

MoSTHealth: Applying Digital Twins to Smart Healthcare Monitoring Systems for Chronic Disease Treatments

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Introduction

In recent times, due to the progressive aging of the population in the countries of the European Union, there has been a significant increase in the number of people with one or several chronic diseases and disabilities. For this reason, one of the main challenges identified for the European Public Health Association is adopting more effective and safe treatments based on digital health tools that allow continuous remote monitoring of patients by preventing and managing chronic diseases. In this project, we explored 4 case studies:

Respiratory disease

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death in the world, accounting for approximately 6% of all deaths. Chronic respiratory diseases (CRD) are not curable, but various forms of treatment can help control symptoms and improve the quality of life of people suffering from the disease. Patients with CRD and those in need of rehabilitation face many problems: lack of professionals and institutions in the field of CRD; no regular treatment; overcrowding of hospitals with patients; a high risk of infection during an epidemic. Therefore, there is a need to use Smart Health Monitoring Systems (SHMS) that manage prevention, CRD treatment and rehabilitation.

Infertility disease

One in four couples in a developed country has trouble conceiving, and about 48.5 million couples suffer from infertility worldwide. And unfortunately, infertility is increasing. To support the growing demand, physicians need to define personalized remote monitoring treatments supported by devices that send real-time information on hormones levels, heart rate, temperature, etc. To this end, HMS have recently appeared, based on increasingly advanced devices that help to manage this task. However, current solutions are expensive, little customizable by physicians themselves and no one sends hormone levels in real time.

Alzheimer's disease

Alzheimer's disease affects millions of people globally and is currently the sixth-leading cause of death in the USA, having increased by 98% since 2000. 15 million Americans will be living with Alzheimer's disease at the end of 2050, compared with about 6 million today. For this reason, it is necessary to implement measures that not only help to combat the disease but also help improve the quality of life of those affected by allowing practitioners to monitor their progress on an ongoing basis.

Cardiovascular disease

The World Health Organisation has determined that more than 18 million deaths worldwide are caused by cardiovascular diseases each year. Therefore, early prediction of cardiovascular disease is recommended to be of fundamental importance in the effective treatment of patients before a heart attack or stroke occurs.

Proposal

MoSTHealth is based on a set of disciplines such as **Digital Twins, Internet of Things, Discrete Event Simulation and Model-Driven Engineering**, which allows the modelling, simulating and providing a rapid deployment of different remote smart healthcare monitoring scenarios with IoT devices. The definition of SHMS scenarios can be modelled and subsequently evolved by the healthcare experts themselves, providing a familiar language uses terms from their domain.

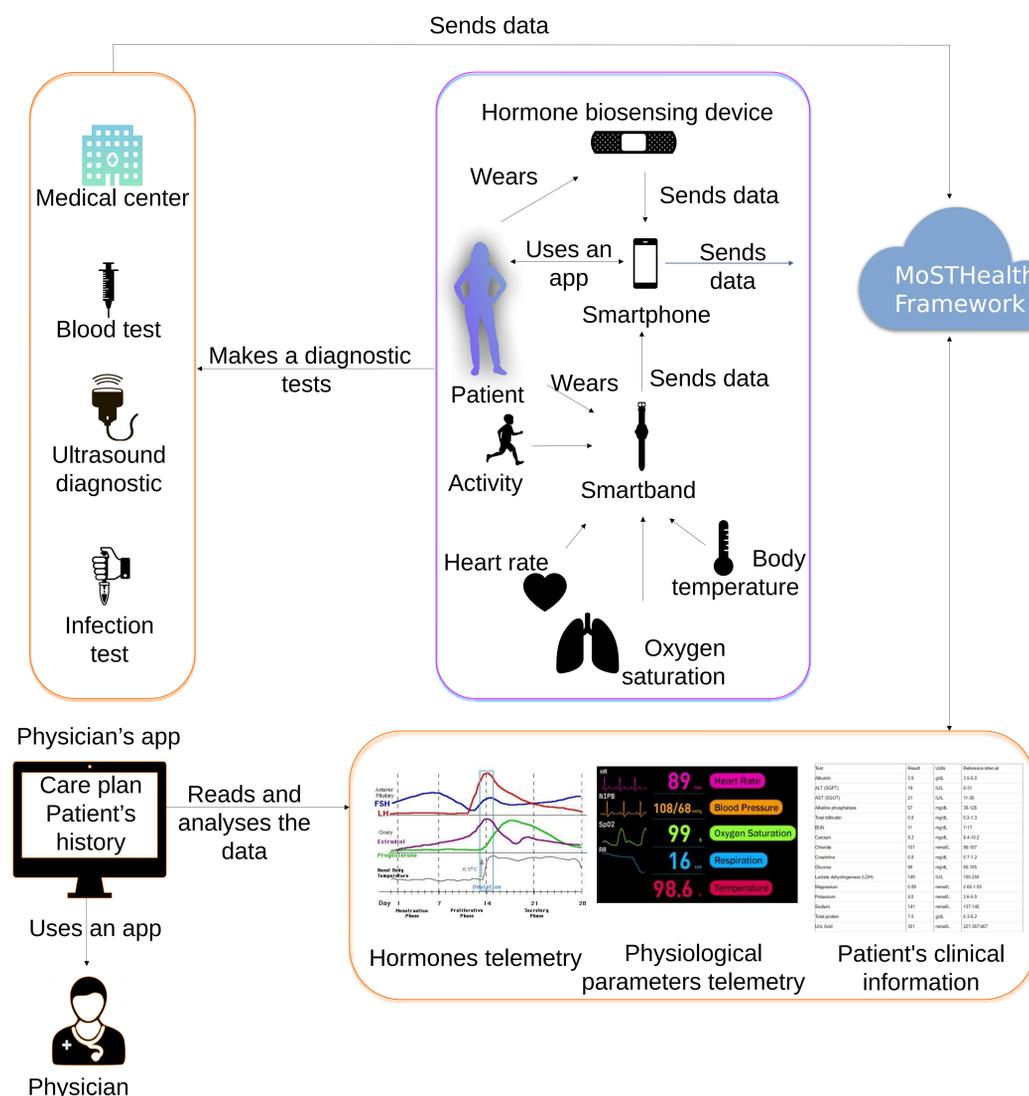


Fig.1 Pregnancy SHMS Scenario with MoSTHealth

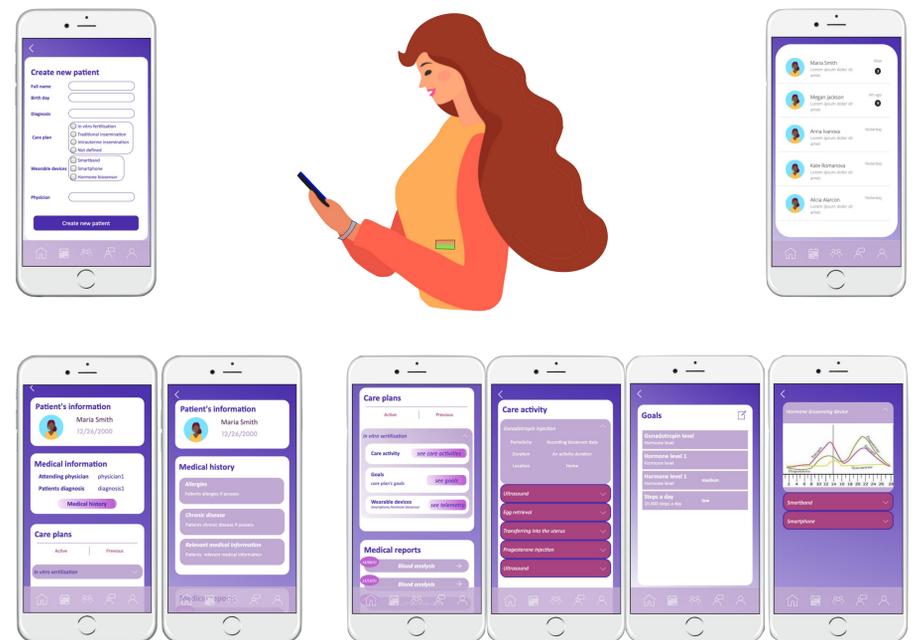


Fig.2 Physician's MoSTHealth mobile application

Four clinical trials are categorized according to Article 2 of the EU REG 536/2014 as low-intervention clinical trials and will be carried out in different hospitals:

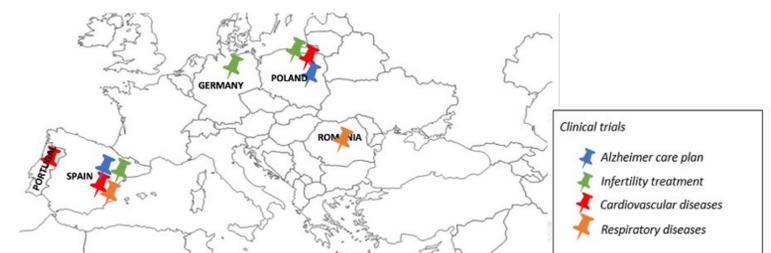


Fig.3 Map of clinical studies distribution

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