281. Co-designing a mHealth app for the collection of patient-reported outcomes in frail patients

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Introduction

- Smartchronic is a non-profit collaborative Spanish project for developing a platform to improve and optimize the management of chronic patients based on artificial intelligence tools[1]. Smartchronic platform models the frailty states from patients' data from electronic health records to predict and simulate their evolution and associated care pathways.
- This platform has incorporated a non-invasive, continuous monitoring mobile health application (mHealth app) for patient self-reporting variables. Patient-reported outcomes (PROs) could help enriching the information obtained in routine clinical practice to assess frailty and used for predictive analytics[2,3].

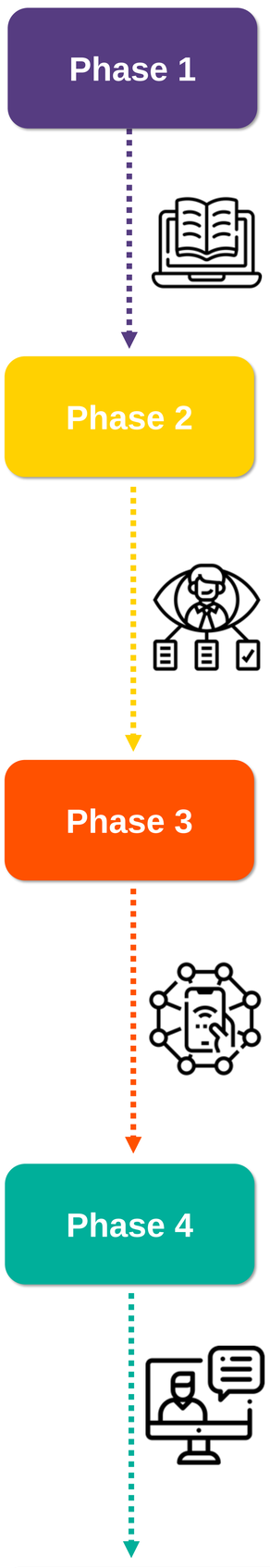
Objectives

- To design an mHealth app for smartphones for continuous and non-invasive monitoring of patients with chronic diseases by collecting relevant variables for frailty assessment.

Methods

- The mHealth app development involved a four-phase process ***(Figure 1).***

Figure 1. Phases of Smartchronic app development.



Literature review

To identify dimensions and variables related to frailty assessment that could be collected with smartphones as PROs or passive sensors.

The search strategy focused on frailty-related terms, dimensions and variables, and mHealth terms. Databases consulted:

- International database: Pubmed/MEDLINE
- Grey literature: Google/Google Scholar

Healthcare professionals' (HCPs) and patients' opinion

Five HCPs (primary care, internal medicine, geriatrics, and nursing) identified dimensions and variables through an ad-hoc questionnaire according to their importance degree for assessing patient frailty in clinical practice.

Five chronic older patients answered a phone semi-structured interview to identify those dimensions and variables that they consider relevant to their quality of life.

Technical design and development

A mHealth app prototype was designed based on the HCPs' and patients' opinions.

The smartphone app was developed for Android and iOS with Flutter and subsequently was integrated into Smartchronic platform to visualize data collected by patients.

Pilot testing

A pilot study to prove app usability and feasibility for collecting PROs was conducted with 33 participants*.

Socio-demographic (gender, age) data were collected at the participant enrolment by the investigators .

PROs were collected through the developed app and checked by investigators for their integration and visualization into the Smartchronic platform.

Next steps: implementation in routine clinical practice

**Because of restrictions due to the sixth wave of the COVID-19 pandemic, older patients could not be involved in the pilot study, so the usability and feasibility of the app were tested in the general adult population.*

- The study was approved by the ethics committee of University and Polytechnic La Fe Hospital.

References

1. Instituto de Investigación Sanitaria La Fe. SMARTCHRONIC. Plataforma para la mejora y optimización de la gestión de pacientes crónicos, basada en técnicas de Inteligencia Artificial y monitorización no invasiva, modelando los estados de fragilidad con capacidad de predecir y simular su evolución https://www.iislafe.es/en/innovation/innovation-incentives/cat/36/page/2; **2**. Roberto Bernabeu-Mora, et al. Frailty is a predictive factor of readmission within 90 days of hospitalization for acute exacerbations of chronic obstructive pulmonary disease: a longitudinal study. Ther Adv Respir Dis. 2017; 11(10): 383–392; **3**. Efstathios Papachristou, et al. Ability of Self-Reported Frailty Components to Predict Incident Disability, Falls, and All-Cause Mortality: Results From a Population-Based Study of Older British Men. J Am Med Dir Assoc. 2017; 18(2): 152–157..

Results

Phase 1. Literature review

- The following dimensions were identified: physical function, mood, health-related quality of life (HRQoL), nutritional status, cognitive and social function, symptoms, and sleep quality. For each dimension, variables and tools (PROs or passive sensors) to collect them were registered.

Phase 2. HCPs and patients' opinion

- Five dimensions were identified by HCPs and patients as important and feasible to collect (***Figure 2***). ***Table 1*** shows the selected variables for each dimension.

Figure 2. Dimensions that matters to HCPs and patients.

Table 1. Selected variables according to the dimension.

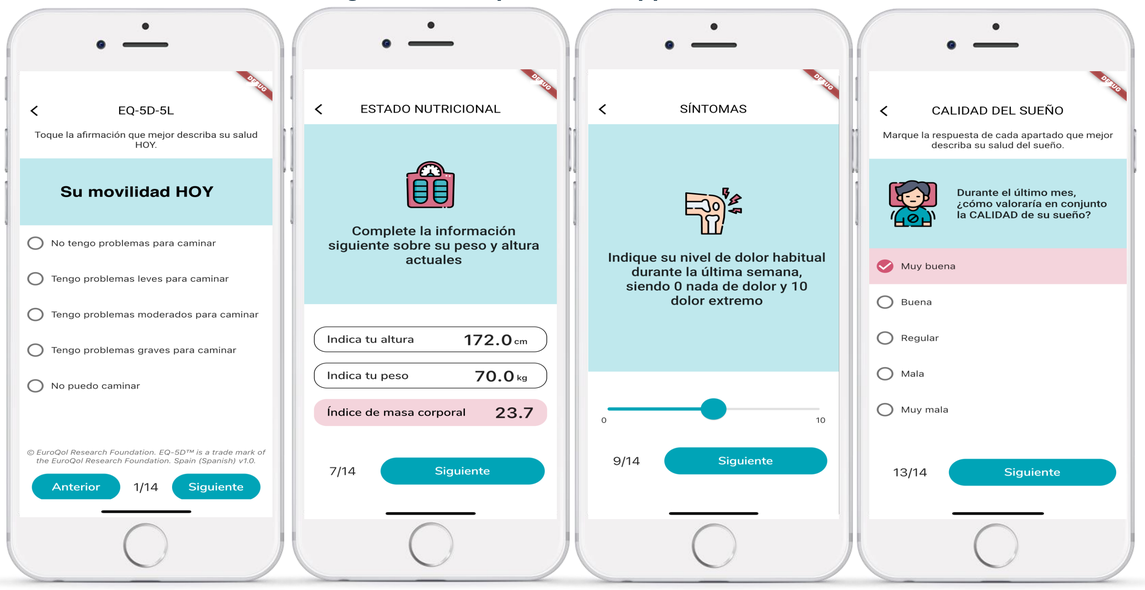
Active monitoring								Passive monitoring
HRQoL	Nutritional status		Symptoms			Sleep quality		Physical function
EQ-5D-5L	Weight and height, to estimate BMI	Appetite level VAS	Pain VAS	Fatigue VAS	Hearing and sight VAS	Sleep quality question	Hours of sleep question	Number of daily steps measured by smartphone-accelerometer

EQ-5D, EuroQoL questionnaire with 5 dimensions, 5 levels; BMI, body mass index; VAS, visual analogue scale.

Phase 3. Technical design and development

According to these variables the app was developed ***(Figure 3).***

Figure 3. Examples of the app screenshots.



Phase 4. Pilot testing

- Participants (48% women, mean age of 49.8±20.3 years) had no problems with mobility, self-care, and activities of daily living, with an EQ-VAS average score of 90. 33.3% reported mild to moderate pain/discomfort and were mildly or moderately anxious/depressed. They had an average weight of 71.2±10.3 kg and BMI of 24.8±3.6. An average of 7.9 points was the usual appetite level during the last week.
- Regarding symptoms, the mean level of pain was 2.2 points, fatigue 1.0 points, and they had high levels of hearing and sight (8.2 and 7.9 points, respectively). 88% slept between 6-8 hours/day, and the quality of sleep was perceived as good or very good in 79% of them.

Study limitations

- In phases 2 and 4 the small sample of participants may limit the generalization of results; however, app usability will be tested in more chronic patients. During phase 4, unfortunately, participants could not collect daily step count data from the connection to the Google Fit app as expected. These data will be analyzed in later phases of the implementation.

Conclusions

Involving clinicians and patients is essential in the design and development as recipients of the potential benefits. Our methodology has allowed us to develop an app that easily collects outcomes that matter to patients. This new tool has been integrated into the Smartchronic platform and could support HCPs to assess patient frailty and to improve the care of frail patients.

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