blevis et al. (2007). Design critique, though primarily used in design practice, is also an important tool for HCI research; it allows the study of the "ultimate particular" (Nelson and Stolterman 2014), specifically understanding the qualities of design exemplars from holistic value perspectives, such as ethics, user experience, and contextuality (Blevis et al. 2007). Blevis et al. (2007) highlight some qualities of design critique, including the possibility of

understanding the effect of a particular design in different contexts, a way to understand particular designs, and fostering communal discourse. As one of the aims of this article is to highlight possible directions for further research on the design of digital self-triage and to emphasize the complexities of such systems, a design critique approach was considered suitable.

The design critique was structured in two steps: (1) a user journey mapping activity that focused on outlining the holistic perspective of the user journey and (2) a pattern-finding process that focused on specific aspects of the digital triage applications. In this way, we included both a holistic and a detail-oriented perspective of the design critique.

The first step of the analysis consisted of a journey mapping stage to explore the overall intended user journey through the digital self-triage process. User journey maps are tools for visualizing the user experience over the entire use of a digital service (Howard 2014). In this study, the focus was placed on the digital triage process from each of the five applications was mapped; this means the steps from opening the application for the first time, to making an appointment with a healthcare professional. The journey mapping stage was done by the whole team, together. We used journey mapping to surface the intended stages of the digital self-triage process as they were designed in the apps, we explored since user journey mapping is valuable for highlighting the central phases of the user experience, concurrently addressing several dimensions of the user experience (Howard 2014).

In the second step of the analysis, we used the concept of design patterns to look for critical aspects of the digital triage journeys, working in iterations of individually identifying patterns, and then collectively discussing our findings to improve the quality of the design recognition activity. After five such iterations, we produced a final list of mutually agreed upon identified pre-patterns in the design exemplars we studied. These pre-patterns are important first steps to understanding the key components of design patterns (Chung et al. 2004; Saponas et al. 2006), indicating possibilities for future research on the design of digital self-triage.

Findings

User Journey

The digital healthcare applications that we analyzed all share a similar sequence of steps that form a user journey of interactions with technology that ultimately leads to interacting with a human healthcare professional. In all applications included in this study, first-time users are presented with an introduction to the service and a request to authenticate and log in with a digital identity (BankID); this is a common, established authentication method in Sweden that can work as a single sign-on method. The next steps of the journey consisted of a health issue category selection, followed by health issue specification prompted by questions, and then ultimately, a payment or confirmation screen where the healthcare seeker can see their "case" and potentially receive information on what might happen next in the healthcare journey. Figure 1 presents this identified sequence of steps in the healthcare journey. Each of these steps has been analyzed and formulated into a pre-pattern, which we

describe in detail further in this article, with attention to the diversities of how each step has been designed in the different healthcare applications.

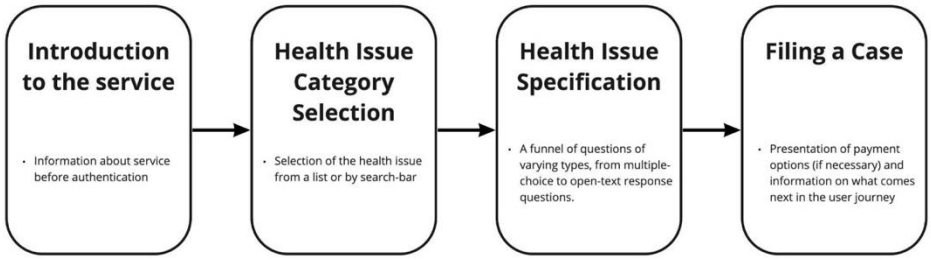

Figure 1: The Identified Steps of the Healthcare Seeker's Journey through Digital Self-triage

Pre-Patterns

In this section, we describe the pre-patterns that were identified from the analysis of the five applications, in terms of context, design challenge, and solutions found. Each pre-pattern corresponds to an identified design challenge that emerged during the user journey.

Pre-Pattern 1: Introduction to the Service

The introduction to the service pre-pattern highlights the importance of providing necessary information to users versus overloading users with too much information.

Context:

The introduction to the service is designed as the first encounter with the digital healthcare app itself. Digital healthcare applications communicate information about their service before the user logs in/signs up. The applications are available for both Android and iOS platforms and are designed for smartphone use.

Design Challenge:

The apparent design challenge for this pre-pattern is to provide enough relevant information to healthcare seekers before they are asked to log in to the digital healthcare center using digital national identification, without overwhelming the users with information. What constitutes "enough information" varies between the analyzed applications; this is visible in Figure 2 where we present the application with the least amount of information in Figure 2a, and the application with the most amount of information in screenshots 2b, 2c, 2d, and 2e.

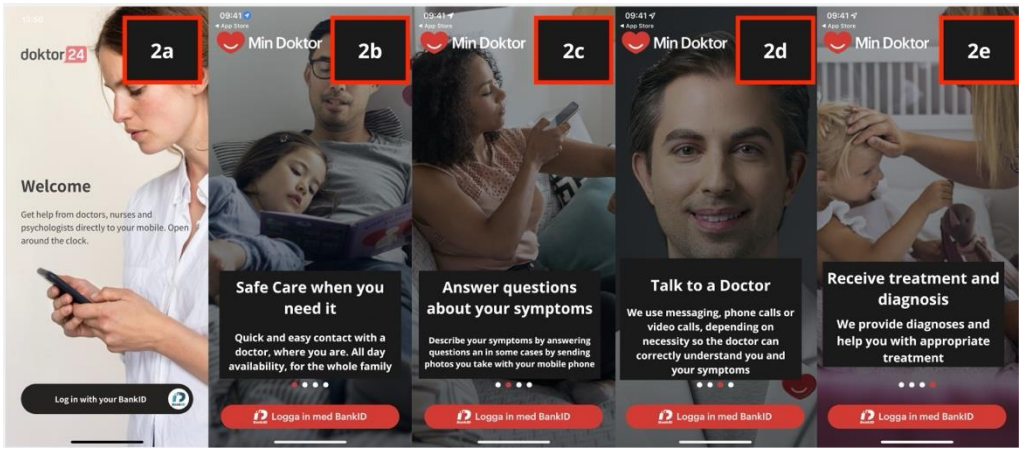

Figure 2: The App with the Least Available Information on the Left—Doktor24 (2022) Next to the App with the Most Available Information Min Doktor (n.d.). The Min Doktor Screens Are Translated from Swedish to English by the Researchers

Solutions Found:

Commonly, the introduction screen step of the user journey is designed as one, nonscrollable screen with bullet points or multiple, swipeable screens located before logging in to the service. When multiple screens are present, a midline horizontal ellipsis (three dots) is presented in the lower part of the screen to indicate that swiping for more information is an option. Categories of information that we found are opening hours and information about what kind of healthcare professionals can be accessed through the service (available in all services), information that help is available via text, audio, and video chat at the discretion of the healthcare professional (Min Doktor, n.d.; Doktor.Se, n.d.), and average waiting times (Capio 2022; Kry, n.d.).

The "prelogin information pre-pattern" is significant as it is the first point of contact between the user and the digital triage application. Increasing numbers of healthcare seekers choosing to use digital health care means that explaining how a digital healthcare visit works can be important in providing enough knowledge and setting expectations about the possibilities and qualities of the provided health care within this, still new, medium. The diversity of existing solutions underlines the lack of consensus among design teams as to how digital healthcare services should be introduced to new users.

Pre-Pattern 2: Health Issue Category Selection

The health issue category selection pre-pattern emphasizes the balancing of providing guidance for the user versus providing useful input to the digital healthcare system.

Context:

This is the first step of the digital self-triage process. This pre-pattern appears on the home page of the applications we explored, and this is a mandatory first step in filing a case that may result in conversing with a healthcare professional.

Design Challenge:

The apparent design challenge for this pre-pattern is to guide users in selecting the most suitable category for their symptoms. Since the selection made here affects the upcoming questions in pre-pattern 3, and eventually the outcome of the digital self-triage process, it is important that the health issue category selection is accurate to the experience of the user.

Solutions Found:

As shown in Figure 3, the selection of health issue categories is made by scrolling through predefined categories (see 3b, 3c), by typing free text into a search bar (Figure 3a), or by a combination of these interaction methods (Figure 3d, 3e). In all applications, the health issue categories were presented as single words or short phrases. Only one of the five applications presented more information about the health issue categories before selection, and the rest did not show any additional information to explain the health issue categories.

Most often, the predefined health issue categories are different types of illnesses, but in some of the analyzed applications, these predefined categories also include the selection of the type of healthcare professional (psychologist or medical doctor). The diversity in how health issue categories are searched for and how health issue categories are described illustrates a lack of established design patterns for this design problem. Furthermore, and as is mentioned in the literature, adapting solutions to this challenge to the health literacy and experience of the user would result in different design solutions; more knowledgeable users need little information, whereas less knowledgeable users may need more guidance in selecting a health issue category, meaning there is no one-solution-fits-all option for designers. In many of the apps we explored, we found multiple different yet similar categories when we searched for anxiety such as “stress,” “anxiety,” “stage-fright” forcing us to take a guess as to which category would be most appropriate to choose. In one of the apps, we found inconsistencies in the available health issue categories depending on the category selection method we used, getting different results when we used the search bar to results presented to us when we scrolled through the health issue category list.

Some applications complement the textual names of the health issue categories with visual elements, such as icons. For example, the category “anxiety and worry” can indicate meeting with a doctor for prescription and medication management or a psychiatrist for mental support.

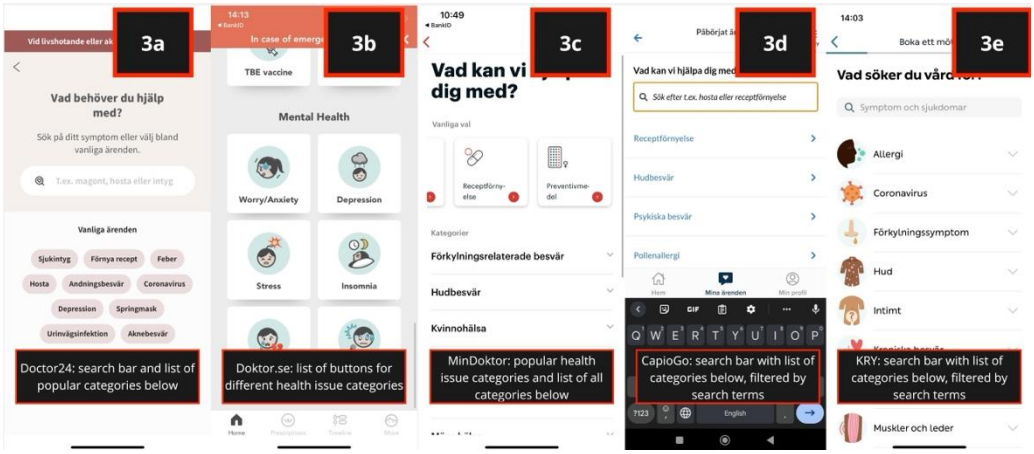

Figure 3: Screenshots from the Health Issue Category Sections for Each of the Apps that We Analyzed, along with Descriptions of the Depicted Design Solutions from Left: Doktor24 (2022), Doktor.Se (2022), Min Doktor (n.d.), Capio (2022), Kry (2022)

Selecting the health issue category closest to the health issue users are facing is important as the selection determines upcoming questions in the next step of the user journey. In some of the analyzed applications, the health issue selection determines whether users gain access to a psychologist, are offered talk therapy, or meet with a physician, leading to the pattern itself being an enabler or disabler of medication, treatment, or referral to a specialist.

Pre-Pattern 3: Health Issue Specification

The health issue specification pre-pattern emphasizes the balancing of not overloading the user with questions versus collecting usable and accurate healthcare information to support the healthcare professional.

Context:

After selecting a health issue, users are asked questions specific to their health issue and their general health based on the choices they previously made in pre-pattern 2. The health issue specification is an important step as this is the opportunity for a mental healthcare seeker to provide an accurate description of their symptoms so that they receive appropriate care from the digital healthcare center.

Design Challenge:

The apparent design challenge is to enable and guide users in correctly and accurately describing their symptoms, while also collecting and succinctly presenting this information to healthcare professionals. A secondary challenge is to get an overview of the healthcare seeker's general health.

Solutions Found:

In all the analyzed applications, questions aimed at specifying the health issue are presented to the user. Most of the questions were multiple choice questions focused on the severity and length of symptoms as seen in Figure 4a, 4b. Free text response questions were available for symptom description (Figure 4e), allowing users to describe their experiences freely. The questions were either presented as questionnaire forms (Figure 4a, 4b) or chatbots (Figure 4c, 4d). Certain answers lead to subsequently more specific questions, indicating the use of a decision-tree structure. Some of the applications in this study ask an extensive set of questions (we counted over 100 questions in some cases), while other applications ask fewer than ten questions before moving on to filing a case. While commenting on the content of the questions is beyond the scope of this article, it is worth noting that different formulations of similar questions were found in all the applications and that questions seem to be inspired, but not an exact match, to standardized anxiety questionnaires like the Generalized Anxiety Disorder Assessment (GAD-7) (Spitzer et al. 2006).

Based on the answers, some of the analyzed applications guide the user to emergency care by presenting information on where the nearest emergency room is located if the health issue is deemed to be too urgent for the scope of the healthcare service. We did not find that any of the applications provided any support to serious or acute cases beyond the contact information for emergency services.

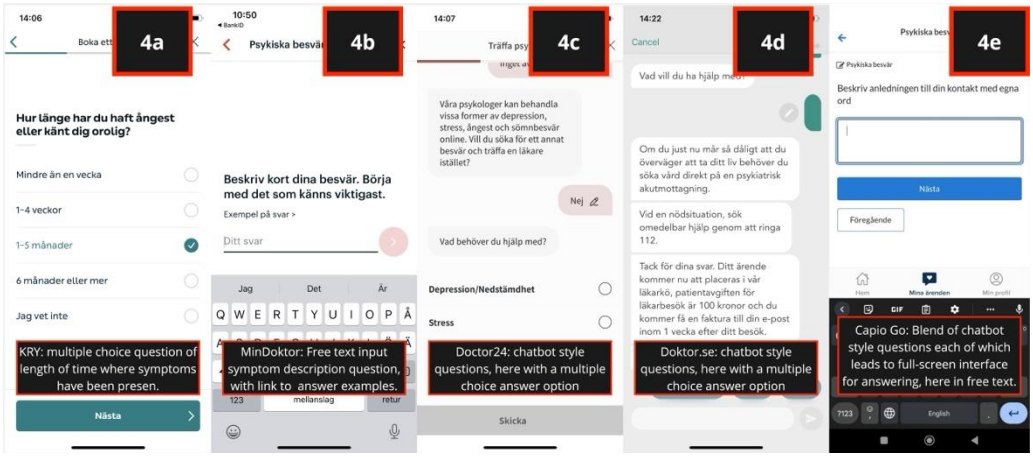

Figure 4: Screenshots Showing an Example of the Healthcare Issue Questionnaire Sections for Each of the Analyzed Apps, along with Descriptions of the Depicted Design Solutions from Left: Doktor24(2022), Doktor.Se (2022), Min Doktor (n.d.), Capio (2022), Kry (2022)

In all applications in this study, users can backtrack or edit their answers. Some of the applications also assist users in remembering their answers by providing summaries before moving users into the next step in the user journey, which is filing a case.

Pre-Pattern 4: Filing a Case

The filing a case pre-pattern emphasizes the balancing of transparency of the next steps in the healthcare process.

Context:

Once a health issue category has been selected and questions specifying the health issue have been answered, users are expected to file their case. This is considered the last step of the user journey before meeting with a healthcare professional.

Design Challenge:

The apparent design challenge is to summarize the information given by the user and simultaneously communicate to the user what can be expected from that appointment while creating an appointment with an appropriate healthcare professional.

Solutions Found:

The analyzed applications often presented a summary of the user-provided healthcare issue and general health status in a web-store checkout format, including time for visit, price, and payment options, as seen in Figure 5d. However, in some applications, the summary is fragmented in parts and woven into previous steps of the healthcare journey instead, meaning that users would have to backtrack if they wanted to check their answers, as seen in Figure 5f.

The information presented varied among the analyzed applications in terms of clear information as to what exactly happens during the next steps in the healthcare journey. An example is that during the analysis of the applications, one of the researchers accidentally started a meeting with a nurse due to a lack of transparency of information on what happens after clicking next in the healthcare journey process. Available information was if the meeting would be conducted using video, audio, chat, or in a physical setting, an opportunity to select which healthcare professional to meet (available only in one application, see Figure 5a) and if the meeting would be immediate or to be booked at a later date.

One of the explicit purposes of digital self-triage reveals itself in this pre-pattern. If the user has answered questions in a way that indicates an acute situation, the digital self-triage stops by design. In one example, the app would not allow filing a case at all, as seen in Figure 5e, whereas in another case, the user is urged to seek care elsewhere, but the option to file a case online is still available by clicking on a corresponding button (Figure 5b). Based on the design material we analyzed, it seems that the action of ending the healthcare journey in cases judged as "too urgent" is taken by the app itself, without the active participation of a healthcare professional.

The digital triage applications in this analysis differed in the approach to payment. Some applications required users to pay to confirm (and thereby file) the case. Other applications allowed users to file a case and pay afterward, sometimes within a specific time frame.

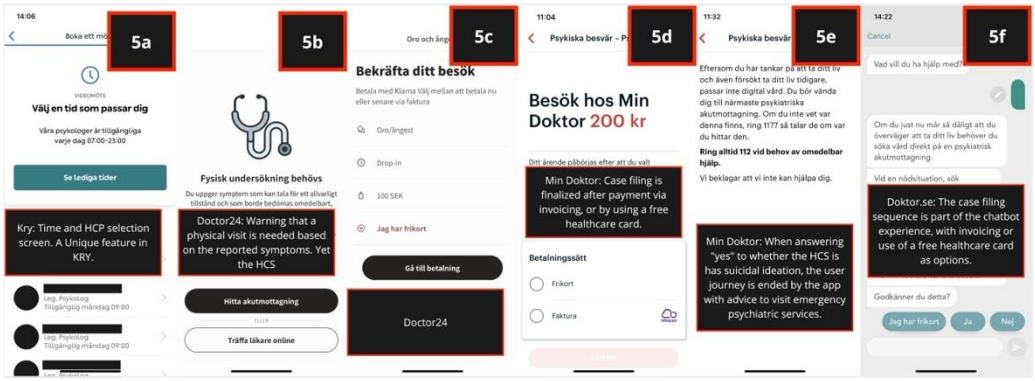

Figure 5: Screenshots from the Filing a Case Sections for Each of the Analyzed Apps, with Example of the Digital Delf-triage Stopping Users from Meeting Healthcare Professionals Online. From Left to Right: Kry (2022), Doktor24 (2022), Min Doktor (n.d.), Doktor.Se (2022)

This pre-pattern is the final step before meeting with a healthcare professional and where the self-triage process ends.

Discussion

Findings indicate that commercially available digital self-triage design solutions can be broken down into the following steps: introducing the digital healthcare center, collecting information about the nature and symptoms of health issues of users, and creating appointments with healthcare professionals. In the following text, we discuss how our findings relate to the broader design challenge of digital self-triage for mental health.

All the digital healthcare centers we explored offer healthcare journeys that involve interacting with a human healthcare professional, meaning that the typical healthcare journey through a digital healthcare center is a blending of digital self-triage followed by a consultation with a healthcare professional of some sort. This middle-ground approach to digitalizing health care contributes to the view that digital self-triage may in fact increase the workload for medical practitioners (Kujala et al. 2020) as the digital self-triage output adds on to the preexisting processes in health care. The blending of digital and physical is a new concept to prospective users, illustrated by the first pre-pattern of introducing the digital care center. The pre-pattern shows that some commercial applications provide very little information, offering only information on opening hours and a general statement that it is possible to meet doctors and nurses through the digital care center. Others offer more extensive additional information on cost, how the service works in terms of the mode of communication with the healthcare professionals, and even a short description of the digital self-triage part of the healthcare journey. However, neither of these approaches fully utilizes the possibilities of the digital material to support new users or adapt to recurring users. We see a great deal of potential from switching to a digital-first approach in the design of digital self-triage, for instance, by enabling user experience that adapts to the skills, knowledge, and needs of each user (Yang et al. 2016).

Another aspect that emerged from the analysis is that the user is required to undertake certain risk-taking behaviors when using digital self-triage applications. Several of the analyzed applications require that users make choices before they are given more extensive information about what these choices may entail. For reasons of clarity, the digital triage process is separated into distinct steps, but the lack of transparency in several of these applications leads to a lack of understanding of what the following step in the user journey will be. As some choices can lead to the user not meeting with a physician, but instead receiving advice to contact a physical healthcare center or emergency care, each choice presents a certain risk to the user who wants a digital meeting with a physician. The lack of transparency is a question of fundamental usability, indicating that a stronger healthcare seeker involvement in the design of these services would be beneficial in designing more transparent user journeys. Careful consideration should be put on who should have the agency to decide if a digital self-triage visit will lead to meeting a healthcare professional, or not, underlining the need for a more ethical, user-centered perspective on the design of digital self-triage, which involves healthcare professionals, technologists, and patients. It is not hard to imagine situations where a physical healthcare visit might not be an option for a user, for instance, due to living in a rural area with no easy access to health care.

Digital self-triage places higher requirements on the users compared to traditional triage. Digital self-triage often requires advanced health literacy (Aboueid et al. 2019; Eldh et al. 2020) as users must be able to understand nuances of medical terminology when selecting their health issue. Our analysis showed that not all applications supported the user equally in understanding these nuances; for example, when seeking mental health care for anxiety, it may be necessary for the user to understand the difference between worry and anxiety. Some of the applications also provide the user with an extensive number of questions, which require knowledge, patience, and the ability to focus. Since the choices the user makes during digital self-triage affect the care they receive (e.g., some choices may lead to meeting a physician, while others lead to meeting a psychologist), there is a risk of users with lower health literacy receiving less appropriate health care. In comparison to traditional triage, where a nurse typically asks questions and guides the healthcare seeker in person, in digital self-triage, the user is left on their own. As such, the digital service must support the user in understanding the nuances of healthcare terminology. Moreover, not only is health literacy required, but there is an additional expectation that users are able to communicate their symptoms succinctly and clearly in text form, often using a mobile interface. This excludes groups that do not use digital technology or have limited movement. What we note, however, is that there is also a potential socioeconomic divide, where people with higher levels of education and health literacy may benefit more from the potential of digital self-triage than those who are less used to expressing themselves in writing and have a lower health literacy. In comparison to traditional triage, digital self-triage thus has a higher risk of creating a divide between already advantaged and disadvantaged groups in society. We argue that there is a

potential for the use of AI and Natural Language Processing to reduce this divide, if suitably applied to these problems.

A further, related, reflection brought about by the analysis pertains to the amount of data collected by these applications; some of the analyzed applications collect answers to upward of 100 questions, and the purpose of this data collection is unclear. The purpose of triage, either digital or analog, is essentially to guide the healthcare seeker to appropriate care (Eldh et al. 2020; Lai et al. 2020). However, in most of the applications in our analysis, it was unclear whether the data collected in digital self-triage would be used to direct the user to an appropriate healthcare professional. In one case, one of the healthcare services asks users to preselect whether they wish to see a psychologist who can offer talk therapy or a psychiatrist who could offer medication, before answering any of the triage questions. In other applications, the user is directed to a general practitioner no matter how they answer the questions. It is out of the scope of our analysis to see if the collected data is used in the consultation with the physician, but whether this is the case was not communicated in any of the analyzed applications. In fact, how the data is used is not easily available information in any of the analyzed applications; given the sensitivity of the collected data, it becomes particularly important to have a high level of transparency on data usage policies.

Finally, one aspect that permeates all other issues raised here is that the analysis indicates that these self-triage applications have been designed from the perspective of the healthcare provider and not a user perspective. We draw this conclusion from the lack of transparency of information on what is possible to get help with through a digital healthcare visit and the lack of information on how the digital healthcare journeys work and what to expect as a user. Furthermore, the expectation that users can correctly select health issues with sometimes confusingly similar names (for instance, anxiety, stress, panic) and the extensiveness of the healthcare questions that presuppose certain levels of health literacy result in an expectation that users will either be very knowledgeable about their health issues prior to the healthcare visit or that users will be willing to take a chance and test out a digital healthcare center. Our analysis shows that a first-time user will have to guess what to do and engage in risk-taking behavior to be able to reach a consultation with a physician. As such, the identified pre-patterns in this article are meant to not only emphasize what is being done by commercial self-triage applications but also to serve as directions for future, healthcare seeker-oriented HCI research. In studying what is missing from these pre-patterns, more complete design patterns can be developed in the future.

Beyond design patterns, we believe that fundamental HCI concepts such as designing to accommodate the user's mental model, using affordances to communicate what is possible to do for the user, and even following basic usability heuristics have a high potential to improve the user experience of digital self-triage, and prevent user errors that could result in healthcare seekers not being able to receive much-needed health care, or cause unnecessary strain on the healthcare system. We urge designers of commercial healthcare applications to increasingly work with a user-centered perspective that includes not only healthcare

professionals but also patient perspectives and advocate further research that furthers these perspectives in the design of healthcare technology. Future work should include user-centered empirical work on identifying and designing software for digital self-triage that elevates healthcare seeker perspectives while keeping healthcare professional perspectives in the loop. We also believe that there is a great opportunity for research work that utilizes participatory design and participatory healthcare principles to empower healthcare seekers, as mentioned in the section titled "HCI Research in Digital Health Care" . Such work must comply with and be sensitive to ethical and privacy issues that come with user research in healthcare settings.

We want to emphasize that in this article, we have only examined digital self-triage for anxiety in the five most popular national digital healthcare centers available in Sweden, which is a very limited part of the expansive user journeys that exist in digital health care. Among others, we believe that examining user journeys past digital self-triage and examining the healthcare professional's user journey with digital healthcare applications are vital continuation steps that will reveal more of the existing solutions and the opportunities to get one step closer to establishing interaction design patterns for digital health care.

Conclusion

This article set out to answer the question "What design challenges and solutions can be identified in commercially available digital self-triage applications for anxiety?" From a design critique of the top five commercial digital self-triage applications available in Sweden, we have formulated four pre-patterns that highlight the need for further HCI research within this field.

The pre-patterns, summarized in Figure 1, emphasize four challenges: (1) in the introduction to the service, enough information has to be provided to the healthcare seeker to set reasonable expectations of what can be achieved through a digital healthcare center without overwhelming the user with information; (2) in the health issue categorization, the application has to guide the user to pick the most suitable category for their symptoms to provide appropriate health care; (3) in the health issue specification, the user has to be supported in their description and specification of their health condition, while also supporting their understanding of medical terminology; and (4) when filing a case, the application should summarize the user's own information as well as communicate what is to be expected from the appointment with the healthcare professional.

The study reveals the diverse design solutions that are commercially available for these challenges and discusses the consequences of an apparent analog-first and healthcare-centered approach to the design of digital self-triage. We conclude that the value of a user-centered, digital-first approach must not be underestimated and that future HCI research on digital healthcare centers should focus on these issues.

Acknowledgment

This work was conducted as part of the CAISR Health Research Profile at Halmstad University with funding made possible by the Knowledge Foundation (grant number 20200208 01H).

Conflict of Interest

The authors declare that there is no conflict of interest.

REFERENCES

Aboueid, Stephanie, Rebecca H. Liu, Binyam Negussie Desta, Ashok Chaurasia, and Shanil Ebrahim. 2019. "The Use of Artificially Intelligent Self-diagnosing Digital Platforms by the General Public: Scoping Review." *JMIR Medical Informatics* 7 (2): e13445. https://doi.org/10.2196/13445.

Alabood, Lorans, Zahra Aminolroaya, Dianna Yim, Omar Addam, and Frank Maurer. 2023. "A Systematic Literature Review of the Design Critique Method." *Information and Software Technology* 153 (January): 107081. https://doi.org/10.1016/j.infsof.2022.107081.

Alexander, Christopher. 1977. *A Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press.

Bardzell, Jeffrey, Shaowen Bardzell, Amanda Lazar, and Norman Makoto Su. 2019. "(Re-)Framing Menopause Experiences for HCI and Design." In CHI '19: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–13. New York: Association for Computing Machinery. https://doi.org/10.1145/3290605.3300345.

Blandford, Ann. 2019. "HCI for Health and Wellbeing: Challenges and Opportunities." *International Journal of Human-Computer Studies* 131 (November): 41–51. https://doi.org/10.1016/j.ijhcs.2019.06.007.

Blevis, Eli, Youn-Kyung Lim, David Roedl, and Erik Stolterman. 2007. "Using Design Critique as Research to Link Sustainability and Interactive Technologies." In *Online Communities and Social Computing*, 22–31. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-540-73257-0_3.

Bombard, Yvonne, G. Ross Baker, Elaina Orlando, Carol Fancott, Pooja Bhatia, Selina Casalino, Kanecy Onate, Jean-Louis Denis, and Marie-Pascale Pomey. 2018. "Engaging Patients to Improve Quality of Care: A Systematic Review." *Implementation Science: IS* 13 (1): 98. https://doi.org/10.1186/s13012-018-0784-z.

Bor, William, Angela J. Dean, Jacob Najman, and Reza Hayatbakhsh. 2014. "Are Child and Adolescent Mental Health Problems Increasing in the 21st Century? A Systematic

Review." *Australian and New Zealand Journal of Psychiatry* 48 (7): 606–616. https://doi.org/10.1177/0004867414533834.

Borchers, Jan O. 2001. "A Pattern Approach to Interaction Design." *AI & Society* 15 (4): 359–376. https://doi.org/10.1007/BF01206115.

Capio. 2022. *Capio Go - Trygg Vård Online*. https://capio.se/digitala-tjanster/capio-go/.

Chambers, Duncan, Anna J. Cantrell, Maxine Johnson, Louise Preston, Susan K. Baxter, Andrew Booth, and Janette Turner. 2019. "Digital and Online Symptom Checkers and Health Assessment/Triage Services for Urgent Health Problems: Systematic Review." *BMJ Open* 9 (8): e027743. https://doi.org/10.1136/bmjopen-2018-027743.

Chung, Eric S., Jason I. Hong, James Lin, Madhu K. Prabaker, James A. Landay, and Alan L. Liu. 2004. "Development and Evaluation of Emerging Design Patterns for Ubiquitous Computing." In *DIS '04: Proceedings of the 5th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, 233–242. . New York: Association for Computing Machinery. https://doi.org/10.1145/1013115.1013148.

Dearden, Andy, and Janet Finlay. 2006. "Pattern Languages in HCI: A Critical Review." *Human–Computer Interaction* 21 (1): 49–102. https://doi.org/10.1207/s15327051hci2101_3.

Dearden, Andy, Janet Finlay, Liz Allgar, and Barbara McManus. 2002. "Evaluating Pattern Languages in Participatory Design." In *CHI '02 Extended Abstracts on Human Factors in Computing Systems*, 664–665. New York: Association for Computing Machinery. https://doi.org/10.1145/506443.506535.

"Den digitala utomlänsvården ökar." 2021. *Sveriges Kommuner och Regioner,* April 7, 2021. https://skr.se/skr/halsasjukvard/nyhetsarkivhalsasjukvard/nyheterhalsasjukvard/dendigitalautomlansvardenokar.51990.html.

Detweiler, Christian, and Koen Hindriks. 2012. "Value-Sensitive Design Patterns for Pervasive Health Care." In *2012 IEEE International Conference on Pervasive Computing and Communications Workshops*, 908–913. Lugano, Switzerland. IEEE. https://doi.org/10.1109/PerComW.2012.6197643

Doktor24. n.d. Accessed April 2022. *Doktor24*. https://doktor24.se/.

Doktor.Se. n.d. "Doktor.Se - Meet a Doctor with Our App." Accessed April 2022. https://doktor.se/en/.

eHälsomyndigheten. 2021. "Digitalt Stöd För Psykisk Hälsa - Fokusrapport." https://www.ehalsomyndigheten.se/globalassets/dokument/rapporter/fokusrapport---digitalt-stod-for-psykisk-halsa.pdf.

Eldh, Ann Catrine, Annette Sverker, Preben Bendtsen, and Evalill Nilsson. 2020. "Health Care Professionals' Experience of a Digital Tool for Patient Exchange, Anamnesis, and Triage in Primary Care: Qualitative Study." *JMIR Human Factors* 7 (4): e21698. https://doi.org/10.2196/21698.

Gambino, Andrew, Jinyoung Kim, and S. Shyam Sundar. 2019. "Digital Doctors and Robot Receptionists: User Attributes That Predict Acceptance of Automation in Healthcare

Facilities." In *CHI EA '19 Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–6. New York: Association for Computing Machinery. https://doi.org/10.1145/3290607.3312916.

Gkouskos, Dimitrios, and Jonathan Burgos. 2017. "I'm in! Towards Participatory Healthcare of Elderly through IOT." *Procedia Computer Science* 113 (2017) 647–652. https://doi.org/10.1016/j.procs.2017.08.325.

Halvorsen, Kristin, Alfhild Dihle, Camilla Hansen, Marita Nordhaug, Heidi Jerpseth, Sidsel Tveiten, Pål Joranger, and Ingrid Ruud Knutsen. 2020. "Empowerment in Healthcare: A Thematic Synthesis and Critical Discussion of Concept Analyses of Empowerment." *Patient Education and Counseling* 103 (7): 1263–1271. https://doi.org/10.1016/j.pec.2020.02.017.

Hartley, Samantha, Jessica Raphael, Karina Lovell, and Katherine Berry. 2020. "Effective Nurse–Patient Relationships in Mental Health Care: A Systematic Review of Interventions to Improve the Therapeutic Alliance." *International Journal of Nursing Studies* 102 (February): 103490. https://doi.org/10.1016/j.ijnurstu.2019.103490.

Hendriks, Niels, Karin Slegers, and Pieter Duysburgh. 2015. "Codesign with People Living with Cognitive or Sensory Impairments: A Case for Method Stories and Uniqueness." *CoDesign* 11 (1): 70–82. https://doi.org/10.1080/15710882.2015.1020316.

Howard, Tharon. 2014. "Journey Mapping: A Brief Overview." *Communication Design Quarterly Review* 2 (3): 10–13. https://doi.org/10.1145/2644448.2644451.

John, Bonnie E., and David E. Kieras. 1996. "Using GOMS for User Interface Design and Evaluation: Which Technique?" *ACM Transactions on Computer-Human Interaction: A Publication of the Association for Computing Machinery* 3 (4): 287–319. https://doi.org/10.1145/235833.236050.

John, Bonnie E., Alonso Vera, Michael Matessa, Michael Freed, and Roger Remington. 2002. "Automating CPM-GOMS." In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 147–154. New York: ACM. https://doi.org/10.1145/503376.503404.

Kirchner, Susanne, Jessica Schroeder, James Fogarty, and Sean A. Munson. 2021. "'They Don't Always Think about That': Translational Needs in the Design of Personal Health Informatics Applications." In *CHI '21 210: Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–16. New York: Association for Computing Machinery. https://doi.org/10.1145/3411764.3445587.

Koukouletsos, Kostas, Babak Khazaei, Andy Dearden, and Mehmet Ozcan. 2009. "Teaching Usability Principles with Patterns and Guidelines." In *Creativity and HCI: From Experience to Design in Education*, 159–174. New York: Springer. https://doi.org/10.1007/978-0-387-89022-7_11.

Kry. n.d. "Kry." Accessed April 2022. https://www.kry.se/en/.

Kujala, Sari, Iiris Hörhammer, Riitta Hänninen-Ervasti, and Tarja Heponiemi. 2020. "Health Professionals' Experiences of the Benefits and Challenges of Online Symptom Checkers." *Studies in Health Technology and Informatics* 270 (June): 966–970. https://doi.org/10.3233/SHTI200305.

Lai, Lucinda, Kelley A. Wittbold, Farah Z. Dadabhoy, Rintaro Sato, Adam B. Landman, Lee H. Schwamm, Shuhan He, Rajesh Patel, Nancy Wei, Gianna Zuccotti, Inga T. Lennes, Danika Medina, Thomas D. Sequist, Garrett Bomba, Yonatan G. Keschner, and Haipeng (Mark) Zhang. 2020. "Digital Triage: Novel Strategies for Population Health Management in Response to the COVID-19 Pandemic." *Healthcare (Amsterdam, Netherlands)* 8 (4): 100493. https://doi.org/10.1016/j.hjdsi.2020.100493.

Liaw, Winston R., Anuradha Jetty, Megan Coffman, Stephen Petterson, Miranda A. Moore, Gayathri Sridhar, Aliza S. Gordon, Judith J. Stephenson, Wallace Adamson, and Andrew W. Bazemore. 2019. "Disconnected: A Survey of Users and Nonusers of Telehealth and Their Use of Primary Care." *Journal of the American Medical Informatics Association: JAMIA* 26 (5): 420–428. https://doi.org/10.1093/jamia/ocy182.

Ligthart, Mike E. U., Mark A. Neerincx, and Koen V. Hindriks. 2020. "Design Patterns for an Interactive Storytelling Robot to Support Children's Engagement and Agency." In *Proceedings of the 2020 ACM/IEEE International Conference on Human-Robot Interaction*, 409–418. New York: Association for Computing Machinery. https://doi.org/10.1145/3319502.3374826.

Lindberg, Susanne, Pontus Wärnestål, Jens Nygren, and Petra Svedberg. 2014. "Designing Digital Peer Support for Children: Design Patterns for Social Interaction." In *IDC '14: Proceedings of the 2014 Conference on Interaction Design and Children*, 47–56. New York: Association for Computing Machinery. https://doi.org/10.1145/2593968.2593972.

Martikainen, Susanna, Johanna Kaipio, and Tinja Lääveri. 2020. "End-user Participation in Health Information Systems (HIS) Development: Physicians' and Nurses' Experiences." *International Journal of Medical Informatics* 137 (May): 104117. https://doi.org/10.1016/j.ijmedinf.2020.104117.

Meyer, Ashley N. D., Traber D. Giardina, Christiane Spitzmueller, Umber Shahid, Taylor M. T. Scott, and Hardeep Singh. 2020. "Patient Perspectives on the Usefulness of an Artificial Intelligence–Assisted Symptom Checker: Cross-sectional Survey Study." *Journal of Medical Internet Research* 22 (1): e14679. https://doi.org/10.2196/14679.

Min Doktor. n.d. "Min Doktor – Din vårdcentral i mobilen." Accessed April 2022.https://www.mindoktor.se/.

Mitzner, Tracy L., Charles C. Kemp, Wendy Rogers, and Lorenza Tiberio. 2013. "Investigating Healthcare Providers' Acceptance of Personal Robots for Assisting with Daily Caregiving Tasks." In *CHI '13 Extended Abstracts on Human Factors in Computing Systems*, 499–504. New York: Association for Computing Machinery. https://doi.org/10.1145/2468356.2468444.

Morse, Keith E., Nicolai P. Ostberg, Veena G. Jones, and Albert S. Chan. 2020. "Use Characteristics and Triage Acuity of a Digital Symptom Checker in a Large Integrated Health System: Population-based Descriptive Study." *Journal of Medical Internet Research* 22 (11): e20549. https://doi.org/10.2196/20549.

Nadal, Camille, Shane McCully, Kevin Doherty, Corina Sas, and Gavin Doherty. 2022. "The TAC Toolkit: Supporting Design for User Acceptance of Health Technologies from a Macro-temporal Perspective." In *CHI '22: Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, 1–18. New York: Association for Computing Machinery. https://doi.org/10.1145/3491102.3502039.

Nelson, Harold G., and Erik Stolterman. 2014. *The Design Way, Second Edition: Intentional Change in an Unpredictable World*. Cambridge: MIT Press.

Oldenburg, Jan, and Mary P. Griskewicz. 2016. *Participatory Healthcare: A Person-centered Approach to Healthcare Transformation*. Boca Raton, FL: CRC Press.

Park, Sohyun, Anja Thieme, Jeongyun Han, Sungwoo Lee, Wonjong Rhee, and Bongwon Suh. 2021. ""I Wrote as If I Were Telling a Story to Someone I Knew": Designing Chatbot Interactions for Expressive Writing in Mental Health." In *DIS '21: Proceedings of the 2021 ACM Designing Interactive Systems Conference 2021*, 926–941. New York: Association for Computing Machinery. https://doi.org/10.1145/3461778.3462143.

Pols, Jeannette. 2012. *Care at a Distance: On the Closeness of Technology*. Amsterdam: Amsterdam University Press.

Polson, Peter G., Clayton Lewis, John Rieman, and Cathleen Wharton. 1992. "Cognitive Walkthroughs: A Method for Theory-Based Evaluation of User Interfaces." *International Journal of Man-Machine Studies* 36 (5): 741–773. https://doi.org/10.1016/0020-7373(92)90039-n.

Ren, Xipei, Gabriele Spina, Babs Faber, and Anna Geraedts. 2020. "Engaging Stakeholders to Design an Intelligent Decision Support Tool in the Occupational Health Context." In *CHI EA '20: Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*, 1–8. New York: Association for Computing Machinery. https://doi.org/10.1145/3334480.3383061.

Saponas, T. Scott, Madhu K. Prabaker, Gregory D. Abowd, and James A. Landay. 2006. "The Impact of Pre-patterns on the Design of Digital Home Applications." In *DIS '06: Proceedings of the 6th Conference on Designing Interactive Systems*, 189–198. New York: Association for Computing Machinery. https://doi.org/10.1145/1142405.1142436.

Schoonderwoerd, Tjeerd A. J., Wiard Jorritsma, Mark A. Neerincx, and Karel van den Bosch. 2021. "Human-centered XAI: Developing Design Patterns for Explanations of Clinical Decision Support Systems." *International Journal of Human-Computer Studies* 154 (October): 102684. https://doi.org/10.1016/j.ijhcs.2021.102684.

Spitzer, Robert L., Kurt Kroenke, Janet B. W. Williams, and Bernd Löwe. 2006. "A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7." *Archives of Internal Medicine* 166 (10): 1092–1097. https://doi.org/10.1001/archinte.166.10.1092.

Statistics for Mental Health for Young Adults in Sweden. 2023. Accessed April 2023. https://www.folkhalsomyndigheten.se/livsvillkor-levnadsvanor/psykisk-halsa-och-suicidprevention/statistik-psykisk-halsa/statistik-om-ungas-psykiska-halsa/.

Stolterman, Erik. 2008. "The Nature of Design Practice and Implications for Interaction Design Research." *International Journal of Design* 2 (1): 55–65. http://ijdesign.org/index.php/IJDesign/article/view/240.

Vahdat, Shaghayegh, Leila Hamzehgardeshi, Somayeh Hessam, and Zeinab Hamzehgardeshi. 2014. "Patient Involvement in Health Care Decision Making: A Review." *Iranian Red Crescent Medical Journal* 16 (1): e12454. https://doi.org/10.5812/ircmj.12454.

van Welie, Martijn, Gerrit C. van der Veer, and Anton Eliëns. 2001. "Patterns as Tools for User Interface Design." In *Tools for Working with Guidelines*, 313–324. London: Springer. https://doi.org/10.1007/978-1-4471-0279-3_30.

"Vision E-Halsa 2025." 2016. https://www.regeringen.se/contentassets/5a2c8365d1b04d33a9bc7512d5d1c5aa/overenskommelse-om-vision-ehalsa-2025.pdf.

Wania, Christine E. 2019. "Exploring Design Patterns as Evaluation Tools in Human Computer Interaction Education." *MWAIS 2019* 9:1–6. https://core.ac.uk/download/pdf/301379697.pdf.

Wiberg, Mikael, and Erik Stolterman. 2014. "What Makes a Prototype Novel? A Knowledge Contribution Concern for Interaction Design Research." In *NordiCHI '14: Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational*, 531–540. New York: Association for Computing Machinery. https://doi.org/10.1145/2639189.2639487.

Yang, Qian, Aaron Steinfeld, and John Zimmerman. 2019. "Unremarkable AI: Fitting Intelligent Decision Support into Critical, Clinical Decision-making Processes." In *CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 1–11. New York: Association for Computing Machinery. https://doi.org/10.1145/3290605.3300468.

Yang, Qing, John Zimmerman, and Aaron Steinfeld. 2015. "Review of Medical Decision Support Tools: Emerging Opportunity for Interaction Design." *IASDR 2015 Interplay*, 1–6. http://doi.org/10.13140/RG.2.1.1441.3284.

Yang, Qian, John Zimmerman, Aaron Steinfeld, and Anthony Tomasic. 2016. "Planning Adaptive Mobile Experiences When Wireframing." In *Dis '16: Proceedings of the 2016 ACM Conference on Designing Interactive Systems*, 565–576. New York: Association for Computing Machinery. https://doi.org/10.1145/2901790.2901858.

Yoo, Minyoung, William Odom, and Arne Berger. 2021. "Understanding Everyday Experiences of Reminiscence for People with Blindness: Practices, Tensions and

Probing New Design Possibilities." In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*, 1–15. New York: Association for Computing Machinery. https://doi.org/10.1145/3411764.3445212.

Zimmerman, John, Jodi Forlizzi, and Shelley Evenson. 2007. "Research through Design as a Method for Interaction Design Research in HCI." In *CHI '07: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 493–502. New York: Association for Computing Machinery. https://doi.org/10.1145/1240624.1240704.

ABOUT THE AUTHORS

Dimitrios Gkouskos: Senior Lecturer in Informatics, School of ITE, Halmstad University, Halmstad, Halland, Sweden
Corresponding Author's Email: dimitrios.gkouskos@hh.se

Susanne Lindberg: Senior Lecturer in Informatics, School of ITE, Halmstad University, Halmstad, Halland, Sweden
Email: susanne.lindberg@hh.se

Oliver Weberg: Doctoral Student in Informatics, School of ITE, Halmstad University, Halmstad, Halland, Sweden
Email: oliver.weberg@hh.se