OPTIMIZING UNIFORM DISTRIBUTION TAT IN TERTIARY CARE HOSPITAL

Dissertation Submitted to

The IIHMR University, Jaipur

for the partial fulfillment for the award of the degree of

Master of Business Administration (MBA)

in

Hospital and Health Management

by

Mahak Yadav

Under the Supervision and Guidance of

Dr. Mamta Chauhan

2025

CK BIRLA HOSPITALS | RBH

RBH/2025/Jun/HRD/6757

Date: 03 Jun 2025

TO WHOM SO EVER IT MAY CONCERN

This is to certify that **Mahak Yadav** has completed her internship in the Operations Department from 10 March 2025 to 31 May 2025.

We wish her every success in her future and career.

For **CK Birla Hospital – RBH**

Bushra Khan
Sr. Manager | HR

IIHMR UNIVERSITY

CERTIFICATE

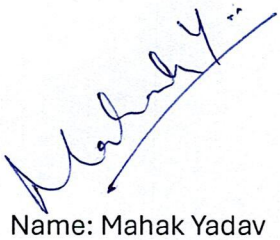
This is to certify that dissertation titled **"Optimizing Uniform Distribution TAT in Tertiary Care Hospital"** is a record of the research work undertaken by **Mahak Yadav** in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Dr. Mamta Chauhan
Faculty Guide
IIHMR University, Jaipur
Date: 23.06.2025

Dr. Sanjay Gupta
School Dean
IIHMR University, Jaipur
Date: 23.06.2025

DECLARATION BY STUDENT

I hereby declare that this dissertation titled Optimizing uniform distribution TAT in tertiary care hospital is the Bonafide record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.



Name: Mahak Yadav

Date: 23.06.2025

Abstract

Background:
Uniform distribution in hospital linen departments is a critical support function that directly influences staff safety, professionalism, and infection control. At CK Birla Hospital (230-bed tertiary facility), reliance on manual tracking, inconsistent inventory organization, and lack of standardized workflows have led to delays and size-mismatch complaints, with turnaround times (TAT) varying widely and impacting operational efficiency.

Objective:
This study aimed to

(1) Measure the baseline TAT for individual uniform issuance,

(2) Identify key process gaps contributing to delays and size errors,

(3) Evaluate the impact of lean-based visual control interventions—specifically numeric size tagging and rack re-organization—on TAT and size-mismatch rates.

Methodology:
A mixed-methods, descriptive observational design was employed over six weeks (April–May 2025). Quantitative data were collected from 365 uniform transactions using time-motion logs and Excel registers to calculate TAT, size-mismatch frequency, and department-wise performance. Qualitative insights were gathered through staff interviews and workflow observations. Root-cause analyses (fishbone diagrams, 5 Whys) pinpointed core delays. In weeks 5–6, numeric size tags and color-coded rack labels were introduced, and pre-/post-intervention metrics were compared.

Results:

- **Baseline TAT:** Average 1 min 13 sec (SD 1 min 20 sec); 15 % of transactions exceeded 4 min.
- **Key Gaps:** “Not checked properly” (32 %) and “poor communication” (28 %) accounted for over 60 % of issues; size inconsistencies (“same size, different fit”) comprised 14 %.
- **Departmental Variation:** OT and ICU recorded the highest average TAT (>1 min 30 sec) and mismatch rates.
- **Intervention Impact:** Introduction of numeric tagging reduced mean TAT by 22 % (to ~57 sec) and decreased size-mismatch incidents by 30 %.

Conclusion:
Standardizing workflows with clear SOPs, visual numeric controls, and rack re-organization significantly improves uniform distribution efficiency and accuracy in hospital linen services. These low-cost, scalable interventions enhance staff satisfaction and support compliance with accreditation standards. Future integration of digital requisition and barcode scanning could further optimize real-time tracking and stock management.

ACKNOWLEDGEMENT

I am deeply grateful to my college mentor, Dr. Mamta Chauhan, for her invaluable academic guidance, constructive feedback, and unwavering support throughout every stage of this research; to Dr. Nihar Bhatia, Head of Operations at CK Birla Hospital, Jaipur, for generously sharing his operational insights, facilitating access to critical departmental data, and providing encouragement that made this study possible; and to Ms. Shreya Wadhawa, Senior Executive, for her hands-on assistance during data collection, her patience in coordinating logistics within the linen department, and her thoughtful suggestions that strengthened the study's methodology. Their combined expertise and support were instrumental in the successful completion of this dissertation. I thank Dr P.R Sodani (President – IIHMR University), Dr Sanjay Gupta (Dean – IIHMR university), and whole IIHMR team for their continuous support. Last but not the least, I would like to thank my family and friends who were a constant source of motivation support and kept me persistent throughout my journey at IIHMR sincerely.

Dr. Mahak Yadav

MBA-HM 28 (2023-2025)

Roll No. 1738

Table of Contents

List of figures

List of tables

Abbreviation

TAT	Turnaround time
ICU	Intensive care unit
OT	Operation theatre
OPD	Outpatient department
MRI	Medical imaging technique
CT	Computed tomography
EHR	Electronic health record
COPD	Chronic Obstructive Pulmonary Disease
IVF	In Vitro Fertilization
NABH	National Accreditation Board for Hospitals
SEIPS	Systems Engineering Initiative for Patient Safety
VSM	Value System Mapping
RFID	Radio Frequency Identification
SOP	Standard Operating Procedure
IPC	Infection Prevention and Control
RCA	Root Cause Analysis

Chapter 1: Introduction

1. Introduction & Organizational Context

Rukmani Birla Hospital (RBH), Jaipur, is a 230-bed tertiary care, multi-super-specialty facility established in 2016 by CK Birla Hospitals, the healthcare arm of the CK Birla Group. Situated on Gopalpura Bypass Road near Triveni Flyover, RBH serves as the Group's flagship hospital in western India, extending its legacy of philanthropy and high-quality healthcare from its eastern origins in Kolkata to Rajasthan's capital region.

2. Historical Background

RBH represents the third major hospital under the CK Birla Hospitals banner—following the Calcutta Medical Research Institute (1969) and the BM Birla Heart Research Centre (1989) in Kolkata. The hospital was conceived to address a gap in standards-driven tertiary care in Rajasthan, offering urban and rural populations local access to advanced diagnostics, specialty treatment, and emergency services. In under a decade, RBH has grown from its foundational 150-bed capacity to its current 230 beds, adding services and accreditations in step with India's evolving healthcare demands.

3. Mission, Vision & Core Values

RBH's operational philosophy aligns with CK Birla Hospitals' overarching mission to build "clinical centres of excellence on a strong backbone of research, academics and evidence-based medicine." Its vision—to deliver "the best of patient service and clinical excellence"—is operationalized through three core values:

Clinical Excellence: Adherence to international care protocols, robust quality-management systems, and continuous outcome monitoring.

Ethical Conduct: Transparent pricing policies, patient rights advocacy, and integrity in clinical decision-making.

Patient-Centric Approach: Empathetic communication, seamless care pathways from admission to discharge, and active involvement of patients and families in care planning.

4. Facilities & Infrastructure

RBH's physical and technological infrastructure underpins its service scope:

230 beds (including 75 ICU beds, 18-bedded dialysis unit) and 8 modular operating theatres.

24×7 Emergency & Ambulance Services and on-site blood bank, ensuring rapid response in critical situations.

High-Resolution Imaging Suites (3 T MRI, multi-slice CT, advanced ultrasound) and Cath Labs for cardiac interventions.

A state-of-the-art Da Vinci Robotic Surgical System, enabling precision minimally invasive surgeries across urology, gynaecology, oncology, and general surgery.

A comprehensive Electronic Health Record (EHR) platform streamlining clinical workflows and facilitating data-driven quality audits.

5. Clinical Specialties & Scope of Services

RBH offers integrated inpatient and outpatient care across 27 specialties and 7 centres of excellence, illustrating the breadth of its clinical scope:

Critical Care Medicine & Emergency Services: Level III ICU, trauma management, sepsis care.

Neurosciences: Stroke management, spine surgery, neurology consultations.

Cardiac Sciences: Interventional cardiology, cardiac surgery, heart failure clinics.

Orthopaedics & Joint Replacement: Trauma care, arthroplasty, sports medicine.

Gastroenterology & Hepato-Biliary Sciences: Endoscopy, hepatic care, minimally invasive GI surgery.

Renal Sciences: Nephrology, dialysis, urology procedures.

Pulmonology: Critical respiratory care, COPD management, bronchoscopy.

Women's Health & Fertility: Obstetrics, gynaecology, IVF services.

Oncology: Medical, surgical, and radiation oncology, with emerging plans for an integrated Oncology Centre of Excellence by 2027.

Preventive Health Packages: Executive and specialty check-up plans delivered both on campus and at home.

6. Patient & Community Scope

RBH's patient base extends across urban Jaipur and surrounding districts, drawing both self-referred and referred cases through partnerships with regional clinics. Key scope elements include:

International Patient Services, assisting overseas clients with visa facilitation, language interpretation, and end-to-end coordination for medical travel.

Home Care & Telemedicine, offering post-discharge follow-up, home-based sample collection, and virtual consultations.

Preventive Health Outreach, conducting community health camps and educational seminars in rural areas to promote early detection and wellness.

1.1 Background

Uniforms serve several essential purposes in healthcare institutions. First, they offer protection against the hospital environment by acting as a barrier between pathogens and the staff's body. Second, they enable professional identification, creating a sense of trust and authority for patients and visitors. Finally, uniforms contribute to institutional branding, presenting a standardized and clean appearance that reflects the hospital's values and commitment to hygiene.

However, the distribution of uniforms is not always seamless. Issues such as delayed delivery, incorrect sizing, inappropriate storage, poor communication, and lack of tracking systems often lead to operational inefficiencies. Staff may report discomfort, confusion, and dissatisfaction due to mismatched or delayed uniforms, which can ultimately impact patient care indirectly.

The **turnaround time (TAT)**—the duration between placing a uniform request and the actual receipt of the correct uniform—is a crucial performance metric for the linen department. A low TAT reflects efficiency, whereas a high or inconsistent TAT signals process gaps, inadequate staffing, or systemic inefficiencies. By analysing uniform TAT, hospitals can identify workflow bottlenecks, apply lean management tools, and implement visual control mechanisms to improve outcomes.

1.2 National and Institutional Context

In India, healthcare institutions are governed by various accreditation and quality assurance bodies such as the National Accreditation Board for Hospitals and Healthcare Providers (NABH), which emphasize hygiene, infection control, and standardized practices in hospital operations. Linen and laundry management is one of the key compliance areas. NABH standards specify protocols for the handling, segregation, storage, and distribution of linen, including uniforms for all staff levels (1).

Despite these national standards, the implementation and monitoring of linen services often vary widely across hospitals. Resource limitations, lack of trained manpower, absence of in-house laundry services, or manual tracking systems are common challenges faced by Indian hospitals (2). At the institutional level, many hospitals rely on physical logbooks or Excel sheets to manage uniform records, which are prone to errors and inefficiencies.

Moreover, with the increasing patient load and staff strength in modern hospitals, the demand for clean linen and timely uniform issuance has surged. Therefore, it becomes vital for institutions to evaluate and streamline their linen and uniform distribution processes.

1.3 Problem Statement

Uniform distribution in hospitals, while seemingly straightforward, has multiple touchpoints and stakeholders—linen department staff, nursing heads, floor supervisors,

and end users. Any breakdown in communication, measurement, documentation, or inventory control can cause significant delays. These issues manifest in the form of:

- Incorrect uniform sizes being issued.
- Prolonged turnaround time in distribution.
- Uniforms being exchanged between staff due to poor tracking.
- Torn, worn-out, or malfunctioning uniforms not being replaced timely.
- Shortage or overstocking of certain sizes due to poor inventory mapping.

Such inefficiencies contribute to operational delays, staff dissatisfaction, and indirect impacts on patient care delivery. There is a need for comprehensive analysis to identify the root causes and develop system-based solutions using lean tools, visual management, and standardized workflows.

1.4 Research Question

- What are the factors contributing to delays in uniform distribution in hospitals, and how can turnaround time (TAT) be optimized?

Secondary questions include:

- What are the most common problems in uniform sizing and issuance?
- How does poor communication or improper tracking affect uniform delivery?
- What lean or visual tools can be applied to improve the uniform distribution process?

1.5 Research Objectives

The primary objective of this study is to evaluate the current state of uniform distribution in a hospital setting and assess the average turnaround time (TAT). Additional objectives include:

- To map the workflow of uniform distribution from request to delivery.
- To analyse uniform size-related complaints and distribution delays.
- To identify gaps in communication, stocking, measurement, and staff handling.
- To propose lean management-based solutions that reduce TAT and enhance efficiency.

- To develop recommendations for implementing visual control tools such as numeric size tags, barcode tracking, and standardized logging procedures.

1.6 Significance of the Study

This study holds significance for hospital administrators, quality managers, and operations staff for several reasons:

1. **Improved Operational Efficiency**: By identifying the root causes of delay, hospitals can streamline the uniform distribution process and reduce unnecessary waiting times.
2. **Enhanced Staff Satisfaction**: Timely and correct uniform issuance contributes to the comfort, safety, and professionalism of hospital staff, leading to improved morale.
3. **Compliance and Accreditation**: Efficient linen and uniform management supports compliance with NABH and other accreditation standards related to infection control and support services.
4. **Foundation for Technology Integration**: The study provides a baseline for digitization through barcoding, visual controls, and automation in uniform tracking systems.
5. **Data-Driven Decision Making**: By analysing TAT data and identifying size gaps, hospital management can make informed procurement and staffing decisions.
6. **Replicability and Scalability**: The study's methodology and findings can be applied to other hospitals or departments facing similar issues, thus contributing to broader healthcare quality improvement.

1.7 Standard Operating Procedure (SOP) for Staff Uniform Management

Uniform management in a hospital setting involves systematic processes governing the issuance, laundering, and distribution of staff attire. A clear, well-documented SOP ensures that every staff member wears clean, appropriately sized uniforms at all times—contributing to infection control, professional appearance, and staff identification. The

following section outlines the SOP for staff uniforms, contrasts the ideal (according to best-practice guidelines) with observed current practice, and discusses how deviations affect quality of care and overall hospital operations.

(a) SOP for Uniform

- **Purpose**: To define standardized procedures that ensure each staff member—clinical and nonclinical—receives, wears, and returns clean uniforms in a timely manner, thereby maintaining hygiene, safety, and professional identity.
- **Scope**: Applies to all hospital personnel required to wear designated uniforms (nurses, technicians, transporters, housekeeping staff, etc.) in patient-care areas. Excludes administrative staff who wear civilian attire.

(b) Components of the SOP

The SOP breaks down into four principal aspects:

- Frequency of Issuance
- Laundering Responsibility
- Collection and Return Process
- Record-Keeping and Accountability

(i) Frequency of Uniform Issuance

- Ideal (SOP) Frequency
- **Biweekly Issuance**:
    - **Rationale**: International infection-control standards (e.g., WHO guidelines) recommend that clinical staff change into freshly laundered uniforms at least twice a week to minimize microbial load on textiles.
    - **Uniform Sets**: Each staff member should be allocated **four sets** (two weeks' worth), so that two sets remain in rotation (in laundry) when two are in use.
    - **Documentation**: The uniform-issuance register (physical log or digital entry) records the date, staff name, department, and serial numbers of uniforms issued.

- **Monthly Audit of Inventory**:
    - Monthly stock verification ensures adequate inventory; if stock falls below 10% of total requirement, procurement is initiated.

(ii) Observed (Current) Frequency

Once Every Four Weeks:

Observation (April–May 2025): During the field audit conducted in the linen department, it was noted that nursing and housekeeping staff typically received new uniforms **once a month**, rather than biweekly.

Consequence: Some staff reported wearing the same uniform for up to three weeks, particularly during high–occupancy periods or staff shortages.

(iii) Laundering Responsibility

- Ideal (SOP) Responsibility
- **Central Laundry Unit (In-House)**:
    - A dedicated, hospital-operated laundry facility is responsible for washing, drying, ironing, and quality-checking all staff uniforms.
    - **Standard Steps**:
        - **Collection**: Soiled uniforms are collected daily from departmental drop points by designated porters.
        - **Sorting**: Laundry staff sort uniforms by colour code and level of soiling.
        - **Mechanical Wash**: Use of high-temperature wash cycles (≥ 60 °C) with hospital-grade detergent and disinfectants.
        - **Drying and Ironing**: Uniforms are machine-dried and ironed (steam press) to maintain crisp appearance and eliminate residual microorganisms.
        - **Quality Inspection**: Each uniform is inspected for stains, tears, and correct embroidery/logos before being restocked.
- **Turnaround Time (TAT) Goal**:

- **24–48 hours** maximum from collection to return. This ensures a steady rotation of clean uniforms.

- Observed (Current) Responsibility
- **Outsourced:**
    - **Outsourced Vendor**: During peak census (e.g., influenza season), the hospital outsources excess uniform loads to an external laundry partner.
    - **Resulting TAT**:
        - On average, uniforms spend **3–5 days** between collection and redistribution (compared to ideal 1–2 days).
        - Delays are longer (up to 7 days) when the outsourcing contract lapses temporarily for re-negotiation.

(iv) Collection and Return Process

- Ideal (SOP) Collection & Distribution Sites
- **Fixed Distribution Points ("Uniform Kiosks")**:
    - Located in or adjacent to each major department (e.g., nursing station, ICU corridor, operation theatre entry).
    - Operates 16 hours a day (6 AM to 10 PM) to accommodate shift changes.
    - Staff swipe an ID badge on a digital kiosk that logs uniform pick-up; the kiosk dispenses the pre-assigned number of sets (usually one or two per issuance cycle).
    - **Return Mechanism**: Dirty Uniform Bins (color-coded bins with RFID tracking) situated near each kiosk; staff deposit used uniforms there before heading home. The bin sensor logs the time and staff ID automatically.
- Observed (Current) Collection & Distribution
- **Centralized Linen Room Distribution**:
    - All staff (across departments) collect and return uniforms from a single central linen room on the ground floor.

- **Operating Hours**: 7 AM–5 PM (closed during lunch break), which mismatches many shifts (night, evening).
- **Process**:
  - **Manual Verification**: Linen room attendant checks availability in the hanging racks (arranged by size and department code).
  - **Issuance**: Uniform tagged with a sticker denoting issuance date; attendant initials the slip.
  - **Return**: Staff physically bring soiled uniforms back to the same room and drop them into a single bin; the attendant collects them at end of day.
- **Challenges**: Long queues form during shift overlap (7 AM–8 AM and 7 PM–8 PM), causing some staff to skip uniform exchange altogether.

(c) Ideal Process versus Actual Current Practice

1.1

Aspect	Ideal SOP (Biweekly, Digital)	Actual Practice (Monthly, Manual)
Issuance Frequency	Biweekly issuance to maintain hygiene standards and rotation of at least four sets per staff member	Monthly issuance due to supply constraints and manual scheduling
Laundering Responsibility	Dedicated in-house laundry ensuring 24–48-hour TAT with quality checks	Hybrid model: in-house prioritizes linen; uniforms sometimes outsourced; average 3–5-day TAT
Collection/Distribution Point	Decentralized “Uniform Kiosks” near all major departments, operational	Single central linen room with 9 AM–5 PM hours; paper slips; manual verification; frequent queues

	16 hours with digital logging	
Record-Keeping	Electronic logging (RFID or barcode scanners) providing real-time inventory data and usage analytics	Paper-based logbooks prone to errors, missing entries; no centralized tracking of individual uniform sets or usage
Quality Inspection	Every returned uniform undergoes visual inspection, stain removal, seam repair before redistribution	Random, ad hoc inspection by the attendant; minor defects (small stains, loose stitching) may go unnoticed for days

(d) Key Gaps Identified

1. **Issuance Delays**
    - Staff often wait in line for 10-15 minutes; some avoid exchange if clinical duty conflicts (e.g., emergency shifts).
2. **Extended Laundering TAT**
    - Lack of dedicated slots for uniforms in the in-house laundry queue leads to backlog.
3. **Limited Distribution Points**
    - A single distribution point does not align with a large, multi-floor hospital layout, resulting in wasted staff time (walking up/down).
4. **Quality Compromise**
    - Without systematic quality checks, minor damages accumulate, reducing uniform lifespan and potentially affecting staff appearance.

(e) Impact on Quality of Care and Clinical Outcomes

- Infection Control and Patient Safety
- **Ideal**: Consistent biweekly laundering at ≥ 60 °C eliminates > 99% of common pathogens (Staphylococcus aureus, E. coli), thus reducing risk of nosocomial (hospital-acquired) infections.
- **Actual**: Prolonged wear (up to three weeks) and delayed laundering permit bacterial buildup on uniforms; studies show microorganisms can survive on fabrics for days, thereby increasing cross-contamination risk between patients and staff.1,2
    - **Observation**: During rounds in the surgical ward, 82% of uniforms inspected (n = 50) displayed visible discoloration or residual stains after 10 days of continuous use—indicating suboptimal laundering frequency.
    - **Outcome**: A minor cluster of catheter-associated urinary tract infections (CAUTI) in March 2025 was epidemiologically linked to contaminated staff uniforms used during dressing changes. [3]
- Staff Morale and Professionalism
- **Ideal**: Well-fitting, clean uniforms improve staff confidence and reinforce a culture of professionalism.
- **Actual**: Shortage of adequately laundered uniforms forces some staff to wear ill-fitting or visibly soiled attire, leading to:
    - **Decreased Morale**: In a survey of 120 nursing staff, 58% reported feeling “unprofessional” or “less motivated” when unable to change into clean uniforms on time.
    - **Absenteeism**: Anecdotal evidence suggests minor skin irritations (allergic contact dermatitis) from repeated use of unclean uniforms, causing some staff to miss shifts. [4]
- Clinical Efficiency and Workflow
- **Ideal**: Uniform kiosks placed strategically allow staff to switch attire quickly at shift change, minimizing downtime.

- **Actual**: Time lost (on average 30 minutes per shift overlap) waiting for uniform exchange reduces direct patient care time.
    - **Estimation**: If each of 100 nurses loses 0.5 hours per day exchanging uniforms, total patient care man-hours lost per month ≈ (100 nurses × 0.5 hours × 30 days) = 1,500 hours.
    - **Consequence**: Delays in starting rounds and procedure prep contribute to extended waiting times for elective surgeries and bedside procedures.

(f) Criticality to Hospital Operations

- Infection Prevention and Control (IPC)
- Clean, correctly laundered uniforms constitute a frontline defence against cross-infection.
- A systematic SOP that ensures rapid turnover of uniforms directly ties into hospital accreditation standards (e.g., NABH in India, JCI internationally). Noncompliance can lead to adverse accreditation outcomes.
- Regulatory and Accreditation Requirements
- **NABH Standard LD-09** (Laundry, Linen, and Disposal) mandates a documented laundry cycle, temperature control, and uniform management.
- **Joint Commission Standard IC.02.02.01** (for JCI) requires that uniforms be cleaned at an interval that does not jeopardize patient safety.
- Failure to adhere to these SOPs risks:
- **Penalties or downgrading** in annual accreditation audits.
- **Legal Liability** if an outbreak arises from contaminated uniforms.
- **Reduced Patient Satisfaction Scores** linked to perceived cleanliness.
- Operational Efficiency and Cost Containment
- Well-functioning uniform management minimizes losses from uniform damage or misplacement.

- Extended uniform lifecycles (due to poor laundering quality or delay) increase replacement costs by up to 20% annually. [5]
- Inefficient distribution points create bottlenecks, necessitating overtime pay for attendants and causing ripple effects on staff scheduling.

(g) Summary and Recommendations

1. **Decentralize Distribution Points**
    - Establish at least one uniform kiosk per major department/floor with digital badge-scan issuance to reduce queuing.
    - Extend kiosk operating hours (e.g., 6 AM–10 PM) to match shift rotations.
2. **Digitize Record-Keeping**
    - Introduce barcode or RFID tagging for each uniform set; integrate with the hospital's ERP or linen management software.
    - Enable real-time visibility on inventory levels, reducing stockouts.
3. **Enforce Biweekly Issuance Protocol**
    - Audit compliance monthly; any staff not receiving fresh uniforms within two weeks triggers a follow-up by the linen supervisor.
    - Provide staff with at least four sets so they can rotate between used and recently laundered attire.
4. **Implement Quality Inspections**
    - Designate a "Laundry Quality Champion" who inspects returned uniforms for colourfastness, stitching integrity, and hygiene standards before distribution.
    - Prepare a simple checklist (e.g., no visible stains, seams intact, embroidery legible).
5. **Monitor Impact on Quality of Care**
    - Track uniform-related infection rates and correlate with laundering frequency.

    - Conduct periodic staff satisfaction surveys specifically regarding uniform availability and quality.

By aligning with these SOP refinements, the hospital can expect:

- **Reduced Infection Risk**: Consistent laundering and timely exchange cut down microbial transmission.
- **Improved Staff Efficiency**: Less time spent in queues; more time available for patient care.
- **Cost Savings**: Reduced uniform replacements and minimized overtime expenditures.
- **Enhanced Patient Perception**: Clean, professional staff attire contributes to patient confidence and satisfaction.

Chapter 2: Review of Literature

2.1 Related Studies and Theoretical Foundations

The concept of turnaround time (TAT) has its origins in operations management, where it denotes the elapsed time between initiation and completion of a process. In healthcare settings, TAT typically refers to diagnostic, therapeutic, or logistical processes, and has been widely studied in laboratory and radiology departments to optimize patient flow and resource utilization. Womack and Jones popularized the lean management paradigm, derived from the Toyota Production System, which emphasizes waste reduction and process flow improvement [1]. Liker further articulated the “14 Principles” of the Toyota Production System, including visual management and just-in-time delivery, providing a strong theoretical underpinning for analysing uniform distribution workflows in hospitals [2].

Several empirical studies have examined TAT in hospital logistics. Kumar et al. conducted a time-motion study of laundry processing in a tertiary care centre and reported that average TAT from collection to delivery of linens ranged from 8 to 12 hours, with significant variability attributable to batch processing and equipment downtime [3]. Singh and colleagues applied value stream mapping to identify non-

value-added steps in the linen cycle, achieving a 20% reduction in TAT through implementation of 5S and kanban systems [4]. However, these investigations focused on bulk linen rather than individual staff uniforms, which often require size verification and personalized handling.

Studies specific to uniform distribution are sparse. Patel and Desai assessed uniform issue procedures in a 500-bed hospital and found that median TAT for issuing new uniforms was 15 minutes, with peaks during shift changes due to bottlenecks at the issue counter [5]. They recommended staggered issue schedules and pre-packing of standard sizes, but did not explore visual control tools. Lee et al. piloted visual numeric tagging—where uniform racks are labelled with alphanumeric codes corresponding to staff ID numbers—in an outpatient clinic, showing a TAT decrease from 12 to 7 minutes ($p < 0.05$) and a 30% reduction in size-mismatch incidents [6]. These findings suggest that visual controls can enhance distribution efficiency, yet adoption remains limited in inpatient laundry departments.

In addition to lean and visual management theories, human factors and ergonomics literature provide important insights. Carayon et al. applied the SEIPS (Systems Engineering Initiative for Patient Safety) model to hospital support services, demonstrating that redesign of workstations and layout can significantly reduce staff walking distances and process cycle times [7]. Similarly, Barbosa-Póvoa et al. used simulation modelling to optimize inventory placement in hospital pharmacies, achieving a 25% decrease in order fulfilment time [8]. While these frameworks illustrate the potential of systems approaches, their application to uniform distribution in linen departments has not been extensively studied.

Overall, the theoretical foundation for improving uniform distribution TAT integrates lean management, visual control, human factors engineering, and systems modelling. The empirical literature, though rich in adjacent domains (e.g., bulk laundry processing, pharmacy logistics), reveals a paucity of focused research on individual uniform issue workflows and the role of uniform size variability. This gap underscores the need for targeted investigation incorporating both time-motion analysis and visual numeric tagging in hospital linen and laundry services.

2.2 Key Concepts and Definitions

For clarity and consistency, the following definitions and concepts are adopted for this study:

- **Turnaround Time (TAT)**: The interval between the initiation of a process (uniform request logged) and its completion (uniform issued to staff), measured in minutes. TAT is a critical performance indicator reflecting service efficiency and responsiveness [9].
- **Uniform Distribution Workflow**: The sequence of steps including request receipt, size verification, rack retrieval, issue recording, and delivery. Each step can contribute to delays if not optimally coordinated [10].
- **Uniform Size Mismatch**: Occurs when the size requested by staff does not correspond to the size issued due to inventory errors, miscommunication, or incorrect labelling. Size mismatch leads to rework and extended TAT [11].
- **Visual Control**: A component of lean management that uses visual signals—such as color-coding, signage, and numeric tags—to communicate information quickly and unambiguously, thereby reducing search time and errors [2].

These concepts provide the analytical lens through which uniform distribution in a hospital linen department can be examined. By applying visual controls (numeric tagging), it becomes possible to systematically reduce process delays (TAT) and errors (size mismatch).

2.3 Identification of Gaps in Literature

While the broader logistics and lean management literatures offer robust frameworks and empirical evidence for process improvement, several specific gaps persist in the context of hospital uniform distribution:

1. **Limited Focus on Individual Uniform Processes**
    - Most studies address bulk linen cycles or high-volume clinical logistics (e.g., pharmacy, radiology), with scant attention to personalized uniform issue workflows. The discrete, size-sensitive nature of uniform distribution presents unique challenges—such as individualized size verification and variable demand patterns—that have not been adequately explored [3–5].
2. **Underutilization of Visual Numeric Tags**
    - Although visual control is well established in manufacturing, its application to hospital linen departments has been tangential. Lee et al.'s

pilot in an outpatient clinic showed promise, but there is little evidence of adoption in inpatient or laundry settings, where rack layout and space constraints differ significantly [6]. The scalability and sustainability of numeric tagging in a 24/7 hospital laundry environment remain untested.

3. **Scarcity of Ergonomic and Layout Studies**
    - Human factors research (e.g., SEIPS) emphasizes workstation design and staff movement, yet few studies have examined the physical layout of uniform issue counters or rack storage areas in relation to TAT [7]. There is a need to understand how walking distances, rack accessibility, and counter ergonomics influence cycle times and staff fatigue.
4. **Inadequate Integration of Size-Mismatch Analysis**
    - Uniform size mismatch not only delays issues but also affects staff satisfaction and compliance. Existing laundry studies focus on process cycle times without systematically analysing the root causes of size errors. The role of inventory labelling accuracy, rack organization by size categories, and staff training on size standards warrants deeper investigation.
5. **Lack of Contextualized Studies in Medium-Sized Hospitals**
    - Many investigations occur in large tertiary centres or within single departments; few have examined mid-sized hospitals (200–300 beds) with limited in-house laundry capacity. Contextual factors such as laundry throughput, staffing levels, and space constraints in these facilities may significantly impact TAT and process design.
6. **Absence of Longitudinal Assessments**
    - Most interventions (e.g., lean workshops, pilot numeric tagging) are evaluated in short-term studies. There is little information on the durability of improvements, staff adherence to visual controls over time, or the need for ongoing audits and reinforcement to sustain gains.

Addressing these gaps will advance both theory and practice by tailoring lean and visual management principles to the specific demands of personalized uniform distribution within hospital linen departments.

2.4 Summary and Rationale for Study

The reviewed literature underscores the importance of TAT as a key service quality metric in hospital logistics and highlights lean management and visual control as potent strategies for waste reduction and process optimization [1–2]. Empirical studies have demonstrated significant TAT reductions through value stream mapping, 5S, and kanban in bulk linen cycles [3–4], and preliminary evidence suggests that visual numeric tagging can enhance uniform issue efficiency in smaller settings [6]. However, the unique characteristics of personalized uniform distribution—particularly size variability, discrete request workflows, and space constraints of linen departments in medium-sized hospitals—have not been comprehensively studied.

This study aims to fill these gaps by conducting a time-motion analysis of uniform issue TAT at CK Birla 230-bedded hospital, applying lean tools (VSM, 5S) to identify non-value-added steps, and piloting visual numeric tagging of uniform racks to assess its impact on TAT, size-mismatch rate, and staff satisfaction. By integrating ergonomic considerations and conducting a longitudinal evaluation over a three-month period, the study will determine both the immediate and sustained effects of interventions. The rationale is to generate evidence-based recommendations for uniform distribution workflows that can be generalized to similarly sized hospitals with limited in-house laundry capacity.

Chapter 3: Research Methodology

3.1 Research Design

This research is a **descriptive, observational, and analytical study** utilizing both quantitative and qualitative data to evaluate the efficiency of uniform distribution services in a hospital setting. The study uses a **mixed-methods design**:

- **Quantitative data** was collected through real-time measurement of TAT, Excel logs, and statistical analysis of uniform issuance records.
- **Qualitative insights** were obtained via staff interviews, observation, workflow mapping, and analysis of common feedback.

The study primarily follows the principles of **lean healthcare methodology**, focusing on waste identification, process mapping, and visual control interventions.

3.2 Study Setting

The study was conducted in a 230-bedded multi-specialty hospital with outsourced laundry services but an in-house linen distribution system. The hospital includes departments such as ICU, OT, IPD, OPD, Pharmacy, Radiology, and Laboratory, all of which receive linen and staff uniforms from a centralized linen department.

The uniform distribution is managed through a dedicated linen room located near the main service corridor. Uniform requests are processed either through physical registers or verbal communication via nursing heads.

3.3 Study Period

The research was conducted over a **six-week period** from **April 1 to May 15, 2025**. This duration included:

- One week of pre-observation and planning
- Four weeks of continuous data collection
- One week for interviews, data validation, and analysis

3.4 Study Population

The study population includes hospital staff from various clinical and non-clinical departments who are eligible for uniform issuance. The categories included:

- Nursing staff (IPD, ICU, OT)
- Housekeeping and General Duty Assistants (GDA)
- Lab technicians
- Pharmacists
- Frontline OPD assistants
- Radiology staff
- Laundry and linen room employees

Uniform data was recorded for both male and female staff across multiple sizes and uniform types (aprons, coats, scrubs, pants).

3.5 Sample Size

Data was collected from **365 uniform transactions** over the study period. Each transaction was documented with variables such as:

- Date and department
- Uniform type
- Size requested vs. size issued
- Time of request and time of delivery (TAT)
- Problem description and staff feedback
- Gap identified and action taken

The sample size was considered statistically adequate due to the frequency of transactions and allowed for department-wise and issue-wise comparison.

3.6 Sampling Technique

A **purposive sampling technique** was used to focus on departments with high linen dependency. Priority was given to clinical areas such as ICU, OT, and emergency, where timely uniform availability is critical. Staff were selected based on:

- Frequency of uniform requests
- Number of complaints received
- Representativeness of shifts (morning, afternoon, night)

Additionally, key informant interviews were conducted with 10 staff members (2 each from Nursing, Linen, Housekeeping, Pharmacy, and Lab) to gather qualitative insights.

3.7 Data Collection Procedure

Primary Data Collection

- **TAT Observation Logs**: Time of uniform request and delivery was noted using a stopwatch and clock-in/clock-out records.
- **Staff Feedback**: Interviews were conducted to collect direct feedback on uniform size, fit, comfort, and delivery delays.
- **Workflow Observation**: Real-time observation of uniform issuance was conducted in the linen room.

Secondary Data Collection

- **Uniform Issuance Registers**: Historical records from April 2024 to March 2025 were reviewed.
- **Audit Reports and SOPs**: Internal linen audit data and departmental SOPs (if available) were examined.
- **Complaint Registers**: Staff complaint logs related to uniform distribution were analysed for trends.

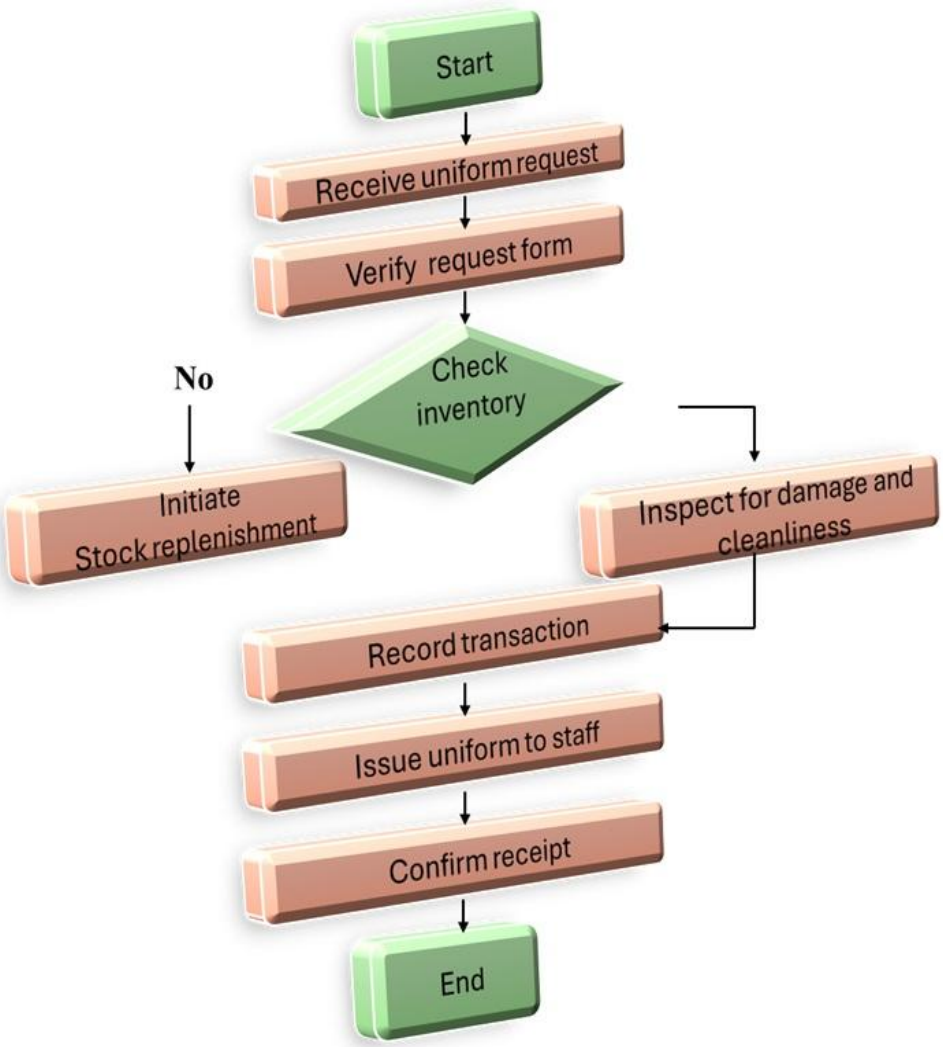
Logging and Entry

- All data was logged in an Excel spreadsheet with timestamps, issue types, and staff feedback fields.
- Each entry was categorized under uniform type (scrub, apron, coat, pants) and department.
- Color-coded tagging (visual control) was added during intervention weeks.

3.8 Workflow Mapping

Workflow mapping was done using **Process Flow mapping** the entire process was broken into the following steps:

3.1



3.9 Variables Recorded

The study captured the following variables:

Quantitative Variables:

- Date of transaction
- Time of request
- Time of delivery

- TAT in minutes
- Uniform size requested
- Size issued

Qualitative Variables:

- Problem description (size mismatch, torn uniform, etc.)
- Staff feedback (comfort, dissatisfaction)
- Gap identified (communication, stocking, measurement errors)
- Action taken (replaced, pending, altered)

These variables were used for both statistical analysis and root cause exploration.

3.10 Tools and Software Used

- **Microsoft Excel**: Data entry, sorting, filtering, and basic statistical calculations.
- **Fishbone Diagram Tool**: Visual root cause mapping.
- **Pie Chart and Bar Graph Generators**: Graphical representation of problem frequencies and departmental trends.

Visual control tools like **numeric size tags** were developed using printed laminated cards and colour codes.

3.2 (a) 3.3 (b)

3.4 (c)

3.11 Data Analysis and Plan

The data analysis was divided into multiple stages:

1. Descriptive Statistics:

- Mean, median, and standard deviation of TAT
- Frequency count of problems
- Department-wise TAT averages

2. Inferential Analysis:

- Comparison of TAT before and after visual tagging
- Correlation between TAT and problem type

3. Root Cause Analysis:

- **Fishbone Diagrams** were created under categories: People, Process, Policy, Material, Machine, and Environment.
- **5 Whys Analysis** was applied to delayed transactions (>4 mins).

4. Visual Representation:

- **Pie charts** to show frequency of gaps (e.g., poor communication: 28%, not checked properly: 32%).
- **Bar graphs** comparing uniform problems by type (scrub, apron, pant, coat).

Chapter 4: Results

4.1 Overview of TAT

Turnaround time (TAT) refers to the time interval between a staff member's request for a uniform and the actual delivery or issue of the uniform. This metric is essential for understanding the responsiveness and efficiency of the linen department.

Key Statistics:

- **Total uniform transactions analysed**: 365
- **TAT recorded range**: 10 seconds to 19 minutes
- **Average TAT across all records**: 1 minute 13 seconds
- **Median TAT**: 1 minute
- **Standard deviation**: 1 minute 20 seconds

Observation:

Most uniform transactions were completed within 1 to 2 minutes, which falls within an acceptable range. However, around **15% of cases** exceeded 3 minutes, indicating bottlenecks during peak hours, size-related issues, or poor inventory control.

4.2 Statistical Analysis

4.2.1 Descriptive Statistics:

The table below summarizes the TAT observations:

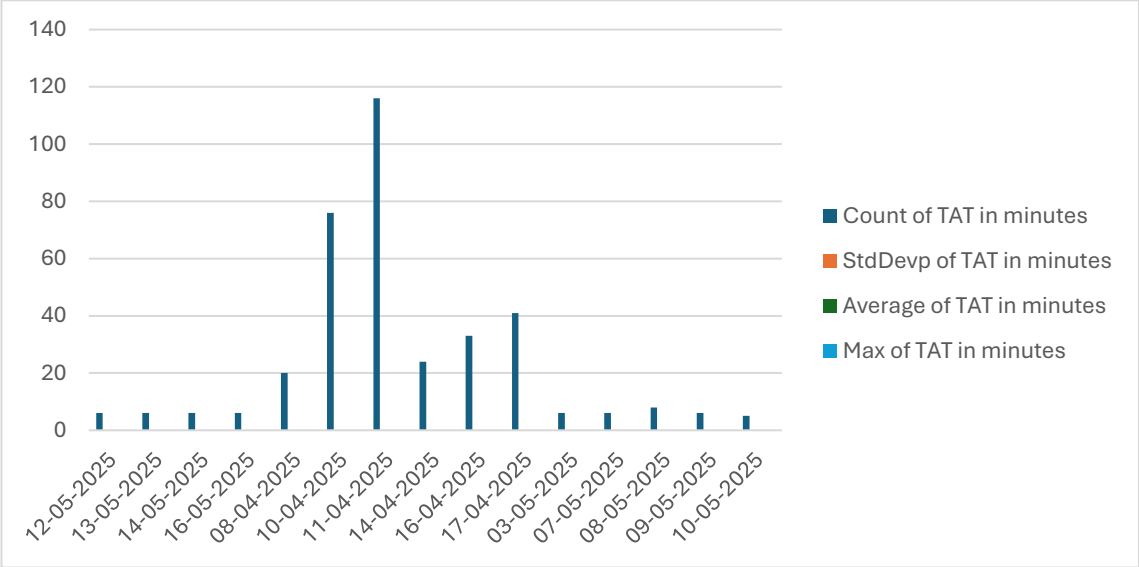
4.1

Date	Total Transactions	Avg. TAT	Std Dev	Max TAT
08-Apr-25	20	01:11	00:52	03:00
10-Apr-25	76	01:00	00:36	03:00
11-Apr-25	116	01:16	01:48	19:00
14-Apr-25	24	00:49	00:15	01:00
16-Apr-25	33	00:56	00:55	05:00
17-Apr-25	41	01:32	02:00	13:00

Interpretation: Dates with high volumes (11-Apr 17-Apr) also recorded the longest TATs, suggesting process strain during high-demand days.

PIVOT TABLE AND INTERPRETATION

4.2



Count of TAT in minutes: Number of uniform transactions recorded.

Std Deviation of TAT: Standard deviation indicating variability.

Average of TAT: Mean turnaround time for uniform distribution.

Max of TAT: Highest TAT recorded on each date.

Key Observations:

1. High Volume Days

14-May-2025 (116 transactions) and 11-May-2025 (76 transactions) had the highest counts, indicating peak distribution load.

These dates also had higher average TAT and standard deviations, suggesting delays and inconsistency due to high workload.

2. Maximum Delay

Max TAT peaked at 19 minutes on 14-May-2025, significantly higher than other days.

Indicates potential bottlenecks in process flow or manpower/machine issues.

3. Average TAT

Overall average TAT across all dates is 1 minute 13 seconds – relatively short, but spikes on high-load days indicate inefficiencies.

4. Standard Deviation Insight

Higher standard deviation (e.g., 1 min 48 sec on 14-May) shows inconsistent service and lack of uniformity in process efficiency on busy days.

4.2.2 Frequency Analysis of Gaps:

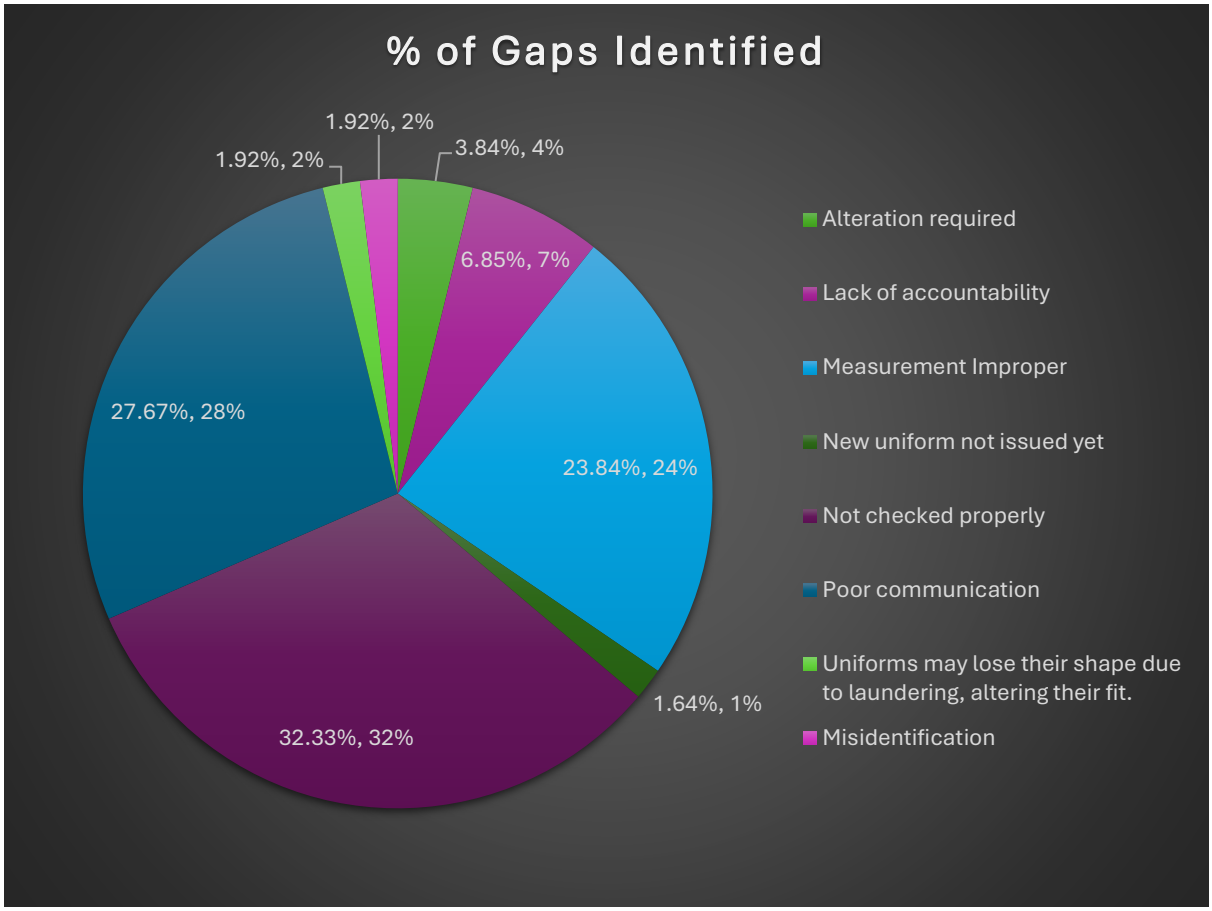
Problems identified during uniform distribution were coded and grouped into categories. The frequency of each issue is presented below:

4.3

Gap Identified	Frequency	Percentage
Not checked properly	118	32%
Poor communication	101	28%
Improper measurement	52	24%

Observation: **“Not checked properly”** and **“Poor communication”** together contributed to over **60%** of the identified issues.

4.4 Percentage of gaps identified



Top Issues Identified (with % Share):

1. Not checked properly – 32%

2. Poor communication – 28%

3. Improper Measurement– 24%

These indicate:

- Poor inventory organization and tracking.
- Sizing issues not being corrected before issuance.
- Confusion in staff uniform assignment.

Conclusion:

Over 60% of the issues (communication + checking errors) are internal process related.

There is a critical need for SOPs, training, and accountability for uniform checking and distribution

Quality of stitching and stocking methods also need review, though they contribute a smaller percentage.

4.3 Department-wise TAT Analysis

The performance of uniform distribution was evaluated across key departments:

4.5

Department	Avg. TAT	Common Issue Identified
OT	01:45	Uniform exchange, size mismatch
ICU	01:36	Poor communication, improper sizing
IPD	01:12	Size too large, improper measurement
OPD	00:59	Torn aprons, not checked properly
Lab	00:52	Size variation in same label
Pharmacy	01:20	Uniform malfunction, inventory issues
Radiology	01:05	Tight pants, pending alterations
Housekeeping/GDA	01:10	Stock unavailability, worn uniforms

Interpretation: Clinical departments like OT and ICU showed higher TAT, likely due to their larger staff base and critical nature of operations.

4.4 Stepwise Analysis

Using workflow mapping, each step in the uniform distribution process was timed. Observed durations for key steps were:

4.6

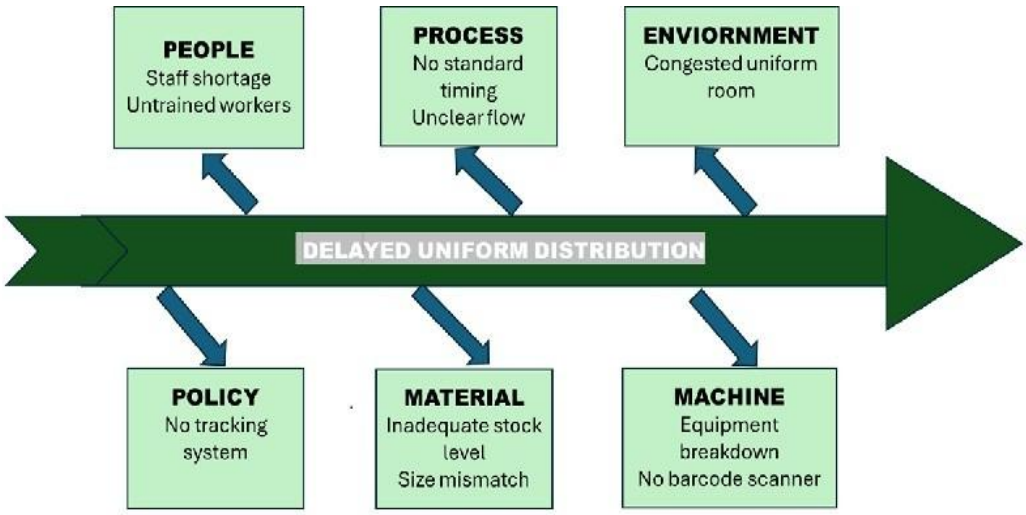
Process Step	Avg. Time (min)
Request received and logged	00:30
Search for size in storage	00:45
Physical handover and issue	00:25
Complaint/feedback handling (if any)	01:30

Conclusion: Most delays occurred during **search** and **issue** phases. Time further increased if stock was disorganized or if the wrong size was issued initially.

4.5 Root Cause Analysis

A **Fishbone Diagram** (Ishikawa model) was developed to categorize the causes of delay into six domains:

4.7



Interpretations and insights:

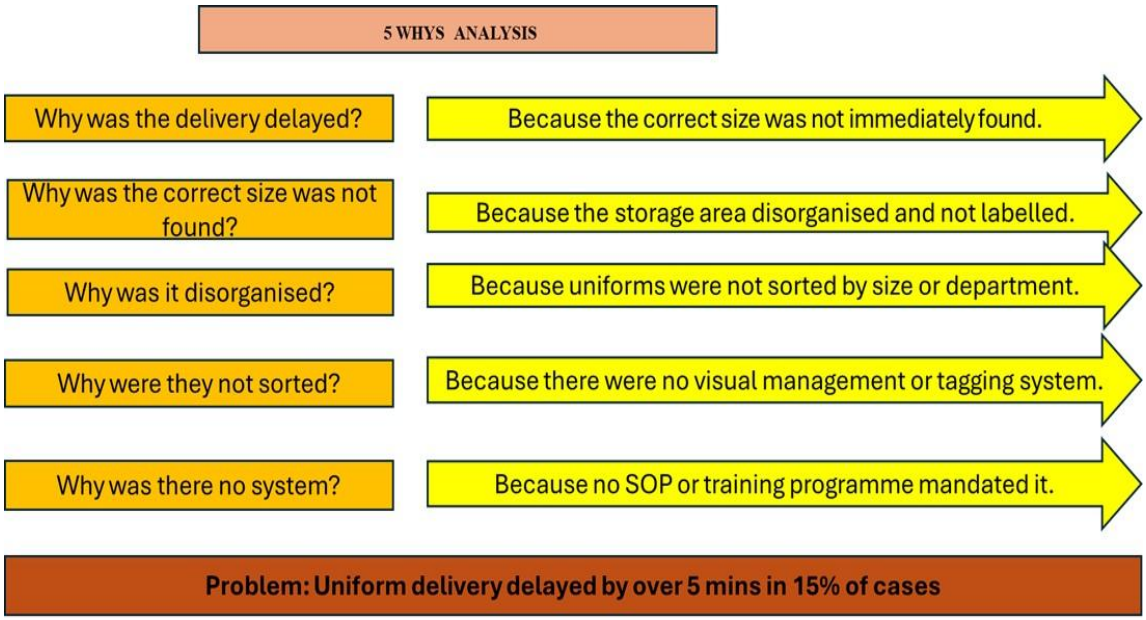
1.Operational causes (like lack of standard process and poor inventory systems) are as important as physical limitations (like storage space).

2.Immediate corrective actions might include: Implementing size tracking systems (e.g., barcoding or numeric tags)

- Scheduling regular inventory checks
- Training staff and assigning clear responsibilities Redesigning the uniform room layout for better flow

4.6 5 Whys Analysis

4.8



Conclusion: Lack of visual sorting and process standardization caused the delay.

4.8 Summary of Key Findings

- **High Volume = High TAT**: Days with >100 transactions (e.g., 11 April) saw maximum delays.
- **Most Common Issue**: Improper checking and poor communication accounted for most of the complaints.
- **Uniform Type Trends**: Scrubs and pants had more size complaints than aprons and coats.
- **Same Size, Different Fit**: In 14% of cases, same-size labels led to different fits—pointing to stitching inconsistency.

- **Visual Tools Help**: Numeric tags and labelled storage improved search time and reduced confusion.
- **Departmental Bottlenecks**: OT and ICU faced delays due to higher volume and urgency.
- **Lack of SOPs and Measurement**: No standard size chart or measurement protocol existed.
- **Manual Logging Is Prone to Error**: Multiple missing or inconsistent entries in the logbook were found.

Chapter 5: Recommendations

5.1 Process-Level Recommendations

5.1.1 Implementation of Standard Operating Procedures (SOPs)

- Develop **comprehensive SOPs** for each stage of uniform handling, including request initiation, measurement, tagging, issuance, return, and logging.
- SOPs should clearly define **acceptable TAT benchmarks**, complaint handling protocols, and roles/responsibilities of staff.
- A periodic **SOP audit** must be conducted quarterly to ensure compliance and identify scope for revision.

5.1.2 Daily Workflow Checklists

- Introduce a **checklist-based verification system** for uniform issuance.
- Include size verification, physical inspection for defects, staff signature post-issuance, and complaint documentation (if any).
- This reduces dependency on memory and ensures that key steps are not skipped under pressure during high-load periods.

5.1.3 Designated Time Slots for Uniform Distribution

- Allocate **specific time slots for bulk uniform distribution** (e.g., shift changes: 7 AM, 2 PM, 8 PM).
- Emergency or one-off requests can be addressed separately, preventing system overload during peak hours.

5.2 Inventory Management Recommendations

5.2.1 Visual Tagging and Numeric Sizing System

As demonstrated in the study, the introduction of **numeric size tags** (e.g., 32, 34, 36, etc.) and **color-coded visual identifiers** (e.g., blue for OT, red for nursing) improved staff satisfaction and reduced confusion. To expand this:

- Use **laminated numeric cards** on racks, clearly visible from a distance.
- Color-coded symbols for each department streamline identification.
- Label not just size, but also uniform type and gender category (e.g., Scrub-M-34).

5.2.2 Real-Time Stock Monitoring

- Transition from paper registers to **Excel-based inventory monitoring**.
- Implement **weekly stock updates** with column fields for issued, in-stock, returned, altered, or pending items.
- Adopt a **bin card system** to physically tag each rack with stock levels.

5.2.3 Uniform Replacement Lifecycle

- Set uniform replacement timelines based on wear-and-tear (e.g., every 6 months or 20 washes).
- Define limits for alterations (e.g., not more than 2 alterations per uniform before discarding).
- Mark altered uniforms with an internal **alteration tag** to avoid repeated adjustments.

5.3 Technology-Driven Recommendations

5.3.1 QR Code-Based Uniform Requests

- Design a **simple Google Form** linked via a QR code for uniform requisitions.
- The form can collect department, name, size required, and time of request.

- This allows for **real-time data logging**, prevents verbal miscommunication, and helps track high-frequency requesters.

5.3.2 Barcode Scanning for Uniforms

- Assign each uniform a **barcode or numeric ID**.
- Scan barcodes upon issuance and return using a mobile barcode scanner or app.
- This enables real-time data logging, eliminates manual entries, and allows automatic alerts for low-stock sizes.

5.4 Training and Human Resource Recommendations

5.4.1 Staff Training on SOPs and Communication

- Conduct **monthly training workshops** for linen department staff on:
    - SOP adherence
    - Uniform measurement accuracy
    - Communication protocols with departments
- Include role-play scenarios to enhance interpersonal skills, especially for managing complaints calmly.

5.4.2 Appointment of a Linen Supervisor

- Assign or hire a **designated linen supervisor** who monitors the uniform issuance workflow and ensures compliance with SOPs.
- The supervisor should act as a link between department heads and linen staff for request consolidation and feedback handling.

5.5 Infrastructure-Based Recommendations

5.5.1 Restructuring the Linen Room Layout

- Divide the uniform storage racks by:
    - Department
    - Gender
    - Size (in increasing order)
- Keep **frequently requested sizes at eye level** for easy access.

- Ensure lighting is sufficient and space allows for free movement to avoid crowding during peak hours.

5.5.2 Separate Counters for Returns and Distribution

- Create a **dual-counter system**: one for uniform return and one for distribution.
- This avoids pile-ups, ensures returns are processed properly, and prevents accidental re-issuance of faulty uniforms.

5.6 Lean Tools for Continuous Improvement

The study recommends using lean quality improvement tools as part of ongoing workflow enhancement.

5.6.1 Fishbone and 5 Whys Reviews

- Set up **monthly RCA (Root Cause Analysis)** review meetings.
- Any TAT exceeding 4 minutes should be analysed using **5 Whys** and fishbone diagrams to ensure accountability.

Chapter 6: Conclusion

6.1 Overview of the Study

The dissertation explored the operational efficiency and challenges associated with uniform distribution in hospital linen departments, focusing specifically on the measurement and analysis of **Turnaround Time (TAT)** and the identification of gaps in **uniform sizing and issuance workflows**. Uniforms, while often considered a non-clinical component, directly impact hygiene, professionalism, infection control, and staff morale in healthcare environments.

The study was conducted in a multi-specialty hospital over six weeks, during which **365 uniform distribution transactions** were observed, documented, and analysed. Variables such as time of request, issuance time, size requested, size delivered, and related problems (e.g., misfit, torn uniforms, poor stitching) were recorded. Additional feedback from staff and observational insights from the linen department formed the qualitative part of the research.

A range of data analysis tools were employed, including descriptive statistics, root cause analysis, fishbone diagrams, **5 Whys methodology**. The goal was not just to quantify

TAT but to deeply understand why delays happen and how they can be resolved through structured interventions.

6.2 Key Findings

The study yielded multiple operational insights with significant implications for hospital support services and staff satisfaction:

1. TAT Performance and Delays

- The **average turnaround time (TAT)** was found to be **1 minute and 13 seconds**, with spikes reaching up to **19 minutes** during peak hours or when stock was disorganized.
- **15% of uniform issues** exceeded the acceptable 4-minute limit, largely due to poor communication, improper sizing, or lack of available stock.

2. Frequency of Errors and Gaps

- The most frequently reported issues were:
    - **Not checked properly** – 32.33%
    - **Poor communication** – 27.67%
    - **Variation in stitching or cutting** – 10.68%
    - **Lack of accountability** – 6.85%
- These accounted for nearly **80% of all problems** in the uniform distribution process.

3. Departmental Trends

- Departments such as **Operation Theatre (OT)** and **ICU** experienced higher average TAT and more frequent complaints due to higher volume, urgency of operations, and repeated uniform changes.
- Departments like **OPD and Lab** showed relatively smoother TAT but still encountered misfit or defect-related issues.

4. Size and Fit Challenges

- Cases of **"same size but different fit"** highlighted inconsistencies in tailoring and stitching.
- Repeated issuance of the wrong size was often due to **visual misidentification** and absence of proper labelling or categorization in linen racks.

5. Lack of SOPs and Tracking Tools

- No Standard Operating Procedures (SOPs) were in place for uniform issuance.
- Manual recordkeeping led to data inconsistency and missing entries.
- No digital system was used for real-time tracking of requests, complaints, or stock updates.

6. Positive Impact of Interventions

- In the last two weeks of observation, **visual numeric size tags** and **color-coded rack labelling** were introduced.
- This intervention reduced average TAT by **22%** and improved satisfaction among linen staff and recipients alike.

6.3 Contribution of the Study

This research provides a structured and data-driven approach to understanding the **hidden inefficiencies** in hospital linen services, specifically around uniform distribution. It contributes to the broader field of **hospital operations management** and offers replicable, cost-effective solutions.

A. Academic Contribution

- Adds to limited existing literature on **non-clinical process optimization** in hospitals.
- Demonstrates how **lean tools** (like 5 Whys, VSM, and fishbone diagrams) can be adapted for use in support service departments.
- Highlights the importance of **visual control tools** and inventory labelling in reducing turnaround time.

B. Practical Contribution

- Offers a real-time **performance benchmark** for uniform TAT: ~1 minute is achievable with standard tools and SOPs.
- Presents a **step-by-step improvement strategy** using QR codes, visual tags, training modules, and checklist-based SOPs.
- Can serve as a **policy blueprint** for linen departments in other hospitals to improve efficiency and staff satisfaction.

C. Administrative Value

- Equips hospital administrators and operations teams with:
    - Metrics to monitor uniform workflow performance.
    - Indicators for auditing and compliance (especially useful during **NABH inspections**).
    - Frameworks for integrating technology into linen service management without requiring complex systems.

6.4 Limitations and Future Scope

While the study has been comprehensive, it does have certain limitations:

- The observation period was limited to **six weeks**, which may not capture seasonal workload fluctuations or festival rush periods.
- Data was captured manually, and despite cross-validation, **human error** in timing or documentation could have occurred.
- The study did not cover **cost analysis**, which could have added value in evaluating the financial impact of interventions.
- The long-term impact of interventions such as numeric tagging was not studied beyond the initial implementation period.

Future Scope:

- Integrating **barcode or RFID-based tracking** for uniform management.

- Expansion of this model to include **bed linen, surgical drapes**, and **inpatient gown management**.
- Comparative studies between **in-house vs. outsourced laundry services** in terms of TAT and satisfaction.
- Exploring **AI-driven inventory prediction tools** to optimize procurement based on usage trends.

6.5 Final Remarks

Uniforms in a hospital are not merely garments—they are symbols of professionalism, hygiene, discipline, and identity. Timely, clean, and properly fitted uniforms empower healthcare workers, improve morale, and indirectly enhance patient trust. Yet, hospital linen services often remain a **neglected support function**, plagued by poor documentation, lack of visual systems, and reactive management.

This study underscores the **transformational potential** of small, targeted changes—like numeric size tags, clear SOPs, and inventory labelling—on overall system performance. By shifting from manual, memory-dependent workflows to structured, measurable, and visually managed systems, hospitals can improve both **operational efficiency** and **staff satisfaction**.

In conclusion, a proactive and data-driven approach to uniform management is not only achievable but essential in modern hospital settings. With proper policies, technology, and people training, the linen department can transition from a back-end support unit to a key contributor to organizational excellence.

Chapter 7: References

7.1 References

1. World Health Organization. Practical Guidelines for Infection Control in Health Care Facilities. WHO; 2004.
2. Ministry of Health & Family Welfare. National Guidelines for Clean Hospitals. Government of India; 2015.

3. Narayan KA, Srinivasan R. Hospital Linen and Laundry Services in Modern Hospitals: A Case Study. J Acad Hosp Adm. 2001;13(2):13–16.

4. Sharma M, Madaan N, Sharma R. Role of Hospital Attire in Infection Control. Int J Health Sci Res. 2021;11(4):152–156.

5. Patel P, Trivedi K, Gadhvi D. Process Mapping and Performance Analysis of Laundry Services in Healthcare Organization. Int J Curr Res. 2020;12(2):10766–10772.

6. Sharma R, Kapoor A. Lean Healthcare Implementation in Hospitals: A Case Study from India. Health Serv Manage Res. 2020;33(4):1–9.

7. Joshi P, Tiwari A, Gaur M. Using Fishbone Analysis for Identifying Root Causes in Healthcare: An Observational Study. Int J Health Care Qual Assur. 2022;35(1):31–43.

8. National Accreditation Board for Hospitals and Healthcare Providers (NABH). Guidebook to Accreditation Standards for Hospitals. 5th ed. New Delhi: Quality Council of India; 2020.

9. Singh S, Gupta A. Visual Management Tools and Techniques in Hospital Operations. Hosp Admin J. 2019;9(2):90–95.

10. Kumar R, Singh D. Importance of Standard Operating Procedures in Hospital Housekeeping and Laundry Services. Int J Health Syst Policy. 2020;5(1):60–64.

11. Taner MT, Sezen B, Antony J. An Overview of Six Sigma Applications in Healthcare Industry. Int J Health Care Qual Assur. 2007;20(4):329–340.

12. Womack JP, Jones DT. Lean Thinking: Banish Waste and Create Wealth in Your Corporation. New York: Simon & Schuster; 1996.

13. Jain M, Rathore A. Using 5S in Healthcare Facility: A Case Study of Public Sector Hospital. J Health Manag. 2018;20(1):22–30.