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Design and evaluation of a mobile phone-based health intervention for patients with hypertensive condition

Na Sun [a], Pei-Luen Patrick Rau [a, *], Yunqiu Li [b], Tom Owen [b], Harold Thimbleby [b]

[a] Institute of Human Factors and Ergonomics, Department of Industrial Engineering, Tsinghua University, China
[b] Future Interaction Technology Laboratory, Computer Science, Swansea University, UK

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ABSTRACT

The objective of this study is to design and evaluate a mobile phone-based intervention which helps users to identify factors that lead to abnormal blood pressure and to motivate them to adopt a healthier lifestyle. An exploratory longitudinal study was conducted to discover the changes of patients' self-management behaviors and their attitude toward the application during the intervention. 20 Chinese patients with hypertensive or pre-hypertensive condition were invited to use the application for 6 weeks, and semi-structured interviews with each participant were carried out every two weeks. The results indicated that participants' attitude toward the application improved a lot during the study. Participants' attitude toward self-reflection and perceived control over that behavior stayed unchanged in the first two weeks of intervention and then increased significantly in the following two weeks. Similar change was found in participants' attitude and perceived behavior control in maintaining a healthy lifestyle. The interview data revealed that the mobile self-reflective intervention motivated Chinese patients to abandon inappropriate beliefs and to modify their health beliefs by the knowledge gained from their own experience.

1. Introduction

Hypertension is one of the key risk factors for cardiovascular diseases such as heart attacks and stroke. A recent report by the World Health Organization in 2013 showed that complications of hypertension account for 9.4 million deaths worldwide every year. Specifically, hypertension is responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke (WHO, 2013). The incidence rate of hypertension is disproportionately high in low- and middle-income countries where health systems are weak (WHO, 2013).

The control of hypertensive condition requires patients' cooperation in keeping a healthy lifestyle and avoiding certain behaviors that may lead to the increase of blood pressure (BP) (Cramm & Nieboer, 2012; Fairbrother et al., 2013; Logan, 2013; McManus et al., 2010). However, many patients failed to behave as their physicians suggested and did not adopt a healthy lifestyle (Baggarly, Kemp, Wang, & Magoun, 2014; Banning, 2009). This study aimed to design and evaluate a mobile phone-based intervention which encourages users to identify factors that lead to abnormal blood pressure (BP) and motivates them to adopt a healthier lifestyle. Specifically, Chinese users' attitude toward the intervention and the effectiveness of the intervention on improving patients' self-reflective and lifestyle modification behaviors was explored.

2. Literature review

2.1. Self-management behaviors

Patients with chronic condition are encouraged to adopt self-management behaviors in daily life, such as taking drugs as prescribed, health monitoring, diet control, taking physical exercises and maintaining a healthy lifestyle. However, studies showed that 40%–50% of patients with chronic condition failed to adhere to the prescribed treatment (Alatawi, Kavookjian, Ekong, and Alrayees, 2015; Dennis et al., 2011), and this rate further increased to almost 70% in undeveloped areas, where medical resources were not sufficient and patients were lack of medical knowledge (AlHewiti, 2014; Khan et al., 2012).

A major reason for patients' nonadherence behaviors was that

* Corresponding author.
E-mail address: rpl@mail.tsinghua.edu.cn (P.-L.P. Rau).

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they failed to realize the impact of daily behaviors on their health condition (Karakurt & Kaşikçi, 2012). The Health Belief Model (HBM) identified six patient-related factors that influenced patients' adherence with a health behavior: perceived susceptibility, perceived severity, perceived benefits, perceived barriers, self-efficacy and cues to action (Glanz, Rimer, & Viswanath, 2008). According to the HBM, patients who perceived higher levels of necessity or concerns about their medicines were more likely to adhere to the prescribed treatment (Cicolini et al., 2016). In another study, patients who showed higher self-efficacy in self-management were more willing to modify behaviors and adopt healthier lifestyle, i.e., diet control and weight loss (Wingo et al., 2013).

2.2. Design of mobile phone-based intervention

Mobile phones are the ideal terminal to deliver health services that enhance patients' self-management behaviors in daily life (Klasnja & Pratt, 2012; Patrick, Griswold, Raab & Intille, 2008) and many mobile phone-based health interventions have been proposed in previous studies (Handel, 2011; Joe & Demiris, 2013; Kiselev, Gridnev, Shvartz, Posnenkova & Dovgalevsky, 2012; Logan et al., 2007; Park & Kim, 2012; Park, Kim & Kim, 2009). Most interventions enhanced patients' adherence behaviors by facilitating the record of health information and involving the healthcare team (Kiselev, Gridnev, Shvartz, Posnenkova & Dovgalevsky, 2012; Logan et al., 2007; McManus et al., 2010; Park & Kim, 2012; Pawar, Jones, van Beijnum & Hermens, 2012). Interventions that record and analyze health data allowed patients to better understand their own condition, and interventions that involve the healthcare team provided patients with professional explanations for the health data and professional advices in improving their self-management behaviors. Some interventions also applied other strategies to motivate patients' self-management behaviors, such as leveraging social influence or utilizing entertainment (Klasnja & Pratt, 2012).

Health interventions in previous studies mainly focused on the external support for patients, i.e., support from the devices or from the social environment. However, patients' health beliefs were barely changed during the intervention. Interventions that modify patients' health beliefs, such as perceived severity of the condition, or the self-efficacy in maintaining a healthy lifestyle, would also enhance patients' self-management behaviors during chronic condition control (Wingo et al., 2013).

2.3. Evaluation of mobile phone-based intervention

Mobile phone-based health interventions were proving to be helpful for the control of chronic condition (Handel, 2011; Kiselev et al., 2012; Logan et al., 2007; Park & Kim, 2012; Park, Kim & Kim, 2009). Empirical data indicated that the number of patients who achieved the goal BP level was 5 times higher when the patients received self-management support by short message services (Kiselev et al., 2012). A web-based intervention using both short message services and Internet improved patients' waist circumference, body weight and blood pressure significantly during 12 weeks (Park & Kim, 2012). In another study, the same intervention improved the blood pressure, body weight and waist circumference of obese patients with hypertension during merely 8 weeks (Park, Kim, & Kim, 2009). These studies mainly collected patients' physical measures to indicate the effectiveness of the intervention. There are also studies that discussed the change of patients' internal emotions such as attitude, behavior intention and subjective norm during the intervention (Khalil and Abdallah, 2013).

3. Design of the self-reflective intervention

This study designed a self-reflective intervention that aimed at motivating patients to reflect on their daily behaviors and to identify activities that may lead to increased BP. The intervention was consisted of an electric BP monitor and a mobile phone that installed with a health application named "BP Tagger".

BP Tagger helps users to store BP data and to generate health report based on simple analysis of the BP data. In addition, BP Tagger provided a self-reflective feature called expectation accuracy tagging (EAT), which asked users to assign one of three tags for each input: a blue tag with a check mark, representing results that meet users' expectation; a purple tag with an exclamation mark, referring to results that are beyond users' expectation with known reason; and a brown tag with a question mark, indicating results that are beyond users' expectation for unknown reason. The mechanism of the EAT feature is shown in Fig. 1. Tags are in neutral colors instead of meaningful colors such as green or red, so that users will not regard tags as judgments of their condition. The design of BP Tagger prototype was introduced in another study (Li, Owen & Thimbleby, 2013), and certain modifications were made for this study. Tags are displayed along with the list of BP readings in the page of history data in order to help users better understand their BP condition. The screenshots of EAT feature are shown in Fig. 2.

The goal of EAT feature is to motivate users to pay more attention to unexpected BP readings and to find out factors that lead to the fluctuation in BP. Therefore, instead of comparing users' BP readings with a normal BP level (such as 120/80 mmHg), EAT feature asks users to highlight the BP readings that fail to meet their expectations. Users may expect their BP to be higher or lower than normal BP level, depending on how they perceived the influence of their activities on BP. For example, a user may assign a blue tag with

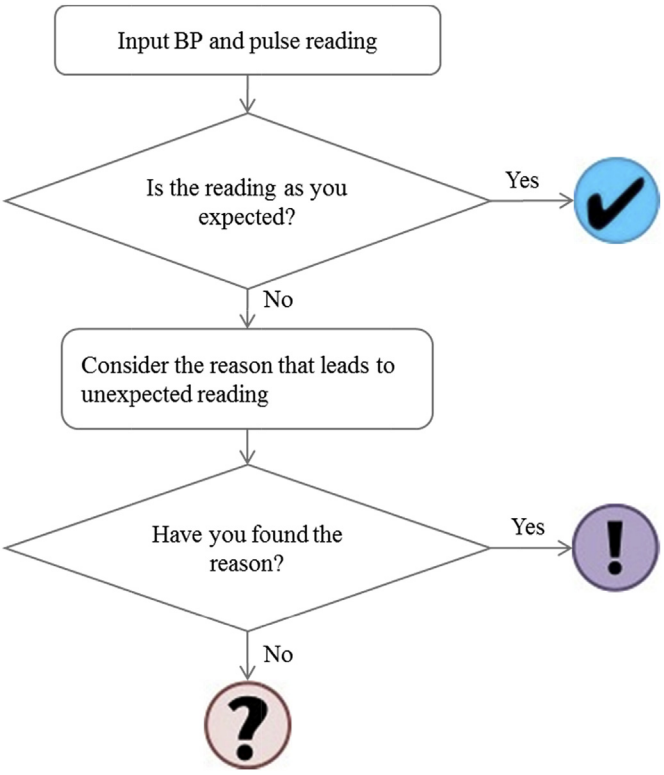

Fig. 1. Mechanism of the EAT feature.