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Research Protocol

Nursing Section

A Comparative Analysis of Process Mapping and Standardised High-line Flow Process in Hospitals to Develop SOPs for Discharge: A Research Protocol

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ABSTRACT

Introduction: Efficient patient discharge is a critical component of hospital workflow that directly influences bed availability, patient satisfaction, and healthcare costs. However, delays in discharge remain a persistent challenge across hospitals, particularly in resource-constrained settings like the Wardha district. These delays are often the result of administrative inefficiencies, inadequate coordination among healthcare providers, and poor communication.

Need of the study: With the National Accreditation Board for Hospitals (NABH) recommending that discharge be completed within 180 minutes, delays beyond this threshold indicate systemic inefficiencies. There is a pressing need to identify the underlying causes of these delays and to develop evidence-based Standard Operating Procedures (SOPs) that can streamline the discharge process and improve hospital performance.

Aim: To compare the efficacy of a process mapping plan of action versus a standardised high-line process strategy in reducing discharge Turnaround Time (TAT) and to develop validated SOPs that enhance discharge efficiency.

Materials and Methods: A Randomised Controlled Trial (RCT) will be conducted at Acharya Vinobha Bhave Rural Hospital in Wardha, Maharashtra, India, from June 2025 to October 2025. Healthcare staff will be randomly allocated to either the experimental group (process mapping) or the control group (high-line process). Both quantitative and qualitative data will be collected on discharge TAT, workflow efficiency, and reasons for delay. A Chi-square test for categorical variables and a paired t-test will be used for time series data to evaluate the impact of both strategies. A p-value of <0.05 will be considered statistically significant.

Keywords: Healthcare workflow efficiency, Outcome assessment, Planning, Quality care, Standard operating procedures

INTRODUCTION

Hospital discharge is a collaborative process where patients and teams of allied health professionals from different disciplines work together to transition safely from an inpatient care environment to another health facility or to their home. From there, other providers can assist the patient in managing their healthcare [1]. The NABH and Healthcare Organisations have suggested that discharge should be completed within 180 minutes (3 hours) [2].

This process begins when the treating team determines that the patient is ready for discharge. It continues through making care recommendations in the discharge plan and concludes with the completion of discharge formalities [3]. This process reflects the operational capacity of all healthcare facilities and the management of patient care. A well-structured discharge plan will reduce the flow within a hospital and utilise potentially limited resources more sustainably. More importantly, it impacts the safety of patient care [3]. Improving discharge processes can optimise operational capacity within the hospital. A coordinated and systematic approach to discharge will enhance patient outcomes and promote high-quality, sustainable healthcare systems. Although discharge is long recognised as essential, it remains an ongoing struggle within the global healthcare system [4].

Delays in discharge can occur for numerous reasons, such as administrative inefficiencies, lack of communication among healthcare providers, technical or logistical issues, and patient-related factors [5]. These delays can lead to substantial costs for payers and increase the length of hospital stays, disrupting both patient care and workflow [5]. Therefore, to reduce delays in discharge, it is necessary to investigate and understand the inefficiencies or barriers at both macro and micro levels [5].

In the context of hospitals in the Wardha district, individuals seeking healthcare come from various social, cultural, and economic backgrounds. There is a strong rationale for exploring and understanding the causes behind discharge delays. This research focuses on identifying and analysing the factors that contribute to delays in process mapping and the implementation of a standardised high-line strategy for the discharge process within a selected hospital. The research will also provide recommendations for formulating SOP that would standardise the discharge process and improve hospital functioning.

REVIEW OF LITERATURE

Timely discharge of patients is a critical component in optimising hospital resource utilisation, enhancing patient satisfaction, and ensuring seamless transitions to post-acute care [6]. Despite the well-recognised importance of efficient discharge planning, delays continue to persist across healthcare systems globally, leading to overcrowding, increased lengths of hospital stays, and compromised quality of care [7,8]. A growing body of literature has attempted to investigate and analyse the multifactorial causes behind discharge delays, propose interventions, and evaluate strategies to improve discharge turnaround time.

Mundodan JM et al., conducted a time and motion study in a teaching hospital, utilising high-flow process mapping to identify discharge delays. The study revealed that the average discharge time extended to five hours and 41 minutes, far exceeding the NABH-prescribed standard of 180 minutes. A major source of delay was

attributed to the completion of discharge summaries, compounded by administrative bottlenecks and inefficient coordination between departments. Only a limited number of patients were discharged within the stipulated timeframe, highlighting the operational inefficiencies prevalent in discharge workflows. This study emphasises the need for a systematic approach to identify and resolve key discharge-related inefficiencies using visual tools like process mapping [9].

Expanding on non-clinical determinants, Luis NL et al., conducted a scoping review focused on non-medical reasons for delayed discharges in acute care hospitals across Spain. The review found that social support deficiencies, such as the lack of home care services, housing instability, and patients' reliance on family members, were significant contributors to delayed discharge. Additionally, administrative bottlenecks, including delays in insurance approvals and medication procurement, along with communication gaps between patients, families, and healthcare professionals, exacerbated the problem. The review called for a broader, systemic strategy to address both logistical and social barriers to timely discharge [10].

Looking at infrastructural innovations, Franklin BJ et al., (2020) proposed the establishment of discharge lounges as a strategic intervention to reduce Emergency Department (ED) crowding. Their conceptual review emphasised how delays in inpatient discharges hinder patient admissions from EDs, thereby affecting overall hospital throughput. Discharge lounges allow patients who are clinically ready for discharge to vacate their inpatient beds while waiting for medication, transportation, or family members. This intervention, while simple, holds potential to improve bed turnover rates and streamline discharge operations. However, the authors emphasised the need for further empirical evaluation of the model's effectiveness on hospital-wide metrics [11].

Complementing this, Micallef A et al., (2022) undertook a scoping review exploring the concept and implications of delayed discharges in acute care settings. The review underscored the absence of a universal definition for "delayed discharge," citing the diverse healthcare scenarios and discharge practices globally. Three major themes emerged as contributors to discharge delays: organisational inefficiencies (such as bed management issues and a lack of defined protocols), inadequate discharge planning (including poor coordination with post-discharge care services), and patient-related factors (like age, limited functional ability, and inadequate social support systems). Their analysis demonstrated that discharge delays were not solely clinical in nature but were also deeply embedded in social, administrative, and systemic contexts [12].

From a quantitative and analytical standpoint, Nair A et al., (2024) explored the application of predictive modeling to estimate discharge TAT in a corporate hospital in Pune, India. The study identified critical process-related variables impacting TAT, including the submission time of discharge summaries, insurance clearance delays, and the overall Length of Stay (LOS). Their findings underscore the importance of optimising internal workflows and enhancing communication with Third-Party Administrators (TPAs). The study also revealed an indirect relationship between LOS and discharge efficiency, suggesting that systemic improvements upstream in the patient care pathway can influence discharge effectiveness [13].

Across these studies, a consistent theme emerges: discharge delays are multifactorial, involving clinical, administrative, social, and infrastructural variables. The literature supports the utility of process-oriented tools like high-flow process charts, predictive modeling, and process mapping in identifying and addressing inefficiencies. Furthermore, the importance of multidisciplinary collaboration, information flow, and infrastructure (such as discharge lounges) is emphasised as critical to effective discharge planning.

Despite the growing awareness, most studies adopt observational or descriptive designs, with limited use of Randomised Controlled Trials (RCTs) or longitudinal assessments. This gap highlights the need for robust interventional studies, such as the present research, which aims to compare a process mapping-based SOP strategy against a standardised high-line process in a real-world hospital setting. This research is positioned to contribute actionable insights for developing and implementing evidence-based SOPs to enhance discharge efficiency in Indian healthcare systems.

Study objectives:

- To evaluate the effectiveness of the process mapping strategy in identifying and eliminating delays in the discharge process across selected medical and surgical wards over three months.
- To evaluate the effectiveness of the standardised high-line process strategy in identifying and eliminating delays in the discharge process across selected medical and surgical wards over three months.
- To compare the effectiveness of the process mapping strategy and standardised high-line process in identifying and eliminating delays in the discharge process across selected medical and surgical wards over three months.

Null Hypothesis (H_0): There is no significant difference between the process mapping strategy and the standardised high-line process in reducing TAT in the discharge process.

Alternative Hypothesis (H_1): The process mapping strategy is more effective than the standardised high-line process in reducing TAT and identifying factors contributing to delays in the discharge process.

MATERIALS AND METHODS

An experimental study will be conducted at Acharya Vinobha Bhave Rural Hospital, Wardha district, Maharashtra, India, from June 2025 to October 2025. Written informed consent will be obtained from all participants, and ethical clearance will be obtained from the Institutional Ethics Committee of Datta Meghe Institute of Higher Education and Research with Ref. No. DMIHER(DU)/IEC/2024/384. The study is registered with the Clinical Trials Registry of India (CTRI/2025/02/080346).

Inclusion criteria: Doctors, nurses, and administrative staff directly involved in the discharge process and file clearance.

Exclusion criteria: Healthcare providers who will not be directly involved in the discharge process.

Sample size calculation: Power and Confidence: Estimate a proportion with ±5% precision (d=0.05) at 95% confidence from an annual discharge population of N=10,000.

Formula (finite-population correction form): $n=N / (1+N\ d^2)$

The study uses an annual discharge population (N=10,000) as the statistical population base for sample-size calculations and finite population correction. These statistics are taken from the Medical Records Department of Acharya Vinobha Bhave Hospital.

Calculation:

$d^2=0.05^2=0.0025$

$N\ d^2=10,000 \times 0.0025=25$

$1+N\ d^2=26$

$n=10,000 / 26 \approx 384.62$=round up to 385

The statistical requirement is 385 participants per group, totaling 770. The study will be conducted in multiple phases to ensure a systematic approach to evaluating the discharge process.

Study Procedure

Phase 1 staff members involved in the discharge process will undergo training, and hospital wards will be randomly allocated to two groups: control and experimental.

Phase 2 involves the introduction of a standardised high-line flow chart in the control group to track the discharge process, using a double-blinded technique to reduce bias. The standardised high-

line flow chart used in this study draws conceptual inspiration from the Six Sigma Define, Measure, Analyse, Improve, Control (DMAIC) methodology, which has been successfully applied to optimise discharge processes in hospital settings. The DMAIC framework provides a structured, data-driven approach to process improvement, focusing on identifying inefficiencies, implementing targeted solutions, and sustaining improvements over time [14].

In the Define phase, the high-line flow chart clearly outlines each step of the discharge process, from consultant confirmation to patient release, ensuring that roles and responsibilities are well-defined. This chart is broken down into five logical subprocesses:

1. Preparation of discharge notes by the attending physician or surgeon.
2. Processing of discharge notes by the ward secretary, appending the necessary laboratory reports.
3. Processing and typesetting of the discharge summary by the editor.
4. Completion of the final discharge summary by the editor after proofreading by the physician or surgeon.
5. Discharge summary ready to be handed over to the patient after being signed by the physician or surgeon [14].

The tool allows systematic tracking of each activity's time consumption, enabling the identification of delays in administrative areas. In the control phase, the standardised chart serves as a real-time monitoring and audit mechanism, ensuring compliance and preventing reversion to inefficient practices.

Phase 3 the process mapping tool will be implemented in the experimental group under the same double-blinded conditions. Eligible wards will be randomly assigned to either the experimental group (process mapping-based Standard Operating Procedure (SOP) strategy) or the control group (standardised high-line process) using sealed, opaque envelopes opened at the time of assignment. A double-blinding strategy will ensure that participants are unaware of their group, and they will be informed only that the hospital is evaluating discharge processes. Outcome assessors will remain blinded to group allocations, as will billing clerks. Wards will use coded identifiers, and the statistician will only receive coded datasets (e.g., "Group-A," "Group-B") to maintain blinding until after the primary analysis, minimising bias in the study results.

All staff involved in the study will be trained on using the high-line flow chart and process mapping tool to ensure standardised data collection, facilitating reliable and comparable evaluation of discharge processes.

The process mapping tool [Annexure 1] provides a detailed approach to identifying delays in the discharge process. This tool will provide specific times (in minutes) for each step in the discharge process and will be used to identify factors causing delays. The tool has been developed by a PhD scholar from community health nursing and underwent content validation by a panel of 40 subject matter experts, including consultants, nurses, and hospital administrators from multiple healthcare settings. Experts evaluated each parameter of the tool for relevance, clarity, and necessity in assessing the hospital discharge process. The Content Validity Index (CVI) was computed based on expert ratings, yielding an overall CVI value of 0.92, which indicates excellent content validity.

The internal consistency reliability of the tool was assessed using Cronbach's alpha. Data from the expert ratings were analysed, resulting in a Cronbach's alpha value of 0.90.

A pilot study was conducted prior to full-scale implementation to test the feasibility, clarity, and practicality of the tool in a real hospital setting. Feedback from the pilot test led to minor refinements in wording and structure, ensuring the tool's appropriateness for the study population. The tool will be self-administered and used by in-charge and billing clerks.

The process mapping tool evaluates each component of the discharge process against predefined criteria. Each step carries a maximum score of 2, with higher scores reflecting greater efficiency. The total maximum score is 32, representing optimal performance. Scores closer to 32 indicate timely discharge, while lower scores highlight inefficiencies. Qualitative reasons for delays are categorised as administrative, technical, patient-related, resource-related, communication-related, or other.

Overall discharge efficiency will be categorised based on the total score obtained from the process mapping tool. Scores are grouped into four efficiency levels: excellent, good, moderate, and poor. Higher scores indicate efficient and timely discharge, whereas lower scores signal significant delays and the need for urgent corrective action [Table/Fig-1].

Total Score	Efficiency level	Interpretation
28-32	Excellent	The discharge process is efficient and timely
23-27	Good	Minor delays observed; some room for improvement
19-22	Moderate	Multiple areas of inefficiency; needs review
<18	Poor	Significant delays in discharge process; urgent SOP revision require

[Table/Fig-1]: Interpretation of process mapping tool scores.

Phase 4 will focus on analysing and comparing the effectiveness of both tools in identifying discharge delays and overall TAT, along with documenting the contributing factors causing these delays. After a gap of three months, the same interventions from Phases 2 and 3 will be repeated in Phase 5 to collect time series data for further analysis. In Phase 6, data from both time points, month 1 and month 4, will be compared to evaluate the consistency and impact of the two approaches.

Building on these findings, Phase 7 will involve developing recommendations for new or improved SOPs. This will include integrating insights from all earlier phases, consulting with healthcare experts, and formulating draft SOPs based on real-world data and stakeholder feedback. Finally, Phase 8 will conclude with the presentation of evidence-based recommendations aimed at improving the discharge processes within Acharya Vinobha Bhave Rural Hospital.

Outcomes

Turnaround Time (TAT): The TAT in the present study is defined as the total time taken from the consultant's confirmation of discharge to the actual release of the patient from the hospital. TAT will be calculated in minutes by aggregating the duration of each process step recorded in the process mapping tool (e.g., discharge summary preparation, pharmacy clearance, billing, insurance approval, and patient release). The mean and median TAT will be compared between the control group (standardised high-line flow chart) and the experimental group (process mapping tool) to evaluate relative efficiency.

Standard Operating Procedures (SOPs): Based on the comparative analysis of the two approaches, evidence-based SOPs will be developed. These SOPs will integrate findings from both quantitative scoring and qualitative delay analysis to streamline the discharge process, minimising delays and aligning hospital practices with NABH benchmarks (180-minute discharge standard).

STATISTICAL ANALYSIS

Data will be analysed using IBM Statistical Package for the Social Sciences (SPSS) Statistics version 26.0. Descriptive statistics such as the mean, standard deviation, and frequency will summarise demographic details and TATs. The independent t-test will compare TATs between the control and experimental groups. Paired t-tests

will assess within-group changes over time. Chi-square tests will analyse associations between delay factors and groups. Tool validation using the Delphi technique involved calculating the CVI. A p-value <0.05 will be considered statistically significant.

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[ANNEXURE 1]: PROCESS MAPPING TOOL FOR COPYRIGHT.

- IPD NO:
- Ward:
- Length of Stay:

Sr No	Particulars	Standard Timeframe
1	Tentative discharge date	Given/Not Given
2	Pre-filling of discharge card	Yes/No
3	Consultant confirmation	Time:
4	Final discharge card printing	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
5	Pharmacy refund and replacement	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
6	Pharmacy medications arrival	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
7	File closure by nurses	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
8	File sent for billing	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
9	File received at billing counter	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
10	Final bill preparation	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
11	Scheme clearance	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
12	Clearance of cash paying bill	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
13	TPA intimation	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
14	TPA approval	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
15	Final settlement	Within 15 min/30 min/1 hr/2 hr/3 hr/>3 hr
16	Patient release	Time
17	Reasons for any delay	Slow IT network/Software update Technical issues like electricity cut Delay in discharge advice Planned discharged postponed Arrangement of Transport Lack of Communication Non availability of relatives To much paperwork/ Complex procedures Inadequate Resources Absent of services due to lack of staffs /holidays Administrative delays Delayed reports/assessment Arrangement of finances Any Other_____