Scientific report on the implementation of the project
PN-III-P2-2.1-PED-2019-5446 (contract no. 429PED/2020) entitled
*"Smart health system based on artificial intelligence as a predictor for chronic kidney disease development – ArtiPred"*, Phase 1 - 2020

Related delivered activities:

- *Small animal models of CKD: ethical concerns;*
- *A SoTA analysis of technologies based on IoT for diseases detection;*
- *Design of Big Data platform and data models.*

Chronic Kidney Disease (CKD) defined as abnormal renal structure or function persisting for more than 3 months is currently recognized as a global public health concern with a high economic cost to health systems and is an independent risk factor for cardiovascular disease (CVD). Even in high income countries, the very high cost of long term dialysis for increasing numbers of people is a problem. For instance in the US, treatment of CKD is likely to exceed $48 billion per year, and the end-stage renal disease (ESRD) program consumes 6.7% of the total Medicare budget to care for less than 1% of the covered population. [1] In low and middle income countries long term dialysis is unaffordable (NKUDIC, 2017). The best hope for reducing the human and economic costs of CKD and end-stage renal disease therefore lies in prevention, for the following reasons:
- A chronic kidney disease is not curable and imposes healthcare services for the entire period of life;
- If CKD is not detected early enough, the patient may progress to kidney failure which requires dialysis or transplantation that is extremely costly and weighs heavily on healthcare budgets.
- Chronic Kidney Diseases trigger other healthcare issues like cardiovascular diseases (heart attack and stroke), which will lead to premature death or disability and multiply the amount of amount of money needed for the healthcare of a patient. [1]

The scope of ArtIPred project is to design and validate a smart health system based on artificial intelligence (AI) as a predictor for chronic kidney disease development using ECG signals from animal models.

***Ethical concerns***

The experimental study will be performed at the *Advanced Research and Development Center for Experimental Medicine (CEMEX)*, Grigore T. Popa University of Medicine and Pharmacy from Iasi and will follow all procedural ethical rules provided by European laws, Directive 2010/63 / EU on the protection of animals used for scientific purposes. The project was developed taking into account the principles of the 3R (Replacement, Reduction, Refinement) and the ethics opinion of principle no. 18 955 / 20.09.2019. In this phase, the entire package of documents for obtaining the ethics opinion from the Research Ethics Commission was submitted. The study will start after receiving the favorable opinion from the Ethics Commission of Grigore T. Popa University of Medicine and Pharmacy from Iasi.

***Analysis of the current state of knowledge in the field of IoT technologies for disease detection***

Considering the current state of knowledge in the field of IoT for disease detection, the solution can be seen from the perspective of concrete solutions available on the market, and also from the perspective of many prototypes and ideas described in scientific publications. It is also important to differentiate between what involves (technologically) symptomatic disease detection and the methods that involve early detection through various prediction techniques. Thus, the use and popularity of IoT devices for the detection of disease symptoms have been strongly amplified by the SARS-VOC-2 pandemic, most of the

public spaces being equipped with thermal imaging cameras or smart thermometers. [2] Monitoring applications for infected people have also been developed to better determine the spread of the virus. [3] On the other hand, in terms of predicting and monitoring diseases, as in the present research project, the literature provides numerous examples.

***Design on Big Data platform architectures and data models***

The term Big Data (metadata) refers to the extraction, manipulation and analysis of data sets that are too large to be routinely processed. This is the reason why special software is used and, in many cases, dedicated computers and hardware. In general, the data are statistically analyzed.

The four main elements of any Big Data project are big data storage, data mining, analysis and visualization.

Among the most important and successful tool providers for Big Data projects we list the following:

- cloud data storage tools - Hadoop, MongoDB;
- data mining - IBM SPSS Modeler, Rapid Miner;
- data analysis - Apache Spark, Presto, Tableau;
- data viewing - Plotly, Data Hero, QlikView.

## *Conclusion*

The deliverables associated with the activities of phase 1:

- *Procedure for obtaining the Ethical Approval;*
- *Analysis of the current state of knowledge in the field of IoT technologies for disease detection;*
- *Design on Big Data platform architectures and data models.*

***References***

[1] Afsar, B., et al. Int Urol Nephrol (2018) 50: 885.

[2] https://www.economica.net/atu-tech-creste-cererea-de-sisteme-de-supraveghere-cu-camere-pentru-masurarea-temperaturii-corporale-la-retaileri-spitale-si-companii-mari_183290.html

[3] https://www.esa.int/Space in Member States/Romania/O aplicatie de mobil romaneasca ce foloseste date Galileo sprijina lupta impotriva Covid-19