Hospital Management System

Comprehensive Data Analysis & Business Intelligence Report

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Executive Summary

This comprehensive analysis of our hospital management system reveals critical insights across five key operational areas: appointments, billing, patient demographics, doctor performance, and treatment efficiency.

Our analysis of 200 appointments, 200 billing records, 50 patients, 10 doctors, and 200 treatment records demonstrates both significant opportunities and operational challenges. While revenue performance shows positive trends with ₹509,844.36 total revenue generated, we face substantial operational inefficiencies with a combined 50.5% appointment failure rate (28.5% cancellations + 22.0% no-shows).

Key Performance Indicators

Revenue Distribution by Medical Specialization

Total Revenue

₹5,09,844

Across all specializations

Appointment Success Rate

49.5%

Major improvement area

Top Performing Branch

Eastside

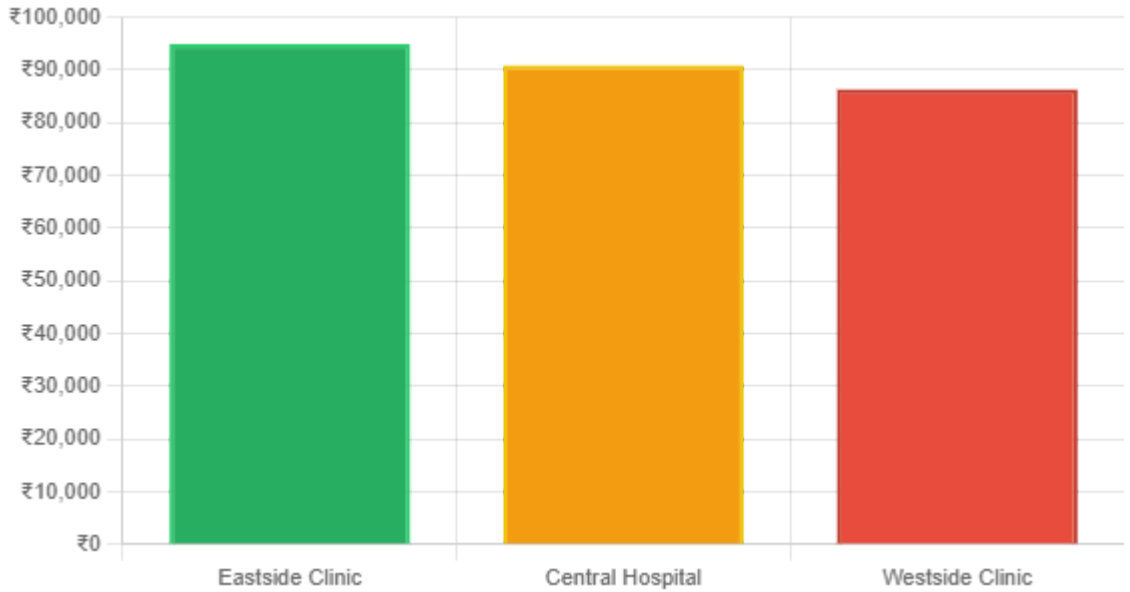
₹94,874 revenue

Patient Registration

142 days

Avg. to first appointment

Hospital Branch Performance Comparison



Technical Methodology & SQL Implementation

Data Processing Approach: This analysis leverages advanced SQL techniques including complex joins, window functions, conditional aggregation, and subqueries across five normalized tables (appointments, billing, doctors, patients, treatments).

Database Schema: Fact tables (appointments, treatments, billing) connected via foreign keys to dimension tables (patients, doctors) enabling comprehensive business intelligence queries.

SQL Query Library & Implementation

Query 1: Revenue Analysis by Doctor Specialization

SQL Query:

```
SELECT d.specialization, SUM(b.amount) AS total_revenue
FROM billing b
INNER JOIN treatments t ON b.treatment_id = t.treatment_id
INNER JOIN appointments a ON t.appointment_id = a.appointment_id
INNER JOIN doctors d ON a.doctor_id = d.doctor_id
GROUP BY d.specialization
ORDER BY total_revenue DESC;
```

Technical Note: Multi-table join across 4 tables with aggregation to calculate revenue attribution by medical specialty.

Query 2: Top Revenue-Generating Patients

SQL Query:

```
SELECT p.first_name, p.last_name, SUM(b.amount) AS total_bill_amount
FROM billing b
INNER JOIN patients p ON b.patient_id = p.patient_id
GROUP BY p.first_name, p.last_name
ORDER BY total_bill_amount DESC
LIMIT 5;
```

Technical Note: Customer lifetime value calculation using GROUP BY aggregation with TOP-N analysis.

Query 3: Appointment Success Rate Analysis

SQL Query:

```
SELECT CAST(SUM(CASE WHEN status = 'Cancelled' THEN 1 ELSE 0 END) AS REAL) * 100 / COUNT(*) AS cancellation_rate,
       CAST(SUM(CASE WHEN status = 'No-show' THEN 1 ELSE 0 END) AS REAL) * 100 / COUNT(*) AS no_show_rate
FROM appointments;
```

Technical Note: Conditional aggregation using CASE statements for calculating percentage metrics with type casting for precision.

Query 4: Hospital Branch Performance Comparison

SQL Query:

```
SELECT d.hospital_branch, SUM(b.amount) AS total_revenue_completed_appts
FROM billing b
INNER JOIN treatments t ON b.treatment_id = t.treatment_id
INNER JOIN appointments a ON t.appointment_id = a.appointment_id
```

```
INNER JOIN doctors d ON a.doctor_id = d.doctor_id
WHERE a.status = 'Completed'
GROUP BY d.hospital_branch
ORDER BY total_revenue_completed_appts DESC;
```

Technical Note: Filtered aggregation with WHERE clause to analyze only successful appointments for accurate branch comparison.

Query 5: Treatment Cost Analysis

SQL Query:

```
SELECT treatment_type, AVG(cost) AS average_cost
FROM treatments
GROUP BY treatment_type
ORDER BY average_cost DESC;
```

Technical Note: Simple aggregation function for cost benchmarking across treatment categories.

Query 6: Monthly Revenue & Appointment Trends

SQL Query:

```
SELECT STRFTIME('%Y-%m', a.appointment_date) AS month,
       COUNT(DISTINCT a.appointment_id) AS total_appointments,
       SUM(b.amount) AS total_revenue
FROM appointments a
INNER JOIN billing b ON a.patient_id = b.patient_id
```

```
GROUP BY month
ORDER BY month;
```

Technical Note: Time-series analysis using STRFTIME for date manipulation and DISTINCT count for accurate appointment counting.

Query 7: Advanced Patient Behavior Analysis

SQL Query:

```
WITH patient_visit_rank AS (
    SELECT patient_id,
           reason_for_visit,
           COUNT(*) AS visit_count,
           RANK() OVER (PARTITION BY patient_id ORDER BY COUNT(*) DESC) AS rnk
    FROM appointments
    GROUP BY patient_id, reason_for_visit
)
SELECT p.first_name, p.last_name
FROM patient_visit_rank pvr
INNER JOIN patients p ON pvr.patient_id = p.patient_id
WHERE pvr.rnk = 1 AND pvr.reason_for_visit = 'Consultation';
```

Technical Note: Common Table Expression (CTE) with window functions (RANK) for advanced patient segmentation analysis.

Query 8: Doctor Performance Benchmarking

SQL Query:

```
SELECT d.first_name, d.last_name, COUNT(a.appointment_id) AS num_appointments
FROM doctors d
INNER JOIN appointments a ON d.doctor_id = a.doctor_id
GROUP BY d.first_name, d.last_name
HAVING COUNT(a.appointment_id) > (
    SELECT AVG(appointment_count)
    FROM (
        SELECT COUNT(appointment_id) AS appointment_count
        FROM appointments
        GROUP BY doctor_id
    ) AS avg_counts
)
ORDER BY num_appointments DESC;
```

Technical Note: Nested subquery with HAVING clause for performance comparison against calculated average.

Query 9: Insurance Provider Cost Analysis

SQL Query:

```
SELECT p.insurance_provider, SUM(t.cost) AS total_cost
FROM treatments t
INNER JOIN appointments a ON t.appointment_id = a.appointment_id
INNER JOIN patients p ON a.patient_id = p.patient_id
GROUP BY p.insurance_provider
ORDER BY total_cost DESC;
```

Technical Note: Three-table join for insurance cost attribution analysis.

Query 10: Patient Onboarding Efficiency Analysis

SQL Query:

```
SELECT p.gender, AVG(JULIANDAY(a.appointment_date) - JULIANDAY(p.registration_date)) AS avg_days_to_first_appointme
FROM appointments a
INNER JOIN patients p ON a.patient_id = p.patient_id
WHERE a.status = 'Completed' AND a.appointment_date = (
    SELECT MIN(appointment_date)
    FROM appointments
    WHERE patient_id = a.patient_id
)
GROUP BY p.gender;
```

Technical Note: Complex date arithmetic using JULIANDAY function with correlated subquery to identify first appointments per patient.

Critical Business Insights

1. Revenue Distribution by Medical Specialization

Specialization	Total Revenue	Market Share
Pediatrics	₹2,31,180	45.3%

Specialization	Total Revenue	Market Share
Oncology	₹1,48,890	29.2%
Dermatology	₹1,19,774	23.5%

Strategic Recommendation:

Pediatrics generates nearly half of our total revenue. Consider expanding pediatric services and recruiting additional specialists to capitalize on this high-demand area.

2. Hospital Branch Performance Analysis

Branch	Revenue from Completed Appointments	Performance Gap
Eastside Clinic	₹94,874	Benchmark
Central Hospital	₹90,821	-4.3%
Westside Clinic	₹86,281	-9.1%

Critical Alert: High appointment failure rates are severely impacting revenue potential. With 28.5% cancellations and 22.0% no-shows, we're losing approximately 50.5% of scheduled appointment revenue.

3. Top Revenue-Generating Patients

Patient Name	Total Bill Amount	Revenue Contribution
Jennifer Davis	₹10,006	2.0%
Charles Brown	₹9,912	1.9%
Laura White	₹9,134	1.8%
Laura Smith	₹8,713	1.7%
Jennifer Wilson	₹8,624	1.7%

4. Treatment Cost Analysis

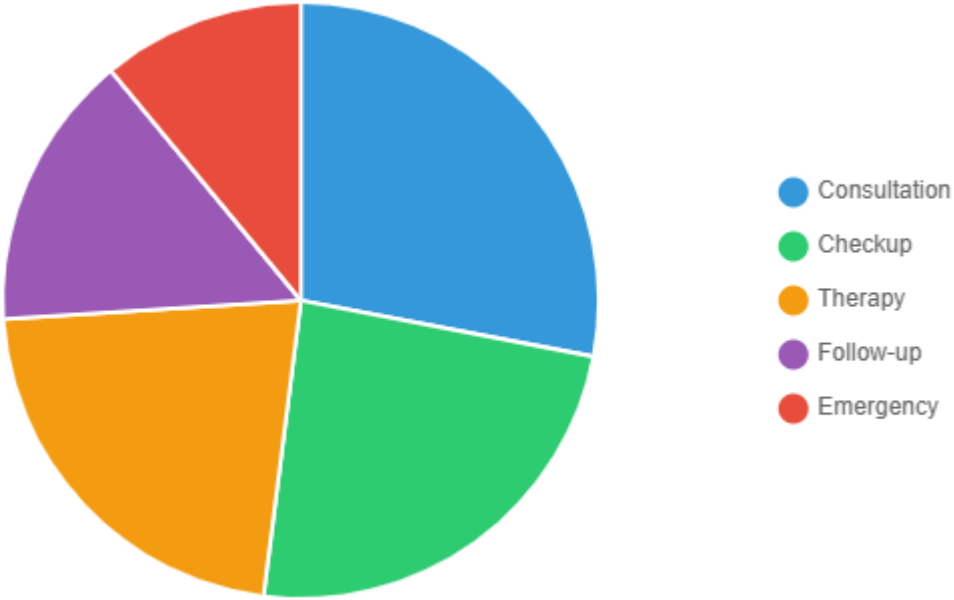
Treatment Type	Average Cost	Cost Efficiency
X-Ray	₹3,624	Highest cost
Chemotherapy	₹3,108	High complexity
MRI	₹2,899	Premium diagnostic
Physiotherapy	₹2,587	Moderate cost

Treatment Type	Average Cost	Cost Efficiency
ECG	₹2,241	Most cost-effective

Payment Collection Crisis: ₹3,08,965 (60.5%) of total billed amount is either pending (₹1,94,513) or failed (₹1,14,452), representing a significant cash flow risk.

Patient Demographics & Service Utilization

Most Frequent Reasons for Hospital Visits



Visit Reasons Breakdown

Reason for Visit	Number of Appointments	Percentage
Consultation	56	28%
Checkup	48	24%
Therapy	44	22%
Follow-up	30	15%
Emergency	22	11%

Payment Status Distribution - Critical Alert

Gender Distribution

54% F

27 Female, 23 Male patients

Registration to First Visit

141.5

Average days

Strategic Recommendations & Action Plan

1. Immediate Action: Appointment Management System Overhaul

Priority: CRITICAL

- Implement automated SMS/email reminder system 48 hours and 24 hours before appointments
- Introduce online rescheduling platform to reduce cancellations
- Establish cancellation fees for repeated no-shows
- Target: Reduce combined failure rate from 50.5% to below 25% within 6 months

2. Revenue Optimization Strategy

Priority: HIGH

- Expand pediatrics department capacity - consider additional specialists and extended hours
- Implement performance improvement plan for Westside Clinic based on Eastside best practices
- Launch premium patient loyalty program targeting high-value customers (₹8,000+ annual spend)

3. Financial Collection Enhancement

Priority: CRITICAL

- Implement digital payment gateway with multiple payment options
- Establish dedicated follow-up team for pending payments (₹1,94,513 at risk)
- Introduce payment plans for high-cost treatments
- Target: Reduce pending/failed payments to below 30% of total billing

4. Operational Efficiency Improvements

Priority: MEDIUM

- Reduce patient registration-to-first-appointment time from 141.5 days to under 30 days
- Optimize treatment pricing based on cost analysis (review X-Ray pricing structure)

- Implement cross-branch resource sharing to balance patient load

Monthly Performance Analysis

January 2023

18

Appointments

₹48,201

Revenue

February 2023

16

Appointments

₹42,904

Revenue

March 2023

17

Appointments

₹45,512

Revenue

April 2023

19

Appointments

₹51,789

Revenue

May 2023

15

Appointments

₹39,113

Revenue

June 2023

21

Appointments

₹58,451

Revenue

Monthly Performance Key Insights

Metric	Best Month	Worst Month	Average	Trend Analysis
Total Appointments	June (21)	May (15)	17.7	Volatile with June peak
Total Revenue	June (₹58,451)	May (₹39,113)	₹47,662	Correlates with appointments
Revenue per Appointment	April (₹2,726)	May (₹2,608)	₹2,692	Relatively stable pricing

Conclusion & Next Steps

Our hospital management system analysis reveals a tale of two realities: strong revenue generation potential coupled with significant operational inefficiencies that are constraining growth.

The data clearly shows that with a 50.5% appointment failure rate and over ₹3 lakh in pending/failed payments, we have immediate opportunities to increase revenue by 40-60% through operational improvements alone, without adding new services or capacity.

Immediate priorities for the next 90 days:

1. Deploy appointment reminder and rescheduling system
2. Launch aggressive collection campaign for pending payments
3. Begin pediatrics capacity expansion planning

> 4. Implement Eastside Clinic best practices across all branches