

# Intracranial aneurysms development and rupture risks: making sense out of the ICAN nationwide cohort.

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**Keywords:** epidemiology, biostatistics, machine learning.

**Required skills** good knowledge of classical statistical models, good programming skills, curiosity.

**Incomes:** 15 % of the hourly ceiling of the french social security, thus 577,50 € per month.

## Context

3.2% of the world's population carries an intracranial aneurysm (ICA). ICAs can be stable, or evolve, until their rupture. It is estimated that 50% of ICA rupture cases are fatal and this event has an incidence ranging from 5 to 20 / 100,000 individuals per year. It is therefore a major public health issue to be able to identify factors predisposing to the development, the stability or the rupture of ICAs.

ICAN [1] is a national multi-center project gathering 34 academic hospital partners (CHUs) aimed at developing diagnostic and predictive approaches to better understand the risks of ICA formation and rupture. Familial forms of ICA suggest a genetic component but today very few studies have identified causal variant. ICAN has already collected a large collection of multi-modal data including phenotyping data (clinical annotations), imaging (MRI, angio-scanner), as well as genetics data (whole exome sequencing). By the end of 2018, 3000 patients with ruptured and unruptured ICAs will be included in the study with more than 40 clinical variables collected for each patient.

## Problem statement

PHASES [2,3] is a clinical risk score for intracranial aneurysm rupture, built as a prediction model for unruptured intracranial aneurysm (UIA) patients. PHASES score is based on 6 predictors: earlier subarachnoid hemorrhage, hemorrhage caused by the rupture of a different IA, location of the UIA, age > 70 years (per 5 years), population and size of the UIA. However, data on other well-established risk factors for UIA growth and rupture, such as smoking status and high blood pressure, are lacking and could not be included in the design of the PHASES score. In addition, several other known risk factors are not yet included due to the retrospective nature of the PHASES study.

## Objective

The ICAN collection, made on approximately 3000 patients, aims at better stratifying patients with a high risk of rupture from patients with a mitigated rupture risk. The objective of this work is to dive into the many clinical observations collected in ICAN through both epidemiology/statistical and machine learning approaches. The challenge will be to evaluate and select the appropriate methods while balancing prediction accuracy and explanations.

## Work plan

- Precisely characterize the ICAN population with state-of-the-art epidemiological practices.
- Evaluate the PHASES score on the ICAN population.
- Benchmark biostatistical, unsupervised and supervised learning approaches in this data collection to unravel possibly new combinations of clinical features.
- Design and develop a computational pipeline for both patient classification and rupture risk prediction.

## Required profile

This internship proposal is offered to a M2-level student, having excellent statistical and programming skills and motivated by their applications in clinical epidemiology. The student will work as part of an interdisciplinary collaboration under the direction of Matilde Karakachoff (statistician and epidemiologist - Clinique des données, CIC Inserm 1413 Cellule d'Épidémiologie Clinique, CHU Nantes), Alban Gaignard (computer scientist - Institut du thorax Inserm UMR 1087 / CNRS UMR 6291 Nantes) and Romain Bourcier (clinical practitioner - Department of Neuroradiology, CHU Nantes).

## References

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