

To predict the future, you need to know the past.

Pre-hospitalisation Healthcare trajectories and 1-year survival among elderly patients hospitalized in ICU for acute respiratory infection

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INTRODUCTION



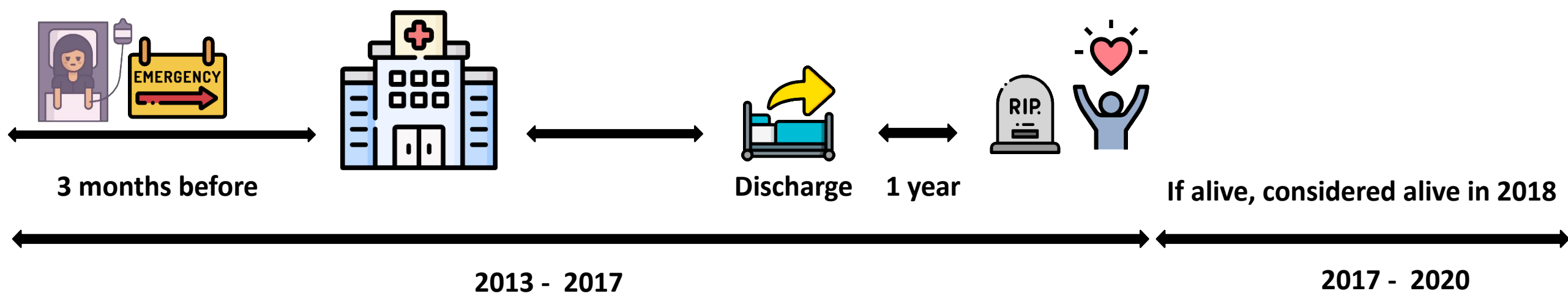
- 80 yo or over: 20% population up to 2050
World population ageing, WHO 2019
- Substantial increase of elderly admission in intensive care units (ICU), especially for acute respiratory infection (ARI)
- But high mortality and healthcare use during the following year
Laporte et al, AIC 2018 Guillon et al, CCA 2020
- Prediction of elderly survival after ICU is hard (frailty, medical conditions...)
Nielson et al, Lancet Dig health 2019

QUESTION : Patient ≥ 80 y.o. hospitalized in ICU for ARI: Is the health care trajectory a good predictor of the long-term outcome?

➤ Proof-of-concept : the healthcare pathway of elderly patients over the 3-month period prior to the ICU admission for ARI could help predicting the 1-year survival and so decision making.

METHODS

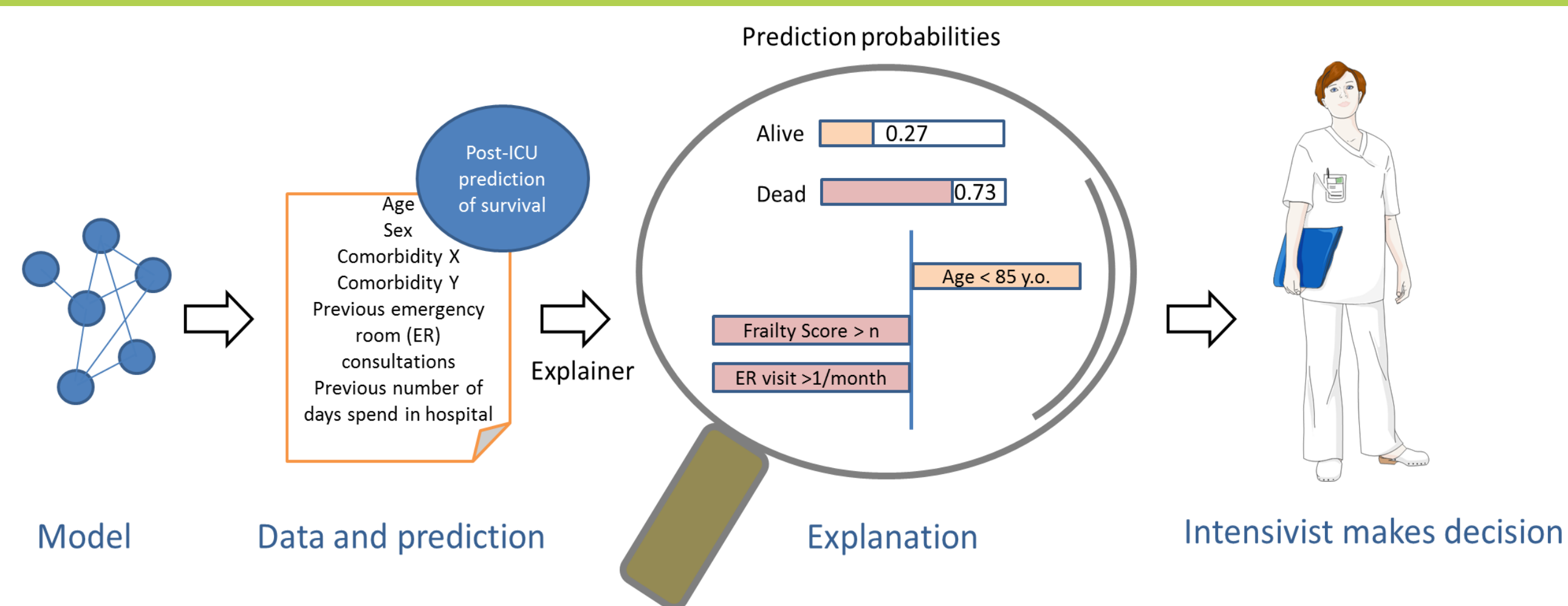
- National historic cohort** based on medico-administrative databases 2013-17 (French-DRG and ICD-10 codes of the hospital discharge resumes)
 - ARI defined as hospital acute pneumonia or exacerbation COPD
 - Variables of interest : age, sex, frailty score, ICU procedures, healthcare consumption before and after ICU
 - Vital status. up to 3 year after ICU (to minimize the lost of follow-up)



- Prediction of mortality**
 - Variable Selection : Random forest /seuil variance/SelectKbest
 - Normalisation and split in 2 samples: 67% TRAIN and 33% TEST
 - Assessment of Machine Learning models
- Performance : accuracy, recall, precision, F1-score ; Discrimination AUC (ROC)
Reliability: calibration plot
- Variables input in the prediction
 - Local Interpretable Model Agnostic Explanations (LIME)
 - Shapley additive explanation (SHARP) : top 10 of the predictive factors

• **Software : R, Python**

Overview: Material and Methods

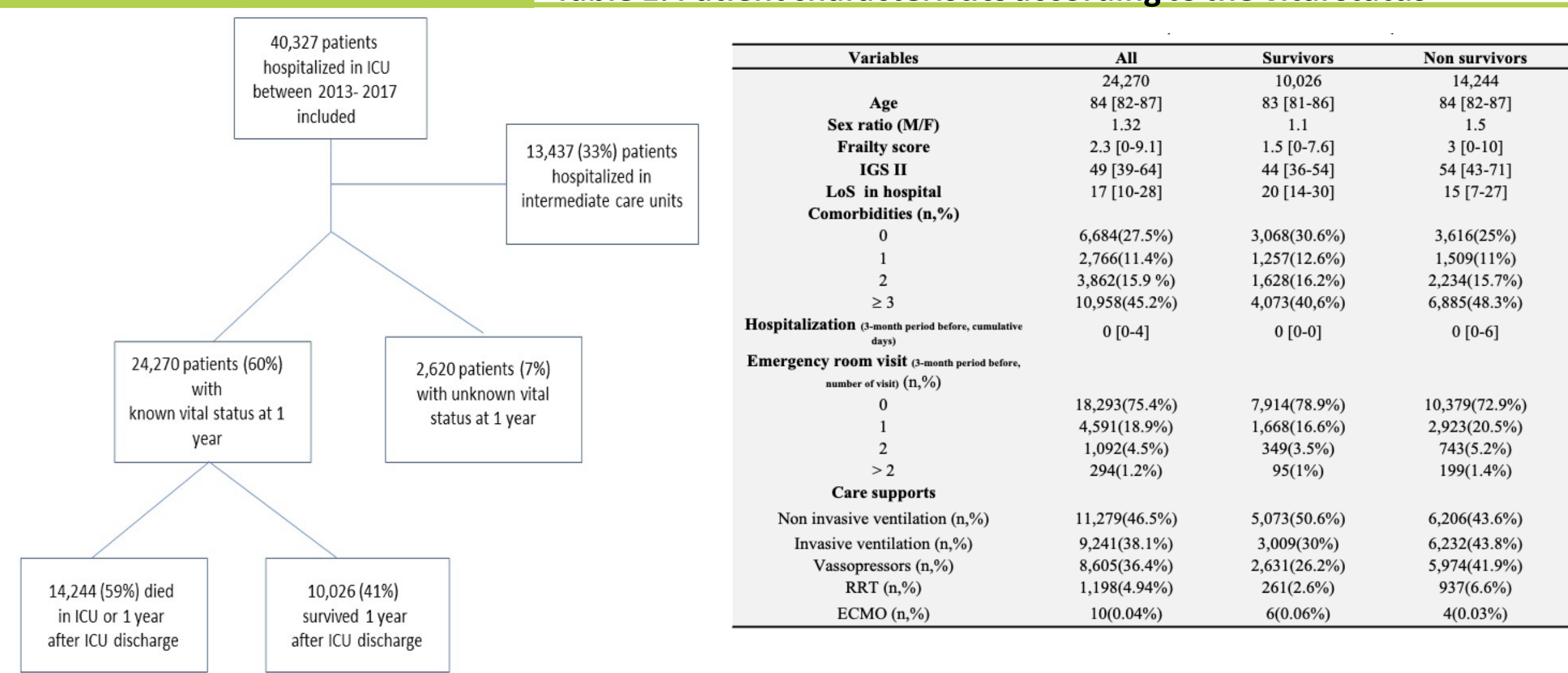


RESULTS

Population and features

Figure: Flow chart of selection

Table 1. Patient characteristics according to the vital status



Machine Learning models

1. Features selection; 2. Prior ICU data; 3. Adding ICU data

1. Features selection

2. Prediction models

- ML models using all the pertinent information over the 3-month period prior to ICU admission were all able to predict the one-year survival with various performances (fig. 2).
- Gxboost modelling was able to discriminate the vital status with an AUC 0,69.

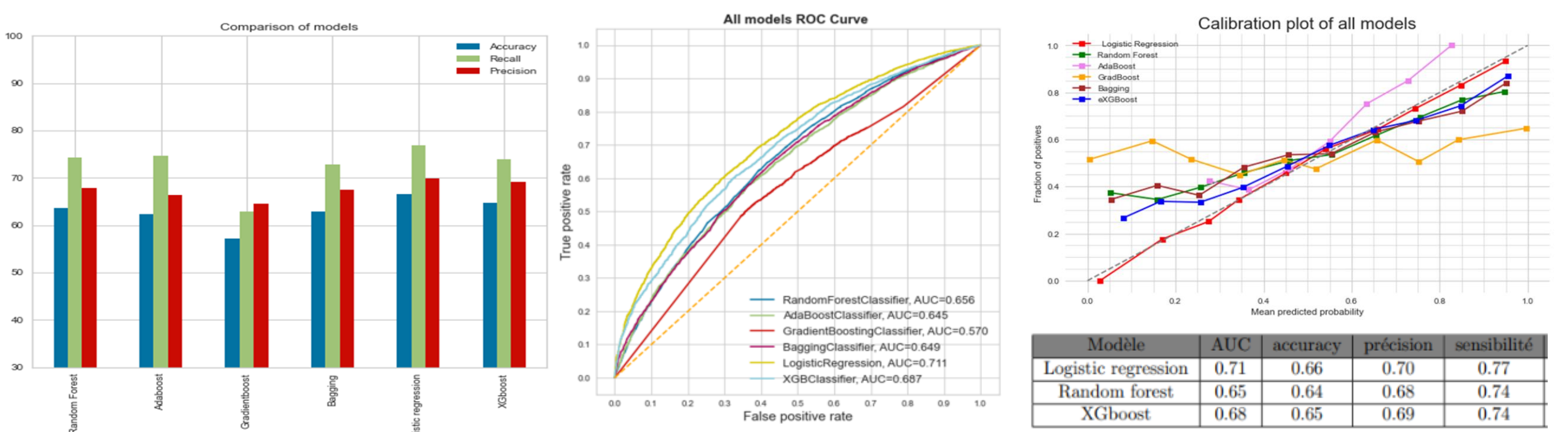


Figure 2- Assessment of the performance of different ML models to predict the mortality at one year of elderly patients admitted in ICU for ARI, 2013-17

3) ML models, including data from the hospital stay (ICU procedures and severity)

A major part of the prediction of the 1-year survival is associated with the patient features and not with the ICU care => model without the ICU data

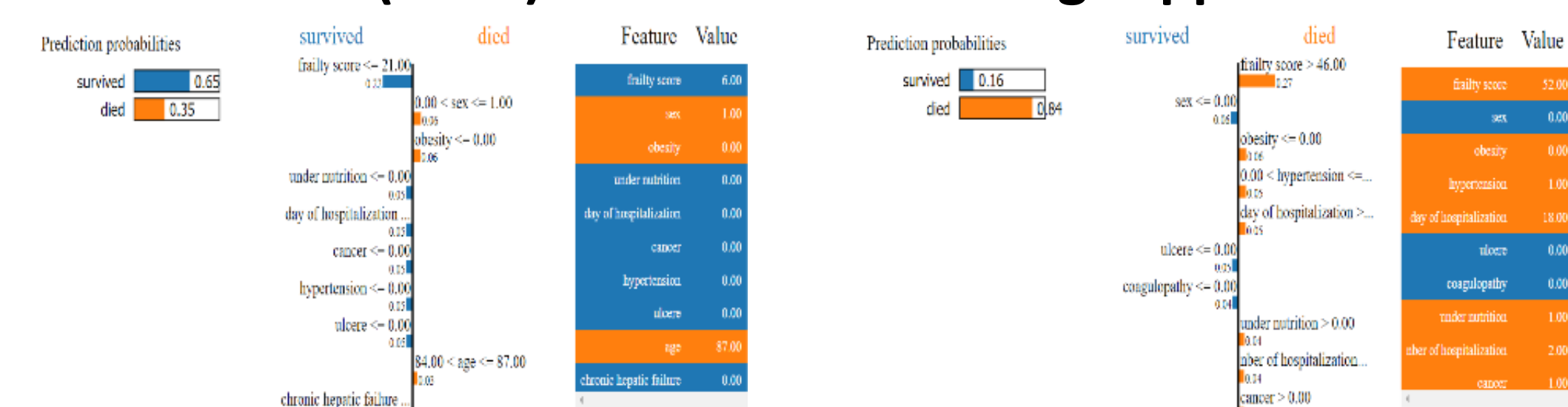
Predictive Variables

1. Major features; 2. LIME

• Population level (SHAP algorithm)

- frailty, hospitalisations, male gender and hypertension

• Individual level (LIME): for decision making support



DISCUSSION

- Integrative approach of machine learning based on hospital data could help the decision of admission of elderly patients with ARI
 - Note: the major part of the prediction of the 1-year survival is associated with patient features and not with ICU characteristics
 - Moreover, sorting the patients must occur before admitting them eventually
- No information on patients with ARI not admitted to ICU, but admitted patients are in fact "sort", hence adding the non-admitted would probably improve performances.
- Next step: strengthen model (more information) and software tool to implement
 - But ethical and societal issues to take in charge before this next step (Genually Project – French MESSIDORE grant)

