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Comparative Effectiveness of Process Mapping and Standardized High Line Flow in Reducing Hospital Discharge Turnaround Time A Randomized Controlled Pilot Study

DEENA VAREEKAL PRINCE

dreamsofdeena@gmail.com

ADANI INSTITUTE OF HIGHER EDUCATION AND RESEARCH

DR DEEPLATA M MENDHE

ADANI INSTITUTE OF HIGHER EDUCATION AND RESEARCH

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Abstract

Background

Prolonged hospital stays increase healthcare costs, reduce bed availability, and negatively affect patient satisfaction. Reducing discharge delays can improve operational efficiency and patient experience. The aim of the study is to To compare the effectiveness of two structured discharge optimization strategies in reducing Discharge Turnaround Time (TAT) and improving discharge workflow efficiency..

Materials and Methods

A randomized controlled comparative pilot study was conducted in two phases, four months apart, in the medical and surgical wards of Acharya VinobaBhave Rural Hospital, Wardha, India. Patients planned for discharge were randomly assigned to either the Process Mapping intervention or the Standardized High-Line Flow Chart control group. The primary outcome was discharge TAT, measured from the final discharge order to patient exit and. Factors causing delay in discharge process was analysed using descriptive and analytical statistics.

Results

The mean (SD) Discharge (TAT) was **313.47 (56.80) minutes** in the Process Mapping group and **375.69 (62.10) minutes** in the Standardized High-Line Flow Process group A statistically significant reduction in TAT was observed in the Process Mapping group (mean difference: − 62.22 minutes; t = − 3.15, P = 0.003). In the High-Line Flow Chart group, major delays were related to physician unavailability (30%) and medication preparation (27%). In contrast, Process Mapping reduced physician-related delays but identified pharmacy (25%) and billing (22%) as residual bottlenecks.

Conclusions

Process Mapping effectively reduced discharge TAT compared to the High-Line Flow Chart approach. Further large-scale studies are needed.

Introduction

Hospital discharge represents a critical transition in the continuum of patient care. Delays during this phase can unnecessarily prolong hospitalization, increase the risk of hospital-acquired infections, falls, and medication errors, and reduce bed availability, thereby adversely affecting patient safety and operational efficiency. In resource-constrained Indian hospitals, timely discharge is particularly essential to optimize patient flow, ensure judicious use of limited resources, and maintain quality of care.[1]

Conventional discharge processes are predominantly checklist-driven and often emphasize regulatory compliance rather than addressing underlying workflow inefficiencies. Such approaches frequently result in fragmented communication, unclear role delineation, and administrative delays, imposing additional

burdens on healthcare staff and patients alike. Consequently, improving discharge efficiency has emerged as a key priority for enhancing patient experience and overall hospital performance in contemporary healthcare systems.[2]

Process Mapping is a structured, multidisciplinary quality-improvement approach that enables identification of real-time bottlenecks in care transitions and facilitates redesign of workflows to enhance efficiency and patient-centered outcomes. A comparative evaluation of Process Mapping against the traditional High-Line Flow Process can generate actionable evidence to strengthen nursing practice, improve discharge planning, and support quality improvement initiatives within the Indian healthcare setting.

Despite the widespread use of standardized discharge flow processes in Indian hospitals, these pathways often fail to capture real-time workflow variations, staff-level constraints, and cross-departmental dependencies that contribute to delays. Process Mapping, although recognized as a robust quality-improvement strategy, remains underutilized within Indian healthcare settings. There is limited empirical evidence comparing these two approaches, particularly within resource-constrained hospitals where discharge delays critically impact patient flow. Accordingly, the aim of this study is to compare Process Mapping and the Standardized High-Line Flow Process in improving discharge workflow efficiency and reducing discharge turnaround time.This study employed a prospective, randomized, comparative pilot design conducted in 2025 at Acharya VinobaBhave Rural Hospital (AVBRH), a 1,500-bed tertiary-care teaching hospital in central India with a high medical–surgical patient turnover and complex multidisciplinary discharge workflows. The study population consisted of adult inpatients from selected medical and surgical wards who were clinically stable, had completed treatment, and had no pending investigations at the time of discharge. To maintain workflow homogeneity, patients from pediatric, psychiatric, intensive care, and maternity units were excluded. Process Mapping and the Standardized High-Line Flow Process were compared as two distinct workflow interventions for optimizing *hospital discharge* processes and reducing discharge-related *time factors*.

Materials and Methods

A prospective randomized control pilot study was conducted during the time period January 2025-June 2025. The sample size for this pilot study was calculated using power analysis based on the expected mean difference in discharge turnaround time derived from preliminary hospital data.

The sample size for the prospective randomized controlled pilot study was calculated using power analysis for comparison of two independent means. The calculation was based on a significance level of 5% with **Zα/2 = 1.96**, statistical power of **80% with Zβ = 0.84**, an estimated standard deviation derived from preliminary hospital discharge turnaround time data, and an expected mean difference representing approximately **20–25% reduction in discharge turnaround time** between the two groups. Based on these assumptions, the required sample size was estimated as **30 patients per group**., and therefore 60 participants were enrolled. Patients were randomly allocated to either the Process Mapping group or the

Standardized High-Line Flow Process group using a computer-generated simple randomization sequence. Data were collected prospectively using structured timing sheets, workflow observation checklists, and discharge documentation audits by trained nursing and quality staff.

Participants were randomly allocated to one of two study groups using simple randomization. The intervention group received the Process Mapping strategy, which was implemented by trained multidisciplinary teams following a structured discharge workflow redesign. The control group followed the existing Standardized High-Line Flow Chart process without any modifications. To ensure uniformity in the application of the Standardized High-Line protocol, a 30-minute refresher training session was conducted for all ward nurses and medical officers prior to the start of the study. This orientation reinforced adherence to the existing discharge workflow and ensured consistency across the control group without introducing any new elements.Data Collection and Validity: Data were collected prospectively over one month. The primary outcome was discharge turnaround time (TAT), measured from the final discharge order to patient exit using electronic timestamps cross-validated with nursing records. Reliability was ensured by independent verification of 10% of entries. Delay factors were documented in real time using a standardized, pretested checklist, and staff training minimized observer bias. Although the data collection period was restricted to one month due to operational feasibility, this may limit the generalizability of findings across seasonal fluctuations in admission rates. This limitation has been acknowledged in the Discussion section

Descriptive statistics (mean, SD, and frequency distribution) were used to summarize the data. The independent-samples t-test compared mean TAT between groups, with significance set at $p < 0.05$. Pareto analysis identified major contributors to discharge delays, supporting focused workflow improvement. Pareto analysis was selected as it enables prioritization of the most significant delay factors by identifying the ‘vital few’ contributors that account for the majority of discharge inefficiencies. This supports targeted quality-improvement interventions.

Patients were considered discharge-ready based on standardized objective criteria applied uniformly across both groups to ensure reproducibility. These criteria included clinical stability for at least 12 hours, completion of all essential investigations required for medical decision-making, absence of new or worsening symptoms, completion of medication reconciliation, and approval through a readiness-to-discharge checklist validated by the treating consultant. The justification for the expected effect size was drawn from previous Indian and international evidence indicating average reductions of 45–90 minutes in discharge-related time factors following workflow-optimization interventions. Additionally, preliminary internal audit data from Acharya VinobaBhave Rural Hospital (2024) demonstrated avoidable delays of 50–70 minutes linked to documentation lapses and interdepartmental coordination issues, supporting the assumed effect size of approximately 60 minutes for sample size estimation.

Ethical considerations

The study protocol was approved by the Institutional Ethics Committee of Datta Meghe Institute of Higher Education and Research (DMIHER), Wardha, Maharashtra, India (Approved Project Number:

DMIHER(DU/IEC/2024/384); DCGI Registration Number: ECR/440/Inst/MH/2013/RR-2019; DHR Registration Number: EC/NEW/INST/2023/MH/0340). The research was conducted in accordance with the ethical guidelines and regulations prescribed by the Institutional Ethics Committee and applicable institutional requirements for research involving human participants. Written informed consent was obtained from all participants before inclusion in the study, and participant confidentiality was maintained throughout.

Results

A total of **60 patients were analyzed**, with 30 participants in each group. The **mean discharge turnaround time (TAT)** was lower in the **Process Mapping group** compared to the **High-Line Flow Process group** (**Table 1**). An independent-samples *t*-test revealed a **statistically significant difference** in mean TAT between the two groups (t58 = –3.15, p = 0.003)indicating a **mean reduction of 62.22 minutes** in the Process Mapping group (**Table 2**).

Delay-causing factors varied between the groups (**Figure 1**). In the **High-Line Flow Process** group, delays were most frequently attributed to **physician unavailability** (*n* = 9; 30%) and **medication preparation** (*n* = 8; 27%). In contrast, in the **Process Mapping** group, the most common delays were related to **pharmacy processing**(n = 7; 25.00%) and billing clearance (n = 6; 22.00%)**Pareto analysis** was applied to identify delay categories contributing the most to overall discharge TAT, helping to prioritize targeted workflow improvements.

Discussion

This pilot randomized study demonstrated that the Process Mapping strategy significantly reduced discharge turnaround time (TAT) compared with the standardized High-Line Flow Process, with a mean reduction of more than one hour per patient. The distinct patterns of delay observed between the two groups suggest that discharge inefficiencies are primarily driven by system-level interactions rather than isolated procedural shortcomings.[3]

These findings highlight the critical role of multidisciplinary collaboration and workflow transparency in improving discharge efficiency. By redistributing responsibilities and strengthening interprofessional coordination, Process Mapping effectively mitigated physician-dependent delays commonly encountered in conventional discharge pathways. This observation is consistent with existing evidence from Lean process improvement initiatives, pharmacist-led discharge interventions, and medication access optimization strategies, all of which demonstrate that structured quality-improvement approaches can enhance patient flow and discharge readiness.[4]

The study also carries important implications for nursing practice. Nurses are central to coordinating patient flow, ensuring timely documentation, and facilitating communication across care teams. Empowering nurses to lead workflow redesign initiatives can therefore promote sustainable improvements in discharge efficiency while advancing patient-centered outcomes.[5] From a nursing

research perspective, these findings underscore the value of evaluating process-oriented interventions that directly influence both operational performance and quality of care.[6]

Several contextual factors may have influenced the study outcomes, including strong interdepartmental collaboration and a pre-existing multidisciplinary culture within the study setting, which may not be uniformly present across other healthcare institutions. Potential confounding factors—such as variability in staff experience, individual clinician discharge practices, and differences in patient clinical complexity—may also have contributed to differences in TAT, although randomization helped minimize systematic imbalance between the groups.

Additionally, the pilot nature of the study characterized by a limited sample size, short study duration, and single-center design limits the generalizability of the findings. The analysis focused solely on discharge turnaround time, without assessing additional outcomes such as patient satisfaction, readmission rates, or staff workload. Furthermore, partial reliance on manual data collection may have introduced observer bias.

Future research should involve larger, multicenter trials with longer follow-up periods and incorporate automated data capture systems for discharge timestamps and delay tracking. Expanding outcome measures to include patient safety indicators, satisfaction, staff experience, and long-term system performance would provide a more comprehensive

This evaluation highlights the impact of Process Mapping on improving hospital discharge workflows. To minimize redundancy, the Conclusion will summarize only the key implications of these findings without repeating detailed interpretations already discussed.This pilot study had several limitations. First, it was conducted in a single tertiary-care hospital—Acharya VinobaBhave Rural Hospital—which may limit generalizability to other healthcare settings with different discharge systems. Second, the sample size was relatively small, as it was designed primarily for feasibility and preliminary effect estimation, and therefore may not fully capture variability in discharge patterns. Third, workflow observations were performed during daytime hours, which may not reflect discharge dynamics during evenings, nights, or weekends. Fourth, although randomization was performed, complete blinding of staff was not possible due to the nature of the interventions, introducing potential performance bias. Finally, external factors such as staffing fluctuations, physician availability, and concurrent hospital initiatives may have influenced discharge turnaround times beyond the scope of the study interventions.

Conclusion

This pilot study demonstrates that Process Mapping is more effective than the standardized High-Line Flow Process in improving discharge efficiency, as evidenced by a reduction in discharge turnaround time and clearer identification of workflow bottlenecks through a multidisciplinary approach. These findings underscore the importance of system-focused quality-improvement strategies in facilitating smoother patient transitions and enhancing overall hospital operational performance.

Nevertheless, the results should be interpreted with caution due to the study's single-center design, short duration, and limited sample size. Future research involving larger, more diverse populations and incorporating a broader range of outcomes including patient satisfaction, readmission rates, and staff workload is warranted to strengthen generalizability and assess long-term impact. Continued emphasis on nursing leadership and active engagement in workflow redesign remains crucial for achieving sustainable, patient-centered discharge processes.

Declarations

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Nil

Conflict of Interest:

Nothing to declare

Author Contribution

Deena Vareekal Prince . conceptualized the study, developed the research methodology, conducted the investigation and data collection, implemented the intervention, analyzed and interpreted the findings, prepared the tables and figures, and drafted the original manuscript. Dr Deeplata Mahesh Mendhe . supervised the study, contributed to the study design and methodology, provided scientific and academic guidance, and critically reviewed and revised the manuscript. Both authors reviewed and approved the final version of the manuscript and agree to be accountable for their respective contributions to the work.

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Data Availability

The datasets generated and/or analysed during the current study are not publicly available due to patient confidentiality and ethical considerations but may be available from the corresponding author on reasonable request, subject to applicable ethical and institutional approvals.

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Tables

Table 1. Comparison of Mean Discharge Turnaround Time (TAT) Between Groups

Strategy Group	Mean TAT (minutes)	Mean TAT (hours)
Process Mapping	313.47	5.22
Standardized High-Line Process	375.69	6.26

***TAT: Turnaround Time**

Table 2. Independent Samples t-Test Results for Mean TAT Difference

Comparison	t-Statistic	df	p-Value (2-tailed)	Mean Difference (minutes)
Process Mapping vs. Standardized High-Line Process	–3.15	58	0.003	–62.22

* TAT = Turnaround Time**df: Degrees of Freedom; ***p < 0.01 indicates statistically significant difference

Figures

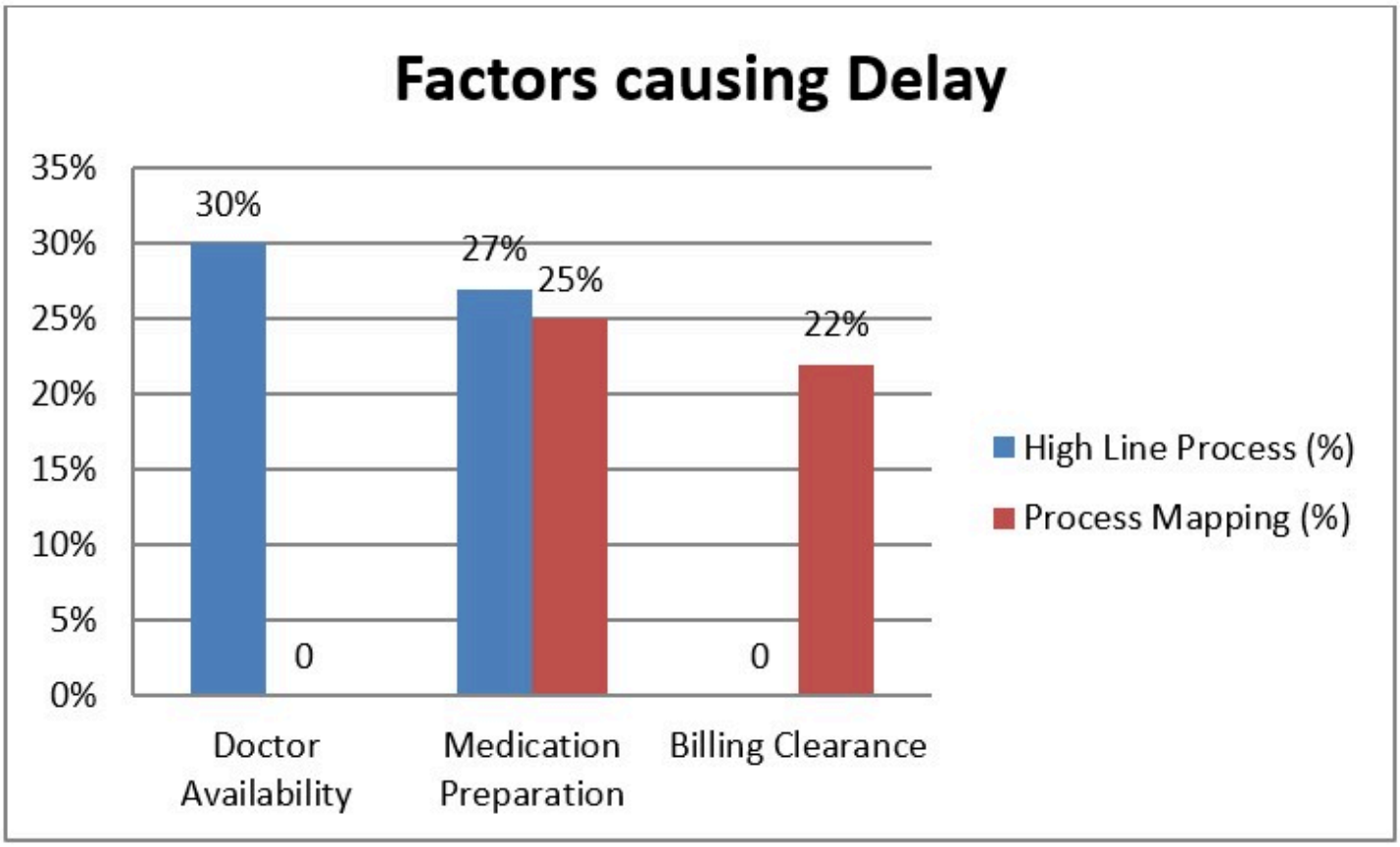


Figure 1

Delay-Causing Factors by Frequency Distribution

***TAT: Turnaround Time; Pareto analysis used to identify highest-impact bottlenecks**