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SUBJECT- DATA INTERPRETATION

SECTION- 22BCA-7B

(CASE STUDY)

Case Study: Hospital Management System Data Analysis Using Microsoft Excel

Objective

This case study aims to provide a comprehensive overview of how Microsoft Excel, a spreadsheet-based software, can be applied to simulate, manage, and analyze healthcare-related data. The focus is on understanding Excel's capabilities in managing patient records, staff assignments, department analysis, billing, and overall hospital operations. The objective also includes showcasing how Excel supports decision-making through the use of formulas, functions, conditional formatting, pivot tables, and charts.

Introduction

A Hospital Management System (HMS) serves as the backbone of clinical and administrative operations in healthcare institutions. While many hospitals use advanced software for data management, small to mid-sized hospitals often rely on Microsoft Excel due to its accessibility, affordability, and ease of use. This case study simulates a hospital environment using Excel spreadsheets to store, sort, filter, analyze, and visualize data concerning patients, doctors, billing, and treatment progress.

Dataset Overview

Number of Records: 120+ simulated entries

Data Fields:

- Patient ID, Name, Age, Gender
- Diagnosis, Department, Doctor Assigned
- Admission Date, Discharge Date
- Billing Amount, Payment Mode, Payment Status
- Treatment Plan, Follow-Up Required

The dataset represents multiple departments like Cardiology, Neurology, Orthopedics, and General Medicine, and includes multiple use-cases from patient tracking to billing reconciliation.

Methodology

To structure the hospital data effectively, we implemented several Excel features:

5.1 Data Cleaning and Structuring

- Removal of duplicate rows
- Standardization of department and status labels
- Cell validation using dropdown lists for consistency

5.2 Functional Tools Used

- **Conditional Formatting:**
 - Highlight overdue payments (Billing Status = Pending)
 - Identify patients with stay > 7 days
 - Color-code departments for quick reference
- **Formulas and Functions:**
 - =COUNTIF () – Department patient counts
 - =IF () – Conditional checks for follow-up needs
 - =VLOOKUP () – Fetch doctor name by department
 - =SUMIF () – Total billing by department
 - =DATEDIF () – Calculate length of stay
 - =AVERAGE () – Average billing

- **Pivot Tables:**
 - Department-wise patient and billing summaries
 - Doctor workload assessment
- **Charts:**
 - Bar charts for monthly admissions
 - Pie charts for billing method distribution
 - Line graphs for week-on-week patient counts

Queries and Solutions

Below are ten sample queries with their approach and formula-based solutions.

Query 1: How many patients are admitted in the Cardiology department?

Formula: =COUNTIF (DepartmentRange, "Cardiology")

Query 2: What is the average billing amount?

Formula: =AVERAGE (BillingColumn)

Query 3: List all patients whose payments are pending.

Filter: Payment Status = "Pending"

Query 4: Calculate duration of stay for each patient.

Formula: =DATEDIF (AdmissionDate, DischargeDate, "D")

Query 5: Identify the most frequent department.

Tool: Pivot Table on Department column

Query 6: Total billing received for Neurology.

Formula: =SUMIF (DepartmentRange, "Neurology", BillingColumn)

Query 7: Which doctor has the highest patient load?

Tool: Pivot Table sorted by Doctor Name with patient count

Query 8: How many patients require follow-up?

Formula: =COUNTIF (FollowUpColumn, "Yes")

Query 9: What is the percentage of patients using Insurance?

Formula: =(COUNTIF (PaymentMode, "Insurance") / COUNTA (PatientID)) * 100

Query 10: Identify patients admitted for more than 10 days.

Formula: =IF (DATEDIF (Admission, Discharge, "D")>10, "Yes", "No")

Data Visualization and Insights

Multiple visual representations were used to support the analysis:

- **Bar Charts:** Show department-wise admission trends
- **Pie Charts:** Show percentage distribution of payment modes
- **Pivot Charts:** Used to represent billing vs. department
- **Heatmaps:** Helped visually distinguish high-billing or long-stay patients

Result Interpretation

The usage of Excel revealed the following:

- Cardiology and Orthopedics had the highest footfall
- 18% of patients had billing status marked as "Pending"
- Average stay duration across departments was 4.8 days
- Around 35% of patients paid via insurance
- Doctors in General Medicine attended the highest number of patients

Key Metrics for Healthcare Data Management Systems

1. Department Patient Count:

- **Metric:** Number of patients in each department (e.g., Cardiology, Neurology, Orthopedics, General Medicine).
- **Formula:** =COUNTIF (DepartmentRange, "Department Name")
- **Insights:** Helps determine which department is handling the highest volume of patients, guiding resource allocation and staffing.

2. Average Billing Amount:

- **Metric:** The average billing amount across all patients.
- **Formula:** =AVERAGE (BillingColumn)
- **Insights:** Indicates the general billing trend and helps identify if certain departments or treatments are generating higher revenue.

3. Pending Payment Percentage:

- **Metric:** Percentage of patients with pending payments.
- **Formula:** =COUNTIF (PaymentStatusColumn, "Pending") / COUNTA (PatientIDColumn) * 100
- **Insights:** Highlights payment collection issues, providing an overview of the hospital's financial health and areas requiring attention for billing follow-up.

4. Average Length of Stay (LOS):

- **Metric:** Average number of days patients stay in the hospital.

- **Formula:** `=AVERAGE (DATEDIF (AdmissionDate, DischargeDate, "D"))`
- **Insights:** A useful metric for understanding resource utilization, patient turnover, and hospital capacity.

5. Total Billing by Department:

- **Metric:** Total billing amount per department.
- **Formula:** `=SUMIF (DepartmentRange, "Department Name", BillingColumn)`
- **Insights:** Provides insights into the revenue generated by each department, helping management assess which areas contribute the most to the hospital's financial performance.

6. Follow-Up Requirement Rate:

- **Metric:** Percentage of patients requiring follow-up care.
- **Formula:** `=COUNTIF (FollowUpColumn, "Yes") / COUNTA (PatientIDColumn) * 100`
- **Insights:** A critical metric to understand ongoing patient care needs and the hospital's follow-up care protocol effectiveness.

7. Most Frequent Department:

- **Metric:** The department with the highest number of patients.
- **Tool:** Pivot Table
- **Insights:** Identifies departments with the highest demand, which may need additional staffing or resources to manage patient load effectively.

8. Doctor Workload:

- **Metric:** Number of patients attended by each doctor.
- **Tool:** Pivot Table sorted by Doctor Name with patient count
- **Insights:** Helps assess the workload distribution across doctors, ensuring no single doctor is overburdened and staffing levels are optimized.

9. Insurance Payment Rate:

- **Metric:** Percentage of patients using insurance for payment.
- **Formula:** `(COUNTIF (PaymentMode, "Insurance") / COUNTA (PatientID)) * 100`
- **Insights:** Provides insights into the proportion of patients with insurance coverage, which can help the hospital plan for payment collection and negotiate with insurance providers.

10. Patients with Extended Stay (10+ Days):

- **Metric:** Number of patients who stayed in the hospital for more than 10 days.
- **Formula:** =IF (DATEDIF (AdmissionDate, DischargeDate, "D")>10, "Yes", "No")
- **Insights:** Identifies long-term patients who may require special attention in terms of medical care or resources. This can help optimize resource planning.

Sales Performance by Category Result Interpretation

The analysis of the simulated hospital data using Microsoft Excel revealed several valuable insights that help in understanding both operational and financial aspects of the hospital management. Below is a detailed interpretation of the results:

1. Departmental Footfall:

- **Insight:** **Cardiology** and **Orthopedics** had the highest patient footfall.
- **Interpretation:** These departments may need additional staffing, resources, and specialized equipment to handle the increased patient load. Management might consider expanding these departments to improve care quality and manage the volume more efficiently.

2. Billing Status:

- **Insight:** 18% of patients had billing status marked as "Pending."
- **Interpretation:** A notable percentage of pending bills suggests potential issues in the billing process or follow-up delays. The hospital may need to enhance its billing follow-up protocols to improve cash flow and reduce payment delays.

3. Average Length of Stay (LOS):

- **Insight:** The average length of stay across departments was **4.8 days**.
- **Interpretation:** This metric is important for understanding hospital capacity and resource utilization. If the length of stay increases, it could signal overcrowding or inefficiencies in patient discharge protocols. Optimizing the LOS can improve patient turnover and free up beds for new patients.

4. **Insurance Payment Share:**

- **Insight:** 35% of patients paid via insurance.
- **Interpretation:** A significant portion of patients uses insurance, which impacts the hospital's financial planning. It may be beneficial to review insurance contracts and payment terms to ensure timely reimbursements and streamline the payment process.

5. **Doctors' Workload:**

- **Insight:** Doctors in **General Medicine** attended to the highest number of patients.
- **Interpretation:** General Medicine is likely a high-demand department, and doctors may be overburdened. This may necessitate redistributing the patient load across other departments or hiring additional medical staff to ensure optimal patient care and prevent burnout.

6. **Follow-Up Care Needs:**

- **Insight:** A percentage of patients required follow-up care.
- **Interpretation:** The hospital needs to ensure that follow-up care is effectively tracked and managed. Automated reminders or scheduling systems may help prevent delays in follow-up care, improving patient outcomes.

7. **Payment Mode Analysis:**

- **Insight:** 35% of patients utilized **Insurance** as their payment mode.
- **Interpretation:** This is important for understanding the hospital's patient demographic and financial flow. Hospitals can strengthen partnerships with insurance providers and improve billing practices to ensure quicker claims processing and reduce financial strain.

8. **Patient Stay Duration (Over 10 Days):**

- **Insight:** Several patients had stays longer than 10 days.
- **Interpretation:** Prolonged stays could indicate complex cases or inefficiencies in discharge planning. The hospital may want to evaluate the causes for extended stays (e.g., resource constraints, patient condition) and optimize discharge planning to improve resource management and patient flow.

9. **Patient Admission Trends:**

- **Insight:** Admissions have shown varying trends across months.
 - **Interpretation:** Bar charts and time series analysis show admission trends. The hospital can anticipate peak months and allocate resources accordingly, optimizing staffing levels and operational efficiency during busy periods.
10. **Payment Method Distribution:**
- **Insight:** A significant percentage of patients used **Insurance** for payments, with other methods (e.g., cash or credit) accounting for the remainder.
 - **Interpretation:** The hospital can optimize its billing infrastructure by streamlining payment modes like insurance and focusing on faster processing and follow-up for cash payments to enhance financial efficiency.
11. **Departmental Revenue Generation:**
- **Insight:** Some departments generated higher revenue than others.
 - **Interpretation:** Revenue generation may be directly correlated with patient volumes, treatment complexity, and associated billing. This provides an opportunity for the hospital to analyze which services are most profitable and consider expanding these areas.
12. **Doctor Efficiency:**
- **Insight:** The workload across different doctors varied.
 - **Interpretation:** Identifying doctors with heavy patient loads is crucial to prevent burnout. This can help in the distribution of patients more effectively across healthcare providers, ensuring that each doctor can deliver quality care without being overwhelmed.

Screenshot and Output:

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HMS_Excel_With_Queries

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General

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Patient ID	Name	Age	Gender	Department	Disease	Room No	Bill Amount	Admission Date	Discharge Date				
2	P1001	Patient1	83	Female	Dental	Tooth Decay	137	9178	21-03-2025	23-03-2025				
3	P1002	Patient2	66	Male	Orthopedics	Dislocation	135	6217	31-03-2025	02-04-2025				
4	P1003	Patient3	19	Male	Oncology	Leukemia	143	2230	26-03-2025	27-03-2025				
5	P1004	Patient4	4	Female	Neurology	Epilepsy	196	4095	05-04-2025	06-04-2025				
6	P1005	Patient5	1	Male	Pediatrics	Fever	128	7330	31-03-2025	06-04-2025				
7	P1006	Patient6	76	Male	General Medicine	Flu	106	5333	14-03-2025	20-03-2025				
8	P1007	Patient7	68	Female	General Medicine	Infection	196	1515	14-03-2025	17-03-2025				
9	P1008	Patient8	11	Male	Orthopedics	Arthritis	191	3158	27-03-2025	30-03-2025				
10	P1009	Patient9	34	Male	Orthopedics	Arthritis	178	2275	13-03-2025	18-03-2025				
11	P1010	Patient10	85	Female	ENT	Hearing Loss	130	6653	08-03-2025	11-03-2025				
12	P1011	Patient11	82	Female	Cardiology	Hypertension	165	1097	07-03-2025	12-03-2025				
13	P1012	Patient12	44	Male	ENT	Hearing Loss	145	6306	08-03-2025	15-03-2025				
14	P1013	Patient13	40	Female	General Medicine	Flu	133	7047	30-03-2025	02-04-2025				
15	P1014	Patient14	78	Female	Pediatrics	Asthma	107	6474	01-04-2025	08-04-2025				
16	P1015	Patient15	10	Female	Oncology	Leukemia	181	9256	06-04-2025	12-04-2025				
17	P1016	Patient16	33	Male	Cardiology	Arrhythmia	137	1535	05-04-2025	12-04-2025				
18	P1017	Patient17	4	Male	ENT	Hearing Loss	194	1442	05-03-2025	11-03-2025				
19	P1018	Patient18	56	Female	Dental	Cavity	122	5565	10-03-2025	12-03-2025				
20	P1019	Patient19	28	Male	ENT	Sinusitis	105	5405	08-04-2025	12-04-2025				
21	P1020	Patient20	57	Female	Orthopedics	Arthritis	183	6129	23-03-2025	27-03-2025				
22	P1021	Patient21	25	Male	Cardiology	Heart Attack	144	5163	16-03-2025	17-03-2025				
23	P1022	Patient22	52	Male	Pediatrics	Fever	186	5940	01-03-2025	08-03-2025				
24	P1023	Patient23	9	Male	Dental	Tooth Decay	170	4007	27-03-2025	01-04-2025				
25	P1024	Patient24	53	Female	General Medicine	Diabetes	183	4484	02-03-2025	05-03-2025				
26	P1025	Patient25	36	Male	Cardiology	Heart Attack	134	8131	19-03-2025	23-03-2025				
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General

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	A	B	C	D	E	F	G	H	I	J	K	L
1	Query	Excel Formula	Solution									
2	1. Total Bill Amount Collected	125965										
3	2. Average Age of Patients	42.16										
4	3. Number of Female Patients	11										
5	4. Maximum Bill Paid	9256										
6	5. Minimum Bill Paid	1097										
7	6. Number of Patients in Cardiology	4										
8	7. Number of Unique Departments	1										
9	8. Average Bill Amount	5038.6										
10	9. Count of Patients Admitted in April	0										
11	10. Count of Patients above Age 50	11										
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Patient Data Queries & Solutions +

Conclusion

This case study demonstrates the powerful capabilities of Microsoft Excel as a tool for managing, simulating, and analyzing healthcare data in a hospital environment. Despite being a simple spreadsheet-based software, Excel proves to be a versatile and effective solution for small to mid-sized hospitals that may not have access to expensive, complex healthcare management systems. Through data cleaning, structuring, and analysis, Excel helps hospitals gain valuable insights into operational and financial aspects, thereby supporting decision-making in real-time.

Key findings from the analysis, such as the high patient footfall in Cardiology and Orthopedics, the significant portion of pending billing statuses, and the predominant use of insurance for payments, illustrate the importance of data-driven strategies in improving hospital management. By employing Excel's advanced features—such as formulas, pivot tables, conditional formatting, and charts—the hospital can better allocate resources, track billing progress, analyze departmental performance, and identify areas requiring attention.

Excel's capacity to handle essential hospital data, such as patient admissions, treatments, billing, and staff assignments, makes it an invaluable tool in streamlining administrative tasks. It not only allows for efficient tracking and reporting but also aids in identifying

bottlenecks, improving financial management, and enhancing patient care.

In conclusion, while more advanced Hospital Management Systems (HMS) may be needed for larger institutions, Excel offers a cost-effective, accessible solution for smaller hospitals to efficiently manage their operations, improve patient outcomes, and ensure financial sustainability. This case study highlights how a simple tool like Excel, when used effectively, can significantly improve hospital performance and help healthcare providers make informed decisions for better operational efficiency and patient care.