A Mobile Health System for In-Clinic Chronic Low Back Pain Assessment: Design, Development, and Usability Study

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INTRODUCTION: Chronic low back pain (cLBP) is one of the most prevalent conditions in the United States[1]. It is a complex condition influenced by numerous factors. To be able to understand and characterize cLBP comprehensively, a substantial volume of assessment data—such as biomechanical, behavioral, and biological data from individuals with cLBP—must be collected and analyzed. This study is part of a larger research project that aims to assess and collect data from 1000 individuals with cLBP. This study focuses on the in-clinic assessment where the physical therapists (PTs) assess and collect data from individuals with cLBP while they perform several physical and performance exams. Traditional pen and paper assessment methods are often time-consuming, resource-intensive, and can impose a burden on the PTs while collecting valuable data during physical testing. In this study, a mobile health (mHealth) system was developed to facilitate the in-clinic assessment and data collection process. Compared to pen and paper methods, an mHealth system has the potential to enhance the efficiency of the assessment process and reduce the burdens on the PTs[2,3]. In addition to designing and developing the mHealth system, this study aims to evaluate the usability of the mHealth system. It is important to assess its usability[4] to ensure that the PTs can use the system effectively and that the system can help them perform their tasks more efficiently.

METHODS: The mHealth system was designed and developed using user-centered design[5] approach. A prototype of the mHealth system was designed and developed based on the requirements and needs of the cLBP assessment research project. Usability evaluations were carried out across multiple iterations to assess the usability of the system. The mHealth App Usability Questionnaire (MAUQ)[6] and free-response answers were used to evaluate the usability. Following each of these iterations, the system was updated based on the feedback and results of the usability evaluations. Three PTs, who use this mHealth system for cLBP assessment, participated in the usability evaluation process.

RESULTS: A prototype of the mHealth app was developed based on the requirements of the research project and the input and feedback from PTs. The main components of the mHealth app consisted of an authentication service, safety screening module, physical test/exam module, and data input and recording module. The first usability evaluation produced a mean MAUQ score of 5.55 (SD=1.14) out of a maximum of 7. Navigation and in-app task confirmation/feedback were two of the main components that needed to be updated in the second iteration of the development. Forward and backward navigation within the app was updated to be more consistent to reduce confusion and error for the users. The navigation was also made to be more flexible to enable the users to skip some tests/exams within the testing protocols. In-app task confirmation/feedback was added to show acknowledgement from the app when the users perform some tasks. This was important to increase the confidence of the users to ensure that they did the correct tasks and all data they collected was preserved in the app. The second usability evaluation produced an improved mean MAUQ score of 6.00 (SD=1.15). Minor changes were made to address the font size and other graphical elements. Detailed MAUQ scores for each evaluation are shown in Figure 1. A selected screenshot and the basic flow of the app is shown in Figure 2 to give illustration of the mHealth app.

DISCUSSION: With a formal evaluation process, the mHealth app improved in usability for PTs to be able to learn and navigate quickly through testing protocols, avoid missed data, and capture unusual events during testing. The PTs found the mHealth app to be valuable and beneficial for the assessment process. The mHealth app enabled the PTs to be in range of the patient for safety reasons and collect data seamlessly with a few clicks without having to take their attention off the patient, enter long strings of text or data, or juggle multiple documents to input data. One of the updates also allowed the PTs flexibility to skip/add tests based on skilled judgments. In the research context, the mHealth app played a role in averting protocol deviations, preventing missed data, and accounting for any data gaps. However, one limitation of this study is that only three PTs participated in the formal usability evaluation. Obtaining feedback from a larger group of PTs through formal usability testing will offer valuable insights to guide future usability improvements.

CLINICAL SIGNIFICANCE: The findings indicate that the mHealth app has good usability, and thereby may improve in-clinic cLBP assessment compared to pen and paper methods. This represents a step toward a future for mHealth to reduce the physical testing burdens on PTs while improving patient care for cLBP, which may potentially serve as the foundation for a future interconnected mHealth platform for PTs and patients with cLBP.

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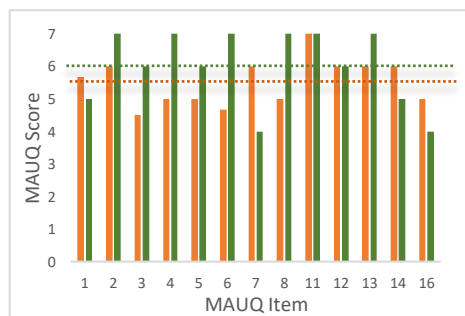
Figure 1. Itemized MAUQ scores for the first (orange) and second (green) usability evaluation. Dotted lines represent the mean MAUQ score of the first (orange) and the second (green) usability evaluation.
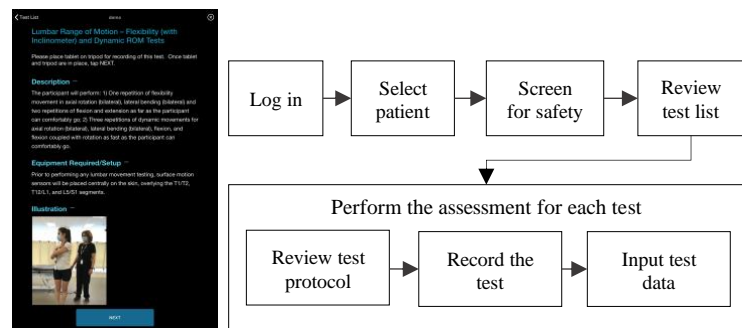

Figure 2. Selected screenshot of the mHealth app that shows the details and protocol of a test for the PT to review (left) and the basic flow of the mHealth app in which the PT logs in to the app, screens the participant for safety, and performs the assessment (right).