Emergency Department Waiting Time Analysis

1. Project Overview

This project analyses waiting time patterns in Emergency Departments (ED) using a synthetic dataset.

The goal is to understand how waiting times vary by:

- Hospital
- Triage Category
- Weekday
- Hour & peak hour

The project demonstrates a complete end-to-end analytics workflow using:

- Python (Data generation)
- Excel / Power Query (Cleaning & feature engineering)
- SQL (KPI validation & grouped analysis)
- Power BI (Visualisation & dashboard)

2. Dataset Description

The dataset contains 6,000 synthetic ED patient records across 5 hospitals over 30 days.

It includes:

- Date & time of arrival
- Hospital name
- Triage Category (1-5)
- Waiting time (minutes)
- Treatment time
- Crowding level
- Peak vs non-peak hour indicator

Synthetic data was used to avoid privacy concerns while enabling realistic workflow practice.

3. Data Preparation

Key preparation steps:

- Cleaned and validated all records
- Extracted weekday, hour, and peak-hour features
- Applied rule-based logic for:
    - Waiting time based on triage urgency
    - Crowding level (Low / Medium / High)
- Ensured consistent data types and formatting
- Exported clean dataset for SQL and Power BI

4. Exploratory Data Analysis (EDA)

4.1 Overall

- Average ED waiting time: Approximately 41 minutes

4.2 By Triage Category

Triage	Avg Waiting Time
1	1 min
2	9.5 min
3	37.4 min
4	53.9 min
5	74.3 min

Insight:

- Waiting time increases sharply for lower urgency cases. Triage 4-5 drive overall congestion.

4.3 By Hospital

All hospitals show similar average waiting times (approximately 41 minutes).

Insight:

- Congestion is system-wide, not hospital-specific.

4.4 By Weekday

- Thursday has the lowest waiting time (approximately 38.4 min).
- All other days remain above 40 min.

Insight:

- Thursday may represent better staffing-demand balance.

4.5 Peak vs non-peak

- Peak: 39.9 min
- Non-peak: 41.4 min

Insight:

- Non-peak hours having longer waits suggests staffing inefficiencies.

5. Key Findings

- ED waiting time is consistently high (approximately 41 minutes).
- Triage urgency is the strongest driver of waiting time.
- Lower urgency patients (Triage 4-5) cause most of the system pressure.
- All hospitals show similar levels of congestion.
- Thursday performs most efficiently.
- Non-peak hours experience unexpected delays $\rightarrow$ possible understaffing.

6. Recommendations

- Implement Fast-Track pathways for Triage 4-5 patients.
- Reallocate staffing to support non-peak hours.
- Use Thursday as a benchmark for schedule optimisation.
- Improve intake workflow & transition from triage to treatment.
- Promote alternative care pathways (GP, urgent care clinics) for non-urgent cases.

7. Limitations

- Synthetic dataset - not real patient records
- Limited clinical variables
- Waiting times follow rule-based logic
- No seasonal or long-term trends included

8. Power BI Dashboard Overview

Include:

8.1 Short Description

The Power BI dashboard provides an interactive view of ED waiting time trends by hospital, triage category, weekday, and peak hour. Users can filter and compare waiting time patterns to identify congestion and operational gaps.

8.2 What users can see

- Hospital-level comparison
- Triage severity impact
- Weekday trends
- Peak vs non-peak visual patterns

- Dashboard