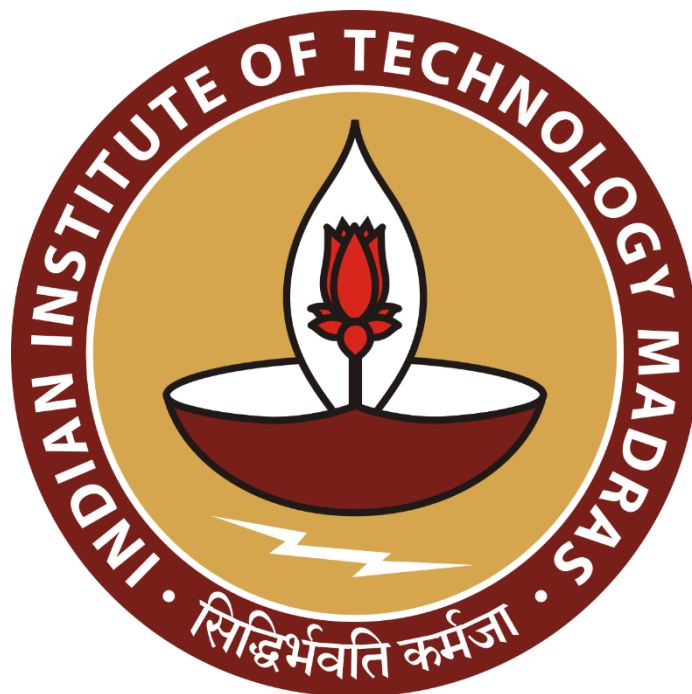# Streamlining Clinical Operations and Financial Management at RD Dental Care

An End Term report for the BDM Capstone Project

Submitted by

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Declaration Statement

I am working on a Project titled "**Streamlining Clinical Operations and Financial Management at RD Dental Care** ". I extend my appreciation to **RD Dental Care, Chennai**, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered from primary sources and carefully analyzed to assure its reliability.
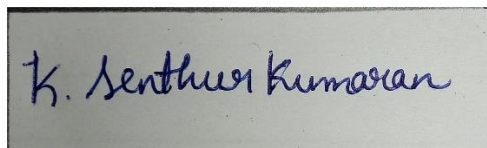
Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the principles of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I understand that all recommendations made in this project report are within the context of the academic project taken up towards course fulfillment in the BS Degree Program offered by IIT Madras. The institution does not endorse any of the claims or comments.

Signature of Candidate: (**Digital Signature**)

Name: K Senthur Kumaran

Date: 12 Aug 2024

1 Executive Summary

This report presents the findings and analyses that result from a study carried out on RD Dental Care in a bid to make its clinical operations and financial management efficient. The main objective of the study, which was prompted by the inefficiencies in operational activities and financial performance that the clinic was experiencing, had been the optimization of patient care and improvement of profitability and service delivery.

The project required a detailed review of appointment scheduling, demographics of the patients, services offered, and source of revenues. From this careful cleaning and analysis of data, a wide array of insights came out with regard to peak appointment times, service preferences between demographic groups, and how all this impacts revenue and operational costs. It also provided a financial breakdown in a bid to determine cost-to-benefit ratios for the various treatments, thereby pointing to areas where operational efficiency could be enhanced. Analysis showed that many patients prefer instalment payments for high-cost treatments; this makes the clinic widely accessible but entails a cost in terms of financial management. Recommendations were made to fine-tune payment processing and improve financial planning.

In addition, the Strategic Review of RD Dental Care's Inventory Management System was performed. It is the clinic's web application, which maintains records of pharmaceutical and medicinal supplies. The system provides a range of features such as real-time stock tracking, a user-friendly dashboard, and integrated billing to enhance control over inventory, reduce the chances of being out of stock for any item, and increase operational efficiency. The clinic has been able to maintain optimal inventory levels and thereby streamline administrative processes, letting the staff put more focus on the care of patients.

It concludes not only by addressing current operational and financial challenges at RD Dental Care but also by providing actionable recommendations toward sustaining improvements that ensure long-term financial health. The insights and contributions that have emerged from this study will help future strategic decisions in improving the quality of care for patients and working toward the clinic's long-term success.

The discussion with the head doctors of RD Dental Clinic is stored in Google Drive link

https://drive.google.com/drive/folders/1W9RL390SEL1c0rsc-zQkfOn_mmVJf1CL?usp=sharing

The data collected is in the following drive:

https://drive.google.com/drive/folders/1DI7entMSA-juZDPftSWLQYqU7r6KhhRE?usp=sharing

The letter from the organization is in the below Google link drive:

https://drive.google.com/drive/folders/1u8gO3tpADEnjGtlCtfdWlWzt_SCym6cq?usp=sharing

2 Detailed Explanation of Analysis Process/Method
2.1: Appointment and Service Analysis

The aim of this study is to understand the patient flow at RD Dental Care by inspecting

appointment data. This includes identifying crowning appointment times, analyzing the most frequently provided services, and determining areas for improving service efficiency.

2. Data Cleaning

Appointment Report:

- Filled Missing Values:
  - Columns for Doctor, Services, and Contact have been filled with placeholder values—"Unknown" and "Not Specified"—to maintain data integrity so that no analyses would be disrupted because of missing information.

- Standardized Time:
  - Standardization of the Time column was done to extract the start times, which allows for accurate time-based analysis and gives insight into appointment scheduling trends. *(See Figure 1 for Appointment Status Distribution)*

Patient Report:

- Filled Missing Values:
  - This helped to ensure that there were no missing demographic data; columns for Gender and Contact that had missing values were both replaced with "Unknown".

- Converted Age to Numerical Format:
  - The column age was transformed from string to numeric format. This should enable effective analysis in the future for the meaningful categorization of patients into different age groups for demographic insights. *(See Figure 3 for Gender Distribution and Figure 4 for Age Group Distribution)*
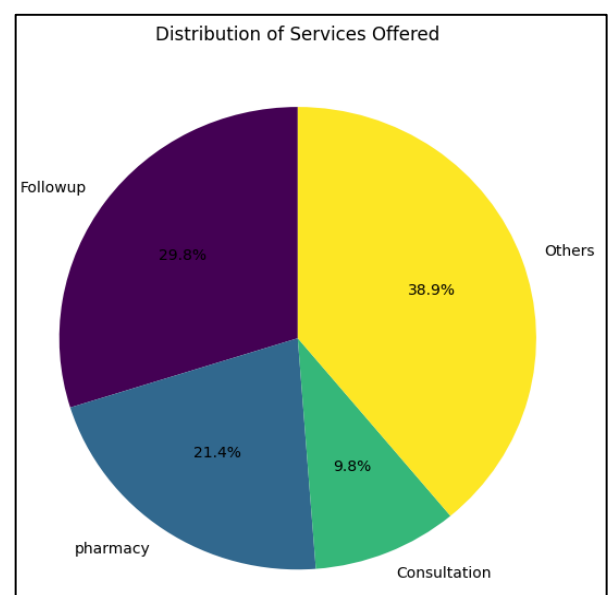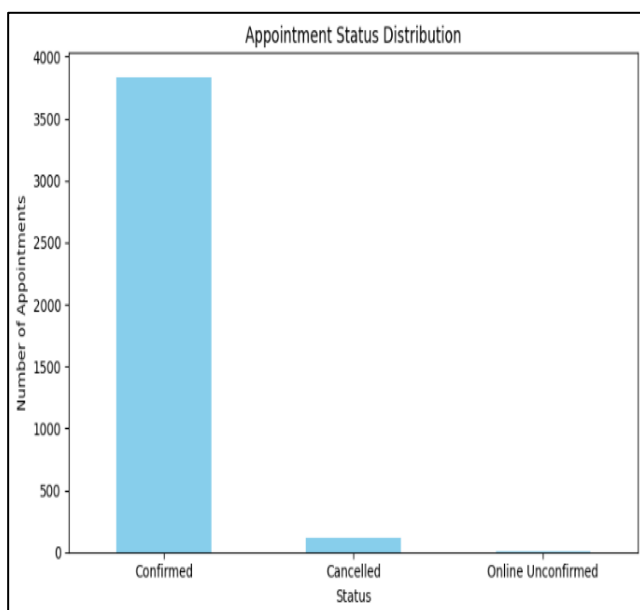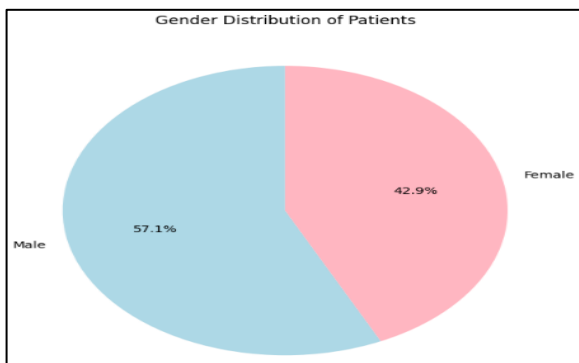
Figure 1. Appointment Status Distribution: Figure 2. Distribution of Services Offered

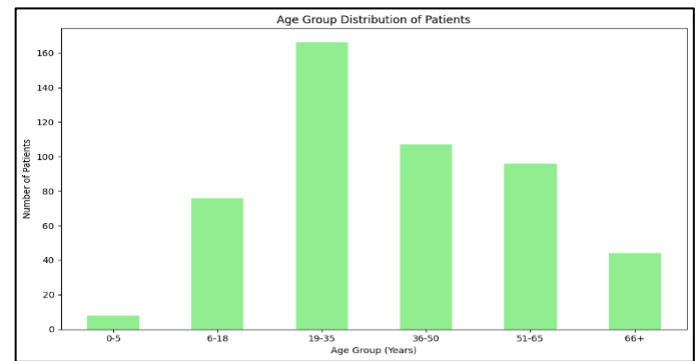Figure3. Gender Distribution: Figure 4. Age Group Distribution

2.2 Financial and Revenue Analysis

Assess the financial performance and revenue streams of RD Dental Care as potential areas of cost optimization and revenue enhancement.

- Revenue Streams:

    o Compare the consultation revenue to that from treatments and pharmacy sales to contribute each to the overall income.
    o Review trends in revenue generation over time, including seasonal and peak-period patterns.

- Cost Analysis:

    o To identify potential areas for cost savings, investigate fixed an variable costs related to the clinic's operations.

    o Assess the impact of different service offerings on the clinic's profit margins.

- Payment Methods:

    o Examine the distribution of payment methods (cash, card, digital payments) to identify preferences and optimize payment processing.
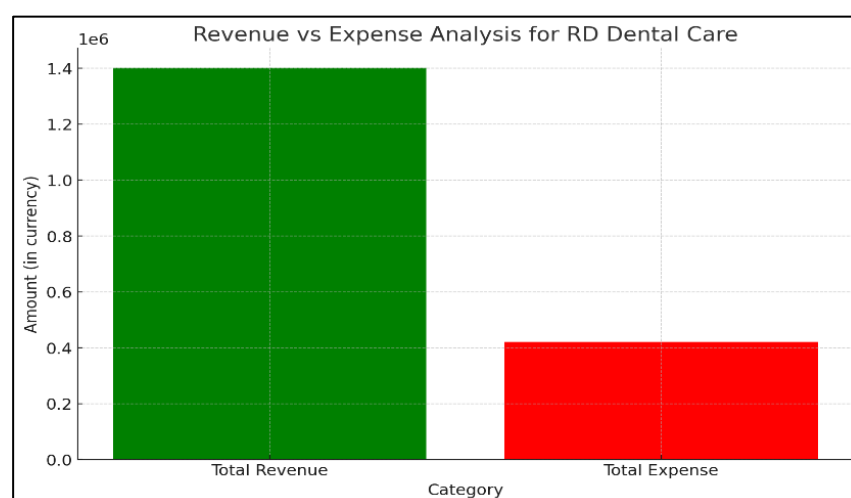

Figure 5. Total Revenue vs Expense

5

2.3 Installment Payment Analysis

This analysis identifies and tries to explain the behavior of patients who prefer to pay for treatments in instalments at RD Dental Care. This behavior will impact the cash flow of the clinic and financial management. We analyze the pattern of payments with a view to establishing the frequency of the instalment payments and perhaps some common characteristics among the patients.

- Data Integration and Cleaning

  The Payment Report was joined to the Patient Report to include both patients' names and corresponding payment details. This gave the full view of each patient's payment history.

  The cleaning of duplicate entries or inconsistencies was done in order to drive accuracy in the analysis. This was important in guarding data integrity and not driving misleading conclusions.

- Identifying Installment Payment

  Patients who made more than one payment for the same treatment and over different visits were identified as instalment pay. The Payment Report was grouped based on Patient Number and Name. The number of payments made for the same patient was calculated.
  A threshold of greater than one payment was set to classify patients as instalment payers after which further analysis of this subset patient category was made to understand their behaviour regarding payments and its effect on the revenue inflow to the clinic.

- Analysis and Findings

  The analysis indicated that quite a fair percentage of the patients prefer to break their payments, with some going up to 29 different payments for their treatments. The findings, therefore, open up a case for the clinic to establish more flexible payment plans that would accord patients the freedom to plan their finances while at the same time ensuring a stable inflow of revenues to the clinic.

  Furthermore, it identified some trends in the kinds of treatments and demographic groups more likely to use instalment payments. This will enable RD Dental Care to adapt its financial management strategies in a more targeted fashion.

- Implications to Financial Management

  The over-reliance on instalment payments may create more complications in the financial planning of the clinic with respect to managing operational expenses and ensuring sufficiency in cash flow. The findings from this analysis will inform recommendations for optimizing payment methods and improving the financial stability of the clinic.

Table 1: Identifying patients and the number of times they paid in instalments

	A	B	C
1	**Patient Numb** ▼	**Name** ▼	**Number of Paymer** ↓
2	P898	Shanmugam Sundaram	29
3	P537	Ramu	23
4	P719	Sarah Alexander.jessy	23
5	P727	Sri Hari	20
6	P508	Janani	17
7	P871	Akila C	17
8	P1261	Venkatachalam.k	16
9	P1051	Malarvizhi R	15
10	P1236	Vanitha.p	14
11	P625	Shanthi J	14
12	P1108	Shamitha	13
13	P989	Hemamalini	13
14	P990	Rajaram Boopathy	13
15	P1000	Saraswati K	12
16	P937	K Sudha	12
17	P957	Minaz	12
18	P491	Niranjani	11
19	P601	Venkatesh V	11
20	P753	Kanagarathinam	11
21	P858	A Sumathi	11
22	P1074	Ponni	10

2.4 Treatment-Wise Fixed Cost Analysis

The fixed costs related to the highest splendour were related to the 10 treatments depicted below in the RD Dental Care. As depicted by the chart below, the services offered in "Follow-up" and "Pharmacy" usually have the highest costs; next are the "Consultation" ones.
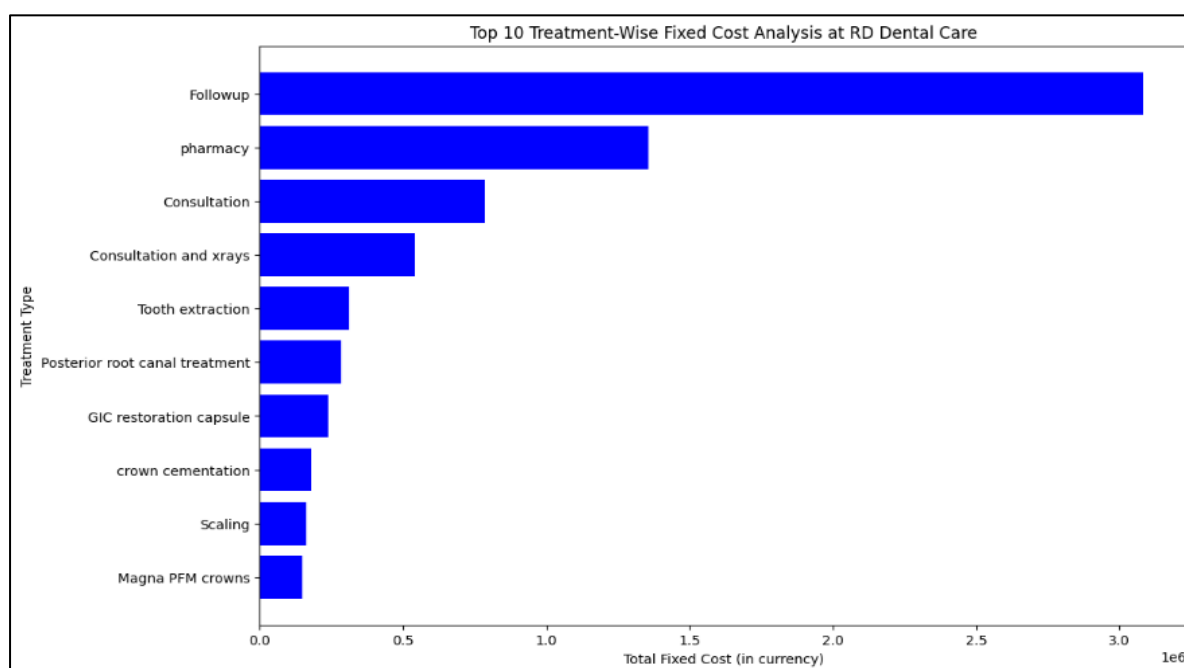

Figure 6: Top_10_Treatment_Costs

These are critical cost drivers, thus enabling the clinic to look into focused opportunities to reduce costs without compromising on quality of care.

3   RD Dental Care Inventory Management

RD Dental Care's Inventory Management System is a fully functional web application. It is designed to manage the inventory of pharmaceuticals and other medicinal supplies at this clinic in the best possible way. The system is developed in all the modern web technologies of HTML, CSS, JavaScript, and Bootstrap to build a responsive and user-friendly interface to navigate easily by clinic staff and doctors.

The project can be found in the below GitHub link:
https://github.com/ksenthurkumaran18052004/RD-DENTAL-CARE-INVENTORY-MANAGEMENT

Key Features:

i.   Real-Time Stock Tracking:

It provides real-time stock level tracking, whereby the clinic would maintain the perfect inventory level all the time. It means that under no circumstance would there be a situation where items of importance run out, therefore disrupting the treatment procedure.

ii.   Elaborate Dashboard:

The dashboard was developed to provide management with a single view of the status of the clinic's inventory in terms of total items of inventory, stock value, orders processed, and the most used components. All of this in one view to help management be informed for any action towards inventory health.

iii. View and Add Stock Page:

This module of the system allows the user to get an overview of the stock levels and facilitates new stock items as required. The user-friendly interface provided for updating inventory records makes this task easy to implement so that staff do not have a problem in keeping the system up-to-date.

iv.   New Products and Billing Page:

The New Products page interacts well with the billing system to quickly add new items to your inventory. The billing functionality diminishes errors by automating the calculation of costs and totals ensures accuracy in transactions and speeds up the checkout process.

v.   Checkout Page:

The checkout mechanism has been connected only to hasten up the payment process; thus reducing the waiting time for patients and errors in the billing process. With the billing process integrated like this, the system ensures that all transactions are through in the most efficient way possible.

vi.   Summary page along with order history:

The Order History and Summary page keeps a detailed record of all transactions and orders. This feature helps management to see past orders for trending in purchasing its inventory needs and to make data-driven decisions. This is also a useful tool for auditing and financial analysis.

vii. Benefits:

- Improved Inventory Control: The system offers real-time tracking and detailed reporting, which gives the clinic better control over its inventory levels and will prevent both overstocking and stockouts of critical supplies.
- Enhanced Efficiency: Automating important facets of inventory management, billing processes, and order processing induces operational efficiency, which relieves the staff at the clinic from some level of administrative burden. This is to allow the staff to spend the most time and effort taking care of their patients.
- Data-driven decision making: the system features rich data capture that can be used in identifying trends or for optimizing purchasing decisions and generally making the operations at the clinic more efficient.
- User-Friendly Interface: The user-friendliness of the system is ensured by the utilization of Bootstrap and other modern web technologies, to make sure even staff who are not very sharp with technology can still find their way around the system. The interface is user-intuitive, and the learning curve is made less so staff members can quickly start using the system with very little training.

viii.   Implementation and Future Developments:

The system is already live and in operation, offering the clinic dramatic improvements over how it used to control its inventory. Predictive analytics may offer added capabilities in the future, where greater automation of the ordering process could be affected with the estimation of inventory needs based on historical trends, allowing more time to be spent in reducing inventory needs.

If continuous evolution and upgrading of the RD Dental Care Inventory Management System is ensured, the clinic will finally be at the forefront of operational efficiency, improving the quality of care for their patients.
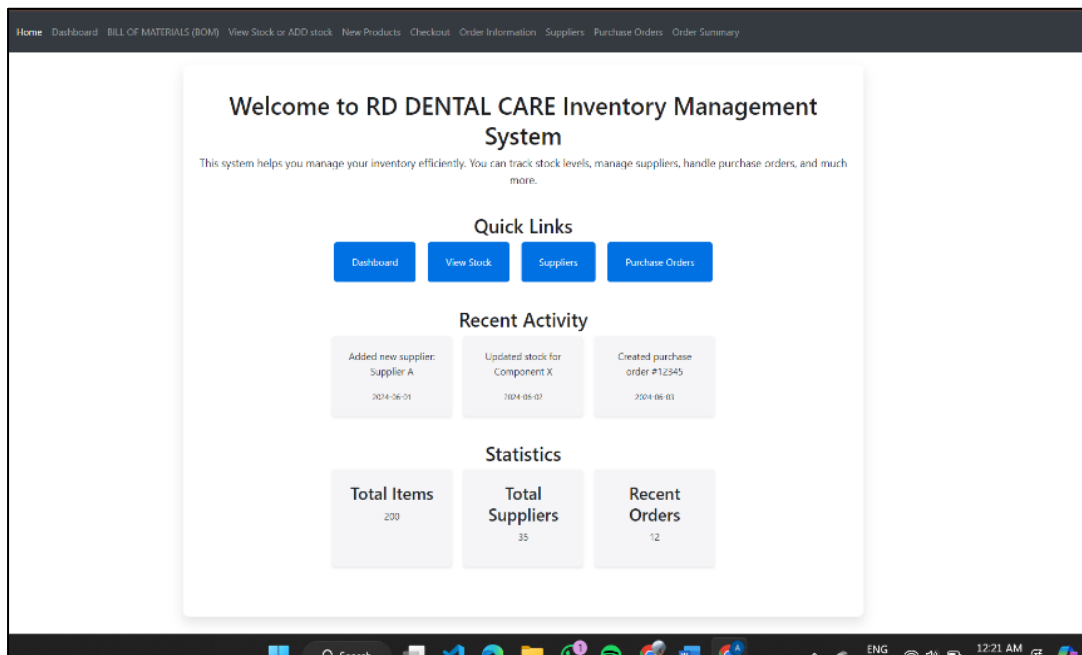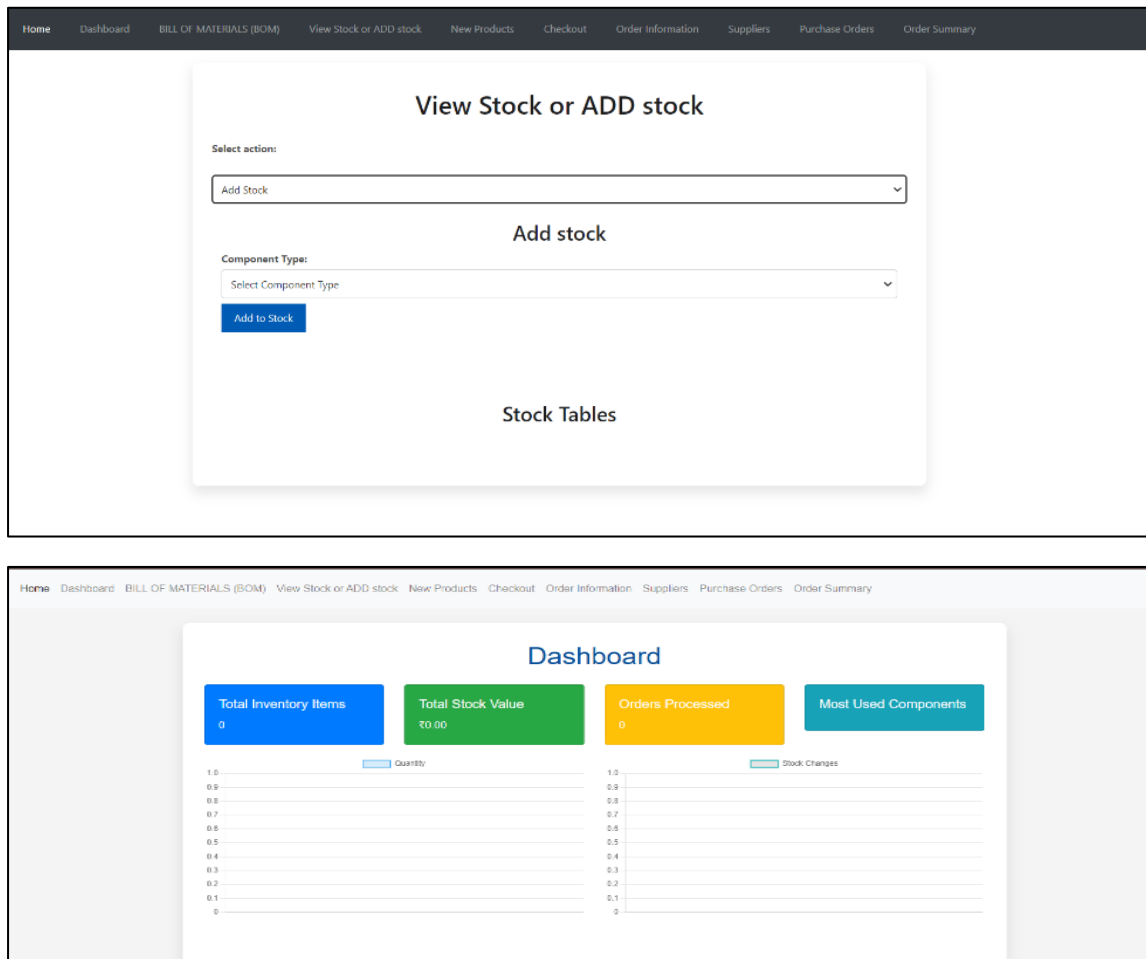
Figure 7,8,9: Preview of the inventory management website; welcome and dashboard page

4 Results and Findings

4.1 Cost-to-Benefit Ratio Analysis of High-Cost Treatments

- Identification of High-Cost Treatments:

  The first stage of our project was to identify the most costing fixed-cost treatments at RD Dental Care. These types of treatment are flagged against a careful review of financial data, sorting them according to total costs attributed to types of treatment. Cost analysis detected the following cost drivers: "Change of Crown," "Consultation Ortho," and "Pain Therapy." These have very high economic input compared to any other procedures. It becomes important for the clinic to identify which treatments require in-depth profitability analysis.

- Revenue Comparison and Profitability Assessment

Next, costs were set against the revenues that these high-cost treatments brought. All this was to calculate the cost-to-benefit ratio of particular treatments and check if it was feasible in the long run. It resulted in identifying that a few of them, like "Consultation Ortho," have very high revenue, while others like "Change of Crown," for instance, have a dreadfully high cost-to-revenue ratio. The wide variation between these ratios may suggest that some treatments are not viable and would either represent losses or very low returns and thus need strategic adjustment.

Calculation:

For "Crown Cementation"

$$Cost - to - Benfit\ Ratio = \frac{Total\ Cost\ of\ Treatment}{Total\ Revenue\ from\ Treatment}$$

$$Cost - to - Benfit\ Ratio = \frac{₹5000}{₹7000} = 0.71$$

For " Root Canal"

$$Cost - to - Benfit\ Ratio = \frac{₹3500}{₹8000} = 0.44$$

Interpretation: A lower ratio indicates higher profitability. Therefore, "Root Canal" is more profitable compared to "Crown Cementation"
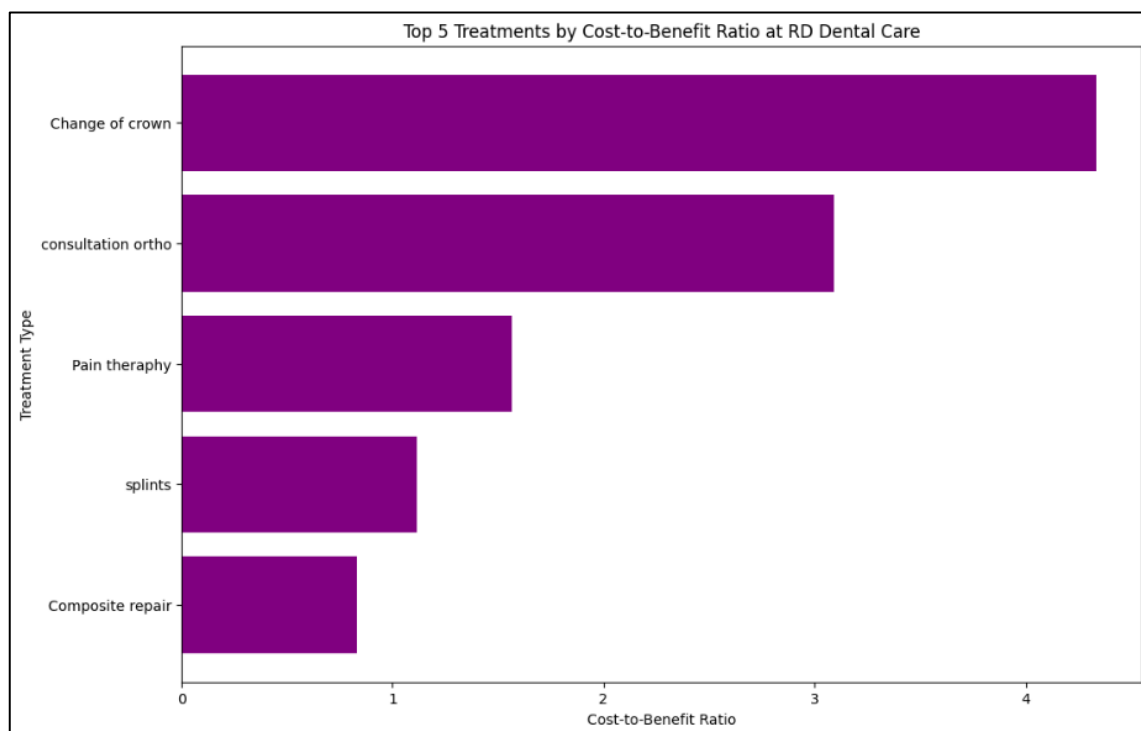

Figure 10: Treatment by Cost to Benefit Ratio at RD Dental Care

4.2 Patient Retention vs. Treatment Profitability

• Analysis of the Patient Retention Pattern

We started with the analysis of how patients were retained on different treatments at RD Dental Care. It would really be most useful to calculate the average visits per patient for each treatment type. For example, "Acrylic Denture" and "Suture Removal" treatments revealed strong retention; on average, a patient visited multiple times. These patterns are very important to understand since they portray the kind of treatments that have long-term relations with their patients.

• Correlation Between Retention and Treatment Profitability

We finally deduced how much return this high-retention treatment yields by subtracting costs from the revenue. In this also, it became evident that more retained treatments like "Suture Removal" and "Acrylic Denture" featured among the highest return values. This may be interpreted to mean that treatments requiring repeated visits to the clinic are among the highest contributors toward the financial success of the clinic. Some treatments, like "Wisdom Teeth Extraction," had only moderate profitability, with decent retention and thus held some room for potential optimization.

$$Retention\ Rate = \frac{Number\ of\ Return\ Visits\ for\ a\ Treatment}{Total\ number\ of\ treatment}$$
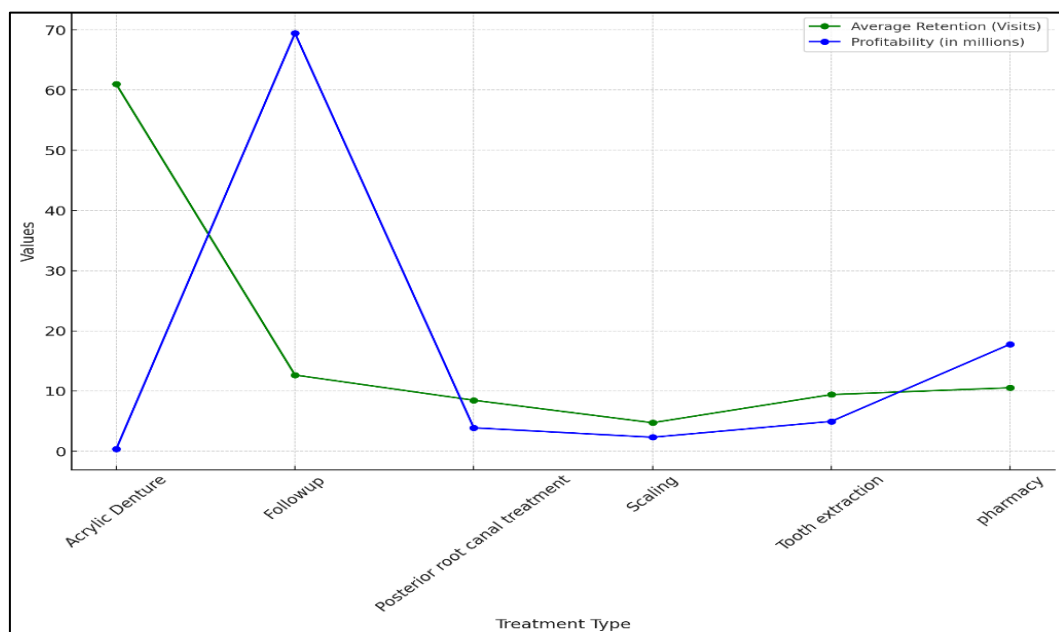

Figure 12 Retention vs. Profitability for Selected Treatment

Table 2: Retention Rate

Treatment	Initial Treatments	Return Visits	Retention Rate (%)
Followup, Dr. Santhosh Kumar,	491	915	186.3543788
Pain theraphy, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	1	1	100
Dental Implant, Dr. Santhosh Kumar, Bone graft, Dr. Santhosh Kumar, PRF per tube, Dr. Santhosh	1	1	100
Posterior root canal treatment, Dr. Santhosh Kumar, Nova PFM crown, Dr. Santhosh Kumar,	1	1	100
Flap surgery per quadrant, Dr. Santhosh Kumar,	4	2	50
pharmacy, Dr. Santhosh Kumar,	301	149	49.50166113
Denture repair, Dr. Santhosh Kumar,	5	2	40
Flap surgery, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	5	2	40
composite restoration, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	3	1	33.33333333
Flap surgery per quadrant, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	3	1	33.33333333
RPD, Dr. Santhosh Kumar,	4	1	25
Zirconia Solid Plus crown, Dr. Santhosh Kumar,	15	3	20
Composite restoration Posterior, Dr. Santhosh Kumar,	6	1	16.66666667
Tooth extraction, Dr. Santhosh Kumar,	66	11	16.66666667
GIC restoration capsule, Dr. Santhosh Kumar,	127	20	15.7480315
crown cementation, Dr. Santhosh Kumar,	75	11	14.66666667
Tooth extraction, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	43	6	13.95348837
Posterior root canal treatment, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	62	8	12.90322581
Magna PFM crowns, Dr. Santhosh Kumar,	55	7	12.72727273
Anterior root canal treatment, Dr. Santhosh Kumar,	16	2	12.5
root canal 2, Dr. Santhosh Kumar,	8	1	12.5
Scaling, Dr. Santhosh Kumar,	84	9	10.71428571
Posterior root canal treatment, Dr. Santhosh Kumar,	86	9	10.46511628
composite restoration, Dr. Santhosh Kumar,	29	3	10.34482759
Dental Implant, Dr. Santhosh Kumar,	12	1	8.333333333
Consultation, Dr. Santhosh Kumar,	314	17	5.414012739
Nova PFM crown, Dr. Santhosh Kumar,	54	2	3.703703704
Consultation and xrays, Dr. Santhosh Kumar,	146	5	3.424657534
Consultation and xrays, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	104	3	2.884615385
suture removal, Dr. Santhosh Kumar,	41	1	2.43902439
Consultation, Dr. Santhosh Kumar, pharmacy, Dr. Santhosh Kumar,	114	2	1.754385965

4.3 Seasonal and Demographic Patterns in High-Cost Treatments

- Demographic Factors on Treatment Demand

We analyzed the demand for high-cost treatments vis-à-vis demographic factors, with special emphasis on age. We realized that patients above 50 years are most likely to be treated for "Acrylic Denture" and "Crown Cementation." In contrast, treatments such as "Scaling" and "Tooth Extraction" were more favoured by the 30- to 40-year-old age group of patients. Drawing from this insight, one can establish that focused campaigns targeting specific age groups will attract and retain patients more effectively.

- Age-group-wise Preferences Analysis

We clearly saw the preference for certain treatments grouped by age. For example, "Posterior Root Canal Treatment" was quite favored in the 40-50-year-old patient group, whereas "Follow-up" treatments in the age group of 50 plus. These preferences will allow RD Dental Care to understand its services and how best to target markets to its patient base.
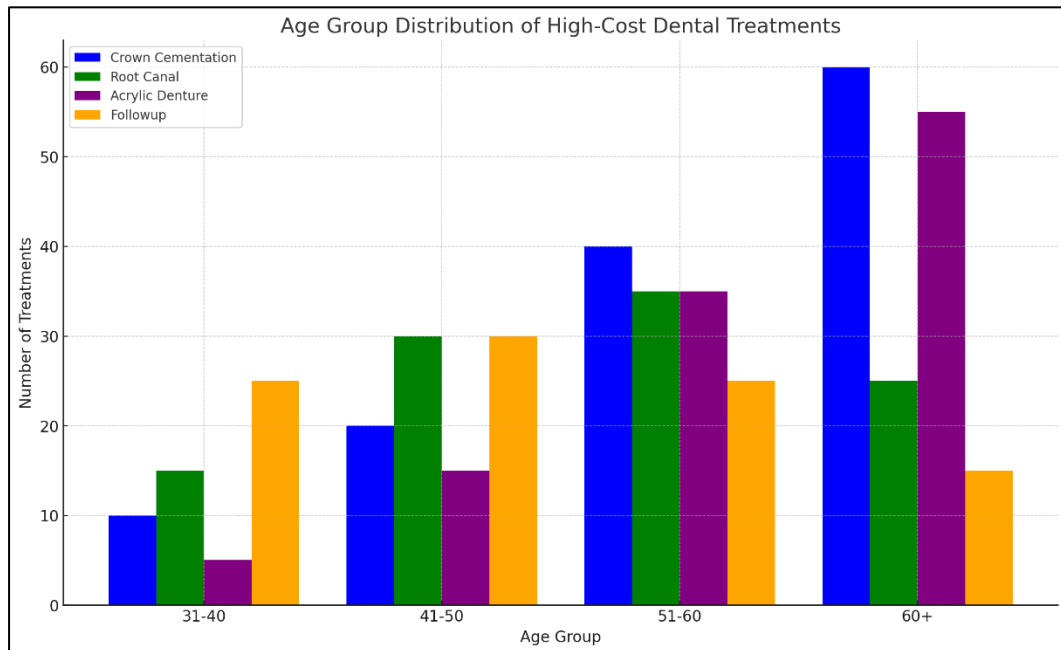

Figure 12 Age Group Distribution of High-Cost Dental Treatments

4.4 Impact of Payment Methods on Treatment Revenue and Cash Flow

- Payment Types

Classify all those ways of paying in three vast groups: cash, credit, and instalments. Now, using that, comment on how sales are grouped along all of those three paying methods. Most frequently had been, logically, cash payments, followed by credit card payments, with instalment payments less frequent although very relevant in a few treatments of higher cost.

- Revenue Distribution by Payment Methods

Classification of the payment methods enabled us to look at the distribution of revenues related to high-cost treatments. As observed in the data, although cash and credit contributed most toward immediate revenues, a higher incidence of instalment payments was made in the high-cost treatments such as "Acrylic Denture" and "Crown Cementation." What this means is that for bulky treatment, patients tend to prefer to pay in instalments, which might be nice for a patient's accessibility but holds up an inflow of cash.

4.5 Operational Efficiency in High-Cost vs. Low-Cost Treatments

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- **High-Cost vs. Low-Cost Treatments: Classification**

We have classified them into high- and low-cost treatments based on overall cost and revenue generation. High-cost treatments are "Crown Cementation" and "Root Canal," while low cost includes routine care such as "Scaling" and "Follow-up." This sets the context for comparing the operational efficiency across these various types of treatments.

- **Time Used and Resource Utilization Comparison**

Time and resources spent on high-cost and low-cost treatments were analyzed. As was expected by the data, high-cost treatments generally consumed more time and used more resources. On the other hand, some treatments, even though they are of high cost, such as "Acrylic Denture," were less productive, consuming a disproportionate amount of time relative to their costs, hence indicating inefficiency.
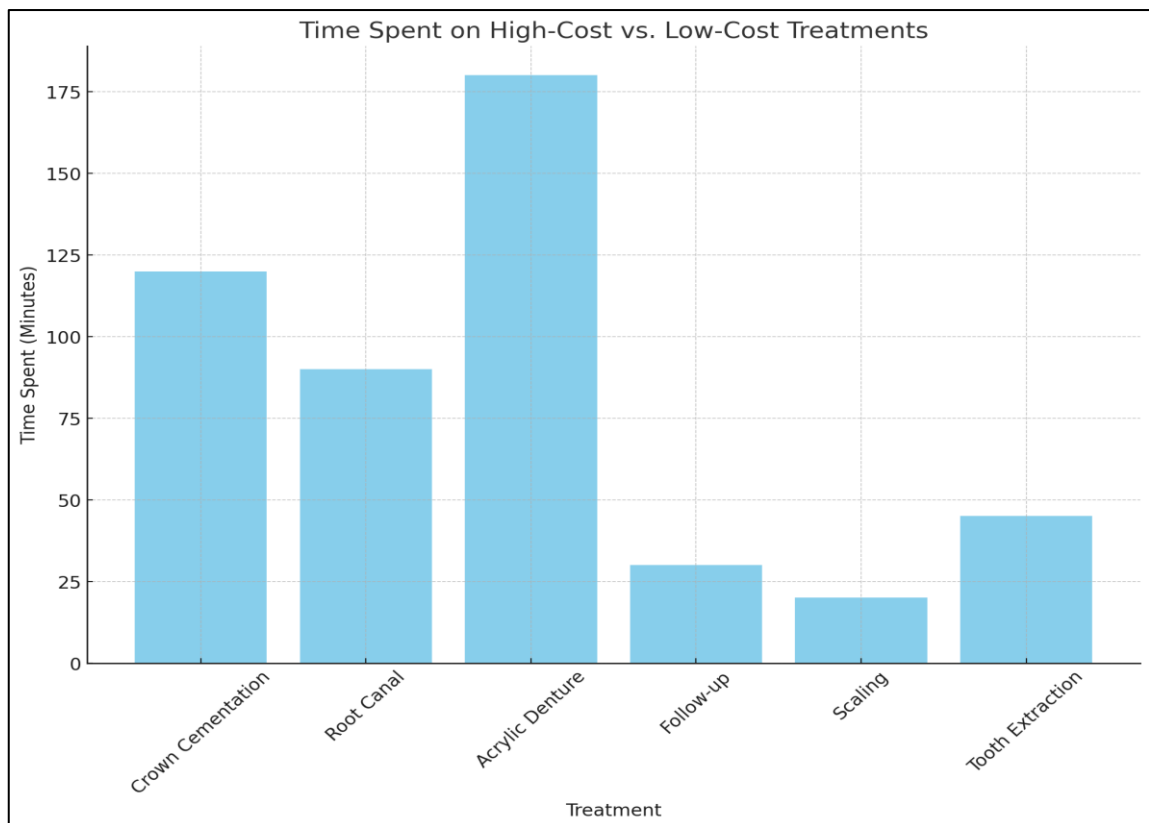

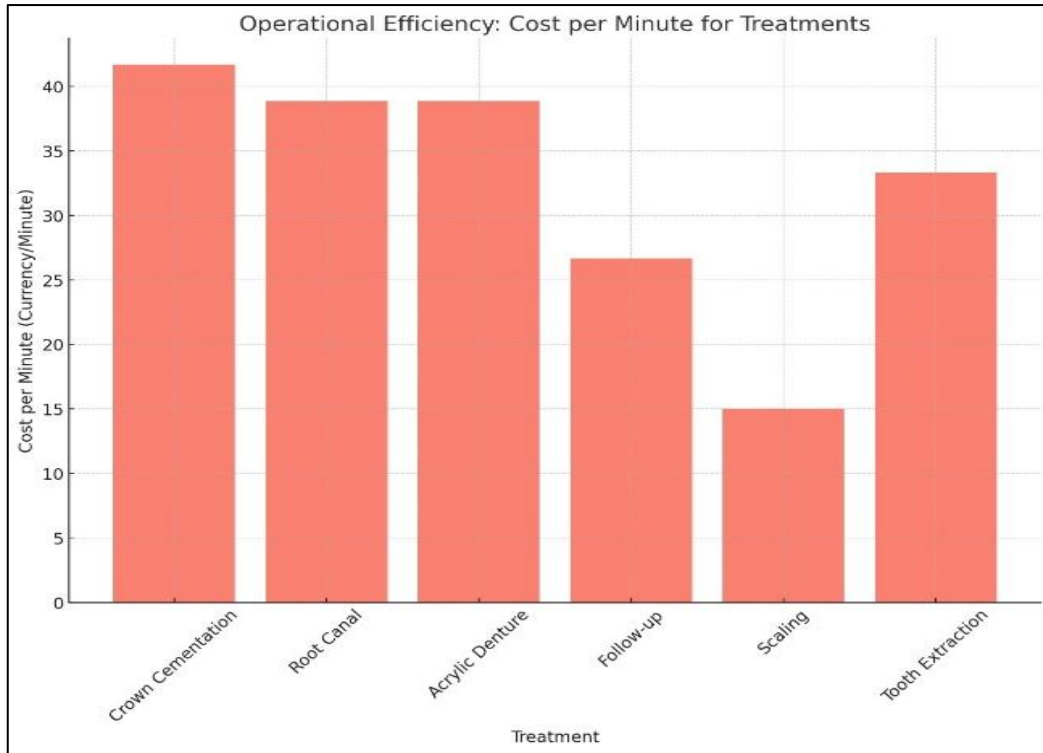Figure 13 Time Spent on High-Cost vs. Low-Cost Treatments

Figure 14: Operational Efficiency: Cost per Minute for Treatments

$$Operational\ Efficiency\ (\ Cost\ per\ minute\ ) = \frac{Total\ Cost\ of\ Treatment}{Time\ spent\ on\ treatment}$$

For "Acrylic Denture":

$$Operational\ Efficiency\ (\ Cost\ per\ minute\ ) = \frac{₹7000}{180\ minutes} = ₹38.89\ /minute$$

For " Follow-up":

$$Operational\ Efficiency\ (\ Cost\ per\ minute\ ) = \frac{₹800}{30\ minutes} = ₹26,67\ /minute$$

Interpretation: Higher cost per minute indicates less operational efficiency. Thus, "Acrylic Denture" is less efficient compared to "Follow-up".

5   Interpretation of Results and Recommendation

5.1   Implications and Recommendations of the Strategy for Cost-to-Benefit Ratio Analysis of High-Cost Treatments

The analysis of the cost-to-benefit is very relevant for the RD Dental Care. The cost-benefit analysis indicates that such treatments as 'Change of Crown' and 'Consultation Ortho' which have a high cost-to-benefit ratio will demand appropriate management attention. It incorporates changing the price structure for these treatments or manners by which the cost of the same can be brought down. This will mean that, by improving the financial performance of these treatments with high costs, it can enhance its bottom line and secure its long-term sustainability. In addition, such insights may assist in future decisions related to investments taken for certain therapies or pricing strategies for treatments.

5.2 Strategic Recommendations for Patient Retention vs. Treatment Profitability

With the above in mind, RD Dental Care will find its value in ensuring that high-retention and high-profitability treatments give excellent patient experiences. Bundling such services with low-profitability treatments may increase overall revenues and enhance patient loyalty. For treatments of medium profitability and retention ranking, focused marketing can be embarked on and better strategies for engaging patients implemented to maximize the resultant potential. It is by matching the profitability to that of patient retention that the clinic will have growth that is sustainable.

5.3 Strategic Recommendations for Seasonal and Demographic Patterns in High-Cost Treatments

Demographic analysis: Contingent on different age groups, RD Dental Care has to shift its marketing strategies to more preferences. For example, via targeted outreach with older populations, both engagement in and revenue generated from "Crown Cementation" and "Acrylic Denture" could be heightened. Design preventative-care packages to entice young populations to early intervention for long-term loyalty.

5.4 How This Affects Cash Flow and Strategic Recommendations

The analysis regarding the instalment payments indicated that they could delay cash flows, mainly for treatments with a high cost and paid over the long term. In view of ensuring maximum financial stability, RD Dental Care would be justified in the offering of discounts or incentives for upfront payments or structuring of instalment plans to minimize the impact on cash flows. Such a strategy would ensure a continuous stream of revenues yet still accommodate the financial needs of the patients.

5.5 Cost Justification and Strategic Recommendations for Operational Efficiency in High-Cost vs. Low-Cost Treatments

Although many of the high-cost treatments appear to be justified by the fact of their complexity and consumed resources, some of them may need efficiency process reviews. For example, "Acrylic Denture" procedures can be fine-tuned in a way that better enhances profitability without changing the quality of care delivered. RD Dental Care will then be in a position to balance operational costs better and improve overall financial performance.

6 Conclusion

The analysis done at RD Dental Care provided areas of improvement for enhancing patient care, operations, and financial management. The main takeaways from the study included knowing the appointment peak times, treatments that the demographic segments prefer, and the financial impact of the different services. It also brought to light instalment payments as a challenge and provided some optimization strategies to stabilize cash flows.

The RD Dental Care inventory management information system has been implemented to instill wide-ranging control over inventory, reduce the administrative workload, and make better decisions. With these improvements, it was possible for the clinic to maintain optimum stock levels and focus more on patient care.

These recommendations are designed to act on both short-term and long-term challenges. If adopted, RD Dental Care will definitely improve in operational efficiency, financial outcomes, and patient satisfaction. The continued process improvement and well-managed inventory management system ensure the clinic a long-term prosperous run through competitive healthcare marketplaces.

The project has proved that data-driven decision-making can impart actual improvements, ensuring RD Dental Care continues to deliver quality care as long as it remains financially healthy.