

BIOENGINEERING AND MEDICAL-SURGICAL SCIENCES

Ateneo - AIPHCDT: AI-based digital twins to support personalized homecare clinical pathways

Funded By	Politecnico di TORINO [P:iva/CF:00518460019]
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Context of the research activity	<p>This research will focus on the development of a digital twin based on artificial intelligence that, associated with telemedicine devices, will be able to support patient, caregivers, and healthcare staff during homecare assistance. The application is intended for patients that are inserted in a homecare clinical pathway related to cardiovascular disorders. The aim is to obtain a digital twin that contributes to personalized care and patient empowerment.</p>
Objectives	<p>Life expectancy is steadily above eighty years, but healthy life is definitively lower, being around sixty-four. This means that there is an increasing demand of assistance for elderly and fragile people. These patients are affected by chronic diseases with a main pathology associated with several comorbidities. To face this situation, novel assistance models that benefit from biomedical technology are under development. Today, healthcare delivery models are based on clinical pathways. These are clinical management tools that describe the best process in a specific organization, using the best procedures and timing, to treat patients with specific diagnoses or conditions according to evidence-based medicine. Clinical pathways are standardized, evidence-based multidisciplinary management plans, which identify an appropriate sequence of clinical interventions, timeframes, milestones, and expected outcomes for a homogenous patient group. The evolution of clinical pathways is the personalization of the process on the characteristics of the patients represented by clinical, omics, environmental ... data.</p> <p>In this context biomedical technology that may be used consists of wearable devices, telemedicine applications, decision support systems based on artificial intelligence methods, APPs.</p> <p>Among the telemedicine applications, telemonitoring proved capable of providing a reliable and effective solution to improve the quality of care and the quality of life of the patients, while decreasing the burden for the healthcare system. It requires both wearable devices and intelligent systems able to aggregate the large number of acquired data, interpret them, and provide feedback on the patient clinical status.</p> <p>These intelligent systems play an important role in the implementation of</p>

personalized care and also to prevent acute events and unnecessary hospitalization.

In this context, the proposed project focuses on chronic patients affected by cardiovascular disorders that need home care assistance. Among the most important objectives there is the prevention of acute episodes that lead to hospitalization.

This research will consist of the development of several components of a digital twin which, in conjunction with telemedicine devices, will be able to support patient, caregivers, and medical staff during the daily activities of homecare assistance. This research is part of a larger project and will benefit of applications and devices previously developed.

The objective of the PhD project is to develop clinical indicators/biomarkers able to detect potentially critical changes in the patient clinical status. These indicators will be part of the digital twin. Additional goals are: (a) to characterize by means of clustering techniques the different typology of patients, to personalize the set of indicators suitable for each patient; (b) to develop a framework based on a network of applications and a decision support system that dynamically chooses the subset of services that optimizes patient assistance; (c) to develop APPs for specific patient needs.

Each component of the digital twin will be first tested on data publicly available and then during specific clinical studies.

**Skills and
competencies
for the
development of
the activity**

The candidate must hold a Laurea magistrale in Ingegneria biomedica or equivalent.

Competences on artificial intelligence (machine learning) are mandatory.

Competences on telemedicine, data science, and biomedical signal processing are welcomed.