Point-of-Care Intelligent Decision Support System for Antimicrobial Prescribing in the Intensive Care Unit

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OVERVIEW

The Problem

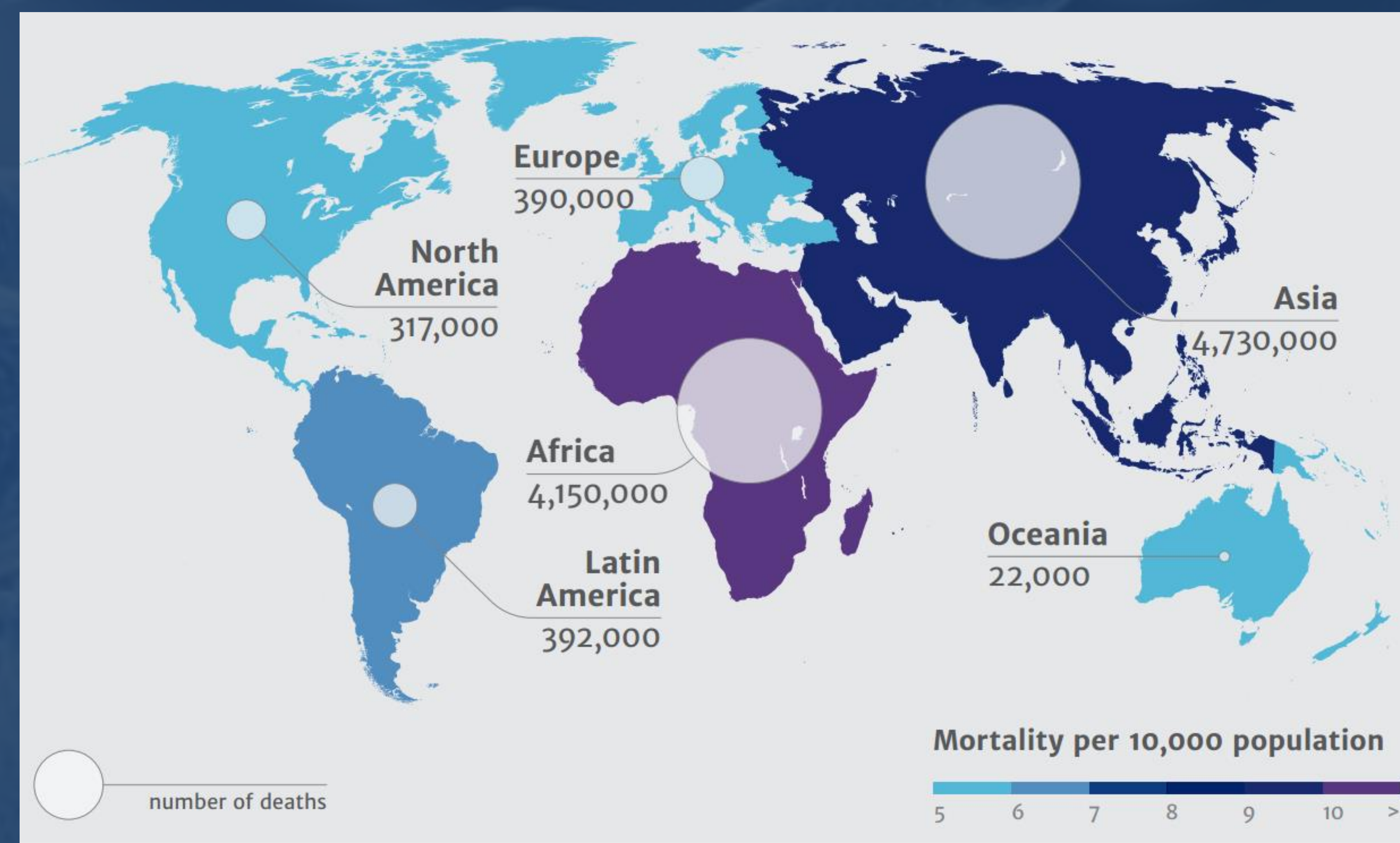
- Antibiotic **Resistance** rise is considered a major problem worldwide [1][2]
- **Consumption** and **misuse** of antibiotic in humans is increasing globally [3]
- Infection by resistant bacteria causes more than 700.000 **deaths** worldwide [1]

Possible Solutions

- Developing new drugs
- Developing new diagnostic tests
- Improve antibiotic prescribing/stewardship using Clinical Decision Support

AIM

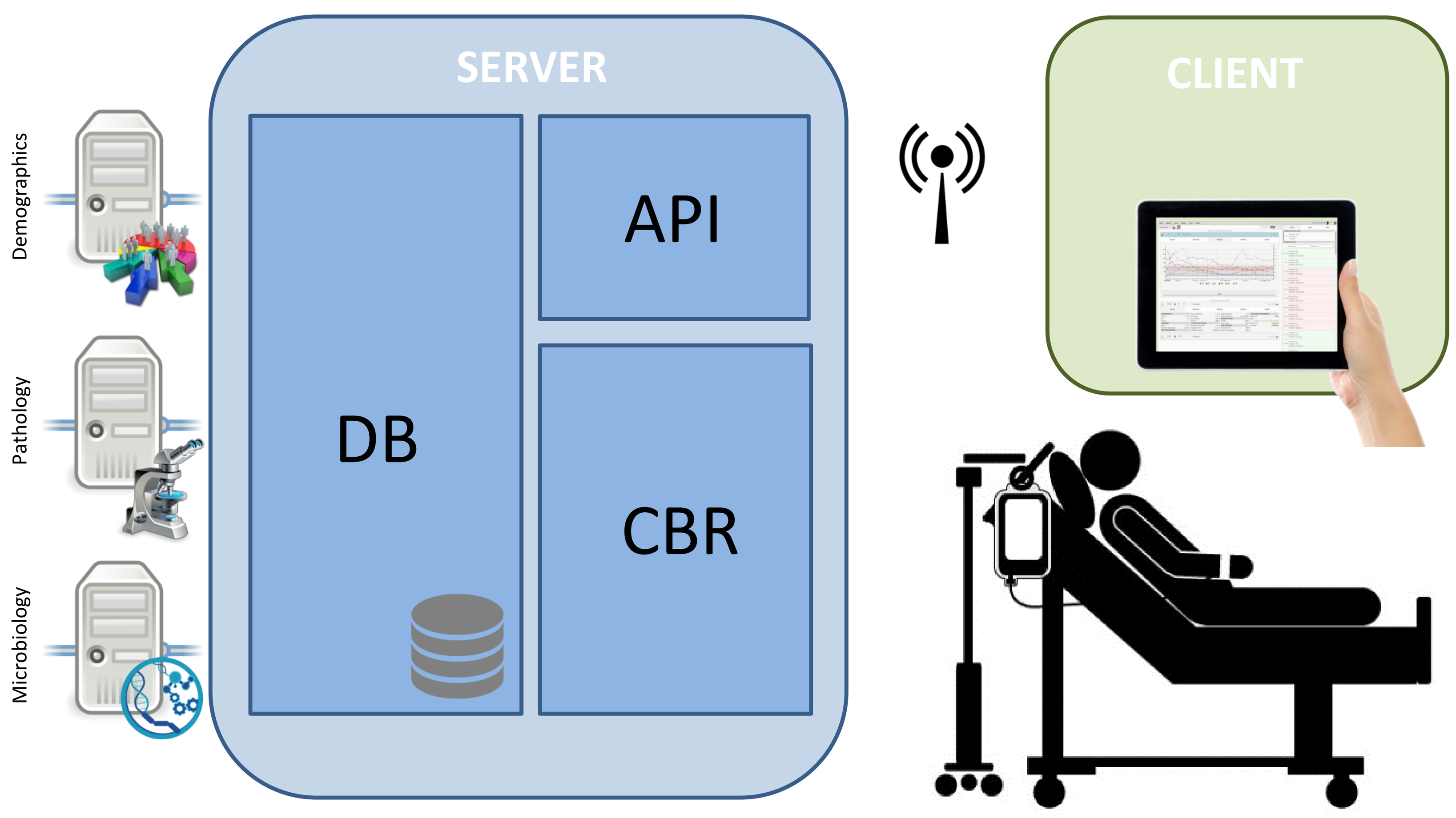
ENIAPP (**EN**hanced **I**mperial **A**ntibiotic **P**rescribing **P**olicy application) is an intelligent clinical decision support system developed at Imperial College that uses past clinical cases to inform clinicians about personalized and effective antimicrobial prescribing at the patient bed side in the Intensive Care Unit.



Deaths per year attributable to AMR by 2050 and mortality per 10.000 population [1]

METHODOLOGY

SYSTEM ARCHITECTURE



The back-end, developed in Java and SQL, runs in a server within the NHS firewall. The front end is developed in JavaScript, CSS and HTML and is accessible to any mobile device connected to a secure NHS Wi-Fi.

CASE-BASED REASONING

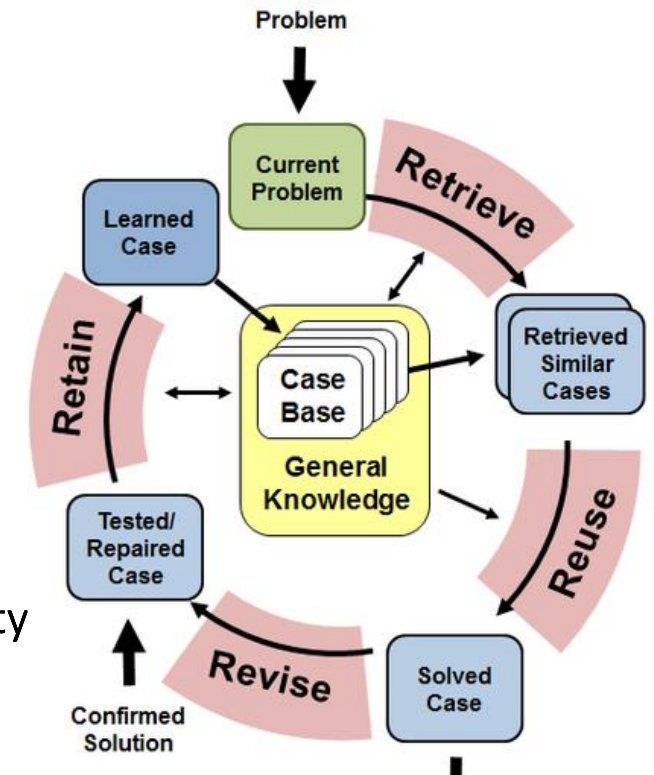
CBR uses previous experience in form of cases to understand and solve new problems [4]

CBR Case: {Parameters, Solution, Outcome}

CBR Cycle:

- **Retrieve** cases based on similarity
- **Reuse** solutions through adaptation/combination
- **Revise** solution monitoring patient evolution
- **Retain** case attending to usefulness and reusability

Similarity Measure: K-Nearest Neighbors



Problem Solving by Case-Based Reasoning
(according to Aamodt and Plaza)

Parameters

Demographics: {Weight, Age, Gender, HIV, Diabetes, Pregnant, Allergies, Body Temperature, Lactate, Abdominal Examination, Chest Examination, Respiratory Rate, Oxygen Requirement, Chest Radiography, Catheter, Renal Support, Ventilation Support, Chest Radiograph, Central Line Situ, Organs Infected}

Pathology: {Alanine Aminotransferase, Alkaline Phosphatase, Bilirubin, Creatinine, C-Reactive Protein, White Blood Cells}

Susceptibility: {Culture, Organism, Antibiotic, Sensitivity}

Solution:

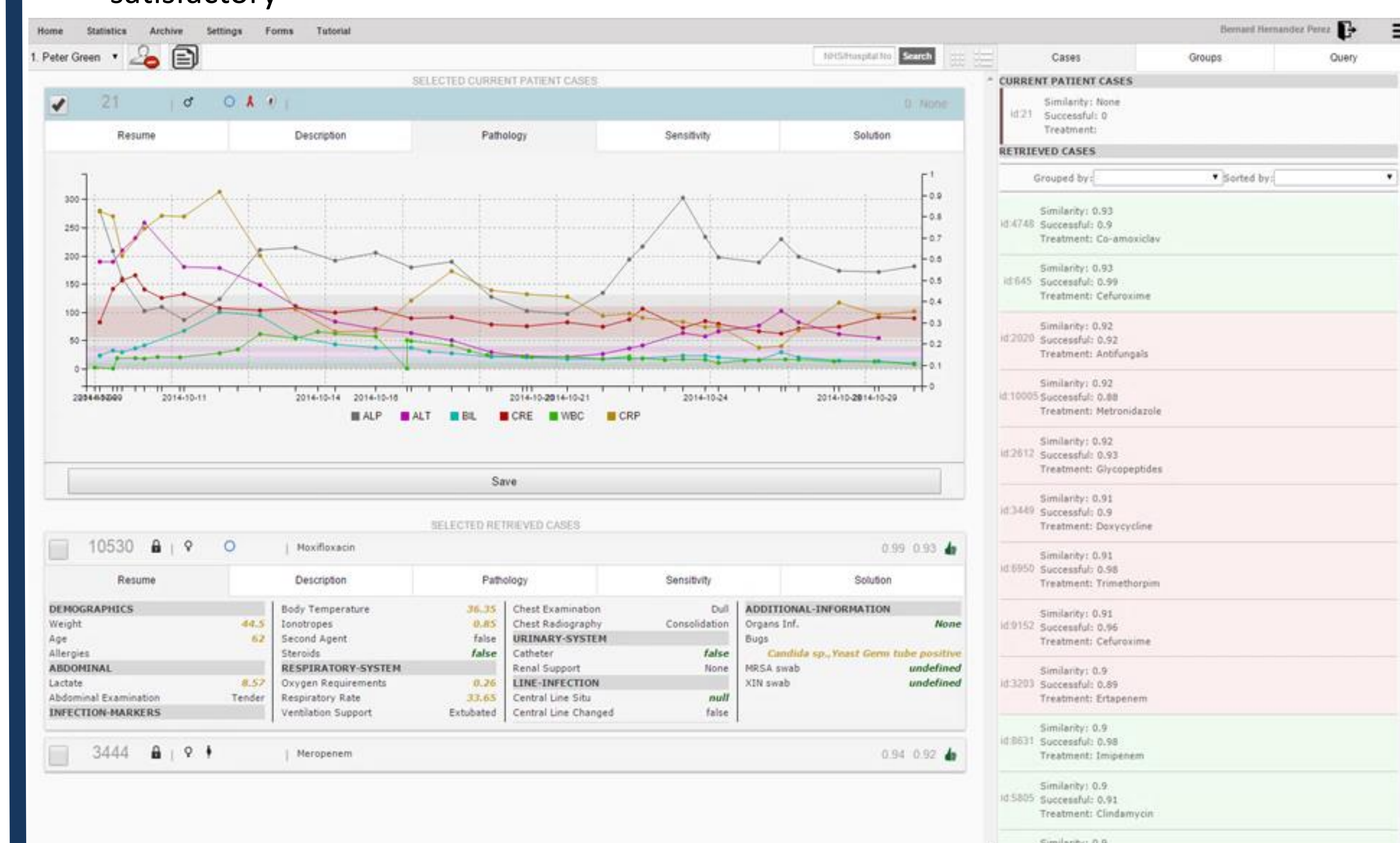
Past successful and unsuccessful cases

Outcome:

Success of applied treatment validated by the clinician

RESULTS

- In a small 6-week pilot study conducted by infection specialists with a small case-base (approximately 80 cases), ENIAPP recommended the correct treatment **95%** of the times
- Initial usability studies based on focus group feedback from potential users were satisfactory



CONCLUSION

We have shown that ENIAPP:

- Enhances continuity, interpersonal communication and knowledge transfer
- Has potential to provide personalized, accurate and effective diagnoses
- Improves reliability and consistency of data collection
- Improves data visualization, interpretation and analysis

Future Work:

- Extend and adapt for use in secondary care
- Introduce patient module
- Therapeutic Drug Monitoring pharmacy module for individualised dosing
- Extend study and validation using interrupted time series analysis

REFERENCES

[1] Review on Antimicrobial Resistance. "Antimicrobial Resistance: Tackling a Crisis for the Health and Wealth of Nations". 2014.
[2] Centre for Disease Control and Prevention. "Antibiotic Resistance Threats in the United States". 2013.
[3] Centre for Disease Control and Prevention. "The State of the World's Antibiotics". 2015.
[4] A. Aamodt and E. Plaza, "Case-based Reasoning: Foundational Issues, Methodological Variations and System Approaches", AI Commun, 1994.

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