Harnessing Data Science for Diagnosis in Health

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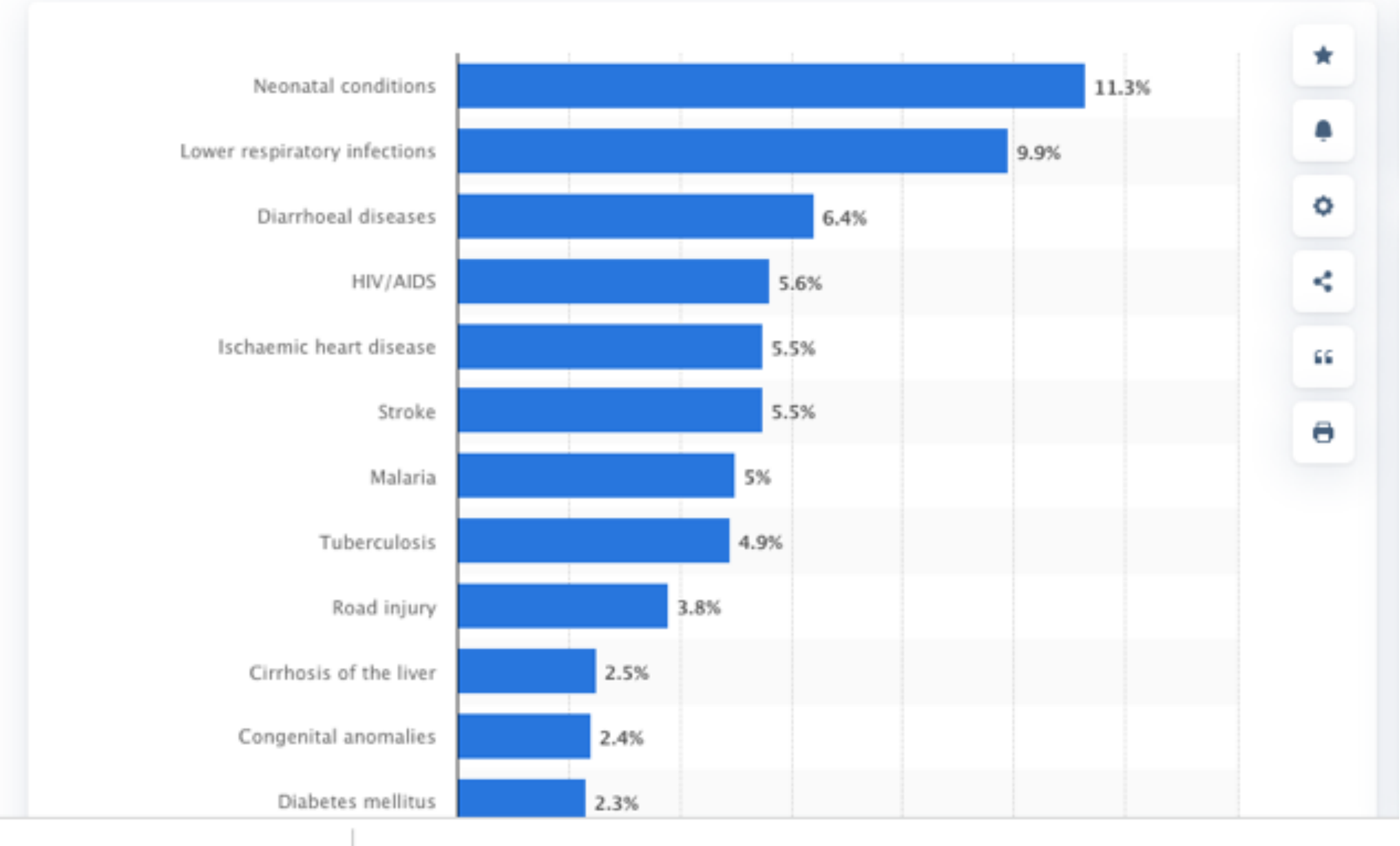
Short bio

- PhD in computer science and networks
- Associate professor at Université Alioune Diop, Senegal
- Member of the Medical Informatics and ICTL research group
- Holding and co-coordinating the AI4CARDIO project funded by AFD
- Project Engineer in the Responsible AI Lab hosted by KNUST and funded by IRDC and SIDA

Healthly vs. Unhealthly

But diseases are always there ….

Distribution of the leading causes of death in Africa in 2019



Source :https://www.statista.com/statistics/1029337/top-causes-of-death-africa/

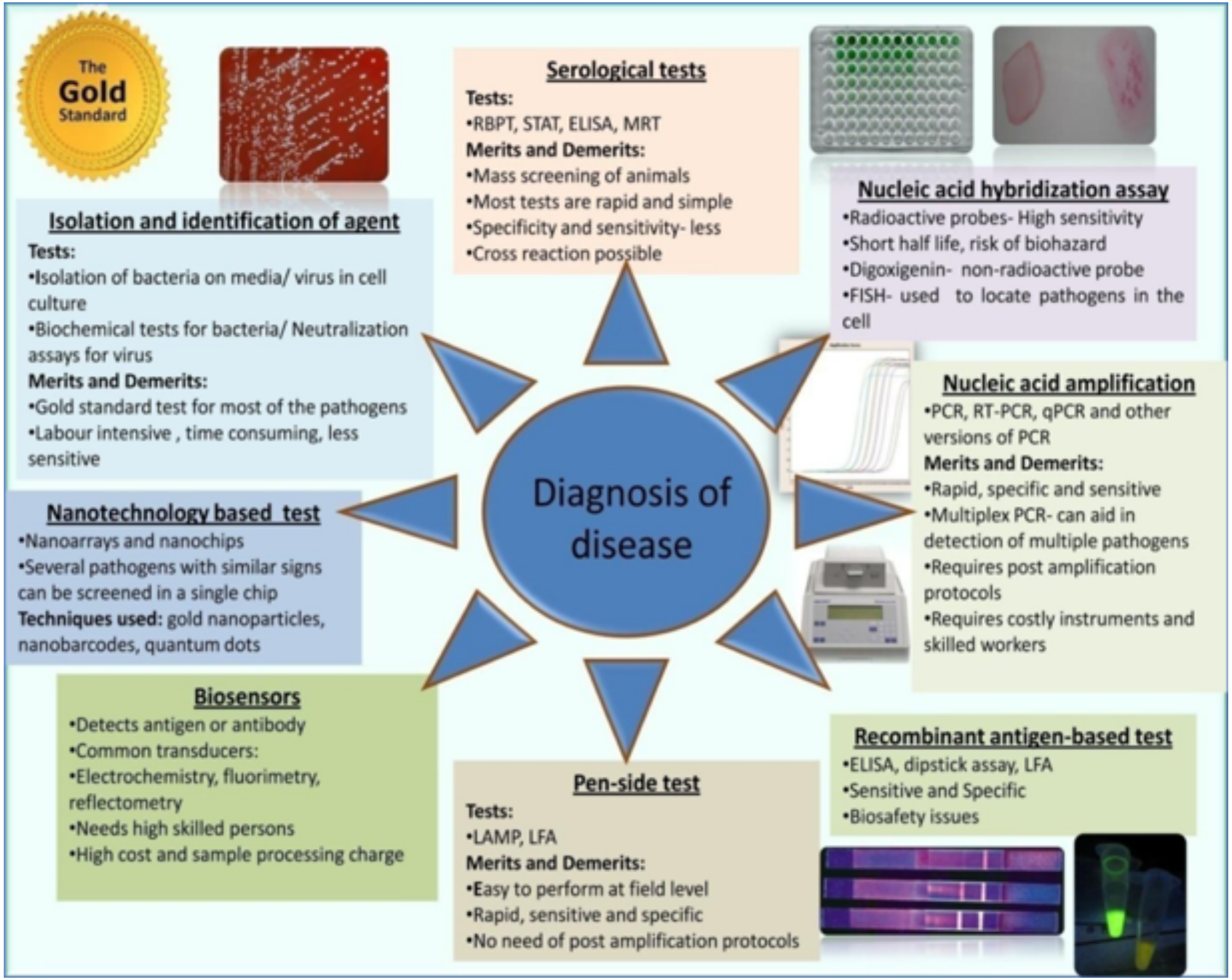
Diagnosis is a key in disease identification and treatment

Early and accurate diagnosis of infectious disease is critically important because:

- Diagnosis can improve the effectiveness of treatments and avoid long-term complications for the infected patient.
- Undiagnosed patients can unknowingly transmit the disease to others. Early diagnosis can help to prevent or stop an outbreak.
- Widespread overuse and misuse of antibiotics contribute to antibiotic resistance. Diagnostic tests can determine when antibiotics are an appropriate treatment—and when they are not.

(Source : MEDICAL TECHNOLOGY life changing innovative)

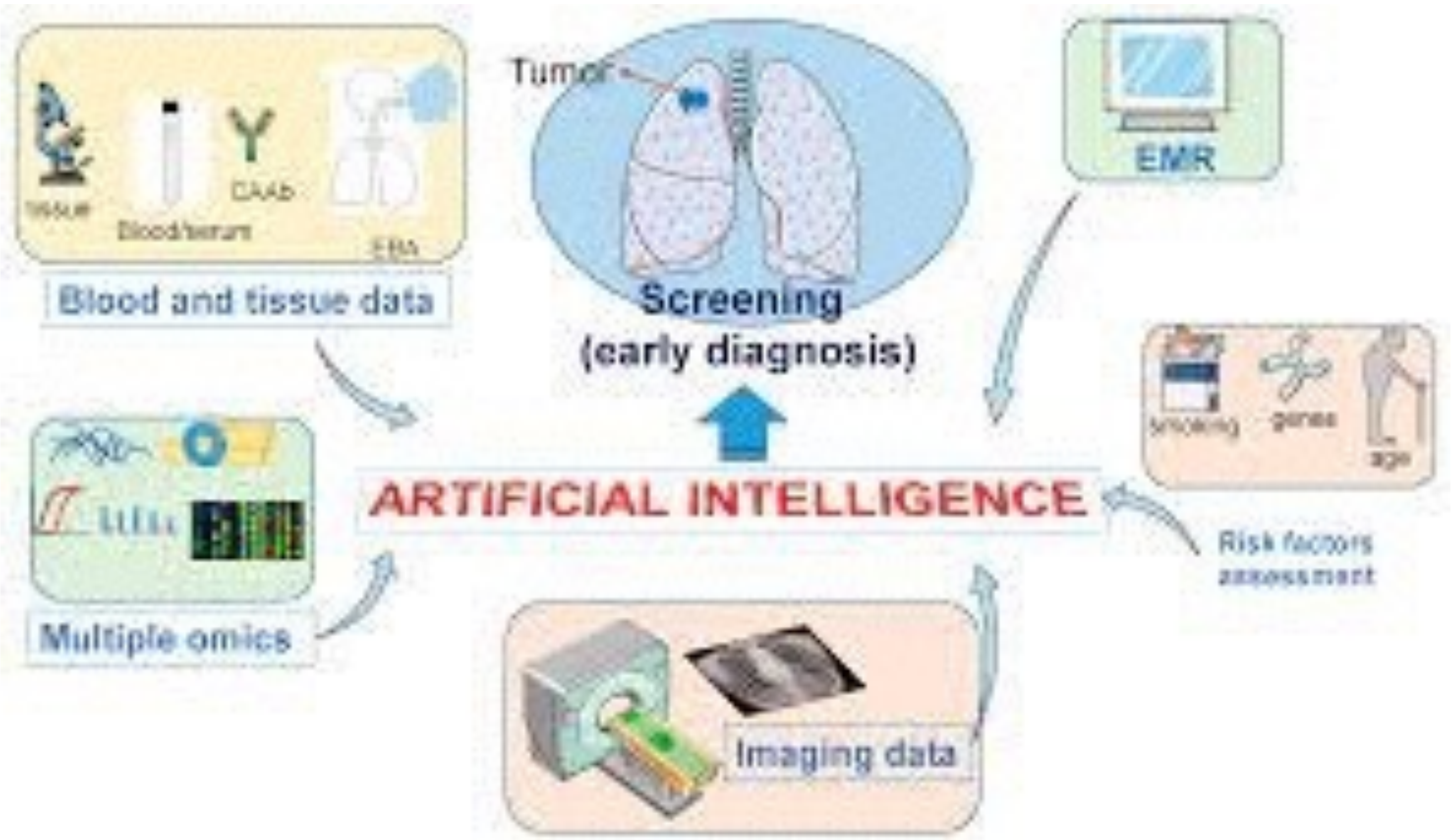
Types of diagnostic methods



Challenges of the diagnosis of diseases in Africa

- Lack of appropriate diagnosis tools
- Lack of enough or well trained specialists

AI-based disease diagnosis



Outline

Use cases

Data Sources

Analysis methodology & Data Science Tools

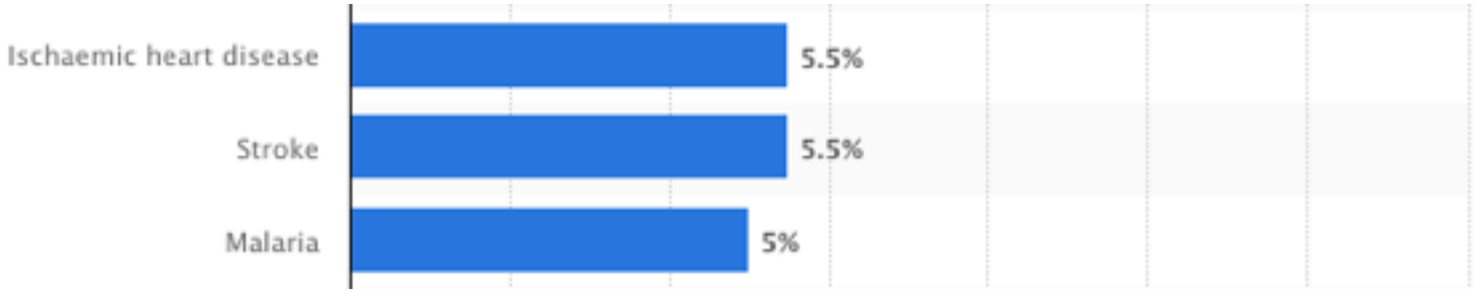
Prediction of Malaria

Prediction of risk factors for CVDs

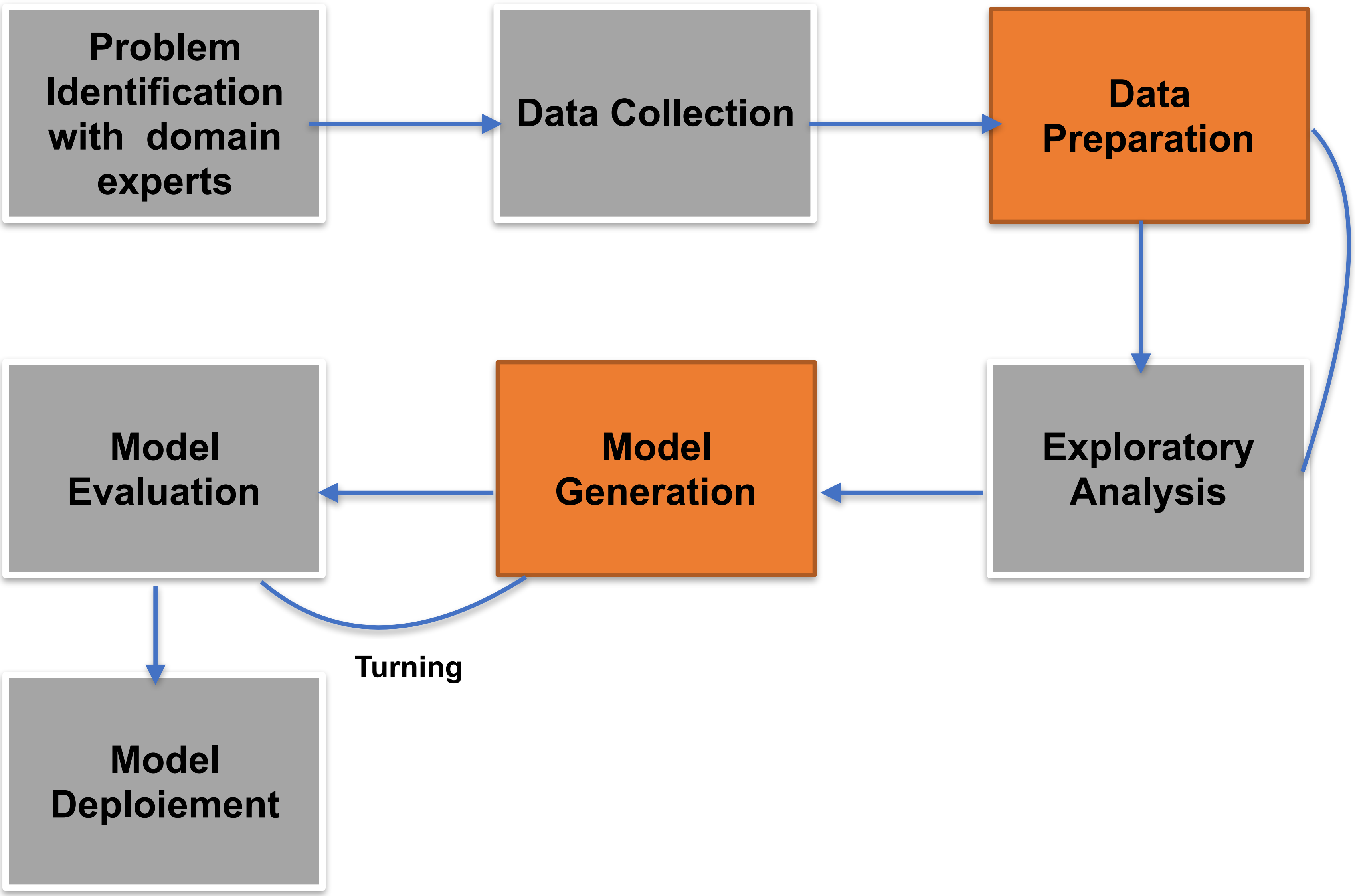
Challenges

Use cases

- Prediction of Malaria using ML algorithms
- Prediction of stoke



Analysis Methodology

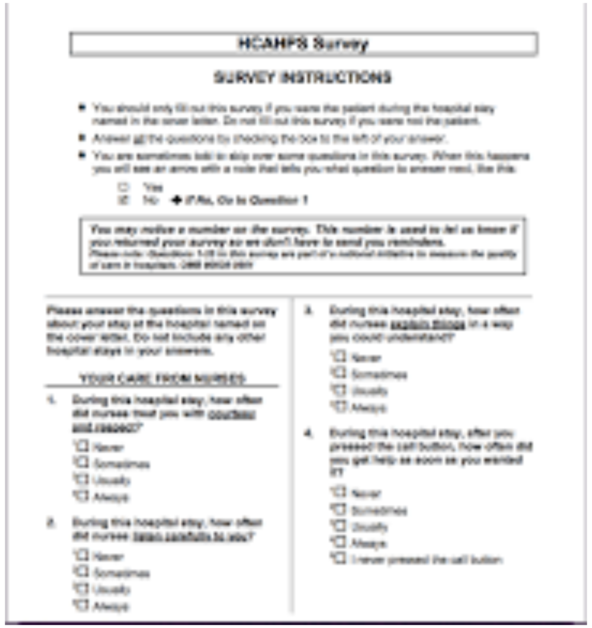


Used Data Science Tools

Data Sources

Two main data sources

Existing patient records on registries



HCAHPS Survey

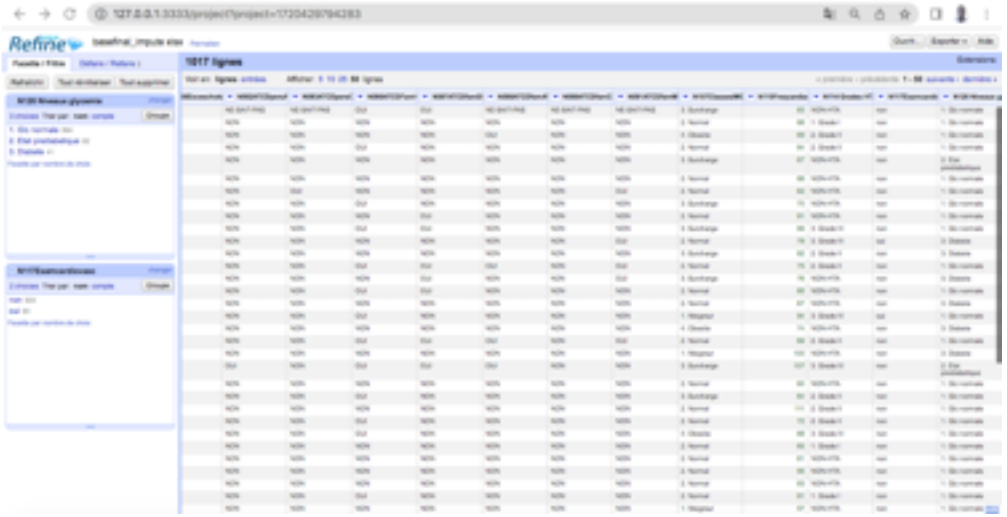
SURVEY INSTRUCTIONS

YOUR CARE FROM NURSES

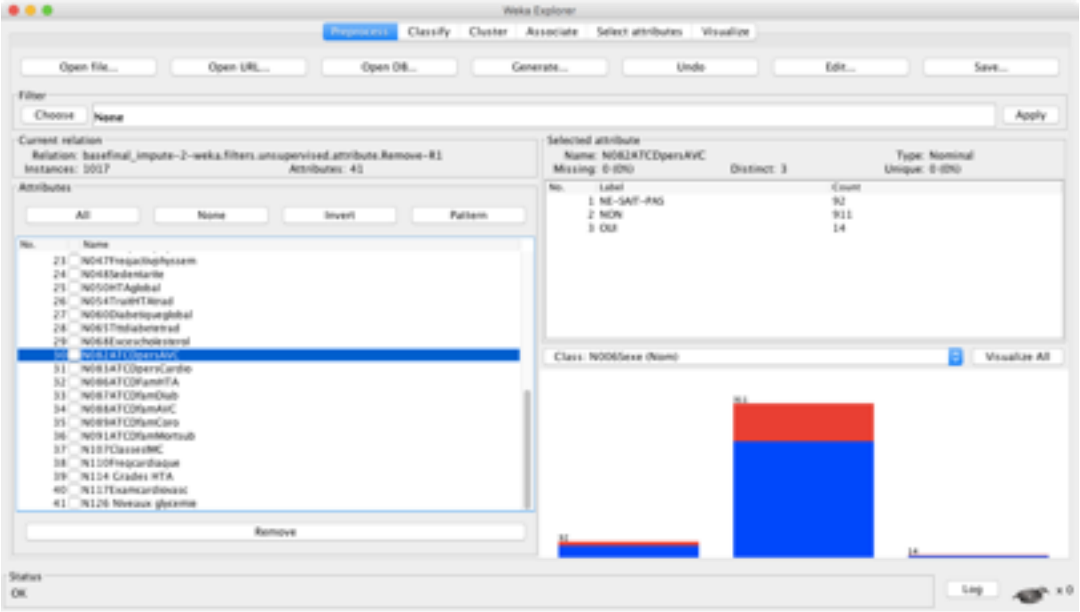
1. During this hospital stay, how often did nurses treat you with courtesy and respect?
   - Never
   - Sometimes
   - Usually
   - Always
2. During this hospital stay, how often did nurses listen carefully to you?
   - Never
   - Sometimes
   - Usually
   - Always
3. During this hospital stay, how often did nurses explain things in a way you could understand?
   - Never
   - Sometimes
   - Usually
   - Always
4. During this hospital stay, after you pressed the call button, how often did you get help as soon as you wanted it?
   - Never
   - Sometimes
   - Usually
   - Always
   - I never pressed the call button

Surveys

Demo



OpenRefine for data preprocessing
(https://openrefine.org/)



Weka for exploratory analysis & Model Generation
(https://www.cs.waikato.ac.nz/ml/weka/)

Malaria prediction

Can we do better with ML models than Rapid Diagnostic Test using sign and symptom data ?

Malaria prediction

Data description

Variables	Observations	Variables types		Classes	
		Numeric	Boolean	Malaria	Not Malaria
16	21083	2	14	614	20469

Table 1. Main characteristics of our real-world dataset of patients in Senegal

Malaria prediction

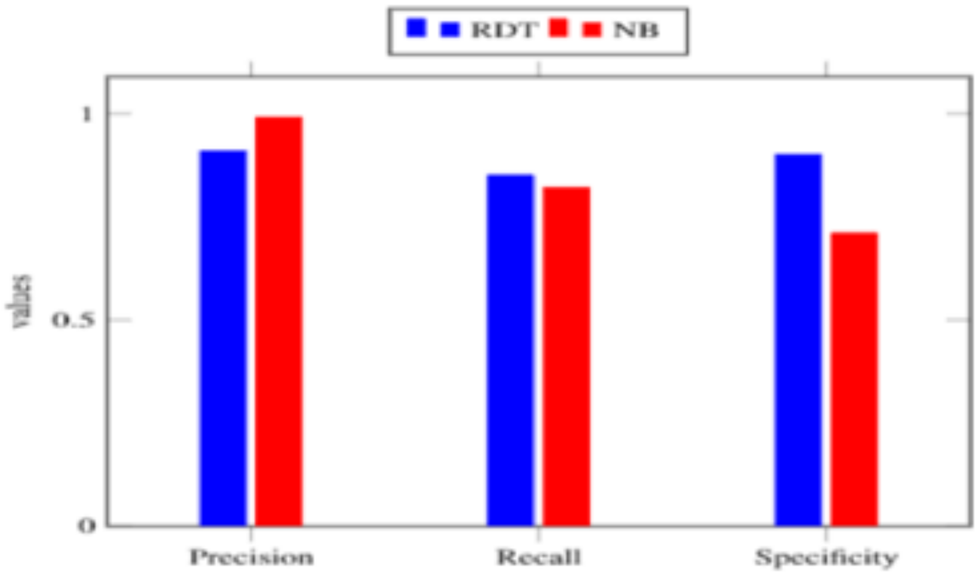
Data preparation

- Data cleaning and normalization
- Feature extraction based on experts of the domain
- Missing data imputation
- Over-sampling of data

Malaria prediction

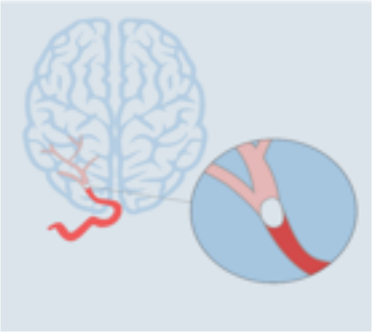
Models and performance

ML Algorithms	Precision	Recall	F1-score	AUC	Specificity
Decision Tree	0.99	0.84	0.91	0.76	0.58
Random Forest	0.99	0.84	0.91	0.76	0.60
Logistic Regression	0.90	0.78	0.88	0.84	0.75
Naive Bayesian	0.99	0.82	0.90	0.84	0.71
Support Vector Machine	0.99	0.86	0.92	0.80	0.62
Artificial Neural Networks	0.99	0.84	0.91	0.79	0.65



Prediction of Stroke

Can we predict accurately the type of stroke based on risk factors with ML?



Prediction of Stroke

Data description

Name	Value
Rows	1,018
Columns	43
Discrete columns	32
Continuous columns	11
All missing columns	0
Missing observations	1,210
Complete Rows	543
Total observations	43,774

Prediction of Stroke

Data preparation

- Removal of useless attributes
- Data values normalization
- Missing data imputation
- Handling inconsistencies

Prediction of Stroke

Models & Performance

Algorithm	Accuracy (%)
K-Nearest Neighbors	95
Random Forest	93
Decision Tree	86

General Challenges

Deploiement and use:

- Design the physical equipment that will host the model
- Evaluate the model in a real condition
- Train doctors

Other challenges:

- The lack of in-domain datasets.
- Sharing the data and privacy.
- Interpretability of the models.
- Sensitivity of medical scenarios

Thanks
Any questions?

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https://sites.google.com/a/uadb.edu.sn/mlba/