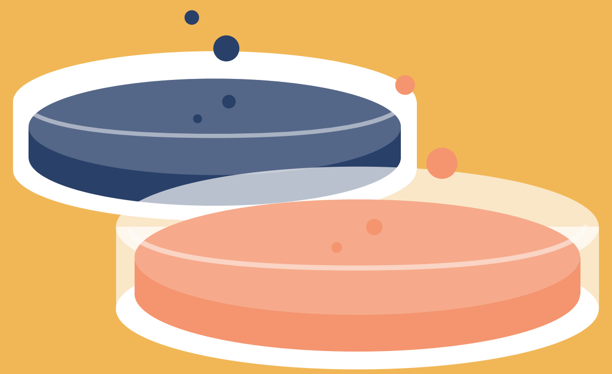
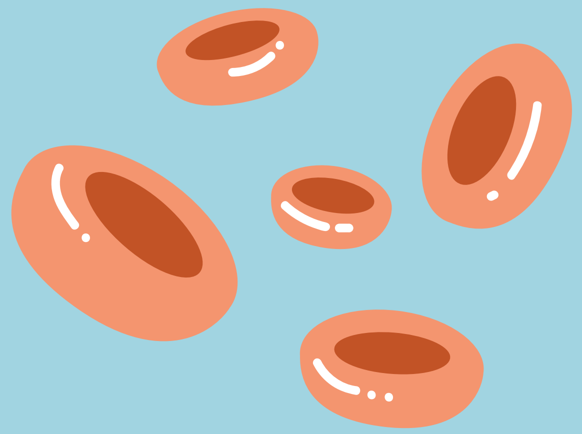
HOSPITAL ANTIBIOTIC RESISTANCE ANALYSIS DATA-DRIVEN CLINICAL & OPERATIONAL INSIGHTS





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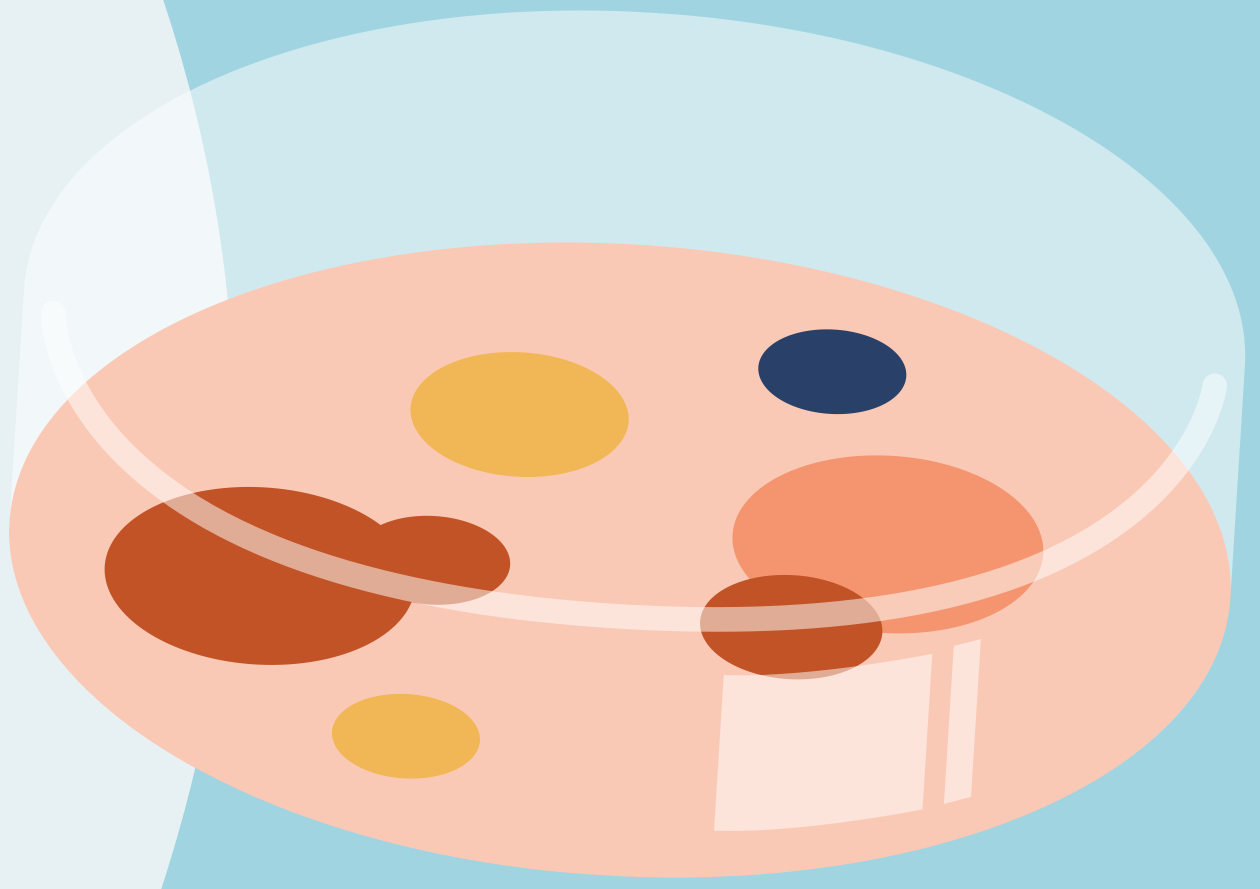
Role: Aspiring Healthcare Data Analyst
Domain Background: Microbiology

Problem Statement

Antibiotic resistance is a rapidly growing challenge in hospital settings, leading to:

- **Increased treatment failure**
- **Higher patient mortality**
- **Longer hospital stays and rising healthcare costs**

Despite this, antibiotic decisions are often made using **experience** rather than **data**.



🎯 Objective

To analyze hospital microbiology data and identify:

- **Resistance patterns across antibiotics**
- **High-risk wards and infection sites**
- **Patient groups with elevated resistance risk**

→ enabling data-backed antibiotic stewardship decisions.

DATASET OVERVIEW

Hospital Dataset Summary:

- 1200 Patients
- 1500 Specimens
- 1000 Bacteria Isolates
- 7 Antibiotics
- 6 Bacteria
- 4 Infection site

Key Tables:

- Patient_Info
- Specimen_Tests
- Bacteria_Isolates
- Antibiotic_Resistance

Data Modeling:

- Relational schema (1-to-many relationships)
- Built for scalable analytics and dashboarding

Tools & Analytical Approach

Excel

- Pivot tables for resistance summaries
- Manual Chi-square test for statistical validation

Power BI

- Interactive dashboards
- Heatmaps, trends, ward-level KPIs

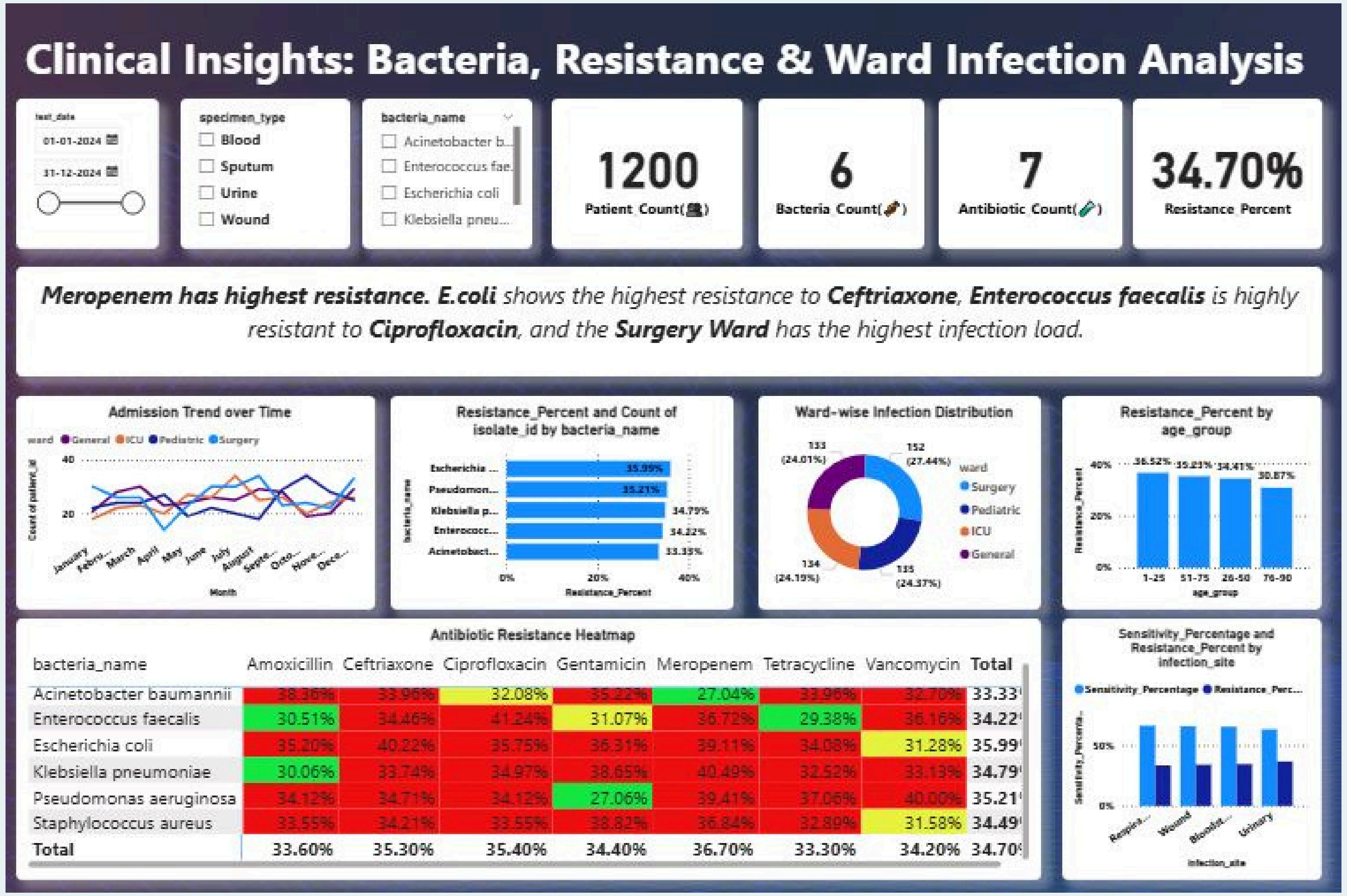
Python

- Exploratory Data Analysis (EDA)
- Logistic Regression for resistance prediction

Statistics

- Distribution analysis
- Chi-square hypothesis testing

Key Dashboard Insights



Major Observations:

- Surgery ward carries the highest infection burden
- Pediatric ward shows elevated resistance risk
- Urinary tract infections exhibit the highest resistance rates
- Respiratory infections show the highest sensitivity overall

➡️ Indicates that resistance risk is not evenly distributed across hospital settings.

Antibiotic Resistance Findings

High-Risk Patterns:

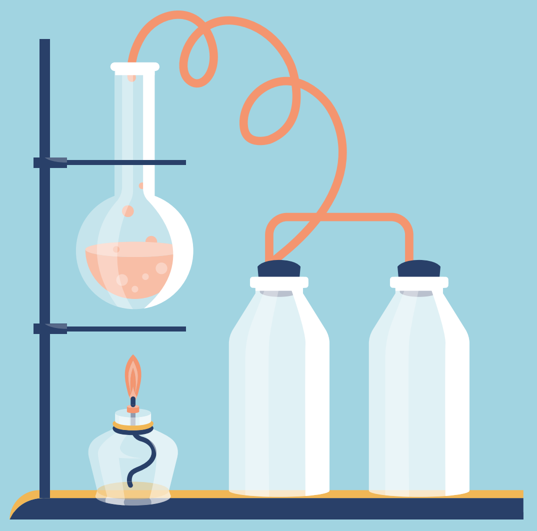
- Escherichia coli shows the highest overall resistance
  ➔ especially against Ceftriaxone
- Enterococcus faecalis is highly resistant to Ciprofloxacin
- Meropenem has the highest resistance rate (~36.7%)
- Ciprofloxacin & Ceftriaxone follow closely

Effective Options:

- Vancomycin ➔ highest sensitivity
- Tetracycline ➔ lowest resistance

⚠️ Key Concern: Resistance emerging even in last-resort antibiotics.

Statistical Validation



Chi-Square Test (Bacteria vs Resistance)

Sensitivity categories collapsed into:

- Resistant (R)
- Not Resistant (S + I)

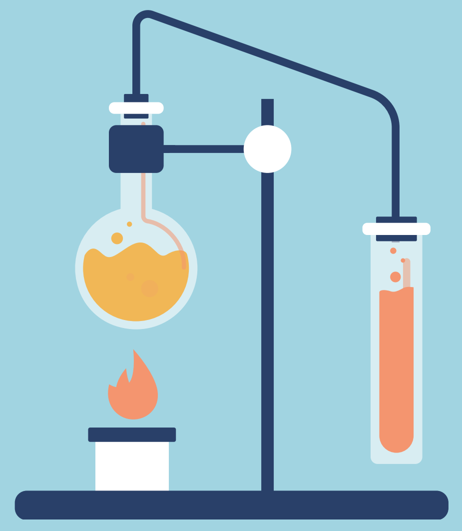
Result:

- No statistically significant association

Interpretation:

Resistance patterns do not vary meaningfully by bacteria alone.
➡️ Antibiotic selection plays a stronger role than bacterial species.
This validates the focus on prescription strategy, not assumptions.

Predictive Modeling (Logistic Regression)



Overall Summary

Model Objective:
Predict whether an isolate is Resistant or Sensitive

Input Features:

- Age
- Bacteria type
- Infection site
- Antibiotic used

Model Performance:

- Resistant recall ≈ 50%
- Sensitive recall ≈ 53%

Clinical Decision Choice:
Resistant recall was prioritized, because missing a resistant case is more dangerous than over-flagging.

Role of My Microbiology Background

This project benefits strongly from domain understanding:

- Clinical understanding of **UTI-driven E. coli dominance**
- Awareness of why **carbapenem resistance** is critical
- Correct interpretation of Intermediate sensitivity
- Realistic grouping and validation choices

➡️ This ensures insights are clinically meaningful, not just statistically correct.

Data-Driven Recommendations

Targeted Actions:

- Strengthen antibiotic stewardship in **Surgery & Pediatric wards**
- Closely monitor **Meropenem and Ciprofloxacin** usage
- Use **Vancomycin and Tetracycline** more strategically
- Implement stricter infection control for **UTI-related cases**

DATA-DRIVEN RECOMMENDATIONS

Business & Clinical Impact:

- Reduced resistance escalation
- Improved treatment success
- Better patient safety and cost control

THANK YOU!

Always open to feedback, suggestions, and meaningful conversations around healthcare data analytics, antibiotic resistance, and clinical insights. Looking forward to connecting with professionals working in healthcare, public health, and data analytics !!!

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