



NUCoach: A Customizable Coaching Platform for Designing Rehabilitation Mobile Apps

Iman Khaghani-Far¹, Xuan Li¹, Maciej Kos¹, Christine M. Gordon-Davis,¹ Haleigh Williams¹, Misha Pavel^{1,2}, Holly B. Jimison^{1,2}

¹Northeastern University, Khoury College of Computer Science,
²Northeastern University, Bouve College of Health Science



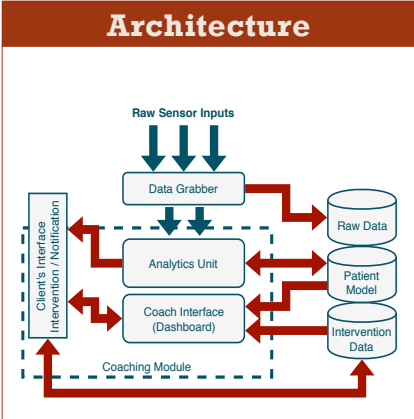
Abstract. Recent advances in wearable sensors and mHealth technology provide unprecedented opportunities for the implementation and development of personalized rehabilitation software, but the lack of sufficient technical expertise may deter clinical researchers from exploring innovations in this area. To mitigate this problem, we designed a modular platform called NUCoach that supports a rapid experimental design and implementation for monitoring and just-in-time intervention (JITAI) for researchers with minimal technical background. The platform supports real-time data collection and storage, data analysis, a dynamic patient model, tailored messaging, and interfaces for coaches, informal caregivers, and patients. The modular and scalable nature of NUCoach overcomes some of the state-of-the-art mHealth design challenges (security and privacy, flexibility, scalability, optimization, and reliability). Moreover, it is designed to enable AI-based semi-automatic coaching modules that offer support to human coaches, making the delivery of tailored health interventions economically feasible.

Design

We designed a modular platform ("NUCoach") that supports a rapid experimental design and implementation for monitoring and just-in-time intervention (JITAI) for clinical researchers with minimal technical background. The platform supports real-time data collection and storage, data analysis, a dynamic patient model, tailored messaging, and interfaces for coaches, informal caregivers, and patients.

Approach

The NUCoach platform features a modular design (i.e., modules are fully programmable and customizable), allowing researchers to combine data from a diverse variety of sensors, implement real-time sensor data analysis algorithms, and design interventions with patients while keeping data organized, easily accessible, and secure. The design is based on reusable modules for integrating and analyzing data, as well as interfacing with several types of users (patients, coaches, clinicians, researchers, and informal caregivers). The resulting platform can support the generation of inferences about patient behaviors and mediate precise interventions.



Coaching console

Manage project, build action plans, monitor and communicate with participants and team members

Mobile app

Coach participants with messages and feedback, collect survey data, connect with companion apps for sensor data collection

Database

Data is stored securely in the cloud. Each user type has different access to the data depending on need.

Connected devices

Activity trackers + HR monitors, Bed sensor for sleep + stress recovery, Camera for physical exercise, Skin conductance for stress monitoring

We can add just about any connected device or service

Interventions

NUCoach was deployed in five empirical pilot studies between June 2017 and December 2018. Each of these studies require participants to attend an enrollment session on

We used NUCoach to deliver self-management-focused interventions through engagement and physical activity. We also used NUCoach to monitor patients' physical state through sensor integrations and surveys and report their activities to study coaches.

Self-Management of Hypertension Lifestyle Behaviors [Douglas]. Using a combination of mobile activity tracking and ecological momentary assessment/intervention, this study is examining the acceptability and usability of an intervention to support hypertension self-management behavior through engagement and physical activity with 51 Black women aged 60+.

Cigarettes Use Among Individuals at High Risk for Lung Cancer [Poghosyan]. We are testing the feasibility, accuracy, and usability of a wearable electrodermal activity sensor and mobile assessment tool to understand the stress levels and stress precipitators of cigarette craving and smoking triggers in older non-white smokers.

Stress Test At Home [Jimison]. The goal of this study was to assess the validity and usability of the Antioxidant Home Monitoring free radical test kit and pilot the use of the test kit in concert with a wellness coaching protocol. We test the feasibility of subjects measuring the level of MDA in their urine using a color chart. We also tested the usability and satisfaction with the overall system that includes the urine sampling kit and a general health coaching intervention.

Sleep, Stress, and Safety in TBI Patients [Jimison/Seel]. In this project, we are testing the usability of active and passive sensors to collect data on sleep quality, stress, and activity; and the ability to integrate sensor data into a data bank/virtual coaching platform for the purpose of informing the participant of progress.

Participants

Participants in the 5 pilot studies were adults aged 18+ (mostly older adults aged 55+) with access to a compatible smart phone and without cognitive impairment. Each pilot had additional eligibility criteria.

Conclusions

The modular design enabled researchers to develop, test, and verify coaching protocols in their studies. Given that NUCoach automatically manages various aspects of a mobile health application (security and privacy, flexibility, scalability, optimization, and reliability), it enabled researchers to rapidly conduct tailored interventions for the target subjects. NUCoach was used as the main intervention delivery method in 5 studies. We have since evaluated NUCoach's design and improved its features and usability to suit broader rehabilitation programs.

Contact

Iman Khaghani-Far
Northeastern University
Email: i.khaghanifar@neu.edu

- ### References
1. Douglas
 2. Poghosyan
 3. Jimison
 4. Jimison/seel

Disclosures

The development of NUCoach was supported by was supported by the NUCare Center on Technology in Support of Self-Management and Health, funded by the National Institute of Nursing Research (P20NR015320, PI: Guthrie); Antioxidant Home Monitoring, LLC (AHM); and the LiveWell RERC for ICT Access in collaboration with Duke University and the Shepherd Center, funded by the National Institute on Disability, Independent Living and Rehabilitation Research in the U.S. Department of Health and Human Services (90RES023, PI: Jones). The opinions contained in this presentation do not necessarily reflect those of the U.S. Department of Health and Human Services, AHM, NINR, or NIDILRR.