



# What is the best echocardiographic approach to assess Heart Failure risk in overweight people?

**MAGIC study: a MACHINE learning model using echocardiography to predict heart failure across different BMI categories**

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## 1 Présentation du pilote

The global prevalence of obesity continues to rise, with over one-third of adults classified as overweight or obese. Obesity is strongly associated with type 2 diabetes and hypertension, both of which increase the risk of cardiovascular complications, including the progression to metabolic heart failure (HF).

Accurate diagnosis of heart failure (HF) in obese patients is essential, especially given the emergence of new obesity treatments that have demonstrated benefits in reducing HF symptom burden, improving functional capacity and quality of life, and decreasing hospitalizations. However, these therapies are costly, underscoring the importance of careful patient selection.

Diagnosing HF and evaluating its prognosis in obese individuals is challenging. Echocardiography is a cornerstone and accessible diagnostic tool to investigate the origin of dyspnea. However, standardized approaches for measurement indexation and diagnostic algorithms for heart failure in obese patients are still lacking.

## 2 Objectifs

The purpose of our study is to develop more precise and personalized diagnosis and stratification algorithms of HF in the current population with increasing proportion of overweight and obese people.

Echocardiography offers multiple parameters and indexation methods and different cut-off value depending of age and sexes. We hypothesize that machine learning (ML) methods could help address this complexity by incorporating a broader spectrum of variables.

### 1) Primary objective:

To investigate the performance of a ML model that uses echographic data in association with basic clinical data to predict heart failure events -during a 2 to 5 years follow-up- in a large cohort across a range of BMI categories.

### 2) Secondary objectives

- Description and categorization of the population
- Description of the echographic findings according to patient's categorization
- Description of events during a 2 to 5 years follow-up globally and according to patient's BMI categorization
- Investigate ML model to predict MACE (cardiovascular death, HF, stroke, MI, new diagnosis of AF)
- Compared ML model with H2FPEF Score and HFpEF-ABA Score in the prediction of HF hospitalization, MACE, ambulatory increase of HF treatment

## 3 Méthodologie

Retrospective cohort study with an index dataset (HCL, France) and one external dataset (La Fe hospital).

### Index dataset (Hospices Civil de Lyon)

The index dataset is based on all patients included in the echocardiographic cohort (Quality Street cohort), referred for a trans-thoracic echocardiography, from July 2018 (beginning of the cohort) to May 2023. This will allow a minimal follow-up duration of 2 years.

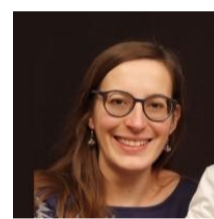
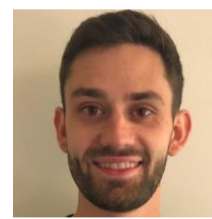
Performance will be compared between the ML model and existing score and approaches using area under the receiver operating characteristic curve.

Prognosis information and basic clinical characteristic

Hospital medical files (easily and PMSI), National Health Data System (SNDS) and general medical record (French personal medical record; DMP) will be used in order to collect prognostic information.

Feature selection will include:

- Minimum clinical data that investigators have at the time of the echocardiography: age, sexe, weight, height, systemic atrial pressure, cardiac rhythm,
- Echocardiographic measurements (listed in the table) and various indexation techniques (variable available in our hospital system)



## 4 Evaluation et durabilité du projet

The project will be evaluated by comparing the performance of the ML model with existing diagnostic scores using AUC for predicting HF hospitalization and cardiovascular events over 2–5 years. Internal validation will use the Hospices Civils de Lyon cohort, and external validation will use the IIS La Fe cohort.

Sustainability is ensured through the use of routinely collected echocardiographic and clinical data from established hospital and national databases, minimizing costs and enabling long-term integration. Collaboration with ML experts guarantees robust development and adaptability to future clinical needs.

This project seeks to develop a machine learning-based algorithm to estimate heart failure risk in patients, with a particular focus on those with obesity. By integrating echocardiographic and clinical data, the algorithm aims to improve diagnostic precision and prognostic stratification. The expected outcome is a tool that could inform future echocardiographic and clinical recommendations, enabling earlier and more personalized management of obese patients and ultimately reducing adverse cardiovascular outcomes.

## 5 Partenaires

Cardiologic Institute of Lyon, Hospices Civils de Lyon

Pole de Santé Publique, Hospices Civils de Lyon

Health Research Institute Hospital La Fe (IIS La Fe)

CREATIS laboratory



This project has received funding from the EU4Health Programme 2021-2027 under Grant Agreement 101126953. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HaDEA). Neither the European Union nor the granting authority can be held responsible for them.



Co-funded by the European Union