Artificial intelligence in blood donation management:

Implementation of an automated and efficient system to optimize the call for donors in three hospitals of Catalonia

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SWISSTRANSFUSION
CONGRÈS ANNUEL 2024

5 and 6 September
Neuchâtel, Suisse

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No disclosure

I have no actual or potential conflict of interest in relation to this congress or this presentation

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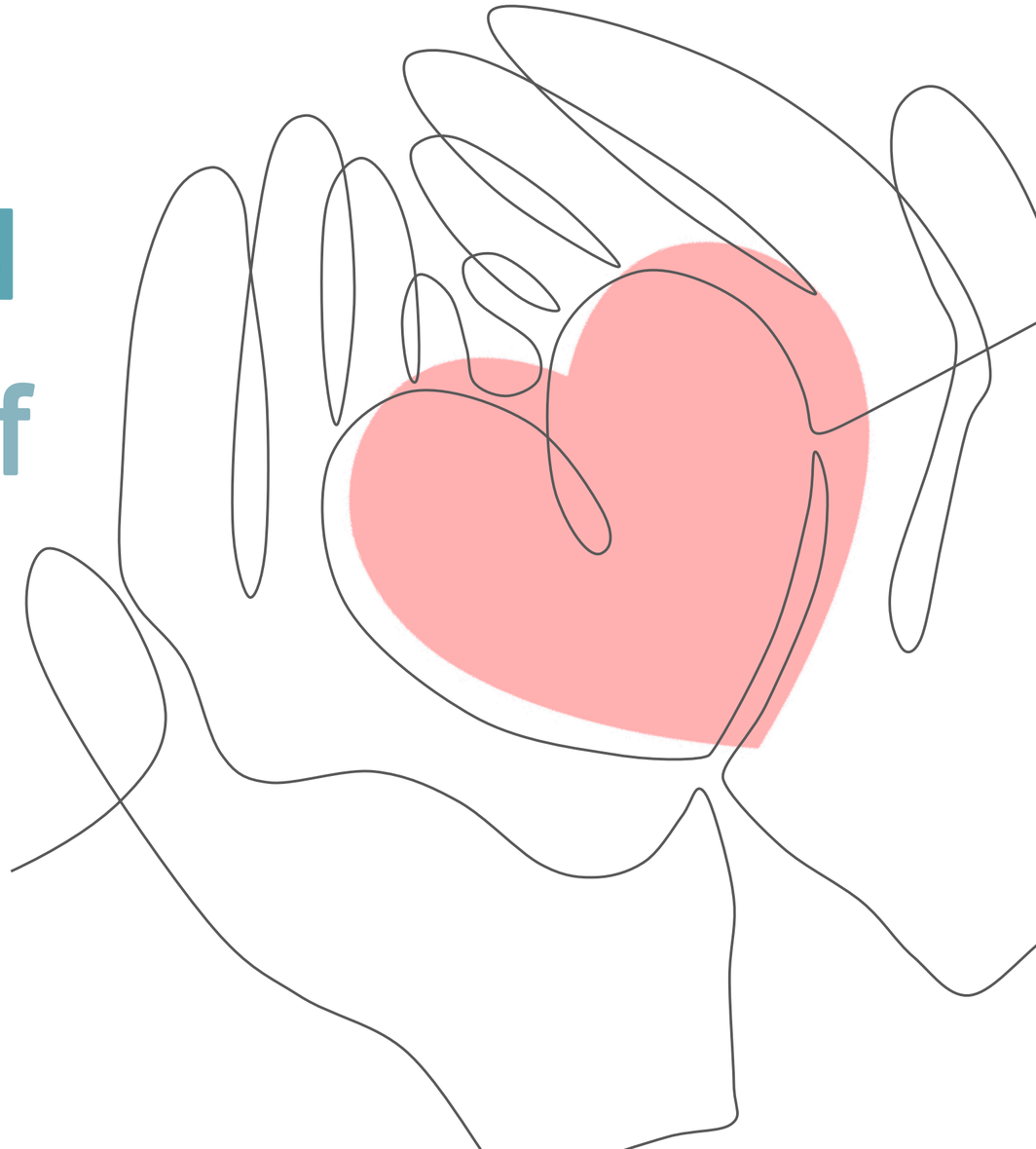

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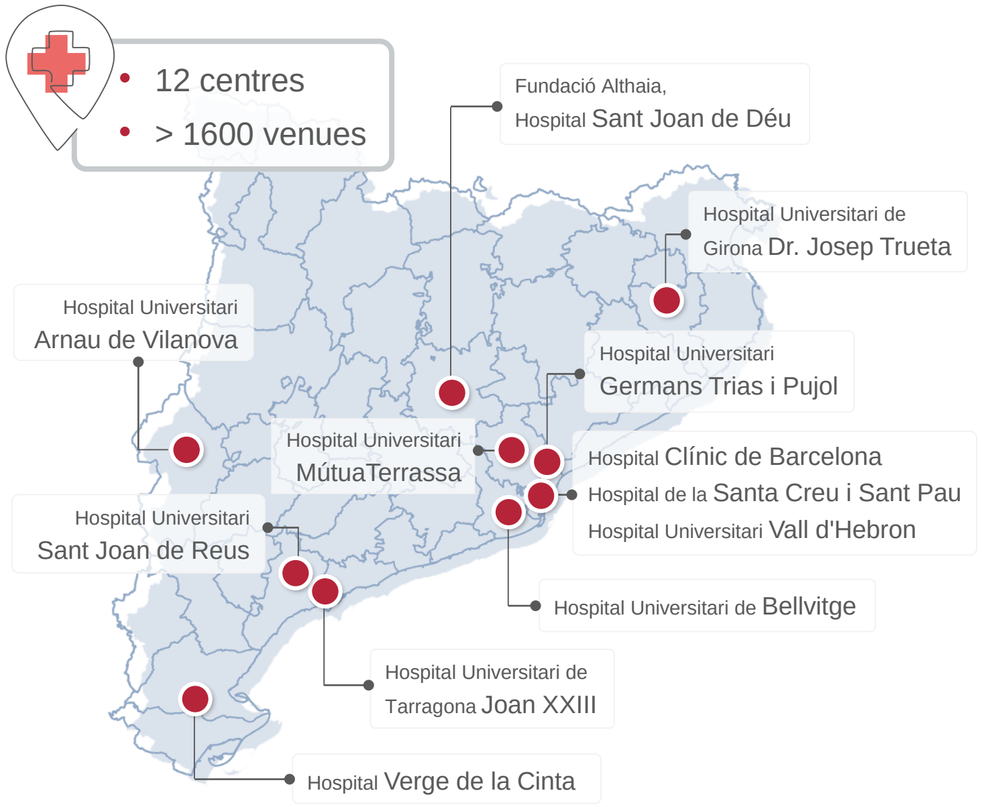

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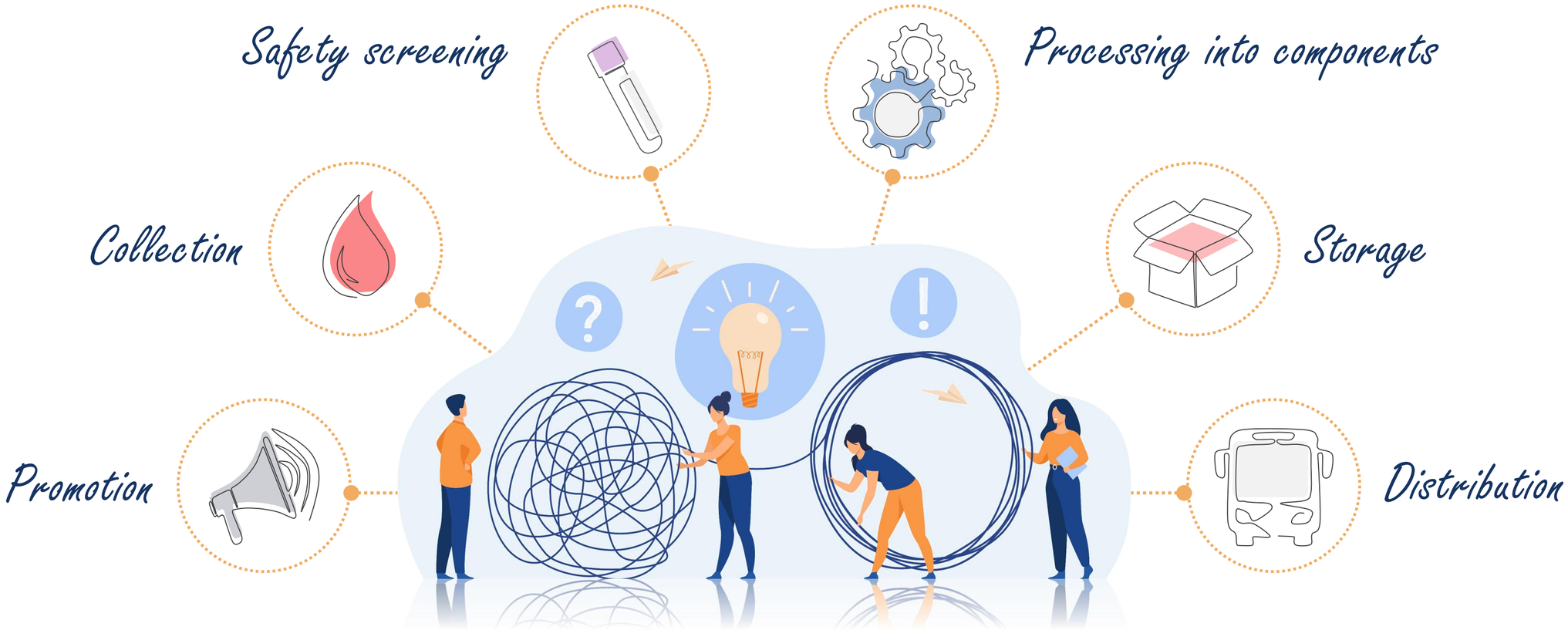
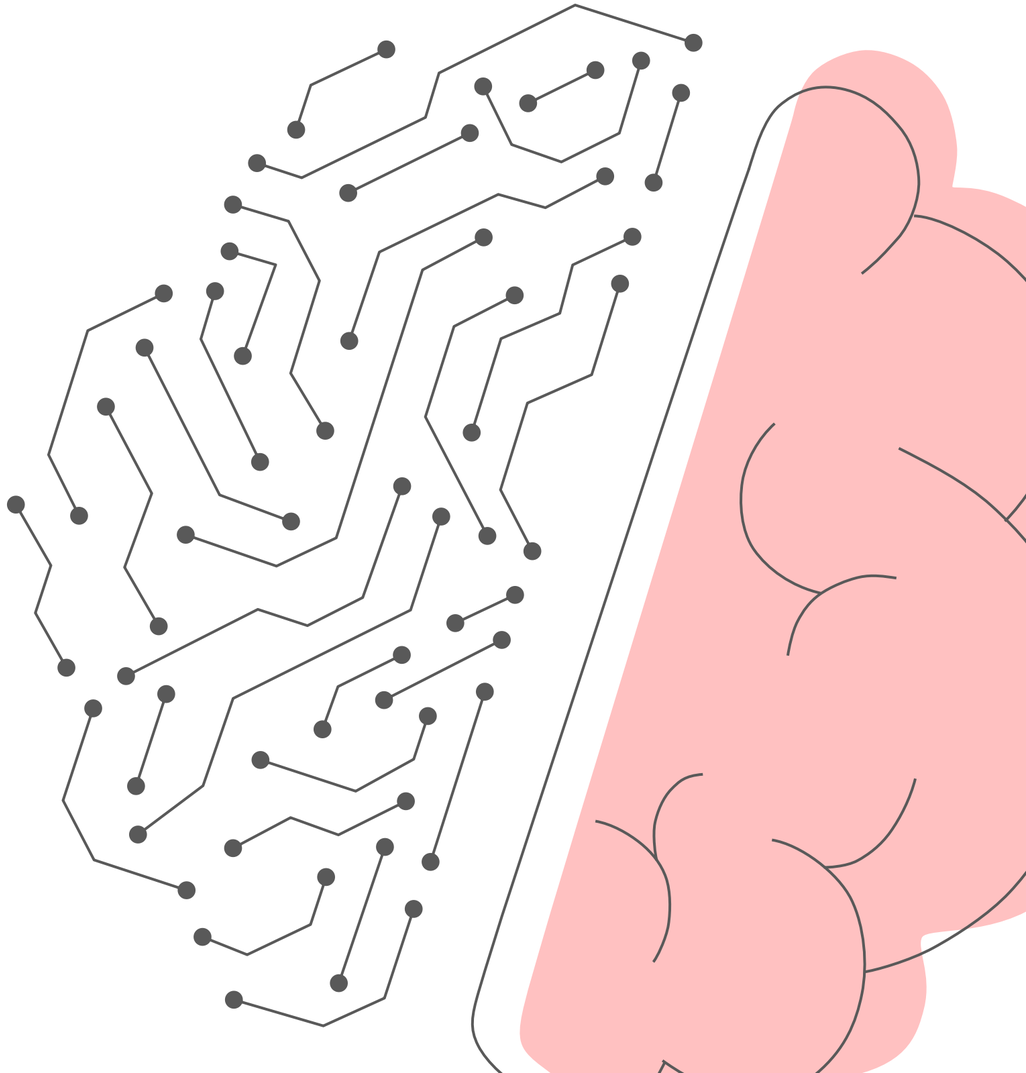


2 | Artificial Intelligence



2 Artificial Intelligence

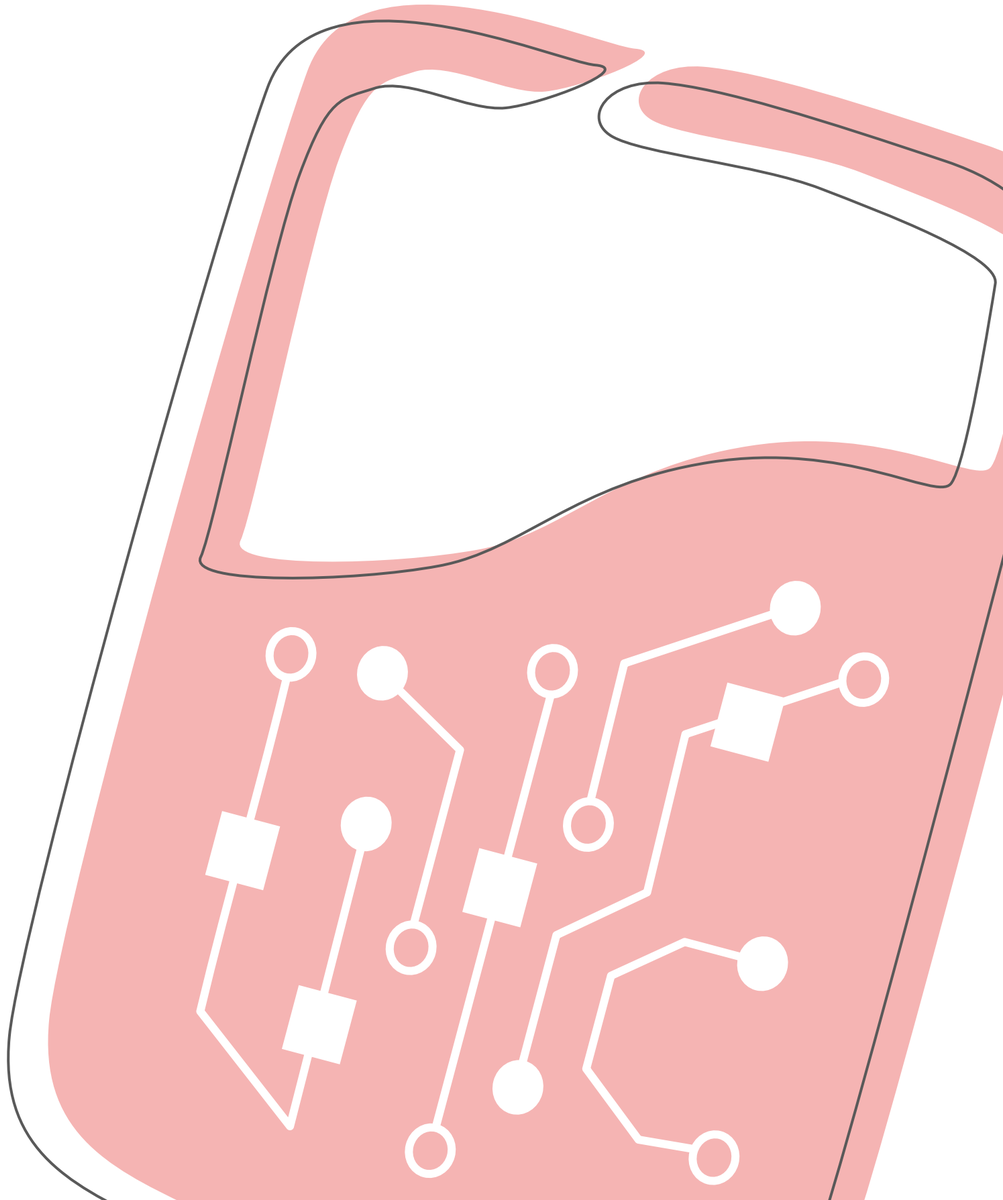
Efficient analysis

Decision-making

Objective information

Process optimization

3 The *BST-Analytics* Initiative



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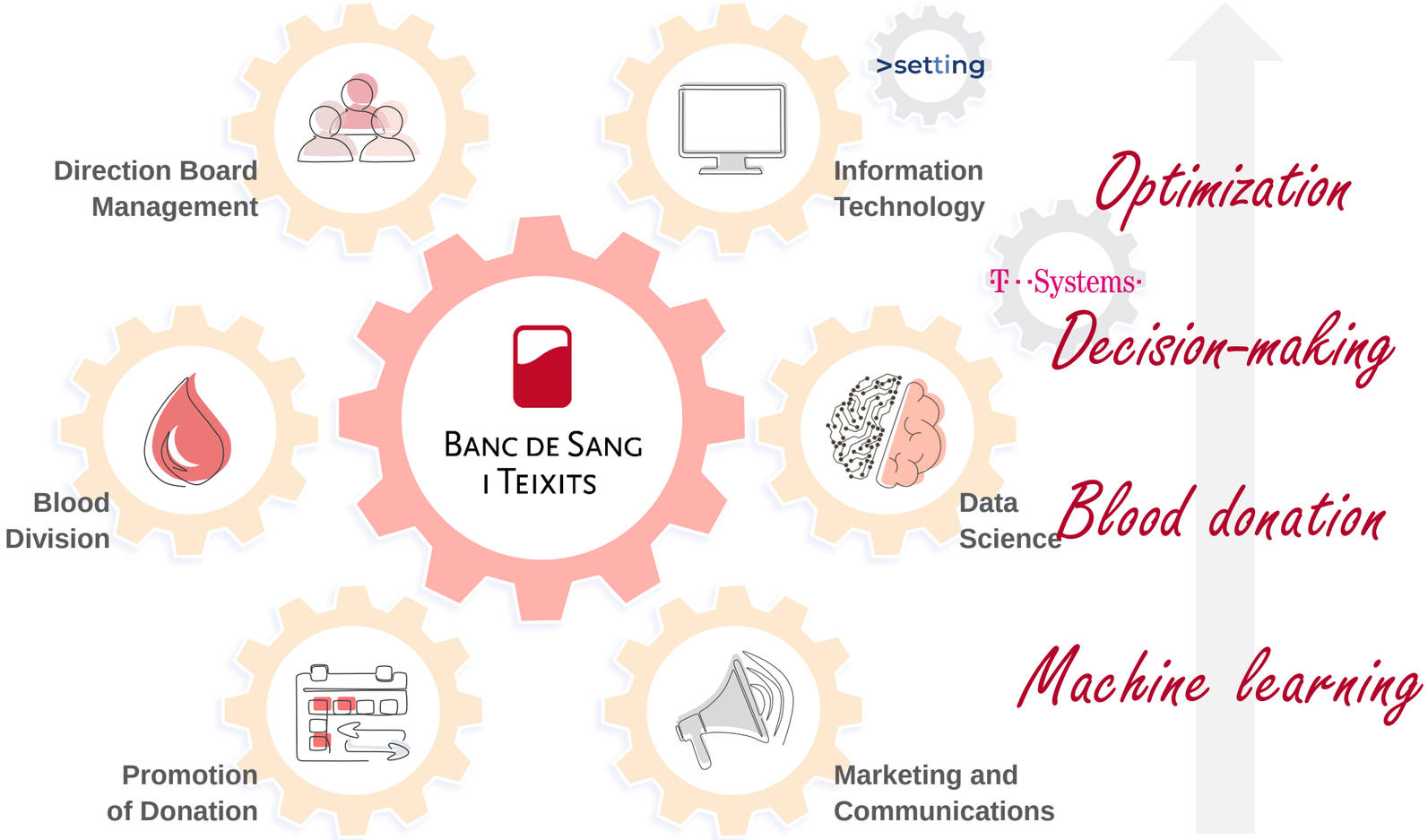

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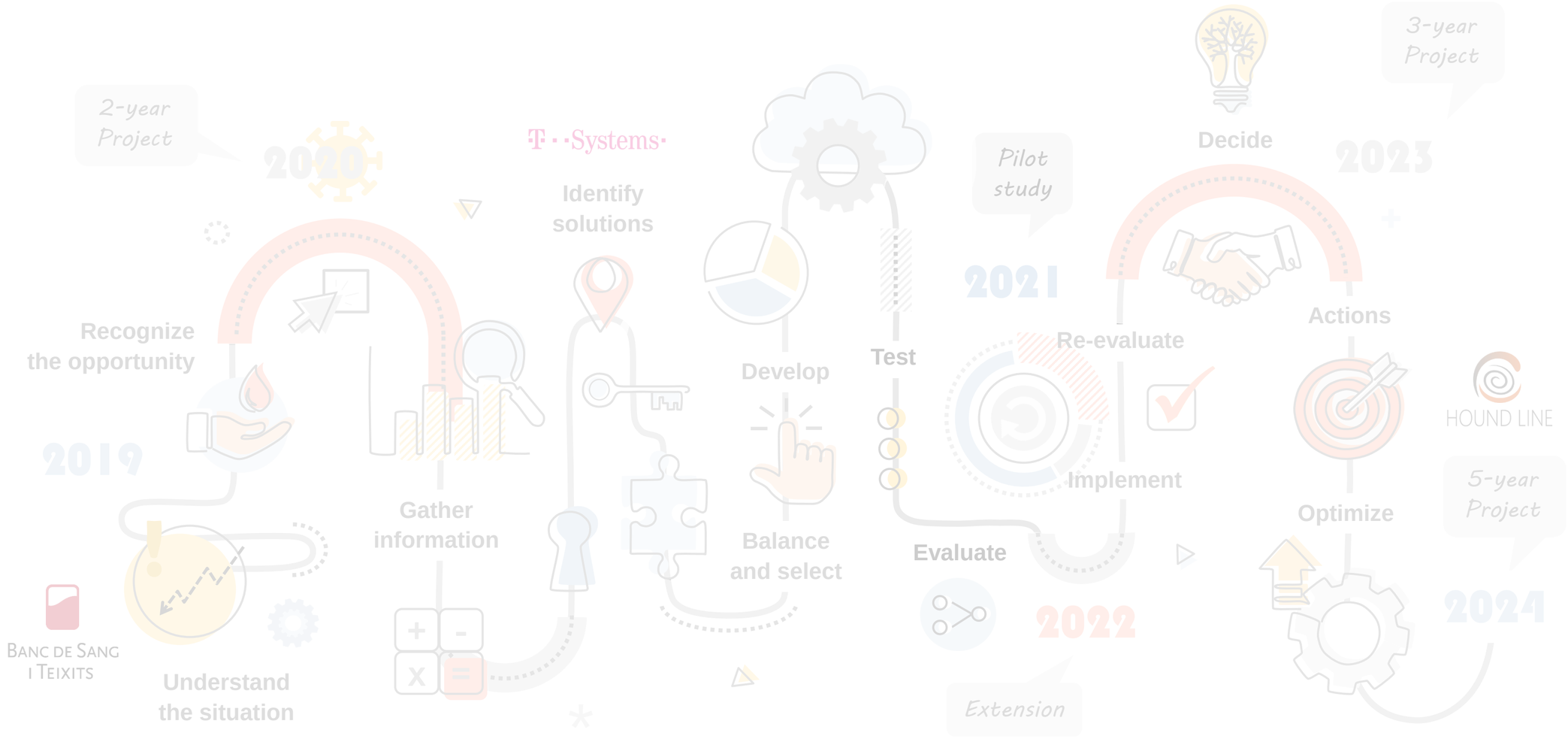

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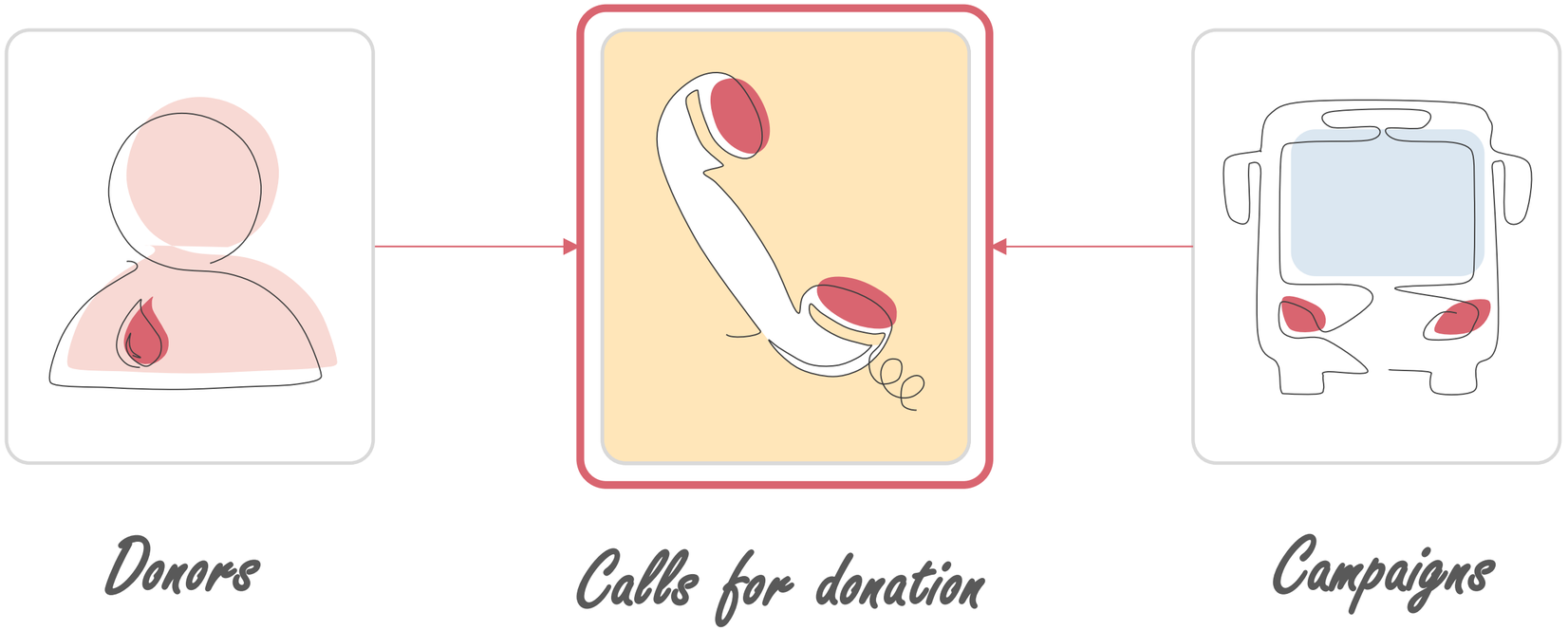
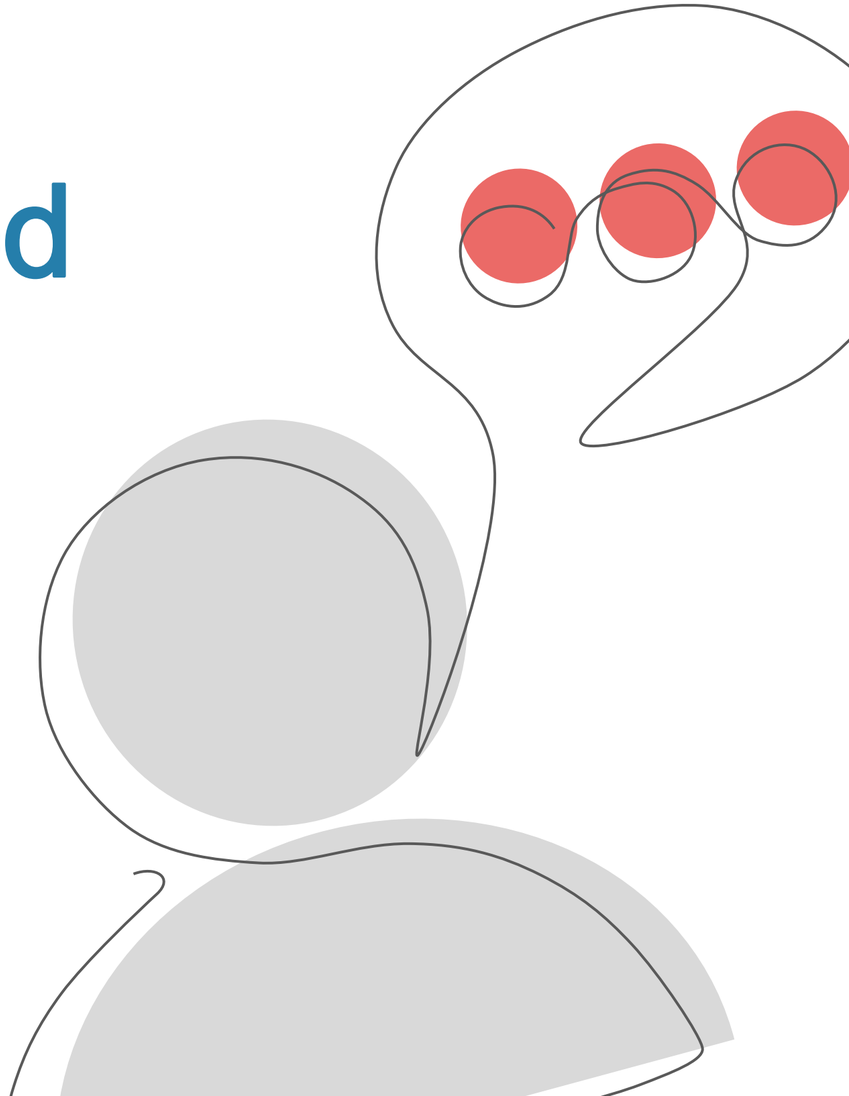


Donors

Calls for donation

Campaigns

4 Prediction of blood donor's response



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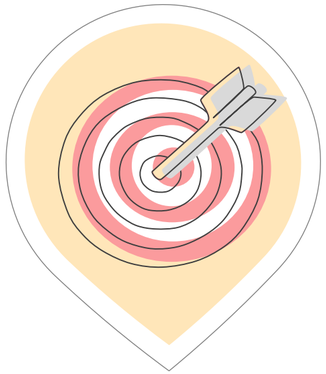
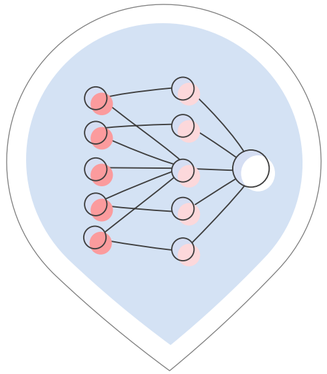


Objective

Anticipate which donors will attend the call for donation, given a specific campaign



Algorithms

Machine Learning

- Clustering
- Classification

Data

BST database (2015 to 2023)

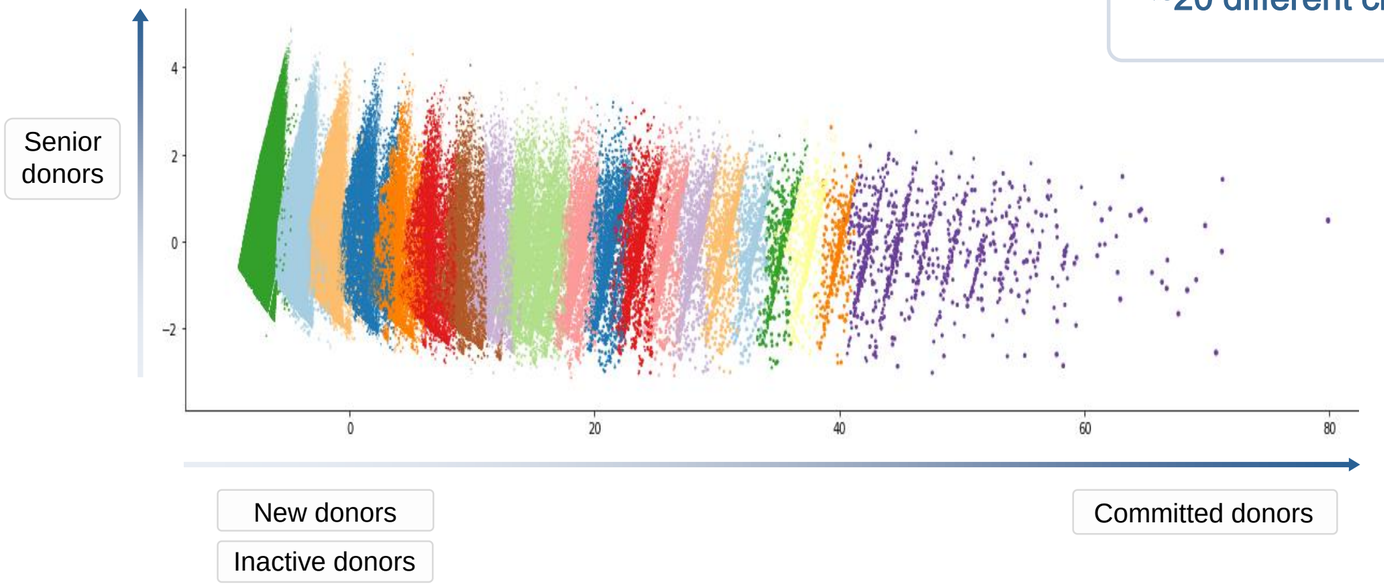
- > 20 million calls
- > 2 million blood donations
- ~ 500.000 donors

4 Prediction of donor's response

4.1 Profile of blood donors

Principal components analysis (PCA): dimensionality reduction

Unsupervised Machine Learning: Clustering with HDBSCAN



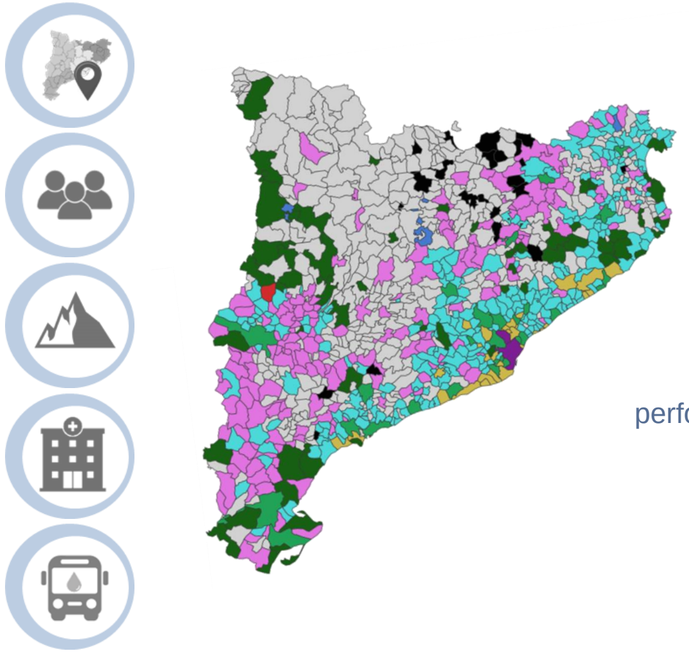
4 Prediction of donor's response

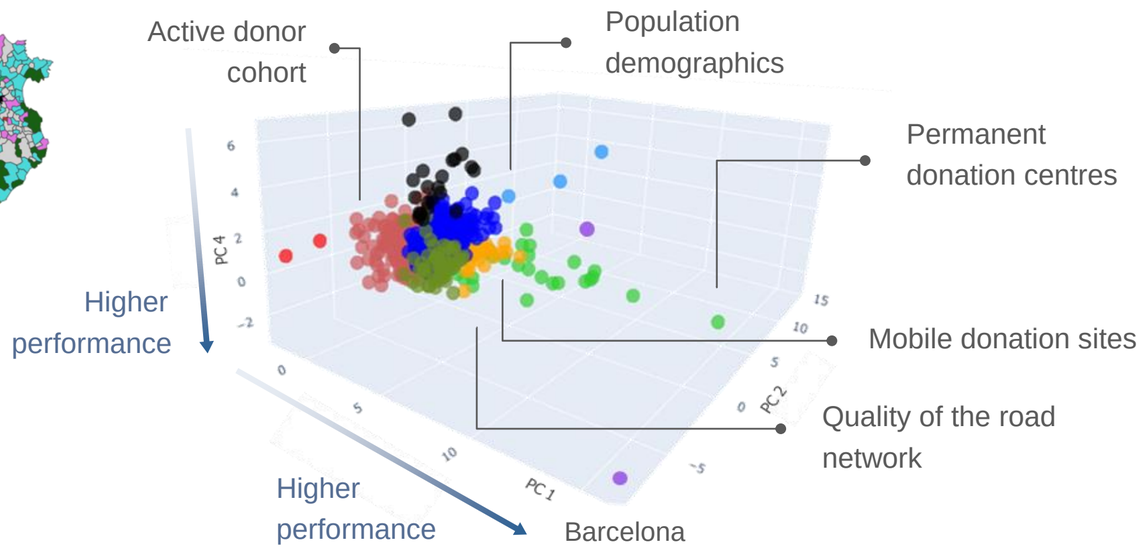
4.2 Profile of localities

Principal components analysis (PCA): dimensionality reduction

Unsupervised Machine Learning: Agglomerative Clustering

~8 different clusters

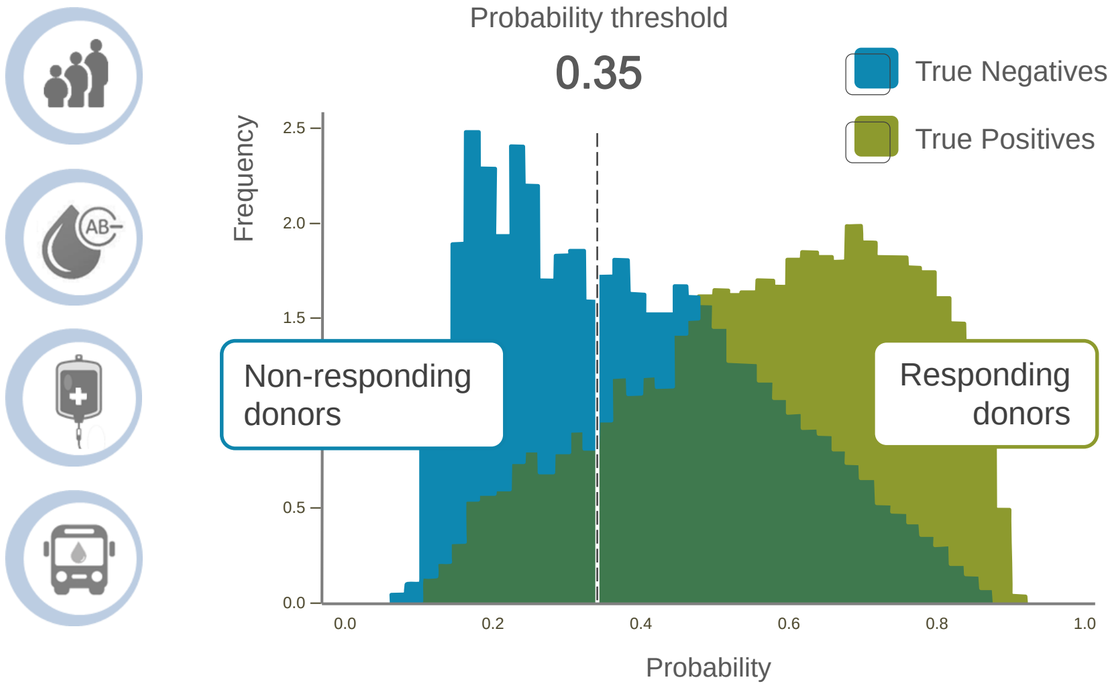




4 Prediction of donor's response

4.3 Prediction of donor's response

Supervised Machine Learning: Classification with XGBoost



Performance

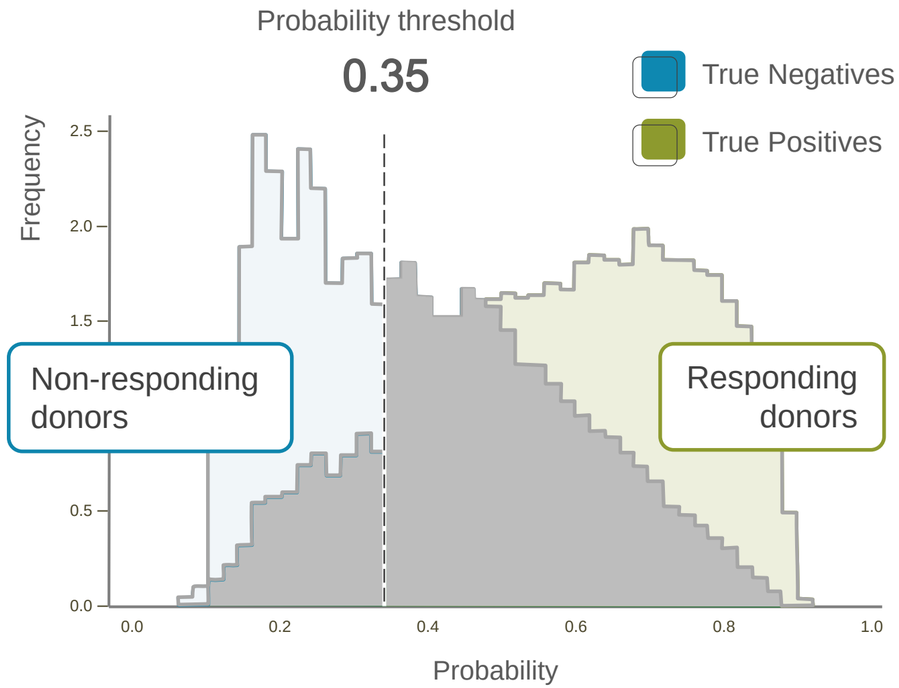
Recall 86%

Accuracy	Precision
65%	61%

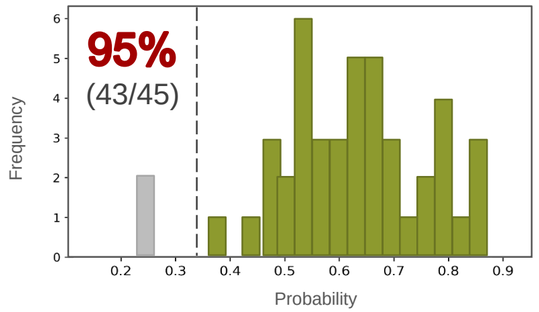
4 Prediction of donor's response

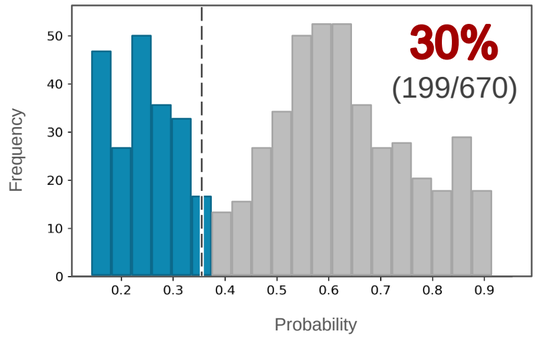
4.3 Prediction of donor's response

Supervised Machine Learning: Classification with XGBoost



Retrospective validation





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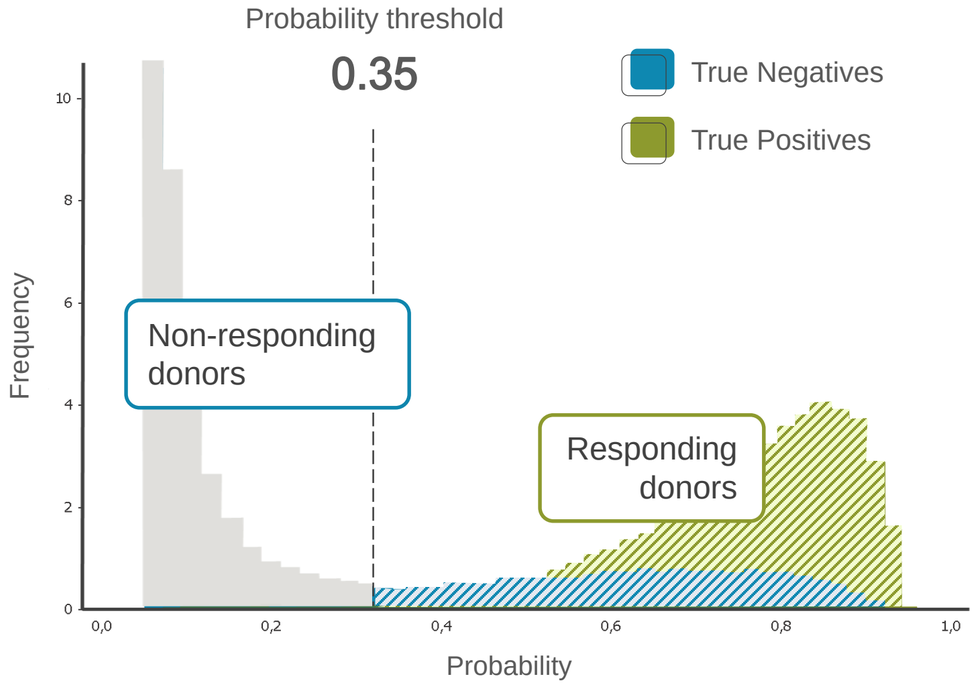


Performance

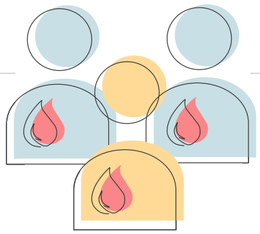
Recall 98.6%

Accuracy	Precision
84.2%	76.4%

5 Implementation and validation of the automated system

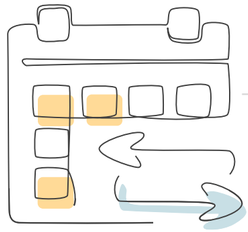
5 Implementation and validation

5.1 Selection of donors

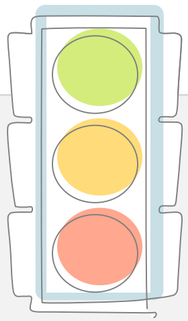


- Active donors
  - 18 – 69 years
  - ≥ 1 donation
  - No exclusions

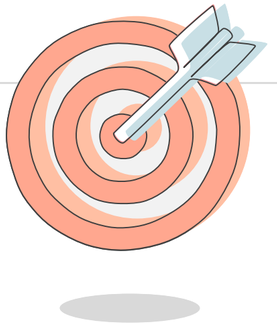
- Live in the area of influence
- ≥1 donation in the campaign



- Donation break (2 months)
- Maximum donations per year (3/4)
- Communication break (60 days)



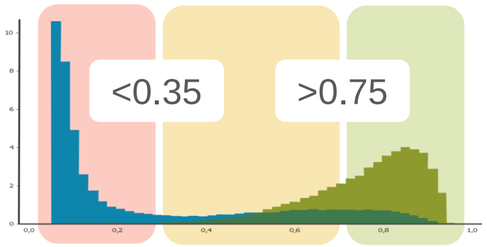
- Model prediction
- Simulation
- % of each probability segment

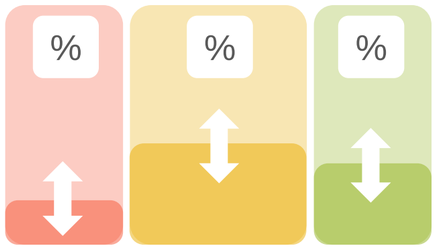


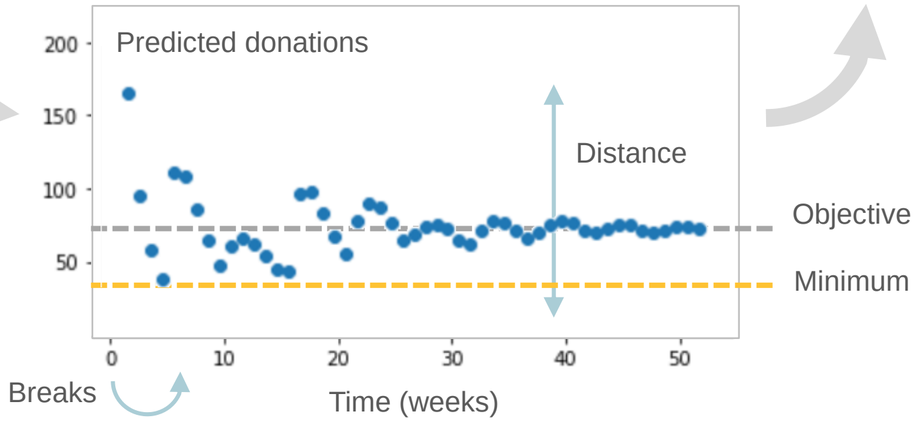
- Target number of donations

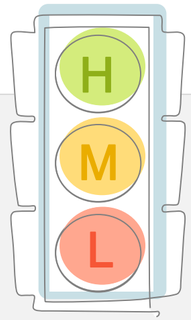
5 Implementation and validation

5.1 Selection of donors









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- Simulation
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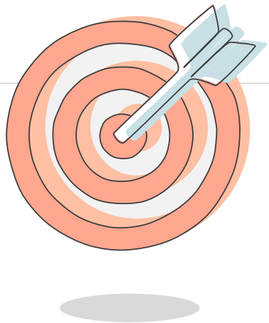


- Target number of donations
- Cohort sustainability

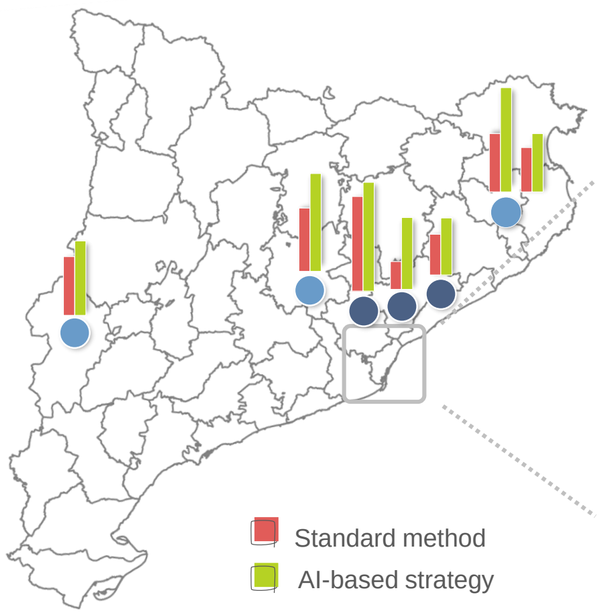
5 Implementation and validation

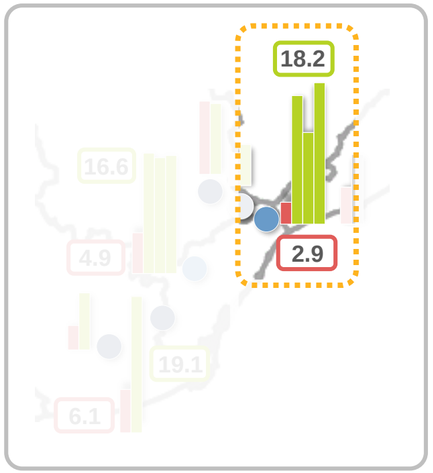
5.2 Phase I: Targeted donation campaigns

5
Permanent donation centres

7
Mobile donation locations

Responding donors / All donors (%)





- **Increased response** in 93% of actions (13/14)
- **0.1 to 6.3-fold increase**

5 Implementation and validation

5.3 Phase II: Three hospitals of Catalonia

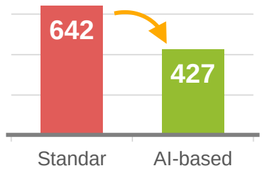
3
Permanent donation centres

12
Months
Weekly

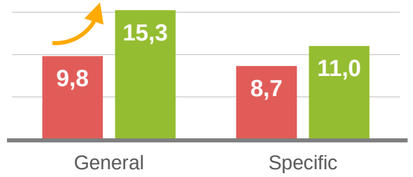
Badalona

University Hospital
Germans Trias i Pujol

Called donors **(n)**



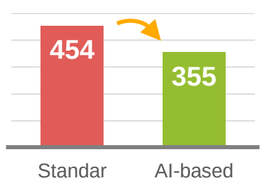
Responding donors / All donors **(%)**



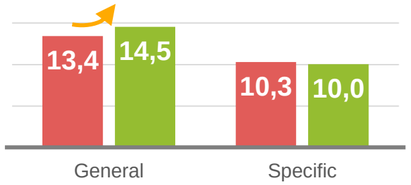
Girona

University Hospital
Doctor Josep Trueta

Called donors **(n)**



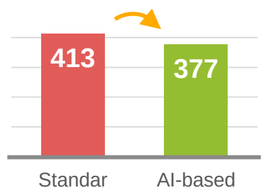
Responding donors / All donors **(%)**



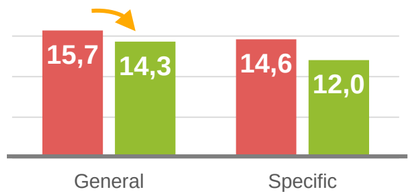
Lleida

University Hospital
Arnau de Vilanova

Called donors **(n)**



Responding donors / All donors **(%)**



General
Donation in any campaign

Specific
Donation in the target campaign

Standard method
AI-based strategy

5 Implementation and validation

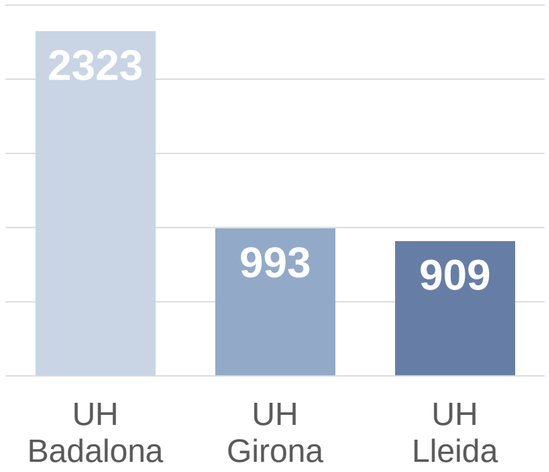
5.4 Influential factors

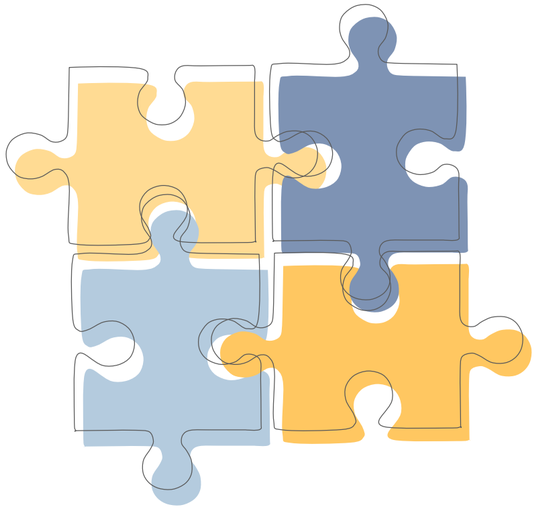
Area of influence

Population demographics

Location of venues

Number of active donors





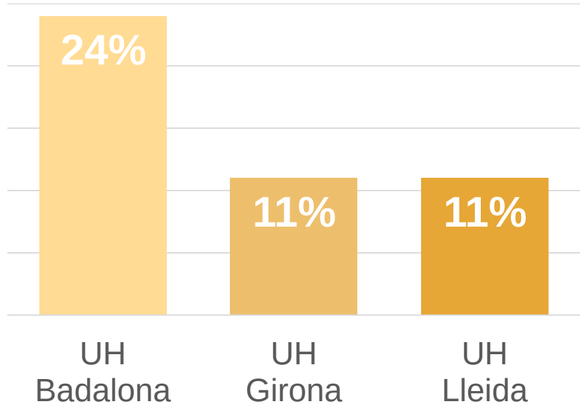
Donor selection algorithm

Number of donors to call

Communication and donation breaks

Campaign assignment vs. preference

Increase in general vs. specific response

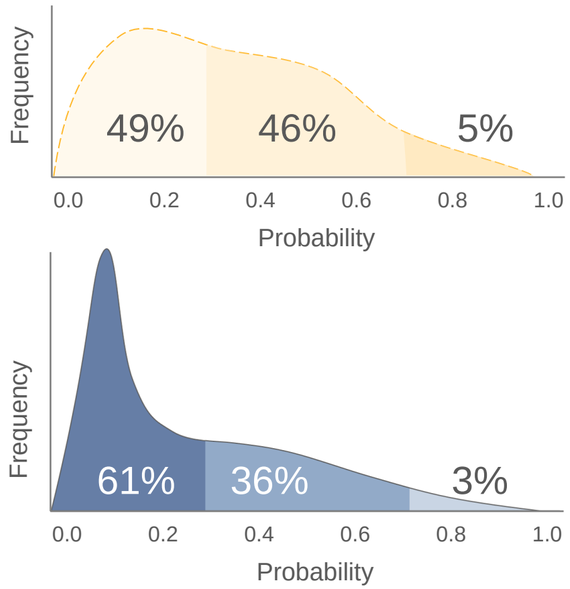


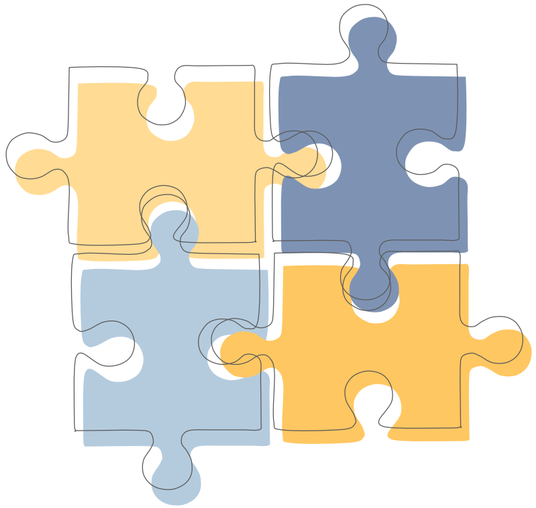
5 Implementation and validation

5.4 Influential factors

Profile of donors

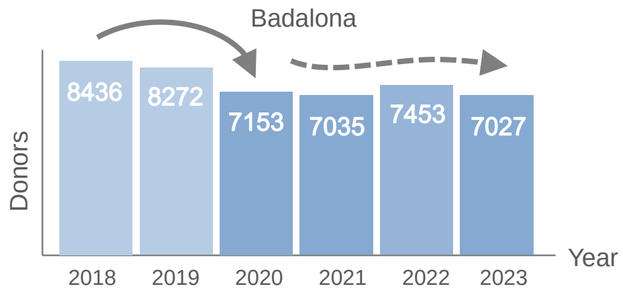
Probability distribution

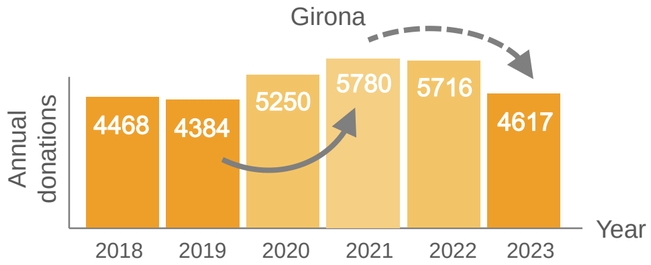




Behavioural patterns

Covid-19



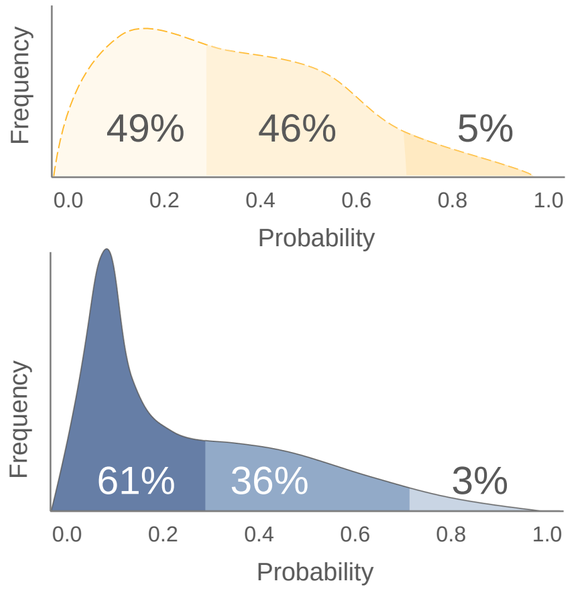


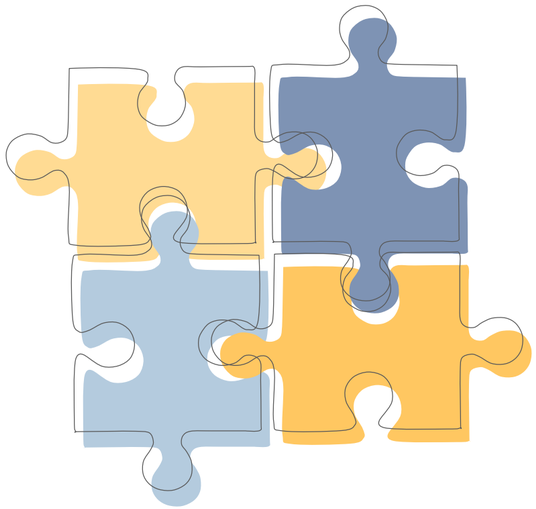
5 Implementation and validation

5.4 Influential factors

Profile of donors

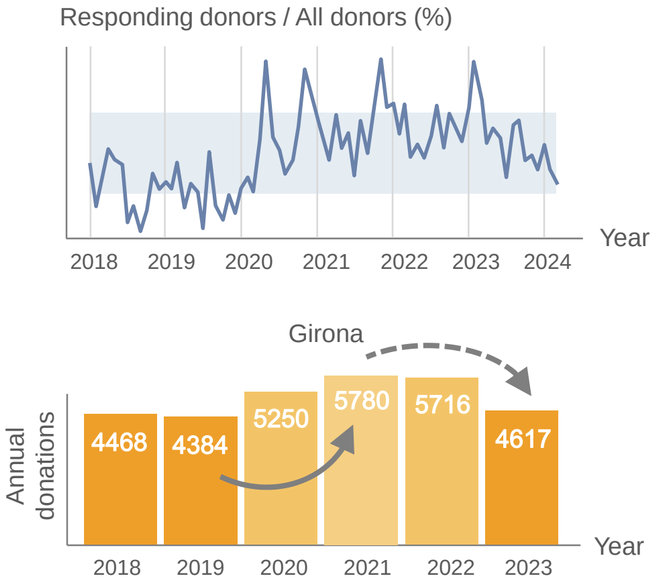
Probability distribution



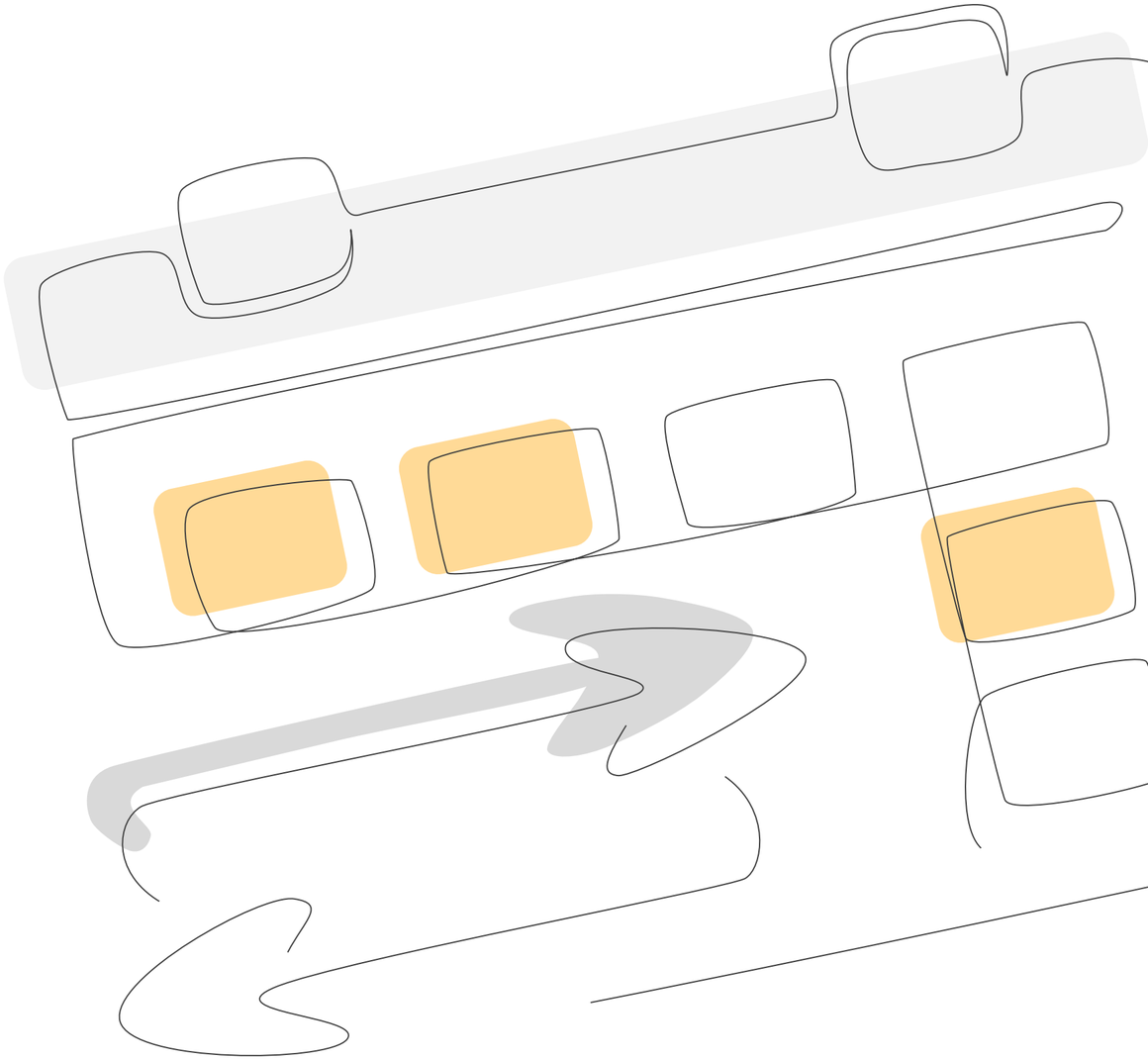


Behavioural patterns

Covid-19



6 Next steps



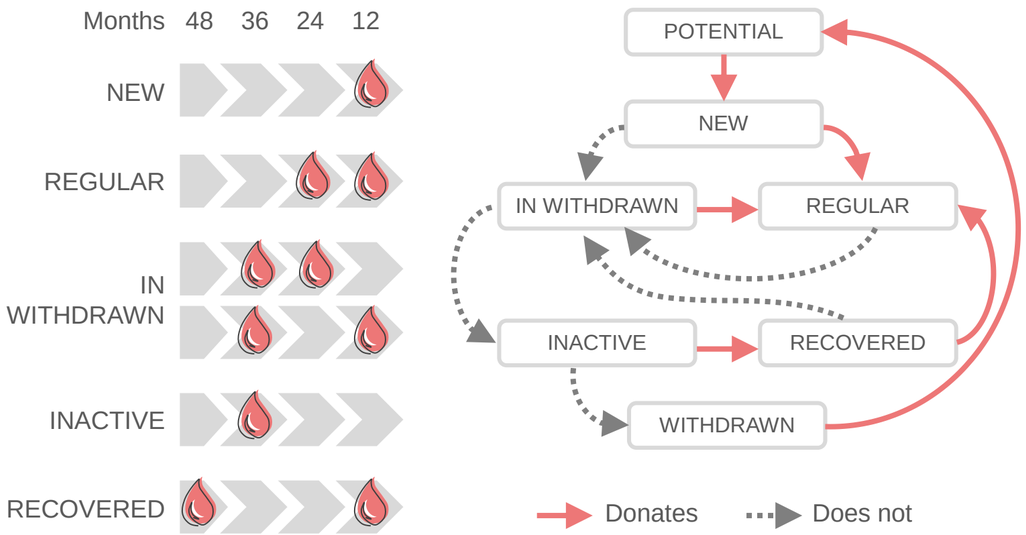
6 Next steps

6.1 Donor selection algorithm

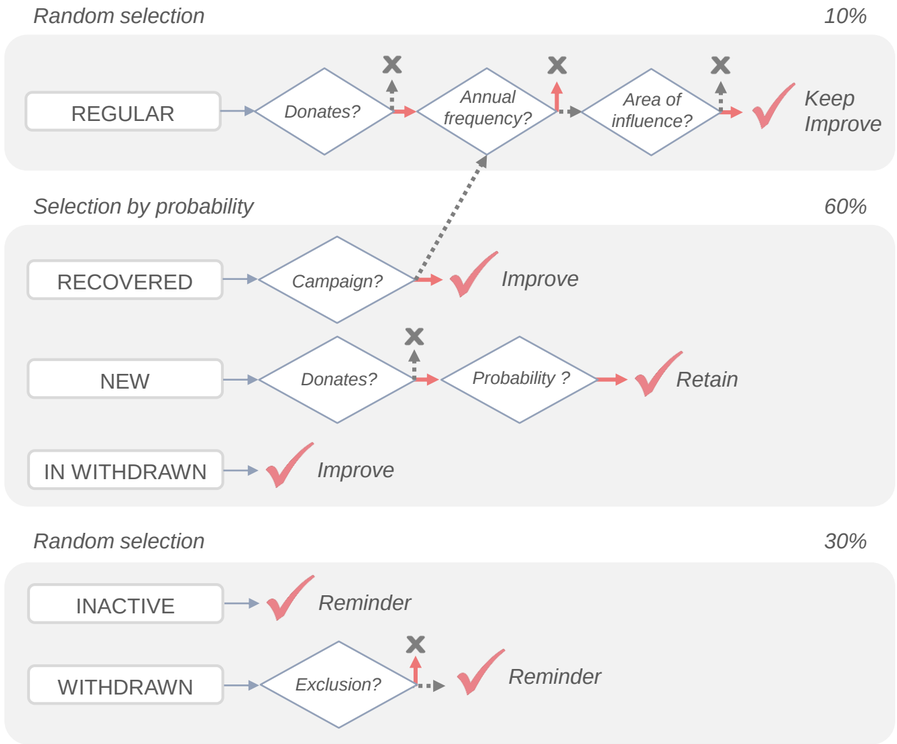
Donor transitions and segmentation

Project DOMAINE

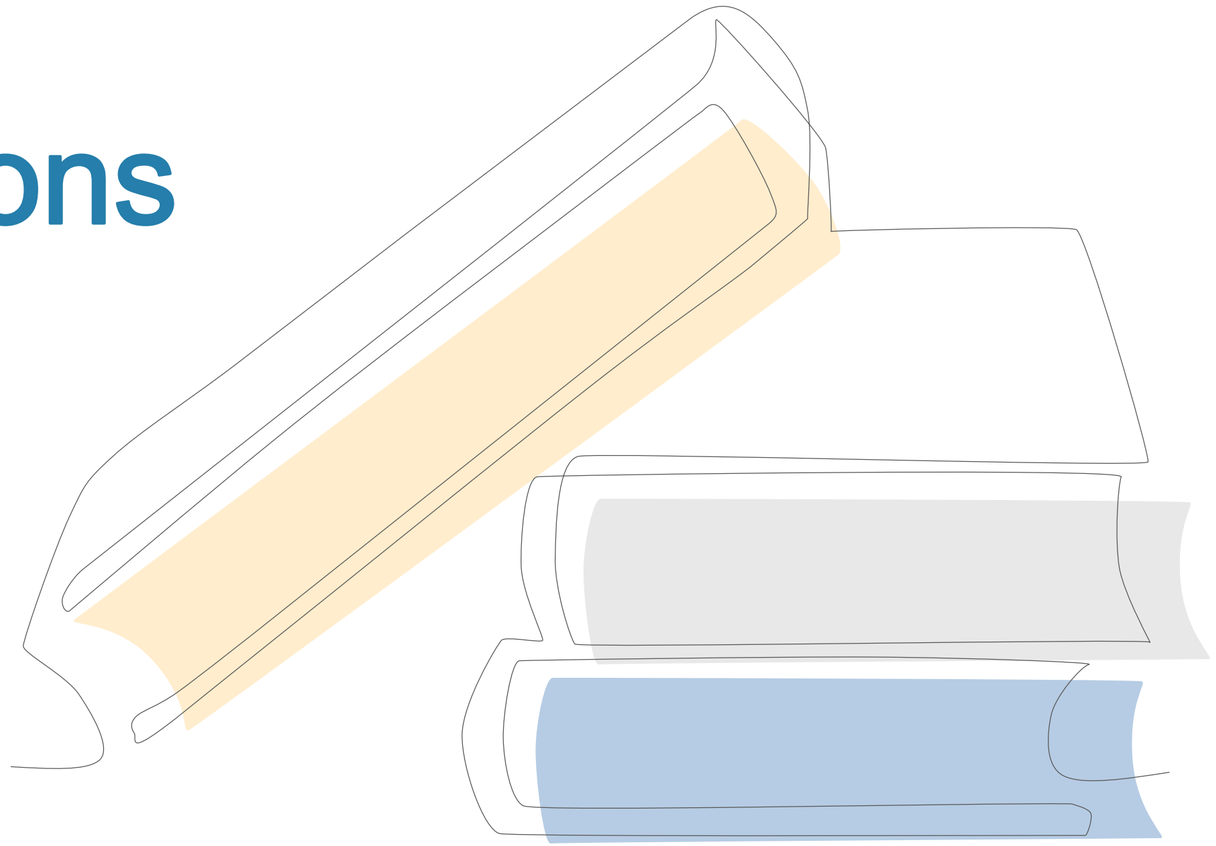
European **Do**nor **Ma**nagement **in** **E**urope



Selection algorithm



7 Conclusions



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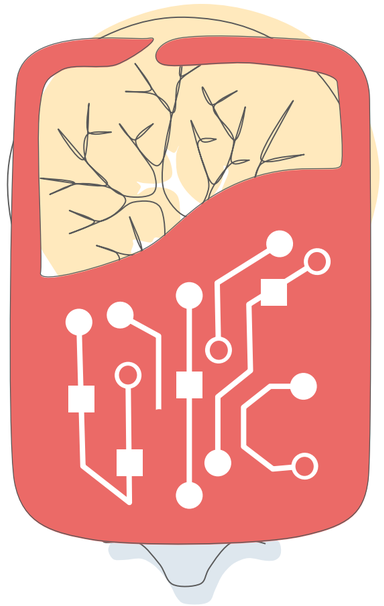
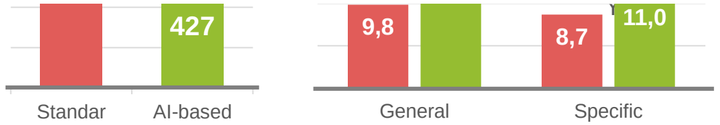


1. AI-based prediction model capable of **discriminating which donors will attend the call for donation**.

2. **Additional factors influence in the final outcome** and need to be accounted for. It Is necessary to study how these factors influence donation to fine-tune the system.

3. The automated, AI-based system developed has great potential to **optimize the calling process** for donation and improve the **efficiency and sustainability** of the distribution of donors and donations in Catalonia.

4. **AI-based strategies are a powerful asset** to improve the processes that guaranty the mission of supplying blood components to the population.



Acknowledgements

Banc de Sang i Teixits

Salut/

Jesica Muñoz Corullón
Jose Antonio Pellejero Gómez
Jordi Gual Obradors
Carlos Hobeich Naya
Pilar Córdoba Tejero
Cristina Valverde Garcia
Eva Alonso Nogues
Emili Colom Gordillo
Elisabet Buxó Medrano
Francisco Vidal Pérez
Antoni Masi Roig

T··Systems·

Francisco Rodríguez Milán
Javier Aguilera Aguilera

>setting

Carles Pi López

SWISSTRANSFUSION
CONGRÈS ANNUEL 2024

BLUTSPENDE SRK SCHWEIZ
TRANSFUSION CRS SUISSE
TRASFUSIONE CRS SVIZZERA

TRANSFUSION CRS FREIBURG
BLUTSPENDE SRK FRIBOURG

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Thank You!