Patient Self-Monitoring Using Intelligent Phonocardiography on a Mobile Platform

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Abstract. The paper presents the design and high-fidelity prototype of the remote patient self-monitoring system using a combination of intelligent phonocardiography, mobile and web-based platforms. The advantage of self-monitoring is patient awareness about potential changes, the convenience of performing the measurement often, and the saving of the findings. A mobile platform enables a physician to see the data, get a summary of patient recordings, and as well as saving the data. We have designed two user profiles to enable such functionality and to enable consultations. During the three development iterations, two main prototypes were developed. In the patient prototype, the main functionality is measuring PCG signals, but with the possibility of reading more details about the results. In the physician's prototype, the main functionality is the patient overview, with the possibility of querying through old patient data to consult newer patients. For physicians to monitor patients monitoring themselves, the solution needs to be properly clinically validated and regulatory demands satisfy before it could be utilized in the Norwegian health domain.

Keywords: heart sound monitoring, intelligent phonocardiography, patient follow up, online consultations, User-Centered Design (UCD)

1. Introduction

The advancement of medical technology has also resulted in monitoring signals such as heart sound and thus contributing to remote patient follow-up [1]. For medical staff, this applies that data and patients need to be managed in different ways. Benefits of remote self-monitoring are avoiding patient visits and immediate assistance of medical staff with the advantage of receiving acute alerts. At the same time, patients are required to obtain knowledge of the equipment and measurement procedure. Due attention has to be given to a documented lack of understanding in patient-physician communication when handing instructions or feedback from an examination or visit [2].

Despite some practical challenges, researchers have explored the options of using smartphone applications to measure heart signals through multiple clinical trials with encouraging outcomes [3,4]. Recorded signals can be sent using wireless technology using electronic stethoscopes at affordable prices even as a part of patient treatment [3,4].

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2. Materials and Methods

The literature overview was performed, user needs were assessed using in-depth semi-structured expert interviews. We aimed at answering the four research questions: RQ1) *How does user experience design affect a patient's understanding of heart monitoring results?* RQ2) *To what degree do patients prefer web-based over mobile-based solutions for monitoring heart signals?* RQ3) *What are physicians' attitudes towards patient self-monitoring using mobile-based solutions?* RQ4) *Are there any systems developed for physicians for monitoring patients who monitor themselves?*

3. Results

The functional and non-functional were identified and two main prototypes (one for patients and one for physicians) were developed through the three design iterations [1].

4. Discussion

To increase health understanding through user experience design, one needs to simplify information in the health sector (RQ1). Patients might find it easier to use one website across multiple platforms, which has become a modern trend when creating new services and products. However, one does not need to prioritize one form over the other, as smartphones provide something that the web version cannot utilize, i.e., the phones' internal sensors. However, both versions should have the possibility of showing the same amount of information but within different layouts (RQ2). One can conclude that physicians' attitude regarding patient self-monitoring is positive in cases of carefully evaluated applications. It is important not to create false positive findings that alert patients and consequently burden the healthcare system. Hence, it is essential to secure a good quality of monitoring, which ensures that patients are using devices correctly and learning in good time how to follow instructions and contact personnel when they are supposed to (RQ3). Lots of effort needs to be put in line with regulatory demands (RQ4).

5. Conclusions

The presented solution promotes remote heart sound monitoring; many functionalities enable gathering data prospectively using affordable sophisticated medical equipment.

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