

# Computational modeling and big data approaches for the stratification of carotid artery disease\*

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**Abstract**— This paper deals with the novel risk stratification framework for carotid artery disease which is under development in the TAXINOMISIS project. TAXINOMISIS aims to establish a multimodal strategy, integrating big data and advanced modeling approaches, in order to improve the stratification and management of patients with carotid artery disease, who are at risk for manifesting cerebrovascular events such as stroke.

## I. INTRODUCTION

Carotid artery disease (CAD) is the main cause leading to ischaemic cerebrovascular events and is responsible for approximately 150,000 deaths per year from stroke, in Europe [1]. This paper presents the conceptual framework of the TAXINOMISIS project, depicted in Fig.1, as well as a brief description of the data management infrastructure developed for the clinical study and the components of the new risk stratification tool.

## II. METHODS AND RESULTS

### A. Clinical Data Management Infrastructure

TAXINOMISIS includes an observational prospective clinical study performed in six European clinical centers. For the purposes of the project, an electronic Case Report Form (eCRF) has been developed as a web-based platform for data curation and management using the infrastructure services

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(IaaS) of a third-party cloud provider. Data Protection by design is implemented in all data processing stages ensuring compliance with the new EU's General Data Protection Regulation (GDPR).

### B. Risk Stratification Tool

The project's main outcome will be the delivery of a new risk stratification platform in the form of a software tool. The main components of the platform under development are : a) a computational multiscale model of plaque progression based on fluid dynamics and finite element analysis of 3D-reconstructed carotid artery bifurcations, b) an agent based model of plaque growth, c) the integration of the two models into a hybrid model, and d) the implementation of big data analytics including machine learning and data mining approaches for the integration of model outcomes with available big data in order to stratify patients according to the risk of manifesting cerebrovascular events. The performance of the new risk stratification platform will be validated during the lifecycle of the prospective clinical study, in three follow-ups within a period of 36 months. The risk stratification tool will be tested for predicting the plaque evolution as well as the plaque's thromboembolytic potential.

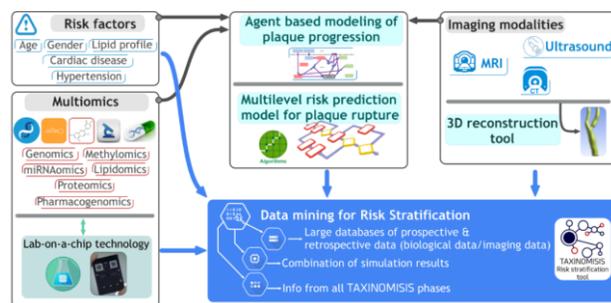


Figure 1: The conceptual framework of the TAXINOMISIS project.

## III. CONCLUSIONS

TAXINOMISIS has been successfully launched as a first of its kind international collaboration implementing a multidisciplinary approach for the stratification of carotid artery disease. Based on the unique consortium of a highly multidisciplinary group of researchers, the access to big data and the advanced modeling and analytical tools under development, the project has strong foundations and the potential to change the state-of-the-art in carotid artery disease improving medical treatment and opening new avenues for therapeutic interventions, with great socioeconomic impact.

## REFERENCES

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