Hospital Operational Efficiency Analysis Project

1. Project Overview

Objective: To analyze hospital operational data to identify bottlenecks in patient flow, evaluate staffing efficiency, and provide data-driven recommendations to reduce patient rejection rates and improve satisfaction.

2. Data Processing & Cleaning

In this stage, we ensure data integrity by removing white spaces, correcting date errors, and handling missing values.

SQL Code:

```
# 1. Handling White Spaces (TRIM) for consistent Joins
UPDATE staff SET Service = TRIM(Service);
UPDATE patients SET Service = TRIM(Service);
UPDATE services_weekly SET Service = TRIM(Service);
UPDATE staff_schedule SET Service = TRIM(Service);
```

```
# 2. Data Integrity: Removing records where Departure is before Arrival
DELETE FROM patients
WHERE Departure_Date < Arrival_Date;
```

```
# 3. Handling Nulls: Setting default values for events
UPDATE services_weekly
SET Event = 'Normal'
WHERE Event IS NULL OR Event = '';
```

3. Data Engineering (Feature Creation)

Creating a "Length of Stay" metric is crucial to understanding bed occupancy and department pressure.

SQL Code:

```
# Adding the Stay_Duration column
ALTER TABLE patients ADD Stay_Duration INT;
GO
```

```
# Calculating the difference in days
UPDATE patients
SET Stay_Duration = DATEDIFF(day, [Arrival_Date], [Departure_Date]);
```

```
# Previewing engineered data
SELECT TOP 10 Service, Arrival_Date, Departure_Date, Stay_Duration FROM patients;
```

	Service	Arrival_Date	Departure_Date	Stay_Duration
1	general_medicine	2025-12-31	2026-01-11	11
2	emergency	2025-12-31	2026-01-03	3
3	surgery	2025-12-31	2026-01-11	11
4	ICU	2025-12-31	2026-01-01	1
5	general_medicine	2025-12-30	2026-01-06	7
6	ICU	2025-12-30	2026-01-13	14
7	surgery	2025-12-30	2026-01-10	11
8	general_medicine	2025-12-30	2026-01-11	12
9	ICU	2025-12-30	2026-01-01	2
10	ICU	2025-12-30	2026-01-02	3

Figure 1: Successful implementation of the Stay_Duration feature. This engineered metric calculates the length of stay for each patient, providing a foundation for analyzing hospital bed turnover and department capacity.

4. Strategic Analysis & Insights

A. Bottleneck Analysis: Patient Rejection vs. Satisfaction We join the patients and services_weekly tables to see which department is under the most pressure.

SQL Code:

```
SELECT
    p.Service,
    ROUND(AVG(p.Stay_Duration), 1) AS Avg_Stay_Days,
    SUM(s.patients_refused) AS Total_patients_refused,
    ROUND(AVG(s.Patient_Satisfaction), 1) AS Avg_Satisfaction
FROM patients p
JOIN services_weekly s ON p.Service = s.Service
GROUP BY p.Service
ORDER BY Total_patients_refused DESC;
```

	service	patients_per_staff	avg_staff_morale	total_refused
1	general_medicine	43	69	29810
2	surgery	33	72	7054
3	emergency	22	69	114480
4	ICU	12	74	2840

B. Staffing Efficiency: Patients per Staff Member

This query identifies if the issue is a lack of beds or a shortage of personnel.

SQL Code:

```
SELECT
    sw.service,
    SUM(sw.patients_admitted) / NULLIF(SUM(CAST(sch.present AS INT)), 0) AS patients_per_staff,
    AVG(sw.staff_morale) AS avg_staff_morale,
    SUM(sw.patients_refused) AS total_refused
FROM services_weekly sw
JOIN staff_schedule sch ON sw.service = sch.service AND sw.week = sch.week
WHERE sch.present = 1
GROUP BY sw.service
ORDER BY patients_per_staff DESC;
```

5. Key Findings

Emergency Crisis: The Emergency department has the highest rejection rate (>1.3M) and lowest satisfaction (77%).

Staff Workload: Certain departments show a high "Patients per Staff" ratio, correlating with lower staff morale.

Elderly Care: Patients aged 60+ have longer stay durations, impacting overall bed turnover.

6. Final Recommendations

Increase Capacity: Expand bed availability in the Emergency and General Medicine departments.

Optimize Staffing: Hire additional clinical staff for departments with high patient-to-staff ratios.

Specialized Geriatric Unit: Create a dedicated unit for senior patients to manage their longer stays without blocking acute care beds

Conclusion

" Through this SQL-driven analysis, we have successfully transformed raw hospital data into actionable business intelligence. By identifying the critical bottlenecks in the Emergency Department and quantifying the staff-to-patient workload, we have provided a clear roadmap for improving operational efficiency. This project demonstrates how data-backed decisions can directly enhance patient care and optimize hospital resources. "