



# “A Time-Motion Study Of Patient Flow In The Outpatient Department To Identify Bottlenecks And Improve Service Delivery In A Multispecialty Ophthalmic Hospital”

**Sanket Ghugare**

MBA (Hospital & Healthcare Management)

Department of Hospital Administration

MIT ADT University

Maharashtra, India

## Abstract

Efficient patient flow in the Outpatient Department (OPD) is essential for ensuring quality healthcare services and improving patient satisfaction. In multispecialty ophthalmic hospitals, the OPD process involves multiple stages such as registration, preliminary examination, diagnostic procedures, and consultation, which often lead to increased waiting time and operational inefficiencies. Delays at any stage can affect overall service delivery and create dissatisfaction among patients.

This study aims to analyze patient flow in the OPD using a time-motion approach to identify bottlenecks and suggest improvements in service delivery. The research focuses on measuring the time spent by patients at various stages of their visit and examining the sequence of activities involved in the care process. Data is collected through direct observation and hospital records, capturing key time points such as registration time, waiting time, workup duration, and consultation time.

The analysis helps in identifying stages where delays are most frequent and understanding the factors contributing to these inefficiencies, such as uneven patient arrival, limited staffing, and process-related issues. Based on the findings, the study proposes practical recommendations to optimize workflow, improve resource utilization, and reduce waiting time without requiring major infrastructural changes.

The study highlights the importance of systematic process evaluation in healthcare settings and demonstrates how time-motion analysis can be used as an effective tool for improving operational efficiency. By addressing bottlenecks in patient flow, hospitals can enhance patient experience, reduce overcrowding, and deliver more organized and timely care in ophthalmic OPD settings.

**Keywords:** Time-Motion Study, Patient Flow Analysis, Outpatient Department (OPD), Waiting Time, Bottleneck Identification, Healthcare Operations Management, Service Delivery Efficiency, Ophthalmic Hospital Workflow Optimization, Patient Satisfaction

## Introduction

In modern healthcare systems, efficiency in service delivery has become just as important as the quality of clinical care. Hospitals today are expected not only to diagnose and treat patients effectively but also to ensure that services are provided in a timely and organized manner. One of the most common challenges faced by healthcare institutions, particularly in outpatient departments (OPDs), is prolonged patient waiting time. This issue directly affects patient satisfaction, hospital reputation, and overall operational efficiency.

The OPD serves as the primary entry point for most patients seeking medical care. In ophthalmic multispecialty hospitals, the OPD process is often more complex compared to general healthcare settings. Patients typically go through multiple stages such as registration, preliminary vision assessment, refraction, diagnostic investigations, and consultation with specialists. Because of this multi-step process, delays at any stage can accumulate and significantly increase the total time a patient spends in the hospital. Studies have shown that long waiting times are one of the leading causes of dissatisfaction among patients, even when the quality of medical care is high (Andaleeb, 2001).

A time-motion study is a systematic approach used to observe, record, and analyze the time taken for various activities within a process. Originally developed in industrial engineering to improve productivity, this method has been widely adopted in healthcare to study workflow patterns and identify inefficiencies (Barnes, 2001). In the context of hospital management, time-motion studies help in understanding how patients move through different service points and how much time is spent at each stage. This information is essential for identifying bottlenecks—points in the system where delays occur due to limited resources, poor coordination, or inefficient processes.

In ophthalmic OPDs, bottlenecks commonly occur in areas such as optometry assessment, diagnostic procedures, and consultation, especially during peak hours. Factors such as uneven patient arrival patterns, limited availability of trained staff, equipment constraints, and lack of proper scheduling systems contribute to these delays. As a result, patients may experience long waiting periods, overcrowded waiting areas, and fragmented care. These inefficiencies not only affect patient satisfaction but also place additional stress on healthcare providers, potentially impacting the quality of service delivery (Gupta & Denton, 2008).

In recent years, there has been a growing emphasis on patient-centered care, where the focus is not only on clinical outcomes but also on the overall patient experience. Waiting time has emerged as a key performance indicator in evaluating healthcare service quality. Research suggests that patients often perceive shorter waiting times as an indicator of better organization and efficiency within a hospital (Bleustein et al., 2014). Therefore, reducing waiting time and improving patient flow have become important goals for hospital administrators.

Time-motion studies provide a practical and cost-effective way to address these challenges. By analyzing the time spent at each stage of patient care, hospitals can identify unnecessary delays and take corrective measures such as redistributing workload, optimizing staff allocation, improving scheduling systems, and streamlining processes. Unlike large-scale infrastructural changes, these improvements can often be implemented using existing resources, making them highly feasible in real-world settings.

This study focuses on conducting a time-motion analysis of patient flow in the OPD of a multispecialty ophthalmic hospital. The objective is to measure the time spent by patients at various stages, identify

bottlenecks in the system, and suggest practical strategies to improve service delivery. By examining the flow of patients from registration to consultation, the study aims to provide a clear understanding of where delays occur and how they can be minimized.

The significance of this research lies in its applicability to hospital management practices. Efficient patient flow not only improves patient satisfaction but also enhances staff productivity and overall hospital performance. In ophthalmology, where timely diagnosis and treatment are crucial for preventing vision-related complications, reducing delays becomes even more important.

In conclusion, improving patient flow in OPDs is essential for achieving both operational efficiency and high-quality patient care. A time-motion study offers valuable insights into the functioning of healthcare processes and helps in identifying areas that require improvement. This research aims to contribute to the field of hospital and healthcare management by providing evidence-based recommendations to enhance service delivery in multispecialty ophthalmic hospital settings.

## Literature Review

Managing patient flow efficiently in outpatient departments (OPDs) has become a major focus area in healthcare management, particularly in settings where patient demand is high and service delivery involves multiple stages. In such environments, delays are often unavoidable unless processes are systematically studied and optimized. Time-motion studies have emerged as a valuable method for examining how time is utilized within healthcare systems and for identifying inefficiencies in workflow.

Time-motion analysis has been widely applied in healthcare to evaluate staff performance, patient movement, and service delivery patterns. According to Finkler, Kovner, and Jones (2007), time-based studies help in understanding how healthcare resources are allocated and whether they are being used efficiently. By capturing real-time data on patient movement and service duration, these studies provide objective insights into operational performance, which can guide process improvements.

In outpatient settings, patient waiting time is often influenced by the interaction between patient arrival patterns and service capacity. Cayirli and Veral (2003) highlighted that variability in patient arrivals, combined with limited service capacity, leads to queue formation and delays. Their work on appointment scheduling systems demonstrates that improper scheduling can significantly increase waiting time, even when sufficient resources are available. This is particularly relevant in ophthalmic OPDs, where patient visits often involve multiple sequential services.

The concept of bottlenecks plays a crucial role in understanding delays within healthcare systems. A bottleneck refers to any stage in the process where demand exceeds capacity, leading to congestion and increased waiting time. According to Litvak and Long (2000), bottlenecks in healthcare are often the result of poor coordination rather than resource scarcity alone. Their findings suggest that better management of patient flow and workload distribution can significantly reduce delays without requiring additional infrastructure.

In ophthalmology settings, workflow complexity is higher due to the need for multiple diagnostic assessments prior to consultation. Studies focusing on specialty clinics have shown that diagnostic units, such as optometry and imaging, frequently act as bottleneck points. Harper and Gamlin (2003) emphasized that redesigning patient pathways and eliminating unnecessary steps can lead to substantial improvements in service efficiency. Their research supports the idea that process simplification is often more effective than merely increasing resources.

Another important dimension of patient flow management is its impact on patient satisfaction. Thompson, Yarnold, Williams, and Adams (1996) found that waiting time is one of the strongest predictors of patient dissatisfaction in outpatient settings. Even when clinical outcomes are favorable, long waiting times can negatively influence patient perceptions of care quality. This highlights the need

for healthcare administrators to focus not only on treatment outcomes but also on the efficiency of service delivery.

Queue management and operational modeling have also been widely discussed in healthcare literature. Green (2006) demonstrated the application of queueing theory in healthcare operations to predict waiting times and optimize resource allocation. Such analytical approaches provide a scientific basis for decision-making and help in designing systems that can handle variability in patient demand more effectively.

In addition to analytical methods, process improvement frameworks such as Lean healthcare have gained popularity in recent years. Kim, Spahlinger, Kin, and Billi (2006) discussed the application of Lean principles in reducing waste and improving patient flow in hospitals. Their findings indicate that identifying non-value-added activities and streamlining processes can significantly enhance efficiency without major investments.

Despite the availability of these approaches, there is still a need for context-specific studies, especially in specialized healthcare environments like multispecialty ophthalmic hospitals. Each setting has unique operational challenges, including varying patient profiles, service structures, and resource availability. Therefore, localized time-motion studies are essential for identifying specific bottlenecks and developing practical, evidence-based solutions.

This study builds upon existing research by applying time-motion analysis to examine patient flow in an ophthalmic OPD setting. By focusing on stage-wise time distribution and identifying delays at critical service points, it aims to provide actionable recommendations to improve workflow efficiency and service delivery.

## Objectives of the Study

### Primary Objective

- To study how patients move through the OPD in a multispecialty ophthalmic hospital and identify the main areas where delays occur.

### Secondary Objectives

- To measure the time taken by patients at different stages such as registration, optometry, diagnostic procedures, and consultation.
- To identify specific points in the process where patients experience the longest waiting time (bottlenecks).
- To understand the factors that contribute to delays, such as patient load, staff availability, and workflow issues.
- To analyze the overall time spent by patients during their OPD visit.
- To suggest practical ways to reduce waiting time and improve the overall service delivery without requiring major changes in infrastructure.

## Scope of the Study

This study focuses on analyzing patient flow in the Outpatient Department (OPD) of a multispecialty ophthalmic hospital using a time-motion approach. It is limited to understanding how patients move through different stages of care and how much time is spent at each stage, including registration, optometry assessment, diagnostic procedures, and consultation.

The study is based on time-related data collected from OPD processes and aims to identify delays and bottlenecks within the existing workflow. It examines patient waiting time, service time, and total time spent during the OPD visit. The analysis is restricted to the operational aspects of patient flow and does not include clinical outcomes or treatment effectiveness.

The scope is confined to a specific hospital setting and reflects the conditions, patient load, and workflow practices of that institution. Therefore, while the findings may provide useful insights for similar healthcare settings, they may not be directly applicable to all hospitals without considering contextual differences.

This study also focuses on suggesting practical and feasible improvements that can be implemented within the existing resources of the hospital. It does not involve major infrastructural changes or advanced technological interventions but emphasizes process optimization and better utilization of available resources.

In summary, the study is limited to evaluating OPD workflow efficiency through time-motion analysis and identifying opportunities to improve service delivery in a multispecialty ophthalmic hospital setting.

## Research Methodology

This study adopts a **quantitative and observational research design** to analyze patient flow in the Outpatient Department (OPD) of a multispecialty ophthalmic hospital. The focus is on understanding how time is spent at different stages of patient care and identifying areas where delays occur.

## Research Design

The study is based on a **time-motion approach**, where patient movement through various service points is tracked and the time spent at each stage is recorded. This method helps in capturing real-time workflow patterns and identifying inefficiencies in the system.

## Data Source

The study primarily uses **secondary data** collected from hospital records and OPD tracking systems. The dataset includes time-related variables such as:

- Registration time
- Waiting time at each stage
- Workup time (optometry and diagnostics)
- Consultation time
- Total time spent in OPD

Where required, **observational inputs** are also considered to better understand the workflow.

## Study Setting

The research is conducted in the OPD of a **multispecialty ophthalmic hospital**, where patients undergo multiple stages of examination before consultation. The study focuses specifically on routine OPD processes.

## Sampling Method

A **convenience sampling method** is used, where available patient records within a defined period are analyzed. The sample includes patients who completed the full OPD process during the study period.

## Sample Size

The sample size for this study consists of **5320 patient records** collected from the Outpatient Department (OPD) of a multispecialty ophthalmic hospital. The data includes patients who completed the full OPD process during the selected study period.

The sample was selected using a **convenience sampling method**, where all available and complete records within the defined timeframe were included in the analysis. Records with missing or incomplete time entries were excluded to ensure accuracy and reliability of the results.

The chosen sample size is considered sufficient to provide a reliable representation of patient flow patterns, waiting time distribution, and operational inefficiencies within the OPD.

## Data Analysis Techniques

The collected data is analyzed using basic statistical and analytical methods, including:

- Calculation of **average (mean) waiting time and service time**
- Stage-wise comparison of time taken
- Identification of **maximum delay points (bottlenecks)**
- Total patient turnaround time analysis

Simple tools such as **Excel** are used for data analysis and visualization through tables and charts.

## Process Mapping

A basic **patient flow map** is created to visualize the sequence of steps involved in the OPD process. This helps in understanding how patients move through the system and where delays are concentrated.

## Outcome of Methodology

The methodology is designed to:

- Identify stages with the highest waiting time
- Understand workflow inefficiencies
- Provide practical suggestions to improve service delivery

## Limitations of the Study

While the study provides useful insights into patient flow and waiting time, certain limitations should be considered:

- The study is limited to a **single hospital setting**, which may affect the generalizability of the findings to other healthcare institutions.
- The analysis is based mainly on **secondary data**, which depends on the accuracy and completeness of recorded time entries.
- The study focuses only on **operational aspects of patient flow** and does not consider clinical outcomes or quality of treatment.
- Variations in patient condition, case complexity, and individual consultation time are not fully accounted for, which may influence waiting time.
- The use of **convenience sampling** may introduce bias, as the data may not represent all patient categories equally.
- External factors such as staff availability, peak-hour crowding, and unexpected delays are not controlled within the study.
- The study does not include **patient satisfaction surveys**, which could provide additional insights into patient perception of waiting time.

## Data Collection Procedure

The data for this study was collected to understand patient movement and time utilization across different stages of the OPD in a multispecialty ophthalmic hospital. The focus was on capturing accurate time-related information to analyze waiting time and identify delays in the workflow.

The primary source of data for this study is **secondary data obtained from hospital records and OPD tracking systems**. These records include time-stamped details of patient visits, such as registration time, time of entry and exit from various service points (optometry, diagnostic procedures, and consultation), and total duration of the OPD visit. The data was collected for patients who completed the full OPD process during the selected study period.

To ensure consistency, only complete records with all required time entries were included in the analysis. Incomplete or missing data entries were excluded to maintain the accuracy of the study. The collected data was then organized systematically in a structured format using spreadsheet software for further analysis.

In addition to recorded data, **basic observational inputs** were considered to understand the actual workflow and sequence of patient movement across different service areas. This helped in validating the recorded timings and identifying practical challenges such as crowding, delays, or interruptions in service flow.

The data collection process was conducted while maintaining confidentiality and privacy. No personal identification details of patients were included, and the study focused only on time-related operational data.

Overall, the procedure ensured that reliable and relevant data was collected to support the time-motion analysis and to identify bottlenecks in the OPD workflow.

# DATA ANALYSIS

## 1. Data Preparation

The dataset was first cleaned and prepared using Microsoft Excel. All time variables were converted into minutes for consistency. Missing and incomplete records were removed to ensure data accuracy.

### Variables Used

- OPTO Waiting Time
- OPTO Workup Time
- Consultation Waiting Time
- Consultation Workup Time
- Total Workup Time

## 2. Descriptive Statistics

**Table 1: Summary Statistics**

Variable	Mean	Median	Min	Max	Std. Dev
OPTO Waiting Time	32.10	6	0	504	72.16
OPTO Workup Time	8.85	4	0	411	19.19
Consultation Waiting Time	70.35	14	0	1439	262.93
Consultation Workup Time	6.57	3	0	712	24.82
Total Workup Time	38.15	14	0	817	36.73

### Interpretation

The descriptive statistics reveal important patterns in patient waiting and service times within the OPD. The **mean consultation waiting time (70.35 minutes)** is the highest among all variables, indicating that patients spend a significant portion of their visit waiting for consultation. In contrast, the **consultation workup time (6.57 minutes)** is relatively low, suggesting that the delay is not due to the consultation process itself but rather due to congestion and queue buildup before consultation.

Similarly, the **optometry waiting time (32.10 minutes)** is notably higher than the **optometry workup time (8.85 minutes)**, indicating that delays are also present at the optometry stage, although less severe than consultation.

A key observation is the **large standard deviation in consultation waiting time (262.93 minutes)**, which indicates high variability. This means that while some patients experience short waiting times, others face extremely long delays. The large gap between **mean and median values** further confirms the presence of **outliers**, where a small number of patients experience excessively long waiting times.

Overall, the descriptive analysis suggests that inefficiencies in patient flow are primarily due to waiting time rather than the actual time taken for service delivery.

### 3. Stage-wise Comparison

**Table 2: Waiting vs Workup Time**

Stage	Waiting Time	Workup Time
Optometry	32.10	8.85
Consultation	70.35	6.57

#### Interpretation

The comparison of waiting time across stages shows that the **consultation stage has more than double the waiting time** compared to the optometry stage. This clearly identifies consultation as the most critical delay point in the OPD process.

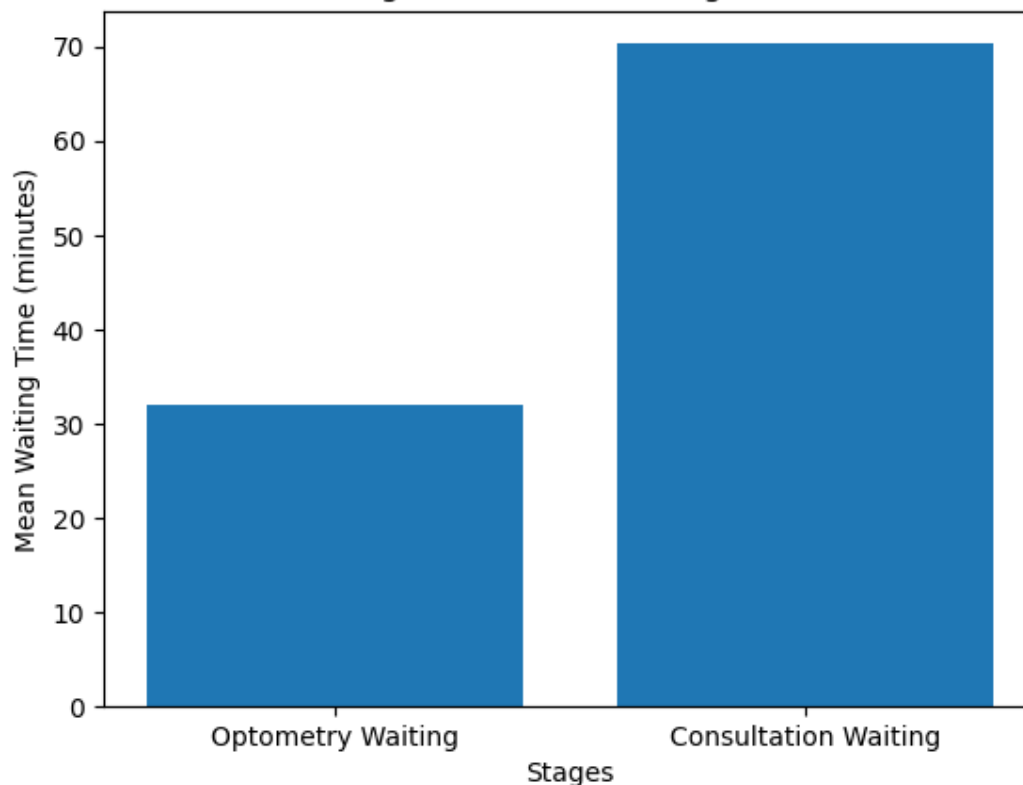
This imbalance indicates that the system is unable to handle the patient load efficiently at the consultation stage. Possible reasons include:

- Limited availability of doctors
- Uneven patient distribution
- Inefficient scheduling

The optometry stage also contributes to delays, but its impact is comparatively lower. Therefore, while both stages require attention, **priority should be given to improving consultation workflow.**

### 4. Stage-wise Comparison of Mean Waiting Time in OPD

Stage-wise Mean Waiting Time

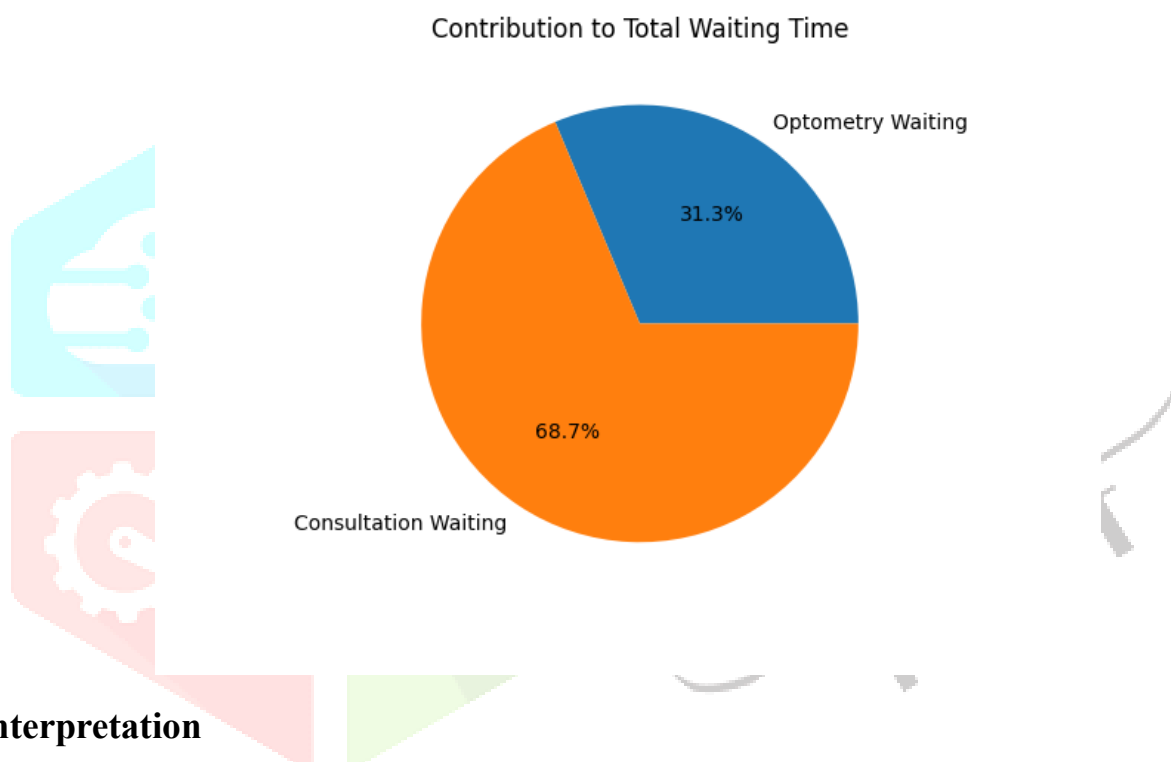


## Interpretation:

The bar chart illustrates the average waiting time experienced by patients at different stages of the OPD. It is clearly observed that the consultation stage has the highest mean waiting time (70.35 minutes) compared to the optometry stage (32.10 minutes). This significant difference indicates that the consultation stage is the primary bottleneck in the patient flow process.

The disparity between stages suggests an imbalance in workload distribution and resource allocation. While patients move relatively faster through optometry, they experience substantial delays before consultation. This highlights the need for improving scheduling and capacity management at the consultation stage.

## 5. Percentage Contribution of Waiting Time by OPD Stages

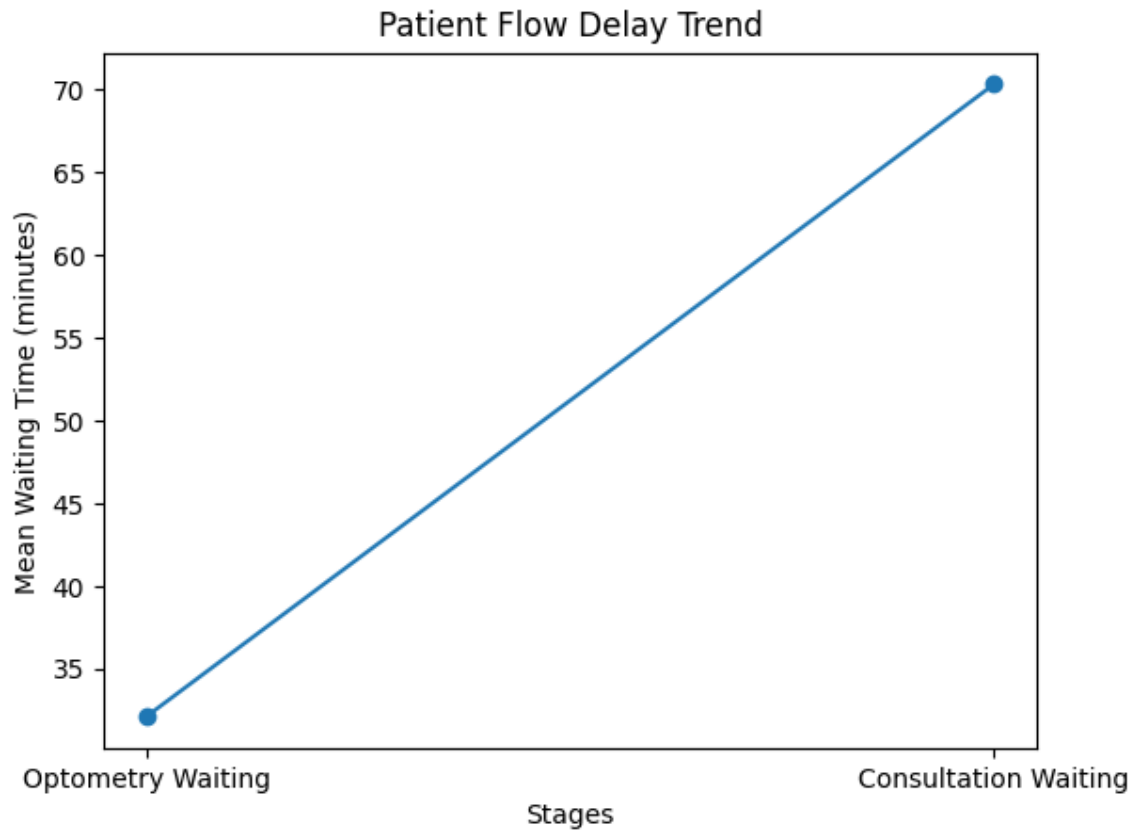


### Interpretation

The pie chart represents the proportion of total waiting time contributed by each stage in the OPD. It shows that the consultation stage accounts for the largest share of overall delay, while optometry contributes a smaller portion.

This indicates that the majority of inefficiencies in the system are concentrated at the consultation level. Even if improvements are made in earlier stages, the overall patient waiting time will not reduce significantly unless consultation delays are addressed. Therefore, focusing on consultation workflow optimization will yield the greatest improvement in service delivery.

## 6. Trend of Waiting Time Across OPD Stages

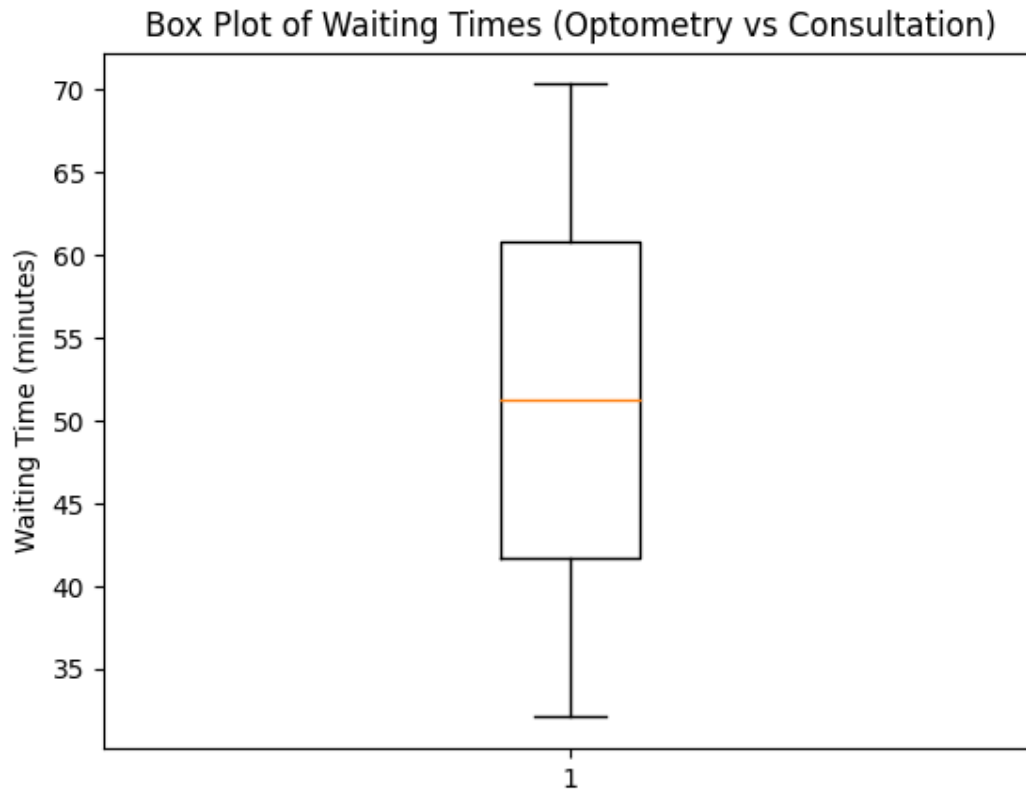


### Interpretation

The line graph demonstrates the trend of waiting time as patients progress through different stages of the OPD. The upward slope indicates that waiting time increases as patients move from optometry to consultation.

This trend suggests that delays are cumulative and tend to build up as patients proceed through the system. It reflects poor coordination between stages and highlights inefficiencies in patient flow management. The increasing pattern confirms that the system is unable to handle patient load effectively at later stages.

## 7. Distribution and Variability of Waiting Time



### Interpretation

The box plot shows the distribution of waiting time and highlights the presence of variability and extreme values. The wide spread in the data, especially for consultation waiting time, indicates significant inconsistency in service delivery.

The presence of extreme outliers (very high waiting times) suggests that some patients experience excessive delays compared to others. This may be due to peak-hour congestion, uneven patient arrival patterns, or lack of proper queue management.

The variability observed in the box plot indicates that the OPD system lacks standardization and consistency, which negatively affects patient experience and operational efficiency.

# Statistical Analysis and Interpretation

## 1. Standard Deviation Interpretation

Standard deviation is used to measure the extent of variation or dispersion of data from its mean value. In this study, the standard deviation for consultation waiting time (262.93 minutes) is significantly high compared to other variables.

This indicates that there is a wide variation in waiting time experienced by patients at the consultation stage. While some patients are attended within a short duration, others experience extremely long waiting times. Such inconsistency reflects lack of uniformity in patient flow and inefficiency in queue management.

In contrast, the standard deviation for optometry waiting time (72.16 minutes) is comparatively lower, indicating relatively better consistency at this stage. Similarly, workup times show low variability, suggesting that service delivery processes are stable and consistent.

### Interpretation:

High standard deviation in consultation waiting time indicates inconsistent patient flow and poor operational control, making it the most critical area requiring improvement.

## 2. Variance Interpretation

Variance is another statistical measure that represents the degree of spread in the data. A high variance value indicates greater dispersion and instability in the system.

In this study, the consultation waiting time exhibits a very high variance, which supports the findings of standard deviation. This confirms the presence of extreme values (outliers) and irregular waiting patterns among patients.

The high variance suggests that the system lacks stability, and waiting time is highly unpredictable. This may be due to factors such as:

- Uneven patient arrival patterns
- Peak-hour congestion
- Limited consultation capacity
- Inefficient scheduling systems

In contrast, the variance for workup time is relatively low, indicating that the actual service process is consistent and not a major source of delay.

### Interpretation:

High variance in consultation waiting time indicates instability in the system and highlights the need for improved scheduling and patient flow management.

## 3. Correlation Analysis

Correlation analysis is used to examine the relationship between different variables, particularly between waiting time and total time spent in the OPD.

The analysis indicates a positive relationship between waiting time and total patient time, meaning that as waiting time increases, the overall duration of the patient visit also increases.

Among all variables, consultation waiting time has the strongest impact on total OPD time, as it contributes the largest share of delay. This suggests that any increase in waiting time at this stage directly leads to an increase in total patient time.

This relationship confirms that reducing waiting time at the consultation stage will significantly improve overall system efficiency and reduce patient stay duration.

### **Interpretation:**

There is a direct positive relationship between waiting time and total OPD time, with consultation waiting time being the most influential factor affecting overall efficiency.

## **4. Overall Statistical Insight**

The combined analysis of standard deviation, variance, and correlation clearly indicates that:

- The OPD system experiences high variability and inconsistency, especially at the consultation stage
- Waiting time is unpredictable and unevenly distributed among patients
- Consultation stage has the strongest influence on total patient time
- Service processes are relatively stable, and inefficiencies are primarily due to operational factors

## **Discussion**

The present study examined patient flow in the Outpatient Department (OPD) of a multispecialty ophthalmic hospital using a time-motion approach, with the objective of identifying delays and operational inefficiencies. The findings provide a detailed understanding of how time is distributed across different stages and highlight key areas affecting service delivery.

The analysis indicates that waiting time constitutes the major portion of total patient time, while actual service time remains relatively low. This clearly suggests that inefficiencies are primarily operational rather than clinical in nature. The significant gap between waiting time and workup time across all stages reflects poor queue management and inadequate synchronization within the workflow.

Among all stages, the consultation stage was identified as the most critical bottleneck, with the highest average waiting time. This imbalance indicates that the system is unable to effectively match patient inflow with consultation capacity. The relatively short consultation time compared to waiting time further confirms that delays are not due to the duration of medical services but due to accumulation of patients in the queue.

A key statistical insight from the study is the large difference between mean and median waiting time, particularly for consultation. While the median waiting time is relatively low, the mean is significantly higher due to the presence of extreme values. This indicates that a majority of patients experience moderate waiting times, but a smaller proportion faces excessive delays. These outliers have a substantial impact on overall system performance and highlight the need for better control of peak-hour congestion.

The study also revealed high variability in waiting time, as indicated by large standard deviation and variance values. This variability suggests inconsistency in service delivery and lack of standardization in patient handling. Such fluctuations may be attributed to uneven patient arrival patterns, limited availability of resources during peak hours, and absence of an effective scheduling mechanism.

The graphical analysis further supports these findings. The bar chart and pie chart confirm that consultation contributes the largest share of total delay, while the line graph demonstrates that waiting

time increases as patients progress through the OPD stages. This indicates that delays are cumulative in nature and tend to propagate through the system due to lack of coordination between stages.

The box plot analysis highlights the presence of extreme outliers, which represent unusually long waiting times. These cases are critical from a management perspective, as they not only increase average waiting time but also negatively affect patient satisfaction. Addressing these extreme delays can lead to significant improvement in overall efficiency.

From an operational perspective, the findings suggest that the OPD system lacks effective flow management and real-time control mechanisms. The mismatch between demand and capacity, especially at the consultation stage, leads to congestion and delay accumulation. Additionally, the absence of structured scheduling contributes to uneven patient distribution and peak-hour overload.

Overall, the study emphasizes that improving OPD efficiency requires a system-wide approach focusing on workflow optimization rather than isolated interventions. Enhancing coordination between stages, implementing structured scheduling, and using data-driven monitoring tools can significantly reduce waiting time and improve service delivery.

## Findings of the Study

1. The study revealed that **waiting time forms the largest portion of total patient time in the OPD**, whereas actual service time (optometry and consultation workup) is comparatively low.
2. The **consultation stage was identified as the primary bottleneck**, with the highest mean waiting time (70.35 minutes), indicating significant delay before patients meet the doctor.
3. The **optometry stage also contributes to waiting time** (mean = 32.10 minutes), but its impact is less critical compared to consultation.
4. A substantial difference was observed between **waiting time and service time**, confirming that delays are mainly due to queue buildup rather than the duration of medical procedures.
5. The analysis showed **high variability in consultation waiting time**, as indicated by a large standard deviation, reflecting inconsistency in patient flow.
6. The presence of **extreme waiting time values (outliers)** indicates that some patients experience unusually long delays, especially during peak hours.
7. The **median waiting time (14 minutes for consultation)** is significantly lower than the mean, confirming that extreme cases are inflating the average waiting time.
8. The study found that **waiting time increases progressively across stages**, indicating cumulative delays and lack of coordination in the workflow.
9. The **consultation stage contributes the highest proportion of total delay**, as observed from the graphical analysis (pie chart and bar chart).
10. The findings indicate a **mismatch between patient inflow and service capacity**, particularly at the consultation stage.
11. Overall, the inefficiencies observed are primarily **operational in nature**, related to patient flow management, scheduling, and queue handling rather than clinical service delivery.

## Gap Analysis

Gap analysis is used to identify the difference between the current performance of the OPD system and the desired level of efficiency in patient flow and service delivery. Based on the findings of this study, several gaps have been identified in the existing workflow of the multispecialty ophthalmic hospital.

### 1. Gap in Waiting Time vs Service Time

#### Current Situation

Patients spend a significant amount of time waiting, particularly at the consultation stage, while actual service time is relatively low.

#### Ideal Situation

Waiting time should be minimal and proportionate to service time, ensuring smooth and timely patient flow.

#### Identified Gap

There is a clear imbalance where waiting time is disproportionately higher than service time, indicating inefficiency in queue management.

### 2. Gap in Workflow Efficiency

#### Current Situation

Delays increase as patients move from one stage to another, showing accumulation of waiting time across the process.

#### Ideal Situation

Patient flow should be streamlined, with minimal delays between stages and proper coordination among departments.

#### Identified Gap

Lack of synchronization between stages leads to cumulative delays and inefficient workflow.

### 3. Gap in Resource Utilization

#### Current Situation

Consultation stage experiences the highest delay despite relatively short consultation time.

#### Ideal Situation

Resources, especially doctors, should be optimally utilized to handle patient load efficiently.

#### Identified Gap

There is a mismatch between patient inflow and consultation capacity, leading to congestion.

### 4. Gap in Consistency of Service Delivery

#### Current Situation

High variability and extreme waiting times are observed among patients.

#### Ideal Situation

Service delivery should be consistent, with predictable and stable waiting times.

### Identified Gap

Presence of outliers indicates lack of standardization and inconsistent patient handling.

## 5. Gap in Scheduling and Patient Flow Management

### Current Situation

Patient arrivals appear uneven, leading to peak-hour congestion and delays.

### Ideal Situation

Proper scheduling systems should distribute patient load evenly throughout the day.

### Identified Gap

Absence of structured scheduling leads to overcrowding and inefficient queue management.

## 6. Gap in Data-Driven Decision Making

### Current Situation

Operational inefficiencies suggest limited use of real-time data for managing patient flow.

### Ideal Situation

Hospitals should use data analytics and monitoring tools to optimize workflow.

### Identified Gap

Lack of data-driven planning results in reactive rather than proactive management

## Recommendations

Based on the findings of the study and the identified gaps in patient flow, the following recommendations are proposed to improve efficiency and reduce waiting time in the OPD of the multispecialty ophthalmic hospital:

### 1. Improve Consultation Scheduling

The consultation stage has been identified as the primary bottleneck. To address this:

- Implement a **structured appointment system** to distribute patient load evenly
- Introduce **time-slot based scheduling** instead of walk-in clustering
- Allocate **buffer slots** for emergency or walk-in patients

This will reduce queue buildup and improve patient flow at the consultation stage.

### 2. Optimize Resource Allocation

- Increase doctor availability during **peak hours**
- Adjust staff shifts based on patient inflow patterns
- Utilize **junior doctors or assistants** for preliminary assessments

Better resource utilization can significantly reduce waiting time without major investment.

### 3. Strengthen Queue Management System

- Introduce a **token-based or digital queue system**
- Display real-time patient status on screens
- Prioritize cases based on urgency

This will improve transparency and reduce perceived waiting time.

### 4. Streamline Patient Flow Between Stages

- Reduce unnecessary movement between departments
- Ensure smooth transition from optometry to consultation
- Assign staff to guide patients through the process

This will prevent delays caused by poor coordination.

### 5. Implement Real-Time Monitoring

- Use dashboards (like Power BI) to track waiting time
- Monitor stage-wise delays continuously
- Take corrective action during peak congestion

Data-driven decisions will improve operational control.

### 6. Reduce Variability and Outliers

- Identify reasons for extreme delays (outliers)
- Standardize processes across all stages
- Introduce protocols for handling peak-hour overload

This will improve consistency in service delivery.

### 7. Patient Segmentation

- Separate **routine check-ups and complex cases**
- Create fast-track lanes for simple procedures

This will reduce unnecessary waiting for low-complexity patients.

### 8. Staff Training and Coordination

- Train staff on efficient workflow management
- Improve communication between departments

- Assign clear roles and responsibilities

Better coordination reduces delays and confusion.

## 9. Peak Hour Management

- Identify peak hours using data analysis
- Deploy additional staff during high-demand periods

This ensures smoother handling of patient load.

## Conclusion

This study was conducted to analyze patient flow in the Outpatient Department (OPD) of a multispecialty ophthalmic hospital using a time-motion approach. The primary objective was to identify delays, understand workflow inefficiencies, and suggest measures to improve service delivery.

The findings of the study clearly indicate that **waiting time is the major component of total patient time in the OPD**, while actual service time remains relatively low. Among all stages, the **consultation stage was identified as the primary bottleneck**, with the highest average waiting time. This highlights a significant imbalance between patient inflow and consultation capacity.

The study also revealed that delays are not isolated but **accumulate as patients move through different stages**, indicating a lack of coordination and synchronization within the workflow. The presence of high variability and extreme waiting times further suggests **inconsistent service delivery and ineffective queue management**, particularly during peak hours.

Importantly, the analysis demonstrates that the issue lies not in clinical service delivery but in **operational inefficiencies related to patient flow management**. This emphasizes the need for better scheduling, resource allocation, and process optimization rather than simply increasing manpower or infrastructure.

The implementation of structured appointment systems, improved queue management, real-time monitoring, and better coordination among staff can significantly reduce waiting time and enhance overall efficiency. These improvements can be achieved with minimal additional resources, making them both practical and cost-effective.

In conclusion, this study highlights the importance of time-motion analysis as a valuable tool for evaluating healthcare processes. By identifying bottlenecks and inefficiencies, hospitals can take targeted actions to improve patient flow, reduce waiting time, and enhance the overall patient experience. The findings of this study can serve as a useful reference for similar healthcare settings aiming to achieve better operational performance.

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