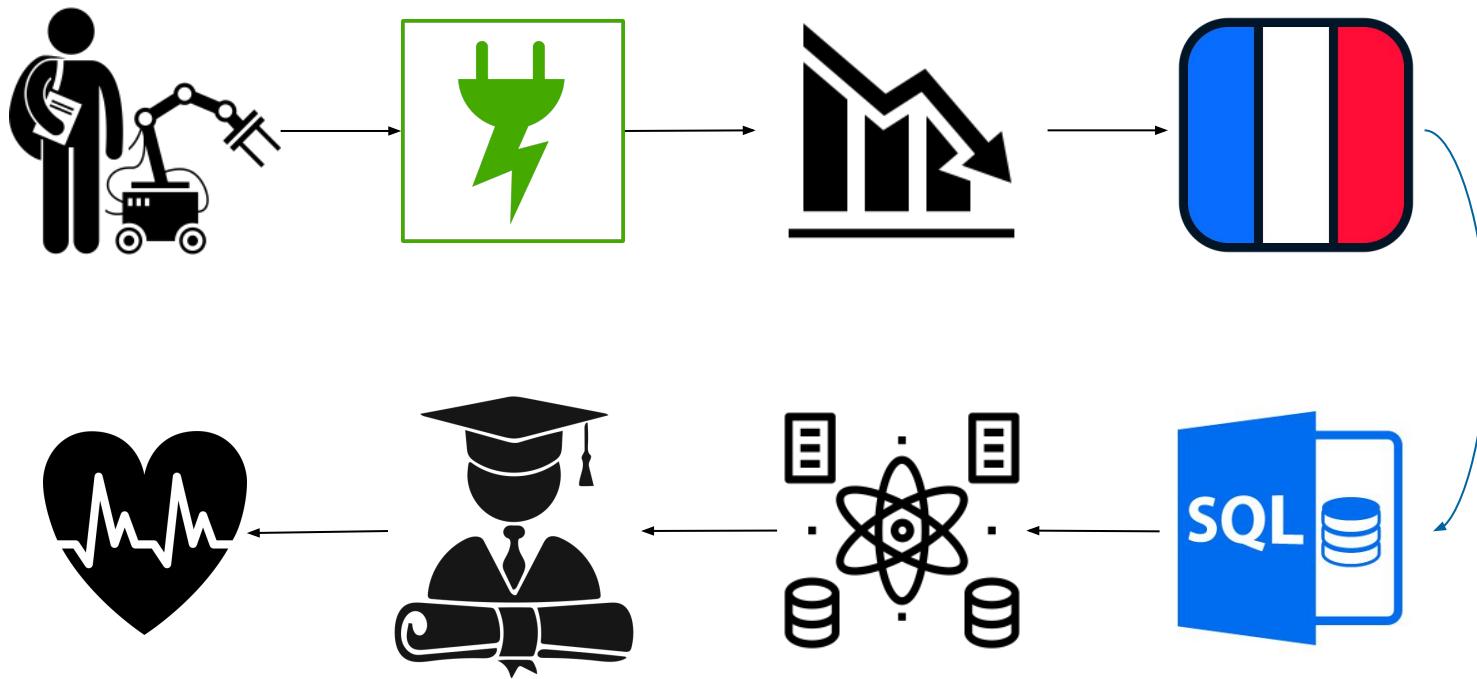


MACHINE LEARNING IN CARDIOLOGY

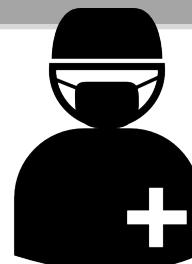
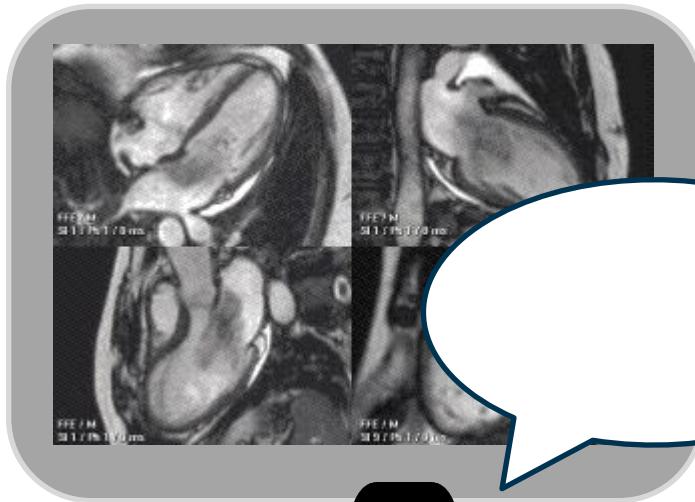


Víctor Vicente Palacios PhD (Data Scientist)
@victorvicpal 

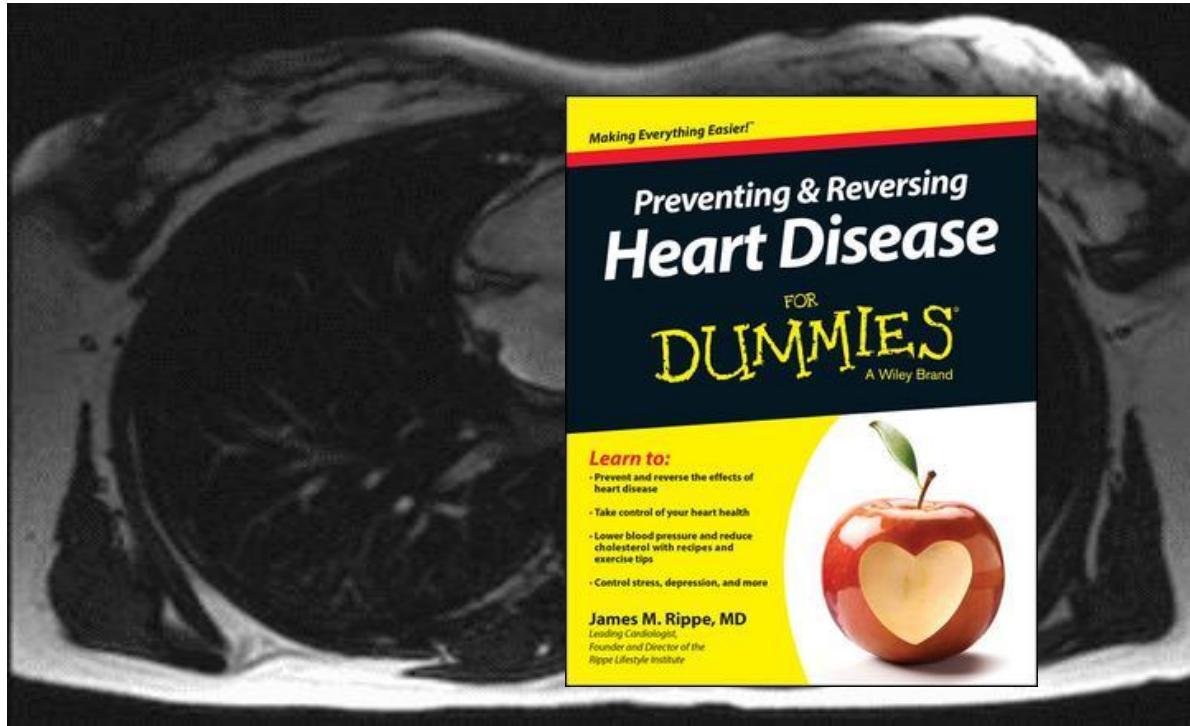
¿Quién soy?



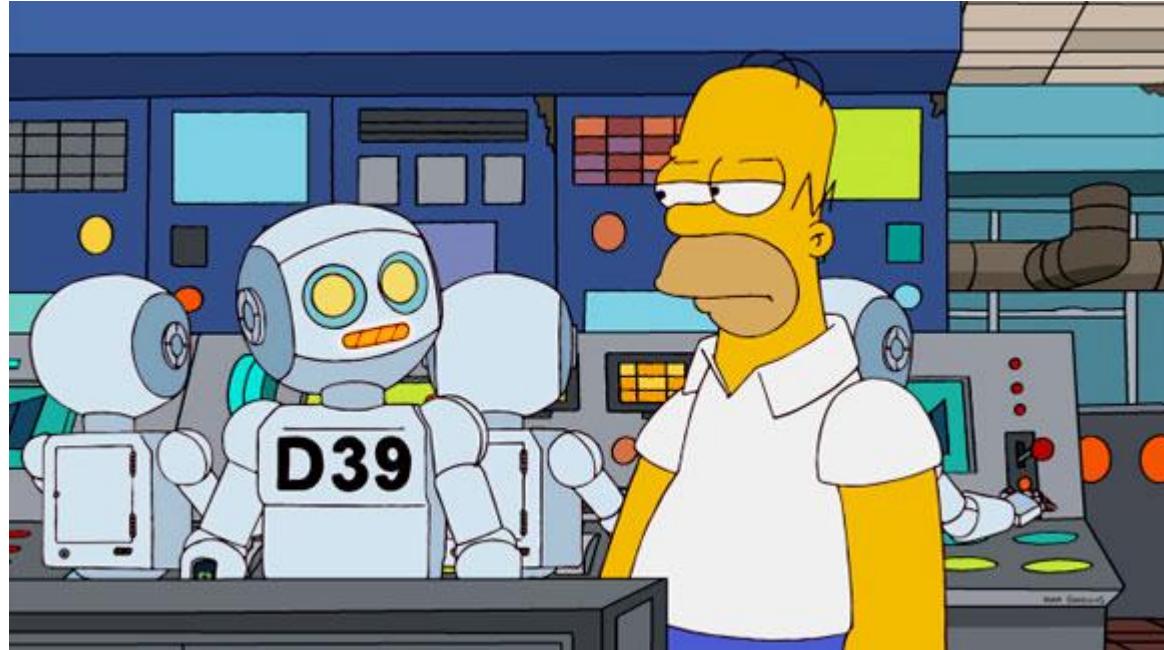
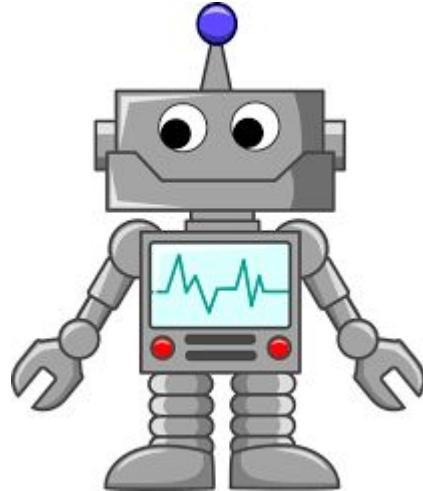
Mi vida en el hospital



¿Cardiología?



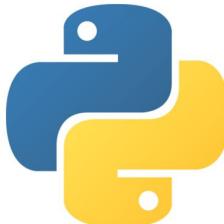
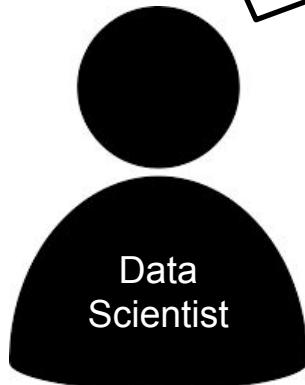
¿Machine Learning?



Python vs SPSS

Tenéis unos datos increíbles.
Estoy deseando empezar a
ajustar modelos con Python!!

Sí, eso está genial. Pero...
Hazme unas tablas de
SPSS por si acaso



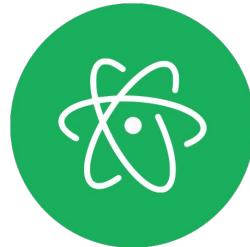
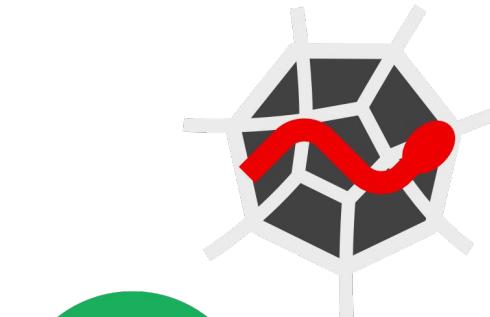
Data
Scientist



SPSS®

PHILIPS

Herramientas de trabajo (IDE)



Jupyter Notebook interface showing multiple tabs: Corr_matrix, Javier2_nb, ElPais, Model_GTB, and Model_GTB.ipynb. The Model_GTB.ipynb tab is active, displaying code and plots.

The code in In [1] imports pandas, numpy, Counter, operator, and pylab, and runs %pylab inline. It also imports data from 'data[tvisprev > 15].tvisprev.hist(bins=90, figsize = (12,8))'.

The plot shows a histogram of the time between visits (Días) in days. The distribution is right-skewed, with the highest frequency occurring between 0 and 500 days.

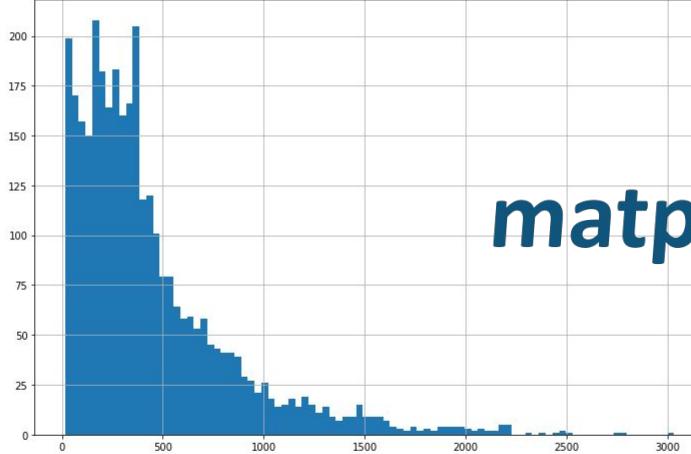
Logos for NumPy, matplotlib, and pandas are displayed on the right side of the notebook interface.

```
In [1]: import pandas as pd  
import numpy as np  
from collections import Counter  
import operator  
%pylab inline  
  
Populating the interactive namespace from numpy and matplotlib
```

Histograma tiempo entre visitas

Días

```
In [11]: data[data.tvisprev > 15].tvisprev.hist(bins=90, figsize = (12,8));
```



NumPy

matplotlib

pandas

Librerías (Machine Learning)



A screenshot of the official scikit-learn website. At the top, there's a navigation bar with links for Home, Installation, Documentation, Examples, Google Custom Search, and a search icon. The main content area features a large image showing a 3x9 grid of 2D scatter plots with decision boundaries, representing various machine learning classification models. Below this, the title "scikit-learn" is displayed in large white letters, followed by the subtitle "Machine Learning in Python". A bulleted list describes the library's features: "Simple and efficient tools for data mining and data analysis", "Accessible to everybody, and reusable in various contexts", "Built on NumPy, SciPy, and matplotlib", and "Open source, commercially usable - BSD license".

Classification

Identifying to which category an object belongs to.

Applications: Spam detection, Image recognition.

Algorithms: SVM, nearest neighbors, random forest, ...

[— Examples](#)

Regression

Predicting a continuous-valued attribute associated with an object.

Applications: Drug response, Stock prices.

Algorithms: SVR, ridge regression, Lasso, ...

[— Examples](#)

Clustering

Automatic grouping of similar objects into sets.

Applications: Customer segmentation, Grouping experiment outcomes

Algorithms: k-Means, spectral clustering, mean-shift, ...

[— Examples](#)

Dimensionality reduction

Reducing the number of random variables to consider.

Applications: Visualization, Increased efficiency

Algorithms: PCA, feature selection, non-negative matrix factorization.

[— Examples](#)

Model selection

Comparing, validating and choosing parameters and models.

Goal: Improved accuracy via parameter tuning

Modules: grid search, cross validation, metrics.

[— Examples](#)

Preprocessing

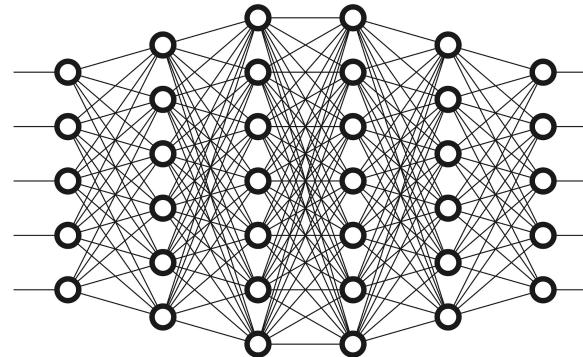
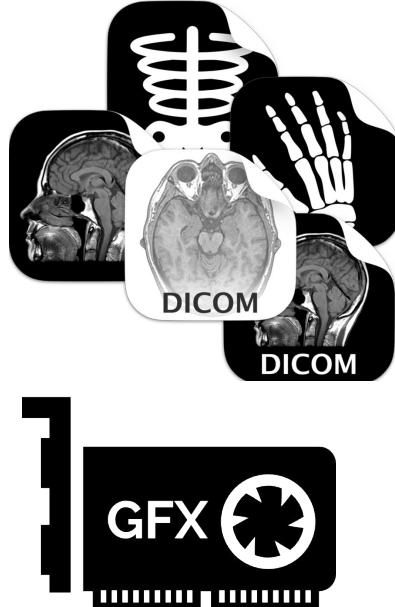
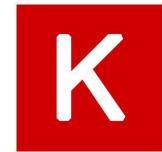
Feature extraction and normalization.

Application: Transforming input data such as text for use with machine learning algorithms.

Modules: preprocessing, feature extraction.

[— Examples](#)

Librerías (Deep Learning)



Aplicaciones en cardiología

1. Cardioversión
2. Estenosis Aórtica
3. Cardiotoxicidad

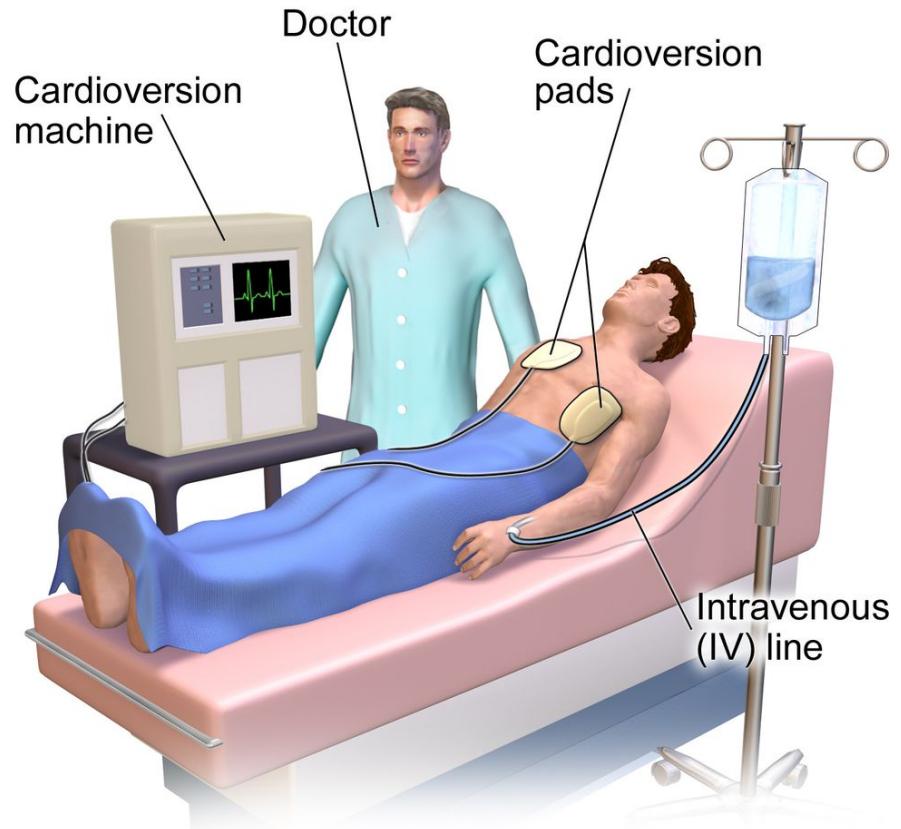
Cardioversión

Revertir arritmias

Terapia de choque eléctrico

¿Efectiva o no?

A los 6 meses de su aplicación no ha
habido eventos



Estenosis Aórtica

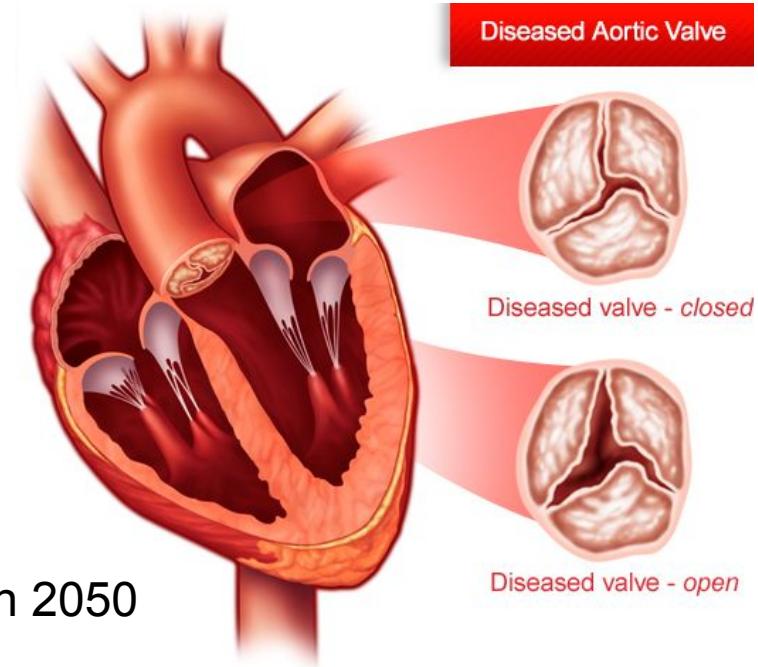
Prevalencia (España)

5 % población > 65 (años)
7 % población > 85 (años)

Más de **150,000 pacientes** (España)

Envejecimiento de la Población

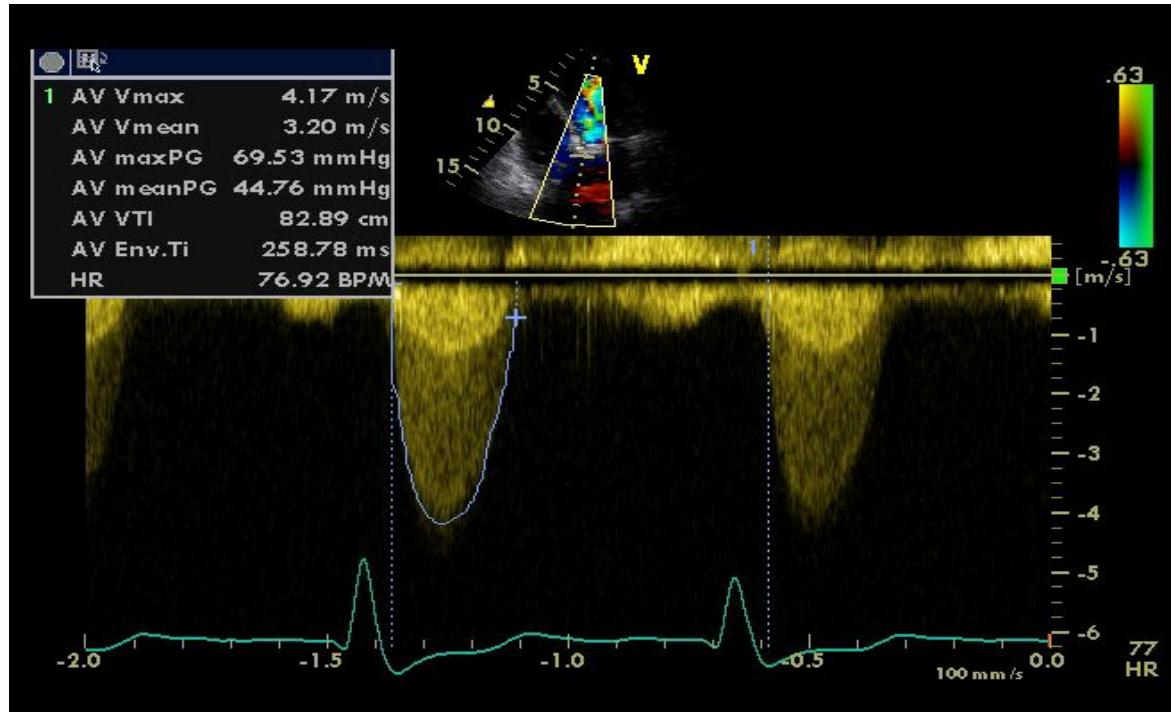
La población de España se reducirá un **11%** en 2050



Ecocardiografía



Ecocardiografía



Guías médicas

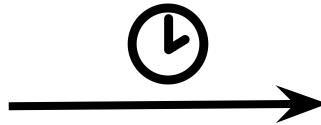
	Velocidad Máx (m/s)	Gradiente medio (mm Hg)	AVA (cm ²)	VISITAS (años)	
					
LEVE	2.5 – 2.9	<20	> 1.5	1	3
MODERADA	3.0 – 4.0	20 – 40	1.0 – 1.5	1	1
GRAVE	> 4.0	> 40	< 1.0	0,5	0,5

Objetivos

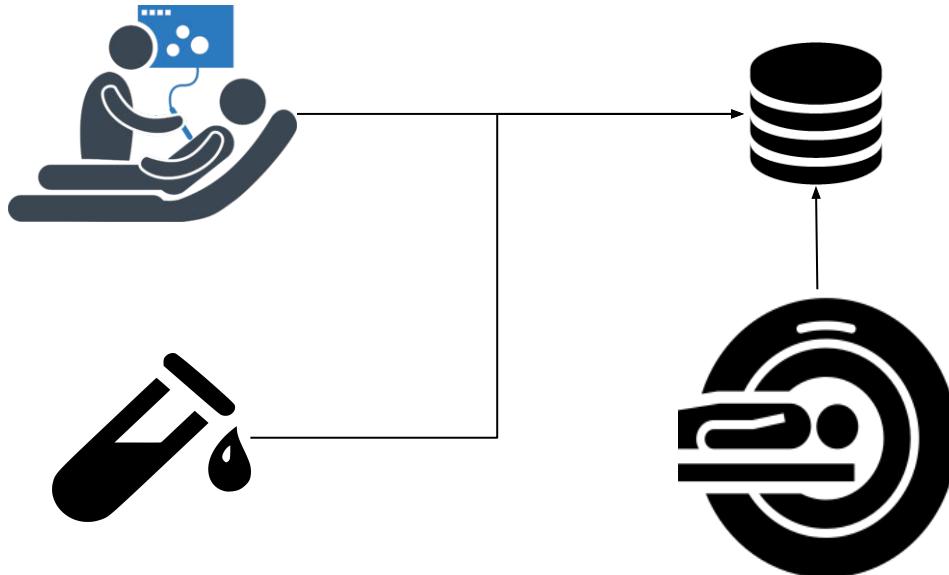
MILD / MODERATE



SEVERE

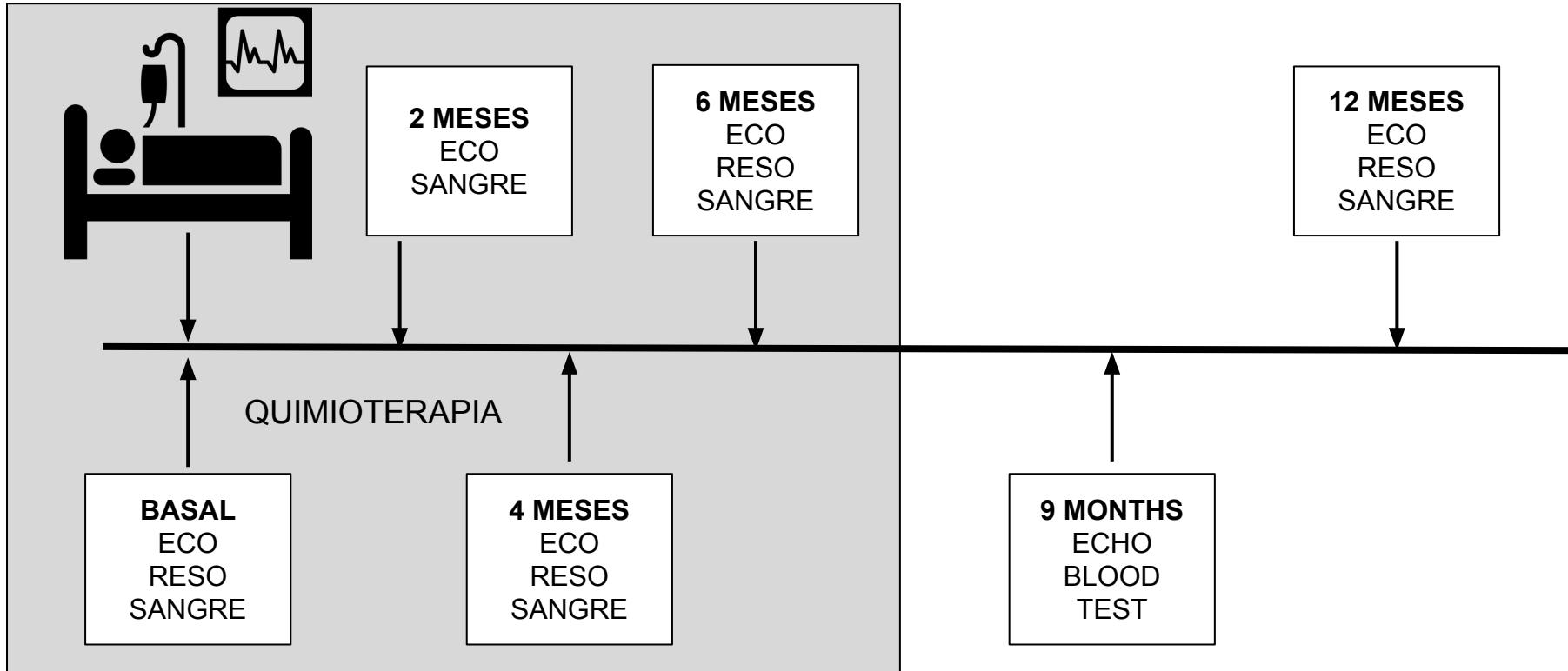


Cardiotoxicidad

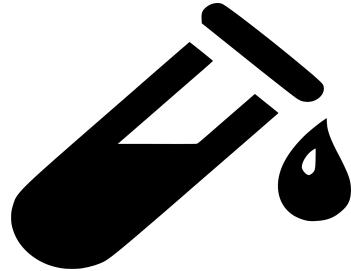
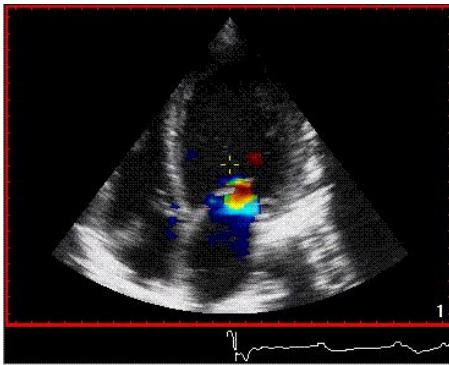


CARTIER

Cardiotoxicidad



¿Riesgo de cardiotoxicidad?



¿Falsos Positivos o Falsos Negativos?

	NO	SÍ
NO	VN 9760	FP 140
SÍ	FN 3	VP 97



9900 casos



100 casos

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

$$\text{PRECISION} = 97 / (97+140) = 0.55$$

$$\text{RECALL} = 97 / (97 + 3) = 0.97$$

¿Falsos Positivos o Falsos Negativos?

	NO	SÍ
NO	VN 9760	FP 140
SÍ	FN 3	VP 97



9900 casos



100 casos

PRUEBA NO INVASIVA

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

$$\text{PRECISION} = 97 / (97+140) = 0.55$$

$$\text{RECALL} = 97 / (97 + 3) = 0.97$$

¿Falsos Positivos o Falsos Negativos?

	NO	SÍ
NO	VN 9760	FP 140
SÍ	FN 3	VP 97



9900 casos



100 casos

PRUEBA INVASIVA

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

$$\text{PRECISION} = 97 / (97+140) = 0.55$$

$$\text{RECALL} = 97 / (97 + 3) = 0.97$$

Muchas gracias por su atención



Víctor Vicente Palacios
victor.vicente.palacios@Philips.com



@victorvicpal