A Framework to Design mHealth Apps for Supporting Self-Management of Chronic Disease

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Research Objective

To present a design framework that guides development of mobile health applications (mHealth apps) for chronic disease self-management based on systematic literature review.

Study Design

Osteoarthritis (OA) is a common chronic disease that causes considerable burden in terms of patients' quality of life and costs for medical treatments.[1, 2] We conducted a systematic review of the literature on using mHealth for OA self management to assess the state of research and surveyed online app stores to determine the current marketplace for OA apps.

Literature Review

- We searched 5 online databases—PubMed, Web of Science, ScienceDirect, ACM Digital Library, and IEEE Xplore Digital Library—for articles that mention both mHealth technologies and OA management, published in English between 2007 and 2016.
- We used the Medical Subject Headings (MeSH) to identify relevant search terms regarding
  - *OA in general and OA of knee and hip joints*: osteoarthritis, knee joint, hip joint, arthroplasty, total joint replacement, total knee replacement, total hip replacement
  - *mHealth technology:* mobile health, mhealth, m-health, mobile application, mobile app, smartphone, and mobile phone
- Of the 117 unique articles searched, we conducted an in-depth review of 25 articles that met our inclusion criteria:
  - Development of mHealth technologies to monitor and manage OA-related pains and symptoms or to provide educational content
  - Development of mHealth technologies to analyze human gestures and motions that were considered to be useful for OA management
  - Use of mHealth technologies to deliver clinical interventions to OA patients in both pre- and post-surgery phases
  - Use of mHealth technologies to provide decision support related to OA management

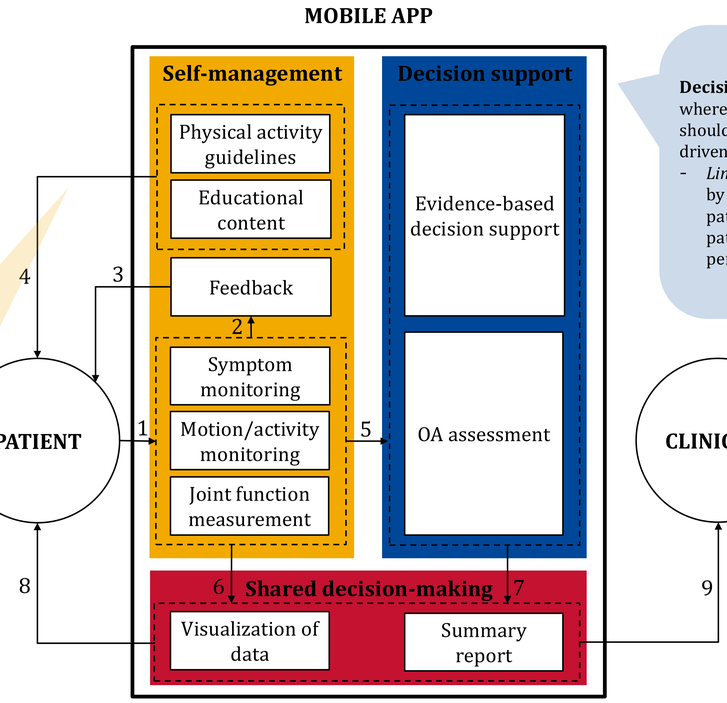
mHealth App Review

- We searched 5 app stores—Google Play Store, Apple iTunes App Store, BlackBerry World, Microsoft Store, and Opera Mobile Store—to investigate the availability of commercial apps for OA management in the marketplace.
- Of the 147 apps identified by the app search as of June 2016, we analyzed 23 unique apps (excluding 4 overlapping apps available in multiple stores) that met our inclusion criteria:
  - Categorized in the health, fitness, or medical categories
  - Centered on OA
  - Developed for humans
  - Written in English

Principal Findings – Design Framework for OA Self-Management Apps

We suggest three modules that should be implemented in an app for any type of chronic disease including OA:

- ***Self-management module***
- ***Decision support module***
- ***Shared decision module***



Self-management module should provide patients with the ability to quantify and log their disease progress and be better informed about the symptoms and available treatment options.

- *Link 1*: The app should enable the patients to quantify and log pain levels, limitations in joint motions, and limitations in activities performed on a regular basis.
- *Link 2*: The patient-reported data should be used to generate concise, yet useful feedback messages for patients.
- *Link 3*: The app should provide feedback to patients to inform their progress in OA self-management and motivate them to continue entering their data into the app.
- *Link 4*: The app should provide educational content to improve patients' understanding of OA and address potential questions patients might have regarding their symptoms and how to manage them.

Decision support module is the backend of the app where the expert knowledge and computational power should come into play to suggest evidence-based, data-driven treatment options for patients.

- *Link 5*: The app should use patient-reported data fed by the Self-management module of the app and patient-centered research outcomes to assess patient's status from the medical treatment perspective.

Shared decision-making module should enable patients and clinicians to share data collected/generated using the Self-Management and Decision Support modules and to choose the ideal treatment together.

- *Links 6 & 7*: The app should allow patients and clinicians to share data and to choose the ideal treatment options together.
- *Link 8*: The app should provide the patients with detailed OA assessment results.
- *Link 9*: The app should allow the clinicians to review assessment summary reports with their patients and involve them in the decision-making process.

Principal Findings

- **Three main research themes emerged from our literature review**.
  - *Mobile OA assessment tools*: 3 articles addressed OA indices to diagnose OA-related symptoms and pains that can be used in mobile platforms (e.g., m-WOMAC)
  - *Mobile OA measurement tools*: 13 articles examined the applicability of smartphones as measurement tools for OA-related joint (knees, hips, and ankles) function (e.g., ROMs)
  - *Mobile OA motion monitoring tools*: 9 articles analyzed motions that are directly related to OA or potentially useful to support OA (e.g., gait)
- **The mHealth app review revealed the lack of apps for OA in the marketplace.**
  - The number of apps for OA management increased only by 12%, a minimal change since 2013 when a review on existing mHealth apps for the eight most prevalent health conditions by WHO found only 24 apps focused on OA in the app stores.[3]
    - As of 2013, more than 1,700 apps were available for diabetes; more than 1,500 apps for depression; 112 apps for asthma; 112 apps for migraine; 64 apps for low vision.

Conclusions & Implications

- The current systematic review identified a gap in the literature on the potential impact of using mHealth apps for OA management. Specifically, mHealth research addressing OA to date has focused more on OA measurement and motion tracking, and less on OA management.
- Future work should focus on designing comprehensive mHealth apps dedicated to OA by combining the relevant research evidence from the previous studies, such as mobile OA assessment tools, measurement tools, and motion tracking technologies.
- The three modules described in the framework can work together to develop mHealth apps for OA and other medical conditions of which self-management and shared decision-making are proven to be helpful to improve clinical treatment outcomes.
- The app should be tested for its usability and the effectiveness in OA self-management from the patient's perspective, as well as in clinical management of OA from the clinician's perspective.

Research Funder & References

Research funder

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