ABSTRACT

This project aims to evaluate changes in the prescribing behaviors of doctors, focusing on psychotropic medications, and identify those exhibiting significant shifts in their prescription patterns. By applying clustering techniques to data from distinct time periods, the system detects anomalies in doctors' prescribing behaviors, identifying those whose behavior deviates drastically, thus indicating potential concerns. The application provides real-time insights by immediately generating a list of doctors exhibiting suspicious activities whenever an inspector accesses the web platform. This proactive approach helps enhance oversight and ensures timely intervention based on current data trends.
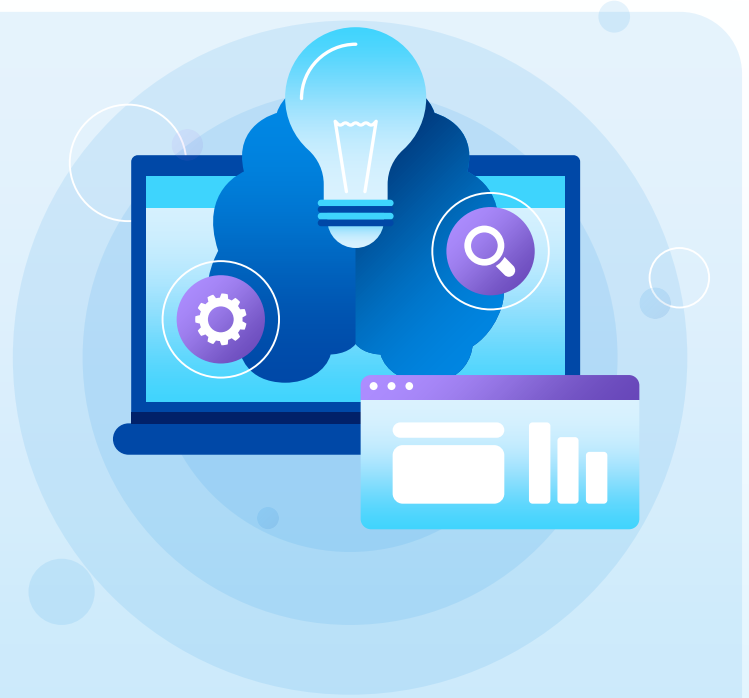
The Context

Medical Prescription

At the Heart of the Doctor–Patient Relationship

Responsibility of Healthcare Professionals Health

Ensuring Medication Safety

Potential Risks

Diversion of Substances into Wrong Hands

Individuals with Malicious Intent

Exploitation of the System for Personal Gain

Risk

For Public Health

Threats

To Trust in Healthcare Professionals

Problem

Manual analysis of records ⯀ delay in identifying fraud

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Exponential Increase in Prescription Abuse of Psychotropic Medications

Proposed Solution

MediSafe: Proactive solution in detecting suspicious cases through machine learning
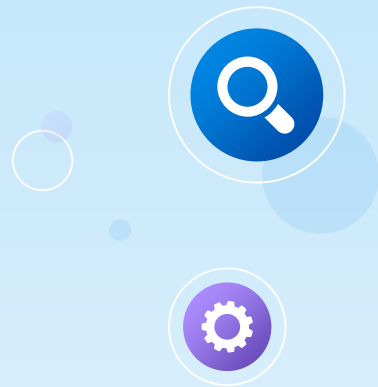
Plan

01 **Existing Application → Data Collection and Preparation**

02 **Machine Learning → Doctor Classification**

03 **Anomaly Detection → Suspicious Activities**

04 **Web Application Implementation → Demonstration**

01

Existing Application → Data Collection and Preparation

Psychotropic and Narcotic Distribution Application

Recording of each prescription

Trimestre	Pharmacie	Nom Medecin	CIN	CIN Tiers	Nom Du Malade	Date Du Prescription	Date Dispensation	Date Fin	Produit	Form	Quantité
T1	Pharmacie1	Medecin 1	46	512	Malade 1	09/03/2022	09/03/2022	23/03/2022	Moscontin 10	comprime	84

Database of all prescriptions

| Trimestre	Pharmacie	Nom Medecin	CIN	CIN Tiers	Nom Du Malade	Date Du Prescription	Date Dispensation	Date Fin	Produit	Form	Quantité
T1	Pharmacie1	Medecin 1	46	512	Malade 1	09/03/2022	09/03/2022	23/03/2022	Moscontin 10 mg	comprime	84
...											
T2	Pharmacie1	Medecin 2	54	112	Malade 2	14/03/2022	14/03/2022	08/04/2022	RITALINE 10 mg	comprime	75
...											
T3	Pharmacie 2	Medecin 1	14	121	Malade 3	14/01/2022	15/01/2022	12/02/2022	skenan 30	comprime	56
...											
T4	Pharmacie 3	Medeinc 3	54	120	Malade 4	24/05/2022	24/05/2022	21/06/2022	OXYNORM 10mg	comprime	112

Transformation

Database of the number of prescriptions for each doctor / medication / quarter

Trimestre	Medecin	Medicament	Quantité
T1	Medecin 1	Moscontin 10 mg	80
T1	Medecin 2	Moscontin 10 mg	60
T2	Medecin 1	Moscontin 10 mg	110
T2	Medecin 2	skenan 30	30
T3	Médecin 3	OXYNORM 10mg	23
..			
T4	Médecin 4	Moscontin 10 mg	35

02

Machine Learning → Doctor Classification
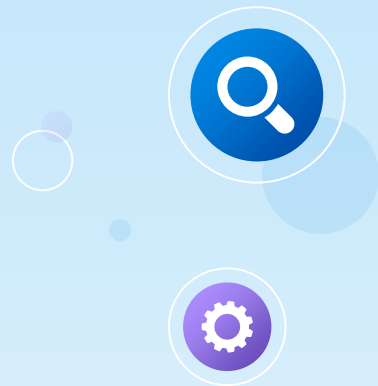
Algorithm Selection

Data NOT "labeled"
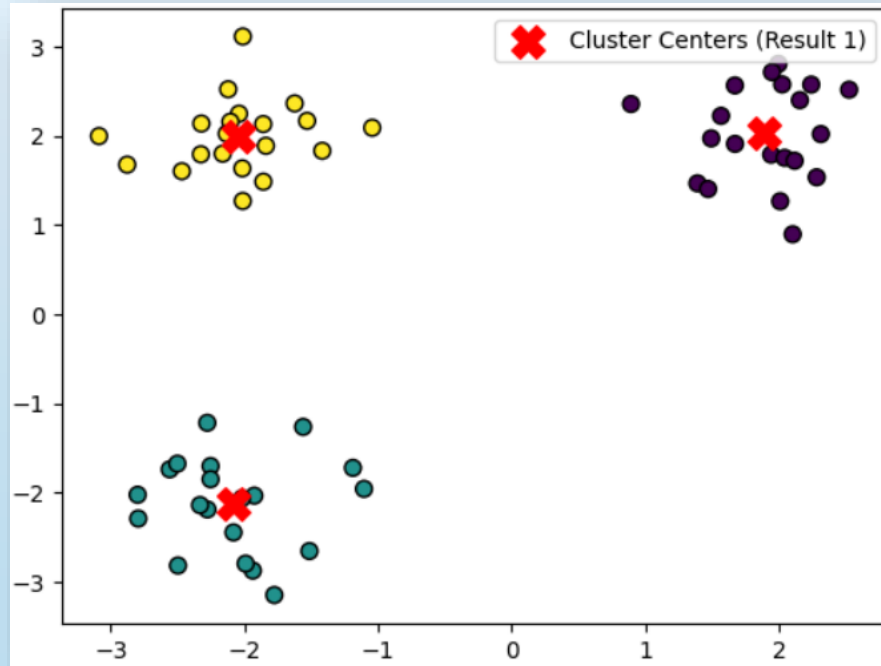
→ Unsupervised Machine Learning Algorithm:

KMeans

The principle of "clustering"

Explores patterns in data autonomously

→ Grouping based on common characteristics and similar behavior.

Graphical visualization of the clustering result (for one quarter)
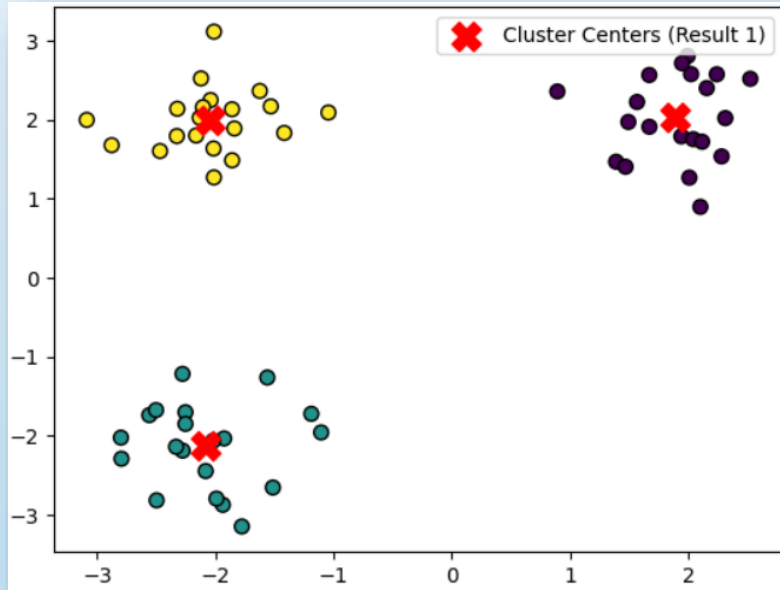
Application to different quarters

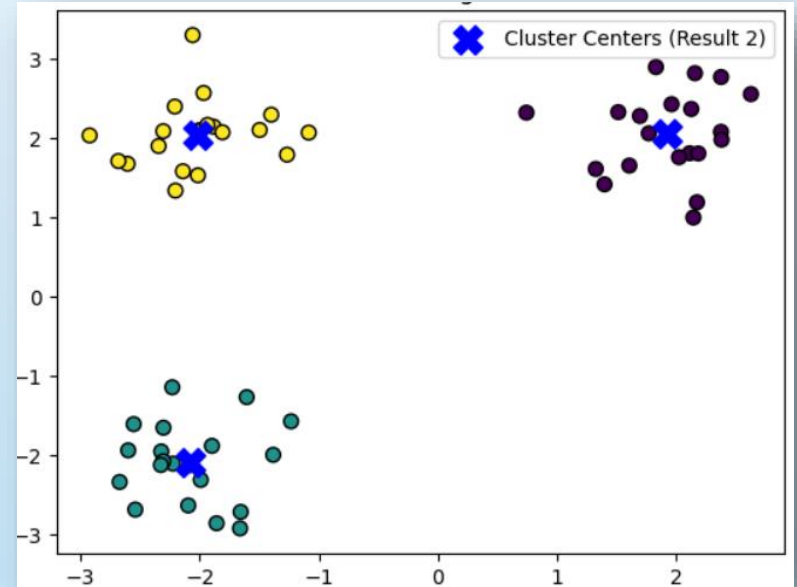| Medecin	Gouvernorat	Trimestre 1	Trimestre 2	Trimestre 3	Trimestre 4
Médecin 1	Ariana	1	1	1	0
Médecin 2	Sousse	1	1	2	1
Médecin 3	Tunis	2	2	1	0
Médecin 4	Bizerte	0	0	0	1
Médecin 5	Sfax	0	2	0	0
Médecin 6	Sousse	1	1	1	2
Médecin 7	Ariana	2	0	0	1
Médecin 8	Bizerte	1	1	1	2
Médecin 9	Sfax	1	1	2	0
Médecin 10	Sousse	0	0	0	1
Médecin 11	Sousse	2	2	0	1
Médecin 12	Bizerte	0	1	1	2

03

Anomaly Detection → Suspicious Activities

Comparative visualization and detection principle
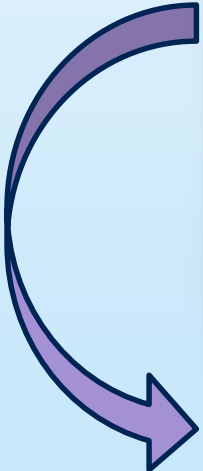## (detection of large cluster changes for certain doctors)

Quarter 1

Quarter 2

Example of a doctor with suspicious activities detected

Medecin	Gouvernorat	Trimestre 1	Trimestre 2	Trimestre 3	Trimestre 4
Médecin 1	Ariana	1	1	1	0
Médecin 2	Sousse	1	1	2	1
Médecin 3	Tunis	2	2	1	0
Médecin 4	Bizerte	0	0	0	1
Médecin 5	Sfax	0	2	0	0
Médecin 6	Sousse	1	1	1	2
Médecin 7	Ariana	2	0	0	1
Médecin 8	Bizerte	1	1	1	2
Médecin 9	Sfax	1	1	2	0
Médecin 10	Sousse	0	0	0	1
Médecin 11	Sousse	2	2	0	1
Médecin 12	Bizerte	0	1	1	2

Medecin	Gouvernorat	Trimestre 1	Trimestre 2	Trimestre 3	Trimestre 4
Médecin 5	Sfax	0	2	0	0

04

**Web application implementation →
Demonstration**

Web application creation

- Creating an intuitive web interface
    - **–> Streamlit**

- Easy data import

- Integration of the detection algorithm

- Automatic execution of the algorithm after data import

- Instant display of results: suspicious cases

Login interface

Login

Username

Password

👁

Login

Login

Successful authentication and access to current data

Username

jsmith

Password

••• 👁

Login

Welcome, John Smith!

Clustering Analysis

Show current detections

Displaying detected doctors

Clustering Analysis

Show current detections

Les médecins à activités suspectes :

Medecin	Gouvernorat	Trimestre 1	Trimestre 2	Trimestre 3	Trimestre 4
Médecin 9	Sfax	0	1	2	1
Médecin 6	Sousse	0	1	0	2
Médecin 8	Bizerte	1	1	0	2
Médecin 4	Bizerte	0	0	2	0
Médecin 5	Sfax	0	2	1	1

Conclusion

- Automatic analysis
- Intelligent detection of fraudulent behavior

Limit cases of fraud in the prescription of psychoactive drugs

Perspectives

Current solution: triggers the alert of inspectors and their intervention.

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Future envisioned: prediction model that promotes prevention.