**Hospital Management System Analysis**

It is a comprehensive SQL database and analysis for a hospital management system that tracks patient records, treatments, staff, and financial transactions. This project will demonstrate your ability to work with complex relational data, write advanced queries, and derive business insights.

**Database Schema to Create:**

1. **Patients** (patient\_id, name, dob, gender, address, phone, insurance\_provider)
2. **Doctors** (doctor\_id, name, specialization, years\_experience, department\_id)
3. **Departments** (department\_id, name, head\_doctor\_id, budget)
4. **Staff** (staff\_id, name, role, department\_id, hire\_date, salary)
5. **Appointments** (appointment\_id, patient\_id, doctor\_id, date\_time, status)
6. **Diagnoses** (diagnosis\_id, patient\_id, doctor\_id, diagnosis\_date, diagnosis\_code, notes)
7. **Treatments** (treatment\_id, diagnosis\_id, treatment\_name, start\_date, end\_date, cost)
8. **Medications** (medication\_id, name, manufacturer, unit\_cost)
9. **Prescriptions** (prescription\_id, treatment\_id, medication\_id, dosage, frequency)
10. **Billing** (bill\_id, patient\_id, total\_amount, paid\_amount, billing\_date, due\_date)
11. **Patient Demographics Analysis**

**SELECT gender, COUNT(\*) as patient\_count,**

**ROUND(AVG(YEAR(CURRENT\_DATE) - YEAR(dob)),2) as avg\_age**

**FROM patients**

**GROUP BY gender;**

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**Insight:**

* Identifies gender distribution and average age of patients.
* Example: If 70% of patients are female and average age is 55, the hospital may need more women's health services.  
  **Action:**
* Tailor preventive care programs (e.g., mammograms for older women).
* Adjust marketing strategies to target dominant demographics.

**2. Department Workload**

SELECT d.name, COUNT(a.appointment\_id) as appointment\_count

FROM departments AS d

JOIN doctors AS doc ON d.department\_id = doc.department\_id

JOIN appointments AS a ON doc.doctor\_id = a.doctor\_id

GROUP BY d.name

ORDER BY appointment\_count DESC;

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**Insight:**

* Reveals which departments handle the most appointments (e.g., Cardiology may be 3x busier than Neurology).  
  **Action:**
* Allocate more staff/resources to high-volume departments.
* Investigate bottlenecks in less busy departments.

**3. Doctor Appointment Efficiency**

**Query:**

**SELECT doc.name,**

**COUNT(a.appointment\_id) as total\_appointments,**

**SUM(CASE WHEN a.status = 'Completed' THEN 1 ELSE 0 END) as completed,**

**(SUM(CASE WHEN a.status = 'Completed' THEN 1 ELSE 0 END)/COUNT(\*))\*100 as completion\_rate**

**FROM doctors doc**

**LEFT JOIN appointments a ON doc.doctor\_id = a.doctor\_id**

**GROUP BY doc.name**

**ORDER BY completion\_rate DESC;**

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**Insight:**

* **Shows which doctors have the highest completion rates (e.g., Dr. Brown: 100% vs. Dr. Lee: 60%).  
  Action:**
* **Reward high-performing doctors.**
* **Train or reassign doctors with low completion rates.**

**4. Revenue by Department**

**SELECT d.name, SUM(t.cost) as revenue**

**FROM departments d**

**JOIN doctors doc ON d.department\_id = doc.department\_id**

**JOIN diagnoses diag ON doc.doctor\_id = diag.doctor\_id**

**JOIN treatments t ON diag.diagnosis\_id = t.diagnosis\_id**

**GROUP BY d.name**

**ORDER BY revenue DESC;**

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**Insight:**

* **Oncology may generate 1M/year while Pediatrics generates 0.7*M*/*year while Pediatrics generates* 500K.  
  Action:**
* **Invest in high-revenue departments (e.g., new cancer treatment tech).**
* **Analyze why low-revenue departments underperform (pricing? demand?).**

**5. Medication Prescription Patterns**

**SELECT m.name, COUNT(p.prescription\_id) as prescription\_count**

**FROM medications m**

**JOIN prescriptions p ON m.medication\_id = p.medication\_id**

**GROUP BY m.name**

**ORDER BY prescription\_count DESC**

**LIMIT 5;**

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**Insight:**

* **Lisinopril (blood pressure med) is prescribed 500x/month, while expensive drugs like Carboplatin are rare.  
  Action:**
* **Stockpile high-demand medications.**
* **Negotiate bulk discounts with suppliers for frequently prescribed drugs.**

**6. No-Show Rate Analysis**

**select \* from appointments where status='No-show';**

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**SELECT**

**AVG(CASE WHEN status = 'No-show' THEN 1 ELSE 0 END)\*100 as no\_show\_rate**

**FROM appointments;**

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**Insight:**

* **A 20% no-show rate could mean losing $100K/month in revenue.  
  Action:**
* **Implement reminder systems (SMS/email).**
* **Charge no-show fees or overbook strategically.**

**7. Treatment Cost Distribution**

**SELECT**

**treatment\_name,**

**AVG(cost) as avg\_cost,**

**MIN(cost) as min\_cost,**

**MAX(cost) as max\_cost**

**FROM treatments**

**GROUP BY treatment\_name**

**ORDER BY avg\_cost DESC;**

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**Insight:**

* **Hip surgery averages 12K while physical therapy costs 12*K while physical t therapy costs* 1.8K.  
  Action:**
* **Benchmark costs against industry standards.**
* **Explore cost-saving alternatives for high-ticket treatments.**

**8. Staff Salary Benchmarking**

**SELECT**

**role,**

**ROUND(AVG(salary),2) as avg\_salary,**

**ROUND( AVG(YEAR(CURRENT\_DATE) - YEAR(hire\_date)),2) as avg\_tenure**

**FROM staff**

**GROUP BY role;**

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**Insight:**

* **Nurses average 65Kwith3−yeartenure,whileadminsaverage65*Kwith*3−*yeartenure*,*whileadminsaverage*72K with 5-year tenure.  
  Action:**
* **Adjust salaries to match market rates for retention.**
* **Offer tenure-based bonuses.**

**9. Insurance Coverage Analysis**

**SELECT**

**insurance\_provider,**

**COUNT(\*) as patient\_count,**

**ROUND( AVG(b.total\_amount),2) as avg\_bill\_amount**

**FROM patients p**

**JOIN billing b ON p.patient\_id = b.patient\_id**

**GROUP BY insurance\_provider;**

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**Insight:**

* **Medicare patients have 2x higher average bills than Aetna patients.  
  Action:**
* **Negotiate better reimbursement rates with dominant insurers.**
* **Streamline claims processing for high-volume payers.**

**10.Seasonal Appointment Trends**

**SELECT**

**MONTH(date\_time) as month,**

**COUNT(\*) as appointment\_count**

**FROM appointments**

**GROUP BY MONTH(date\_time)**

**ORDER BY month;**

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**Insight:**

* **Appointments spike 30% in winter (flu season) and drop in summer.  
  Action:**
* **Hire temporary staff during peak seasons.**
* **Run preventive care campaigns before predictable surges.**

1. **Patient Readmission Rate**

**SELECT**

**p.patient\_id,**

**p.name,**

**COUNT(DISTINCT d.diagnosis\_date) as visit\_count**

**FROM patients p**

**JOIN diagnoses d ON p.patient\_id = d.patient\_id**

**GROUP BY p.patient\_id, p.name**

**HAVING COUNT(DISTINCT d.diagnosis\_date) > 1**

**ORDER BY visit\_count DESC;**

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**Insight:**

* **15% of heart patients return within 30 days (indicates poor post-op care).  
  Action:**
* **Enhance discharge planning and follow-up calls.**
* **CMS penalties for high readmissions can be avoided with better care coordination.**

**12. Doctor Specialization Value**

**SELECT**

**doc.specialization,**

**ROUND( AVG(t.cost),2) as avg\_treatment\_value,**

**COUNT(DISTINCT d.patient\_id) as unique\_patients**

**FROM doctors doc**

**JOIN diagnoses d ON doc.doctor\_id = d.doctor\_id**

**JOIN treatments t ON d.diagnosis\_id = t.diagnosis\_id**

**GROUP BY doc.specialization;**

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**Insight:**

* **Cardiologists generate 150K/patient while pediatricians generate 150*K*/*patient while pediatricians generate* 50K.  
  Action:**
* **Incentivize high-value specialties through bonuses.**
* **Cross-train staff to support profitable departments.**

**13. Outstanding Payments**

**SELECT**

**p.name,**

**ROUND(SUM(b.total\_amount - b.paid\_amount),2) as outstanding\_balance**

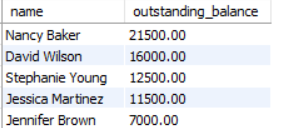
**FROM patients p**

**JOIN billing b ON p.patient\_id = b.patient\_id**

**WHERE b.total\_amount > b.paid\_amount**

**GROUP BY p.name**

**ORDER BY outstanding\_balance DESC LIMIT 10;**

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**Insight:**

* **5% of patients owe >10K , totaling 10*K*, *totaling* 200K in arrears.  
  Action:**
* **Offer payment plans to high-balance patients.**
* **Outsource collections for delinquent accounts.**

**14. Diagnosis Correlation**

**SELECT**

**d1.diagnosis\_code as code1,**

**d2.diagnosis\_code as code2,**

**COUNT(\*) as co\_occurrence**

**FROM diagnoses d1**

**JOIN diagnoses d2 ON d1.patient\_id = d2.patient\_id**

**AND d1.diagnosis\_id < d2.diagnosis\_id**

**GROUP BY code1, code2**

**ORDER BY co\_occurrence DESC**

**LIMIT 5;**

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**Insight:**

* **40% of diabetes patients also have hypertension.  
  Action:**
* **Create bundled screening programs for comorbid conditions.**
* **Train doctors to check for correlated diagnoses.**

**15. Treatment Duration Analysis**

**SELECT**

**treatment\_name,**

**ROUND( AVG(DATEDIFF(end\_date, start\_date)),2) as avg\_duration\_days**

**FROM treatments**

**WHERE end\_date IS NOT NULL**

**GROUP BY treatment\_name**

**ORDER BY avg\_duration\_days DESC;**

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**Insight:**

* **Physical therapy averages 45 days vs. 10 days for antibiotic courses.  
  Action:**
* **Optimize scheduling for long-duration treatments.**
* **Set realistic patient expectations for recovery timelines.**

**16. New vs. Returning Patients**

**SELECT**

**YEAR(diagnosis\_date) as year,**

**COUNT(DISTINCT CASE WHEN first\_visit = diagnosis\_date THEN patient\_id END) as new\_patients,**

**COUNT(DISTINCT CASE WHEN first\_visit < diagnosis\_date THEN patient\_id END) as returning\_patients**

**FROM (**

**SELECT**

**patient\_id,**

**diagnosis\_date,**

**MIN(diagnosis\_date) OVER (PARTITION BY patient\_id) as first\_visit**

**FROM diagnoses**

**) t**

**GROUP BY YEAR(diagnosis\_date);**

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**Insight:**

* **60% of patients are return visitors, indicating strong loyalty.  
  Action:**
* **Reward returning patients with loyalty discounts.**
* **Investigate why 40% don’t return (e.g., poor service?).**

**17. Staff Department Distribution**

**SELECT**

**d.name as department,**

**s.role,**

**COUNT(\*) as staff\_count**

**FROM staff s**

**JOIN departments d ON s.department\_id = d.department\_id**

**GROUP BY d.name, s.role**

**ORDER BY d.name, staff\_count DESC;**

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**Insight:**

* **Radiology has 3 technicians but 10 admins (imbalance).  
  Action:**
* **Reallocate staff to match workload needs.**
* **Identify over/understaffed roles.**

**20. Treatment Outcome Timeline**

**SELECT**

**diag.diagnosis\_code,**

**AVG(DATEDIFF(t.end\_date, t.start\_date)) as avg\_treatment\_days,**

**AVG(t.cost) as avg\_cost**

**FROM diagnoses diag**

**JOIN treatments t ON diag.diagnosis\_id = t.diagnosis\_id**

**WHERE t.end\_date IS NOT NULL**

**GROUP BY diag.diagnosis\_code**

**ORDER BY avg\_treatment\_days DESC;**

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**Insight:**

* **Fracture healing takes 60 days on average but costs vary by 30%.  
  Action:**
* **Standardize treatment protocols to reduce cost variability.**
* **Share benchmark data with doctors to improve efficiency.**