# Development of an AI-based digital platform to improve the healthcare of patients with chronic diseases requiring long-term care

**AUTHORS: Francisco Ródenas-Rigla [1], Fernando Aparicio[2], Jorge Garcés-Ferrer [1], Lorenzo Martínez[2]**

1.PolibienestarResearch Institute-University of Valencia, Valencia, Spain; 2. Nunsys, Valencia, Spain.

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# SMARTCHRONIC Project (2020-2021)

The Smartchronic proposes to apply AI techniques in combination with monitoring techniques based on Patient-Reported Outcomes (PROs) in older patients, with chronic pathologies establishing a predictive model of frailty, based on the Frailty Index of Rockwood, a pathway prediction model, a 30-day readmission risk prediction model and non-invasive monitoring of patients through mobile technology (mHealth).

The **objective** is to improve the integrated care received by older patients who require long-term care, based on their frailty, considering their behavior and needs, from a proactive patient-centered perspective

Approved in 2020 by the Ethical Clinical Research Committee of La FE Hospital (Reference number 2020-138-1).

# SMARTCHRONIC partners

The project has been carried out by an interdisciplinary team made up of researchers from Polibienestar Research Institute (University of Valencia), health professionals and researchers (La Fe hospital), researchers from Technological Institute of Informatics (Polytechnic University of Valencia), and technicians from two companies: a scientific consultancy company in the health area (Outcomes 10) and a tech company (Nunsys).

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# SMARTCHRONIC method

Retrospective study based on data derived from a cohort of patients belonging to the Valencian Health Department La Fe.

Inclusion criteria:

- ✓ Patients with a diagnosis of chronic disease from January 1, 2012 to December 31, 2018.
- ✓ Older patients of both sexes ≥70 years.
- ✓ Patients who had clinical records for follow-up for at least 1 year.

# SMARTCHRONIC hospital data

Retrospective data: electronic medical records of the La Fe Health Department (Valencia, Spain). This information has been transferred to a real-world data analysis platform based on the SAS® Software Analytics infrastructure.
The data includes structured and semi-structured records updated daily, coming from several information systems involving clinical activity. The dataset contains 46,115 hospitalization episodes of 19,424 patients.

Data quality analysis:

- ✓ Completeness (checked for the presence of null values),
- ✓ Coherence (format of fields, data cross-checked between tables),
- ✓ Duplicates (no duplicates detected).
- ✓ Outliers (no anomalous values appear in the data)

Data for frailty, pathways and mHealth (App)

Data for risk model

Transfer of data between the IIS La Fe, guaranteeing that the use of clinical data was carried out in accordance with current data protection laws.

# SMARTCHRONIC classification problems to be solved by the models

The *pathway prediction model*:

Depending on the input variables, the model will predict what the next step will be (and so on up to a total of 4 times) out of 74 possible options for each step.

The values grouping the three most likely predictions are:

- Precision: 0.454
- Accuracy: 0.526
- Recall: 0.248
- F1-Score: 0.263

The *30-day readmission risk prediction model*:

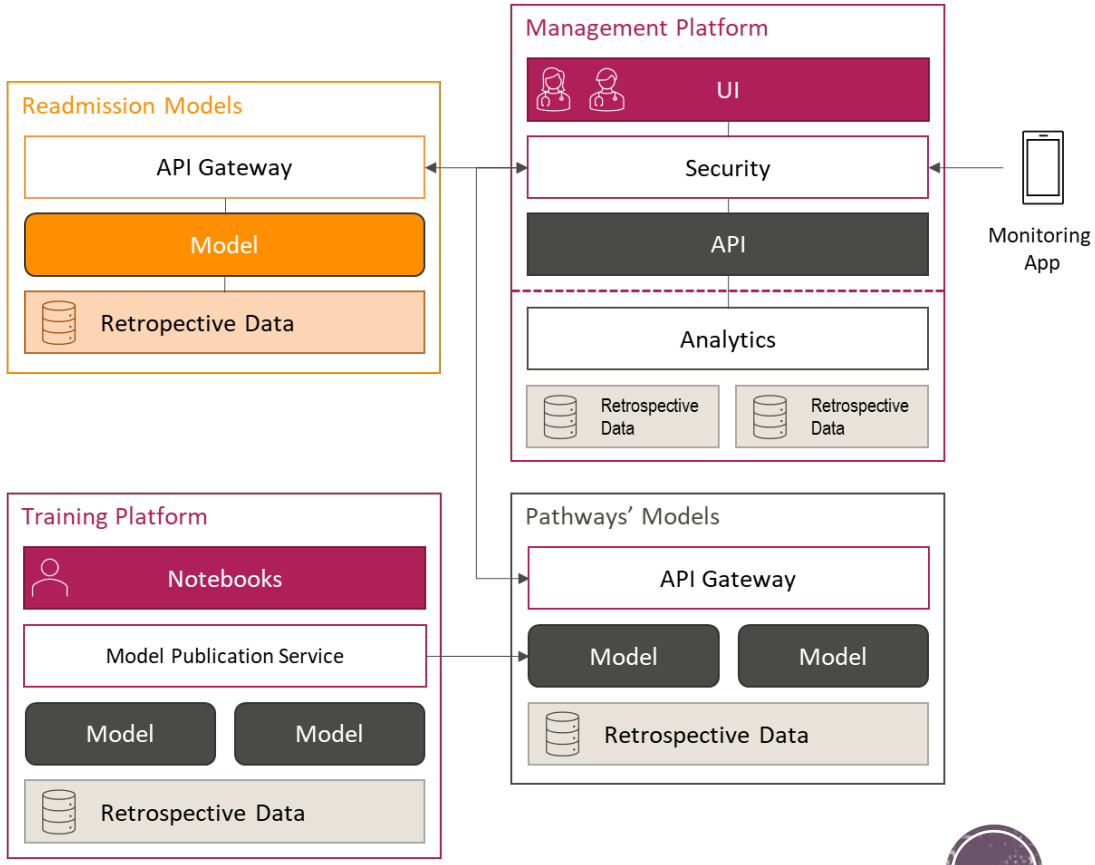
The model returns the percentile of readmission risk (between 0 and 100).
For example, if a query returns a value of 80, this patient has a higher probability of readmission than 80% of the patients, or similarly, only 20% of the patients have a higher probability of readmission.

The best result obtained corresponds to the model with gradient boosted trees, obtaining a value for the area under the ROC curve (AUC) of 0.665.

# SMARTCHRONIC Platform

Elements: A management web based platform; Machine Learning models of care pathways, classification of patients according to IF and hospital readmission; model training platform; analytical solution to optimize retrospective data for visualization within dashboards; and App for Smartphone to patient monitoring.

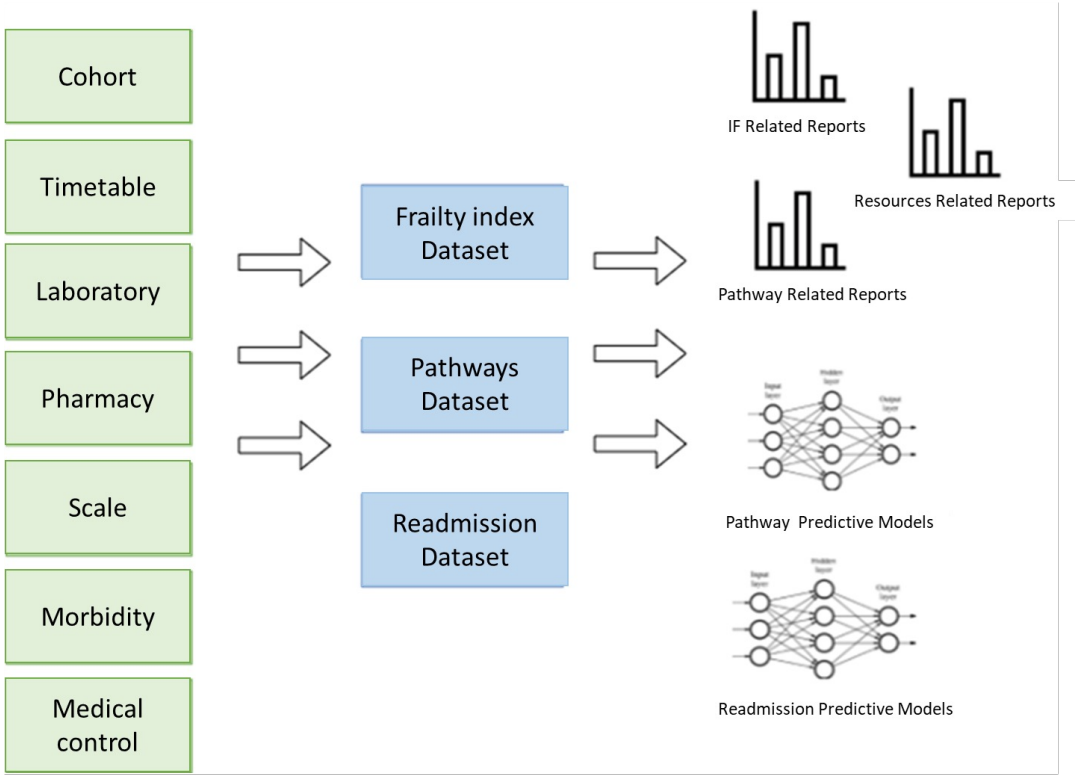
The main result of the platform was the definition of a set of KPIs indicators, aimed at professionals to optimize the long-term care plans of chronic patients. The KPIs use data from the different modules (IF, care pathway, readmissions and PROs) to provide information on real adherence and deviations from the established care plans and those foreseen by Smartchronic, evolution of variables included in the system (fragility, critical conditions, risk of readmission), capacity and reaction of the health system.



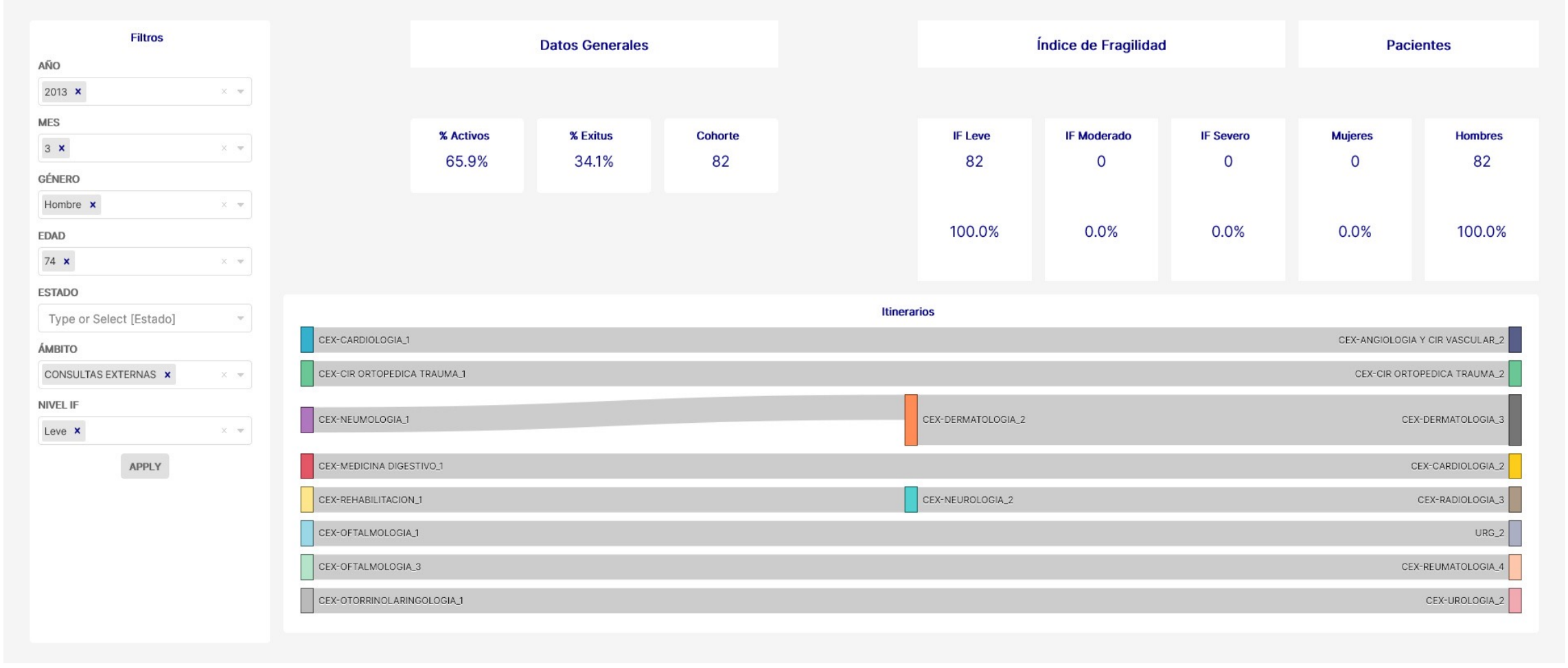
# **SMARTCHRONIC Plaform -** AI modules for determination of the Frailty Index (FI), pathways and readmission

Using the"ETL Pentaho Data Integration" tool, information has been extracted and processed from the available files containing relevant data for the calculation of care pathway, the patients' frailty index and risk of hospital readmission.

Once processed by means of SQL queries, the data were modelled to obtain a data structure oriented to support both the training of predictive models of patients and the reports or dashboards with statistical information for retrospective analysis.



**SMARTCHRONIC Plaform:** Care Pathways Report. The following image shows how the information is displayed on the Smarchronic platform



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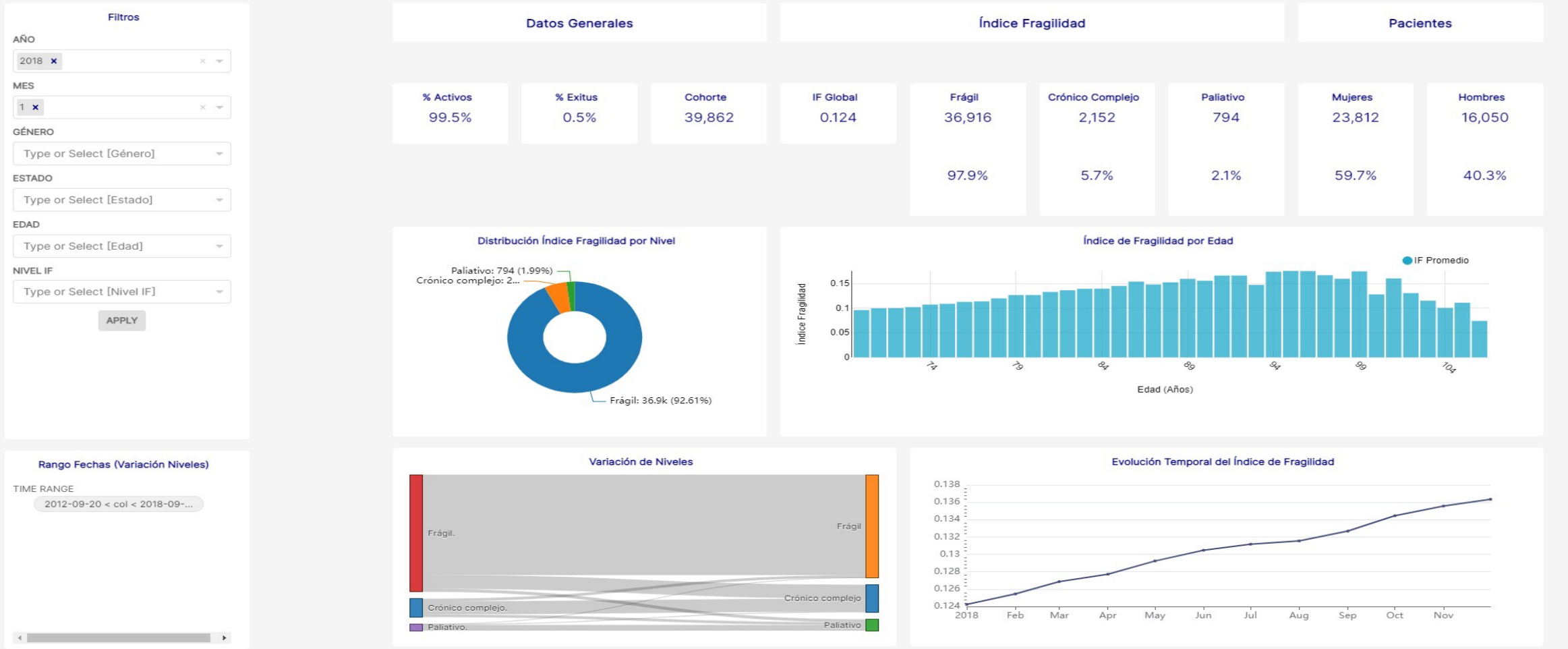
**SMARTCHRONIC Plaform:** Fragility Index Report. The following image shows how the information is displayed on the Smarchronic platform



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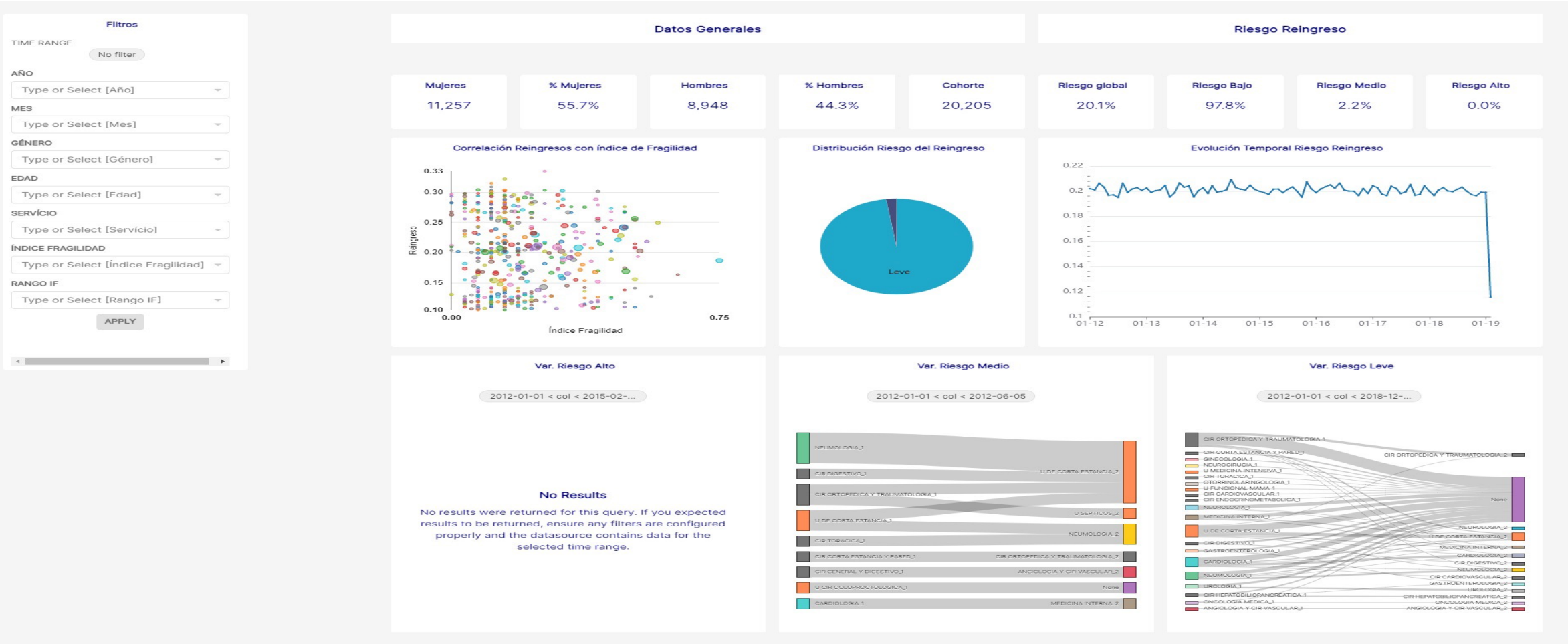
**SMARTCHRONIC Plaform:** Hospital Readmission Risk Report. The following image shows how the information is displayed on the Smarchronic platform



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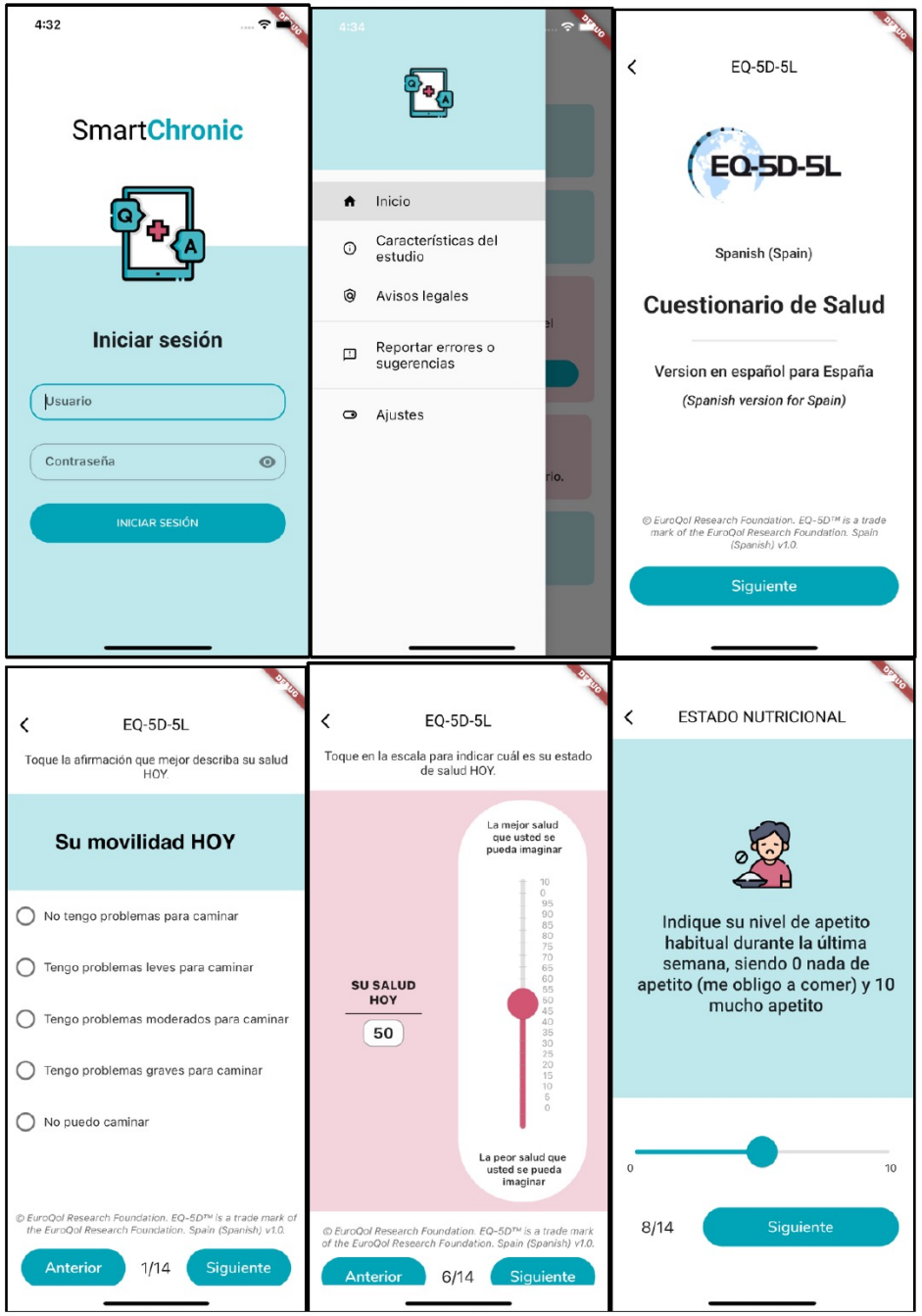
**SMARTCHRONIC Plaform:** App for Smartphone. The following image shows how the information is displayed on the Smarchronic platform



# Conclusion

This technology allows studying big database of patients, contributing to the development of the concept of personalized medicine and to optimize integrated care. Platforms such as SmartChronic would also improve the decision-making of health policy makers.

Some limitations of the models:

- This study was conducted in a single hospital, it should be analysed whether the results can be extrapolated to other hospitals.
- In the scales, priority is given to the patient's last assessment and this value does not change until the next assessment.

# THANKS FOR YOUR ATTENTION

For further information, please contact
francisco.rodenas@uv.es
fernando.aparicio@nunsys.com

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