Usefulness design goals of occupational mHealth apps for healthcare workers

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Usefulness Design Goals of Occupational mHealth Apps for Healthcare Workers.

Nurha Yingta School of Biomedical Sciences University of West London St. Mary's Road, Ealing UK 21363511@student.uwl.ac.uk

Jose Abdelnour-Nocera University of West London St. Mary's Road, Ealing UK. ITI/Larsys, Funchal, Portugal and Jose.Abdelnour-Nocera@uwl.ac.uk

Obed Brew School of Biomedical Sciences University of West London St. Mary's Road, Ealing UK Obed.Brew@uwl.ac.uk

Ikram Ur Rehman School of Computing and Engineering University of West London St. Mary's Road, Ealing UK Ikam.Rehman@uwl.ac.uk

Abstract: To improve healthcare professionals health and wellbeing at work, many available effective treatments including meditation, and workplace intervention, have been developed. However, the utilisation of these interventions is still limited. Currently, various mobile health applications (mHealth Apps) exist to assist a wide range of users with different occupational health issues, such as stress, anxiety, and burnout. Despite their advantages, post-download uptake of mHealth apps by end-users remains low. Some of the reasons for this are poor usability, irrelevant or missing user-desired features, and poor user experience. This review paper explores the usefulness of mHealth Apps to support occupational ill-health in healthcare workers. To achieve this, we developed a conceptual framework that identifies relevant usability, utility, and user experience design goals that enhance the usefulness of such mHealth apps. This paper presents a review of the literature combined with a proposed framework that identifies design goals proven to be relevant or often lacking. The review shows that occupational mHealth apps rarely fit end users' backgrounds, work contexts, and dynamics. In turn, these identified design goals will be used as assessment points with end-users in subsequent stages of our project. Expected results at the end of the project will provide an enhanced understanding of usefulness design goals that contribute to the long-term use and adoption of these apps.

Keywords*: mHealth Apps, Occupational ill-health, Usefulness, Usability, Utility, User Experience, Healthcare Workers*

1. INTRODUCTION

Occupational-related ill-health (ORIH) is a major health concern for successful economic growth. In UK, the rate of ORIH is 4.8 thousand per 100,000 workers (Hse.gov.uk., 2021), and it is commonly associated with any physical and mental health conditions that result from organisational factors as well as an imbalance of demands, skills and social support at work (Rajgopal, 2010). Current data suggests most ORIH in UK are mental health related (51% of 1.6 million cases), followed by musculoskeletal (30%) – other types of illness make up 19% (LSF, 2021).

Workers in the medical sector are at increased risk of occupational-related ill-health due to the extraordinary stressors in this environment (Ravalier, McVicar and Boichat, 2020). Stressors related to the healthcare profession include long work hours, dealing with pain, loss and emotional suffering, disease outbreak, and providing support to families (Liu *et al.*, 2020). These stressors can trigger physical and mental health issues, such as stress, burnout and anxiety.

The COVID-19 pandemic has led to feelings of unhappiness, increased stress, burnout and anxiety, particularly among healthcare workers (HCWs) (Kinman, Teoh and Harriss, 2020). Many HCWs have experienced a high prevalence of emotional burnout, physical symptoms, and work-related pressure (Barello, Palamenghi and Graffigna, 2020). This is because the fear of transmitting COVID-19 could cause HCWs to isolate from their families for months, causing the feeling of loneliness, anxiety, and depression (UK Parliament, 2020). Thus, it is crucial to design effective tools to help HCWs detect the onset of occupational-related ill-health much earlier.

The term mHealth first became popular in the early 1990s when telecommunication systems and electronic processes were used for supporting healthcare practices for the first time (Dicianno *et al.*, 2015). According to Marshall et al. (2020), an mHealth app is defined as an application program that offers health-related services through

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smartphones and tablets to fulfil health-specific purposes, such as stress management and prevention. Mediums for mHealth deployment are not only limited to mobile phone applications but extends to other mobile devices, such as body wearables and swallowed health monitors (Aryana, Brewster and Abdelnour-Nocera, 2018).

Despite their advantages, it remains a huge challenge to find effective mHealth apps to support occupational ill-health. Besides, not much has been done to identify and assess factors that impact on adoption, usefulness, usability, user experience and utility of mHealth apps in early detection of ORIH among healthcare workers. Usefulness refers to the degree to which users believe that using a system enhances their performance and fits with their intended tasks (Davis, 1989). Usability describes aspects that interactive products should have to allow users to continue their daily activities at work or in everyday lives without some difficulties in using the products. Utility is relevant to provide an appropriate set of functions that will allow users to carry out all their specified tasks.

Human-Computer Interaction (HCI) is concerned with understanding and designing human-centred interactive systems, where usability and user experience have been the most studied and applied concepts. Research on usefulness has been more limited (Nocera, Dunckley and Sharp, 2007; MacDonald and Atwood, 2014); therefore, reviewing factors involved with usefulness design goals is a valuable undertaking. This position paper focuses on the usefulness design goals of mobile mHealth apps to support occupational ill-health in HCWs.

The paper's outline is as follows: Section 2 provides a brief review covering related fields of HCI research, including m-Health apps in workplace setting, usefulness, usability, utility, and user experience. Section 2 also highlights a proposed framework relating to usefulness aspects based on the evidence found in the literature. This is followed in section 3 by a description of the methods involved and review findings. The paper closes by highlighting key insights to facilitate the adoption and continued use of such mHealth apps.

2. RELATED AREAS

2.1 mHealth apps in workplace settings

There are a number of studies focused on the use of mHealth app in workplace settings. For instance, de Korte *et al (*2018) have studied the use of an m-Health application called Brightr. This app was developed for workers within high-tech companies, to help them improve their health and wellbeing in the occupational setting. The results indicated that participants had muted enthusiasm about the app, as participants were unable to achieve their preferred features of an app. In another study conducted by Sarkar and colleagues (Sarkar *et al.*, 2016) it was found that participants with depression faced difficulty in using the app because they had to spend substantial among of time entering their mood data into the app. This implies that lack of proper design methods or desired utility features was presented as common reason for abandoning such mHealth apps.

The study of (Yoon *et al.*, 2021) investigated the factors that influence the adoption of m-Health apps among healthcare workers through interviews. Results from the study showed that a few participants found the app unnecessary for promoting their mental health and wellness, as the apps offered were unnecessary for their own treatment needs. The authors suggested that the following recommendations should be considered when designing m-Health apps; (1) technical factors related to the themes perceived ease of use, convenience, security, IT support; (2) personal factors related to perceived usefulness; and lastly, the factors related to rewards and price of app.

It is thus crucial for future research to consider how mHealth apps interact with other important factors that affect the adoption and usage of such apps, for example workers' preferences, and the situations/contexts in which they work and live. The ability to leverage the needs of the end users including UX and usability in work contexts as well as desired utility features are therefore important factors enhancing the usefulness of such apps.

2.2 Defining usefulness

The usefulness of a system is a concept that has been defined and explored in different ways in disciplines such as Information System, HCI and IT (Nocera, Dunckley and Sharp, 2007). Several authors in previous studies have addressed the terms "usefulness" in different ways. For example, for Davis, usefulness is a perception of how a system enhances job performance or task completion (Davis, 1989). As Burns mentions in the context of ergonomics research, usefulness "requires that a design has the functionality required to accomplish work domain objectives" as opposed to just being easy to use (Burns *et al.*, 1997).

Most of the research on mHealth has been focused on perceived usefulness and based on acceptance models such as the Technology Acceptance Model (TAM) and e-Commerce Acceptance Model (EAM) (Schnall et al., 2016; Alsswey and Al-Samarraie, 2020). For instance, Alsswey and Al-Samarraie (2020) use the TAM model to identify the factors impacting intention of

use based on culture, which feeds into the system's perceived usefulness. A similar study was found in (Schnall et al., 2016), which uses the EAM to analyse the need for mHealth to be perceived as beneficial.

Nielsen (Nielsen, 1994) defines a useful interactive system as compounded with the attribution of usability and utility. In addition to usability and utility, usefulness is influenced by the emotional feelings with a system, including enjoyment and trust to provide a richer experience of continued use (Lankton and Wilson, 2007; MacDonald and Atwood, 2014). Usefulness has also been defined as subject to interpretations grounded in the sociocultural spaces of both developers and users (Nocera, Dunckley and Sharp, 2007). Overall, the literature on usefulness reflects that this is a complex construct defined by usability, utility and user experience (UX) factors contingent on users' contexts and sociocultural backgrounds.

Designing useful mHealth apps is vital to HCWs' adoption and continued use. Considering HCWs' real-world experiences is essential to designing integrated and useful mHealth solutions (Aryana, Brewster and Abdelnour-Nocera, 2018). Therefore, to build useful mHealth apps, understanding usability, utility, and UX design goals must be considered when designing a new mobile design solution.

2.3 Proposed Framework

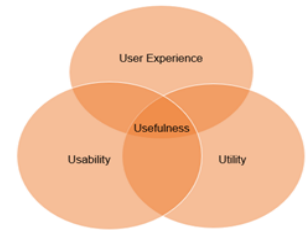

Figure 1 *A Design-Driven Conceptual Framework for Occupational mHealth*

The framework presented in Figure 1 summaries the types of goals for the usefulness of occupational mHealth apps in term of relevant usability, utility and user experience goals. These identified goals will be used as part of a questionnaire with healthcare workers in the context of a diary study of occupational mHealth app use.

3. Review Methodology and Findings

Four resources including ACM digital Library, IEEE Xplore, SAGE journal, and Google Scholar were searched in December 2020, and repeated in February 2021, to identify relevant studies. The search terms relating to mHealth apps, "usefulness", "usability", "utility", and "healthcare workers" in different Boolean permutations were used to identify relevant literature. Studies that were not journal or full conference articles, such as editorials or comments, were excluded. A total of 112 papers reporting on mHealth apps in the occupational contexts were initially identified, and after applying the exclusion criteria, 37 papers were included in the review (see Appendix for complete list of papers). The papers were then read to identify relevant usability, utility, and user experience goals. The following inclusion criteria were considered in the screening process, as shown in Table 1. Papers that did not include all of the four criteria were excluded.

Table 1 *Inclusion criteria*

NO	Inclusion criteria
1	Studies that use mobile health application or mHealth apps
2	Studies relevant to usefulness, usability, user experience, and utility.
3	Studies that use occupational related ill-health or work-related ill-health or health
4	Studies that relevant to healthcare workers or healthcare professionals

We cannot list all reviewed papers here due to space limitations of the position paper, but we have provided at least the most important reference for each goal in Table 2.

Table 2. Identified usefulness goals of occupational mHealth apps

Usability goals	Utility goals	User experience goals
Provide contextually relevant information, which is easy to understand (Yassaee, Mettler and Winter, 2019): *Healthcare workers have said apps should reflect their own work domain context and roles.*	***Support self-help guidance and in-depth knowledge for occupational health and wellbeing (Richert, Lippke and Ziegelmann, 2011):*** *The reviewed literature reveals this as a feature that is lacking or not sufficiently developed.*	***Reinforce trust and perceived security in mHealth apps* (Byambasuren, Beller and Glasziou, 2019):** *It is necessary for users to feel confident that the system will behave as intended. This has resulted in increased collaboration with the system securely and willingly.*
Match user expectations about the type of app:	***Promote social connectedness* (Torous et al., 2018):** *The app*	***Manage the performance expectancy of mHealth apps***

prevention or management **(Torquati *et al.*, 2018)*:*** *Help the user access the information they need, whether the app helps them prevent or manage work-related ill-health.*	*should include some communication and information sharing features such as a group collaboration among app users and with clinicians*	**(Odendaal *et al.*, 2015)*:*** *The app design should be consistent with its intended goal, e.g. if it is presented as a prevention app then its features should be consistent with this aim.*
Provide simple navigation (**Collins *et al.*, 2020**) *This goal has been found to increase adoption in workers with intense workload and constant interruptions.*	***Notify users about app updates*** **(e.g. app changes) (Vaghefi and Tulu, 2019)** *Inform the user when the app has some changes or updates. User should be informed about important new features*	***App should be perceived as easy to use*** **(Gagnon *et al.*, 2016).** *This goal has been found to increase adoption in workers with intense workload and constant interruptions.*
Users need to recover easily from errors **(Russ and Saleem, 2018)** *This goal has been found to increase adoption in workers with intense workload and constant interruptions.*	***Gamifying app tasks wherever possible*** **(Bierbooms *et al.*, 2020).** *Gamification such as points and badges boosts motivation and keeps workouts fun.*	***App engagement should be rewarded (Munson and Consolvo, 2012):*** *the user needs to receive some tokens such as ribbons, coupons or cashback in return when progressing towards health goals to keep an emotional connection.*

4. Discussion and Conclusion

The findings presented here provided a review and conceptual framework that identified relevant usability, utility and user experience design goals that enhance the usefulness of mHealth apps. The identified design goals highlight not only the key dimensions of usefulness, but also the key insights needed to inform design to improve adoption and continued use of such occupational mHealth apps. For instance, in relation to usability and user experience goals, given the fast-paced nature of healthcare work, workers' everyday usage and associated experiences should be considered in the design of such apps. This is in line with previous study by (Clemmensen, Hertzum and Abdelnour-Nocera, 2020), which suggests that understanding ordinary users' experience, cognitive challenges and demands from the workplace context will ensure the design of relevant and useful mHealth solution.

Furthermore, designers or developers need to understand what content works best and how it should be implemented to increase the adoption and continued use of such apps. A future recommendation would be to implement a user-centred design in which the user will be able to express their work domain contexts and roles. This recommendation is in line with Coursaris and Kim (2011), who recommend designing an app that fits users' needs in a particular setting to improve system integrations, adoption, and loyalty.

In relation to utility goals, mHealth apps will have the potential to provide healthcare workers with a better health and wellbeing if the crucial features are effectively incorporated in such apps. This suggests that having a consideration of user desired features could lead to the increased adoption and continued used of the system (Yoon *et al.*, 2021). Future occupational mHealth apps should be more integrated with the identified usefulness design goals found to be relevant to those who work in clinical work environments or workplaces where a high level of work-related ill-health is predominant (Collins et al., 2020).

5. Conclusion

The review presented in this paper provides insightful knowledge for the design of occupational mHealth apps to enhance users' experience in order to continue using such apps. Occupational ill-health is an important issue and calls for new mHealth tools to be explored. Due to the nature of healthcare professionals work contexts and environments, future occupational mHealth apps should be designed differently following domain-relevant and distinct design goals such as those identified in this review. More importantly, Understanding HCWs experiences cognitive challenges and demands from the workplace contexts will ensure the design of relevant and useful occupational mHealth solutions. The proposed framework and goals address these aspects and are contributions to the literature on mHealth by advancing knowledge on the user-centred design of this genre of apps, focusing on healthcare workers (Yen and Bakken, 2012; Torous et al., 2018).

Expected results at the end of the project will provide an enhanced empirical understanding of usefulness design goals that contribute to the long-term use and adoption of occupational mHealth apps.

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APPENDIX 1- LIST OF REVIEWED PAPERS

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