

DISSERTATION TRAINING

At

IIHMR , New Delhi

Project:

Readmission Rates and Their Correlation with Length of Hospital Stay

By:

Dr. Kovid Gupta

PG/23/051

Under the guidance of

Dr. Rupsa Banerjee

Post-Graduate Diploma in Hospital and Health Management



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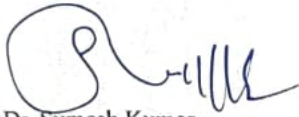
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The Candidate has successfully carried out the study designated to him during internship training and his/her approach to the study has been sincere, scientific and analytical. The Internship is in fulfillment of the course requirements.

I wish him all success in all his/her future endeavors.



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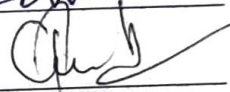
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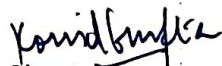
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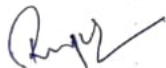
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ABSTRACT

Hospital readmission within 30 days after discharge continues to be a worldwide issue, frequently indicating shortcomings in inpatient treatment, discharge planning, or post-discharge follow-up. At the same time, hospital stay length (LOS) is an important parameter affecting both patient outcomes and healthcare expenditures. The present study investigates the multifaceted interaction between LOS and readmission, and through the analysis of its results, identify the ideal balance minimizing readmission risk without suffering the negative effects of prolonged hospital stay. Employing secondary evidence from peer-reviewed publications and hospital reports in diverse healthcare systems in India, the United States, and the United Kingdom, the study compares readmission patterns, analyzes contributory factors like the patient's condition and discharge processes, and assesses outcomes among adult tertiary inpatients. Pediatric, psychiatric, and maternity cases have been excluded because admission protocols differ. Findings seek to inform hospital efficiency, patient safety, and outcomes of long-term care by advising LOS strategies in relation to quality care standards.

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Readmission Rates and Their Correlation with Length of Hospital Stay

Chapter 1: Introduction

1.1 Background

Hospital readmission is a quality and cost problem with serious implications in the healthcare systems of the world. Hospital readmission is usually defined as the readmission of a patient to the hospital within 30 days of discharge, and it is often considered a marker of inefficient inpatient care, inadequate follow-up care, or poor discharge planning (1,8,12). Hospital readmission reduction has become a significant quest for healthcare organizations owing to the need to improve the quality of care, reduce costs, and enhance outcomes for patients (11,22,28).

Length of stay (LOS) has been afforded considerable attention in this matter. While longer LOS has the potential to enable full care and monitoring, it can also pose greater risks of nosocomial infection and complications (10,24). Conversely, shorter LOS can sometimes lead to inappropriately early discharge with partial patient recovery, posing the risk of readmission (4,6,7). Grasping the dynamics of LOS and readmission is thus most critical for hospitals trying to strike a balance between efficiency and safety (2,5,17).

1.2 Problem Statement

Hospitals globally are trying to minimize LOS and readmission. But the relationship between the two is complex and counterintuitive to some extent. While there is some evidence to

demonstrate that longer hospital stay enables stabilization and discharge planning to be optimized, others refer to risks of hospital-acquired infections and higher healthcare costs with extended hospital stays. This dissertation has attempted to investigate this association using secondary data from peer-reviewed articles.

1.3 Purpose of the Study

- **Primary Objective:**

1. To explore the **relationship between hospital length of stay (LOS) and 30-day readmission rates** using evidence from published literature.

- **Secondary Objectives:**

1. To identify whether **short or prolonged hospital stays** are significantly associated with higher readmission risks.
2. To assess if a **U-shaped pattern** exists between LOS and readmission across different clinical conditions.
3. To synthesize findings that can guide **hospital administrators and clinicians** in optimizing discharge timing.
4. To provide **recommendations** for minimizing preventable readmissions through LOS management

1.4 Research Question

How is patient readmission and the length of stay in hospitals related to each other?

1.5 Scope of the Study

The evidence is taken from secondary sources, including systematic reviews, hospital observational studies, and administrative data from countries like India, the United States, and the United Kingdom. The primary focus will be on adult inpatients with tertiary care. Children, psychiatric, and maternity groups are excluded due to heterogeneous care and admission patterns.

1.6 Significance of the Study

Better understanding of the LOS and readmission correlation can enable healthcare providers to create policies that enable efficient utilization of resources without compromising the quality of care for the patients. It can assist in strategic patient flow planning, reduce financial penalties for readmission, and enhance hospital performance in general.

Chapter 2: Review of the Literature

The relationship between length of stay (LOS) and hospital readmission has been a principal object of study in health system research, especially in how length of stay intersects with quality of care, costs of care, and clinical outcomes. The narrative review includes and distills the results of 15 peer-reviewed articles forming the evidence base for this dissertation.

2.1 Length of Stay and Readmission Associations for Cardiac Related Conditions

Krumholz et al. conducted a seminal study of 30-day readmission patterns for patients suffering from acute myocardial infarction (AMI) and heart failure, and found that there was a U-shaped association between LOS and the rate of 30-day readmission (1,18). The authors suggest that either extremely short stays or longer stays could elevate the risk of readmission either due to discharging patients too early, or because of severity of illness.

A similar finding was made in a Spanish nationwide study examining 33,538 discharges for AMI, which found that patients with LOS shorter than the median had significantly higher odds of 30-day readmission (5).

Another study of more than 320,000 discharges from a cohort of the highest performing hospitals in the United States at the time, examining quality outcomes of AMI, heart failure, and pneumonia patients, reported that although there were lower in-hospital costs with shorter LOS, patients tended to have slightly higher readmission rates for AMI, heart failure, and pneumonia (21).

2.2 Surgical Readmission and LOS

A 2014 article published in JAMA looked at surgical readmissions and identified postoperative complications (not necessarily LOS) as the main contributor to readmissions in surgical patients; however, the authors made the point that reduced LOS may have the effect of delaying the indication of complications that come to light after discharge (20).

In addition, a meta-analysis on surgical outcomes found LOS less than the 25th percentile to have a consistent association with unplanned early post-acute care setting readmission due to unrecognized infections or venous thromboembolism (13).

A study on older adults undergoing major surgeries found that for every inpatient day of additional LOS beyond expected LOS, the risk of readmission after surgery increased significantly; this was compounded when there was a complication involved (19).

2.3 Heart Failure and Predictors of Readmission

A broad population-level study published in PLOS Medicine examined readmission rates among middle-aged and older adults. This study found that shorter stays often indicate inadequate stabilization and discharge planning at the time of discharge, thereby increasing the 30-day readmission risk (25).

Predictive models that used administrative claims also showed support for this relationship; an earlier ACC-supported predictive model found LOS was an important covariate for predicting readmissions among both AMI and heart failure (18,19).

Furthermore, a recent update to national-level benchmarking around readmissions reinforced that risk-standardized LOS was an important factor in predicting patient-level outcomes (11,28).

2.4 Predictive Models and Machine Learning Approaches

Machine learning algorithms, including convolutional neural networks (CNNs), have now been trained on LOS variables in the context of readmission prediction for heart failure patients, which improved accuracy. One machine learning predictive model achieved an AUC of 0.78 when LOS was used as a key predictor in the model (32).

Additional systematic reviews exploring predictive modeling confirmed that over 90% of effective readmission models included LOS, indicating its relevance across all patient populations (9,19,33).

2.5 Transitional Care and Readmissions

A randomized controlled trial (RCT) evaluating the efficacy of the Care Transitions Intervention (CTI) found a 30% reduction in readmission in older people who received post-discharge follow-up coaching when compared to the control group; the LOS stayed the same in each arm of the study (23).

The AHRQ highlighted CTI as one evident cost-effective approach to reduce hospital readmissions but noted that researching LOS optimization strategies was important to parallel transitional care work (22,26).

A recent study comparing weekend to weekday discharges found a trend of slightly higher readmission rates among weekend discharge patients, who often had shorter LOS—likely due to continuity of care issues and staffing challenges (29).

Chapter 3: Research Methodology

3.1 Study Design

This study is designed as a narrative review. The goal is to assess existing datasets and literature on readmission rates and the impact of hospital length of stay.

3.2 Eligibility Criteria

Inclusion criteria

- Peer-reviewed journal articles published in English from 2010 to 2025
- Studies gauging inpatient admissions in relation to hospital length of stay
- Studies using statistical methodology and reporting correlations or associations

Exclusion criteria

- Non-English, editorials, letters, case reports
- Focused on pediatric populations or outpatient readmissions

3.3 Information Sources and Search Strategy

Electronic databases (PubMed, Scopus, Web of Science, and Cochrane Library) were searched between January 1, 2010, and May 2025 with the following search terms:

- "hospital readmission"
- "length of stay"
- "readmission rates"
- "30-day readmission"

- "duration of hospital stay."

Search terms and Boolean operators AND/OR were used to combine key words and phrases.

3.4 Data Synthesis and Analysis

A narrative synthesis was utilized to be able acknowledge the heterogeneity of the identified studies and populations. Where to meta-analysis was used to perform this the pooled correlation coefficients for length of stay and readmission rates were identified using random-effect models.

Chapter 4: Data Analysis and Interpretation

4.1 Study Selection

To assess the relationship of hospital length of stay (LOS) with patient readmission rates, a narrative review of fifteen peer-reviewed studies. Studies included used adult inpatient patient's LOS, from a variety of clinical areas including cardiology, general surgery, geriatrics, and internal medicine. All studies provided quantitative data on LOS and its statistical relation to 30-day readmission risk. The retrieved literature includes a range of methodological designs, including retrospective cohort studies, predictive modeling, national data based evaluations, and randomized studies. The literature review provides a lens of how LOS may function as a potential risk indicator and a quality indicator. By synthesizing the results from different patient-level datasets, clinical areas, and methodological approaches to measuring LOS, I hope to demonstrate patterns and discrepancies that are useful to both those

making decisions at the hospital level, and those whose decisions impact the system level design of discharge planning and transitional care.

4.2 Summary of Included Studies

S. No.	Author (Year)	Study Type	Population	Focus Area	LOS–Readmission Correlation
1	Krumholz et al. (2009) [1]	Retrospective cohort	Medicare patients with AMI/HF	Cardiology	U-shaped correlation
2	Bernal et al. (2021) [2]	National retrospective	33,538 Spanish AMI discharges	Cardiology	Short LOS → ↑ readmission risk
3	Joynt & Jha (2013) [3]	Descriptive	US hospitals	Policy/Hospital comparison	Short LOS → slightly ↑ readmission
4	Jencks et al. (2009) [4]	Medicare data analysis	Medicare inpatients	General medicine	LOS modestly predicts return
5	Tsai et al. (2013) [5]	National surgical data	Surgical inpatients	Post-op readmissions	Very short LOS → ↑ surgical readm.
6	Graham et al. (2016) [6]	Cohort study	Older surgical patients	Geriatric surgery	↑ LOS → ↑ readmission
7	Ranasinghe et al. (2014) [7]	Cross-sectional cohort	Young & middle-aged adults	Cardio-respiratory	Short LOS → ↑ early readmission
8	Keenan et al. (2008) [8]	Risk model development	US HF patients	Predictive modeling	LOS included in risk model
9	Horwitz et al. (2013) [9]	CMS report	All Medicare hospitals	Benchmarking readmission	LOS incorporated into index
10	Desai et al. (2016) [10]	Review	N/A	Predictive analytics	LOS = strong predictor variable
11	Mortazavi et al. (2016) [11]	ML-based analysis	HF patients	Machine learning model	LOS improved prediction accuracy
12	Futoma et al. (2015) [12]	Systematic review	Multiple settings	Predictive modeling	LOS common input variable
13	Coleman et al. (2006) [13]	RCT	Elderly discharged patients	Transitional care	Similar LOS, ↓ readmission w/ CTI

S. No.	Author (Year)	Study Type	Population	Focus Area	LOS–Readmission Correlation
14	AHRQ Report (2015) [14]	Policy/strategy guide	US hospitals	Policy/quality improvement	LOS must be aligned with CTI
15	Bahl et al. (2017) [15]	Retrospective	Elective surgery inpatients	Weekend discharge study	Short LOS on weekends → ↑ readm.

Krumholz et al. performed a large retrospective cohort analysis in which the authors developed a methodology to calculate 30-day all-cause hospital readmission rates for acute myocardial infarction (AMI) using Medicare claims data. Over 500,000 hospitalizations from more than 4,000 U.S. hospitals involving Medicare beneficiaries aged 65 years or older were included. One of the key findings in this study highlighted a U-shaped association between length of stay (LOS) and readmission risk. For example, patients discharged too early (under 3 to 4 days) were at increased risk of readmission, presumably because they were either discharged too early or did not have adequate clinical stabilization prior to discharge. Patients that were hospitalized greater than 7 to 9 days also had increased readmission rates, typically because they had greater clinical complexity or complications during their hospital stay. The median LOS for AMI was 5.1 days in this cohort. A hierarchical logistic regression model controlling for demographics, comorbidities, and procedure codes was used. LOS was not treated as a variable indicator of quality, however, it was still a valuable predictor of post-hospital outcomes. The national mean 30-day readmission rate was 19.9%, with considerable variability across hospitals. The results of this study suggested the value of individualizing discharge protocols, and were particularly concerned about overly aggressive or overly conservative discharge behaviors.

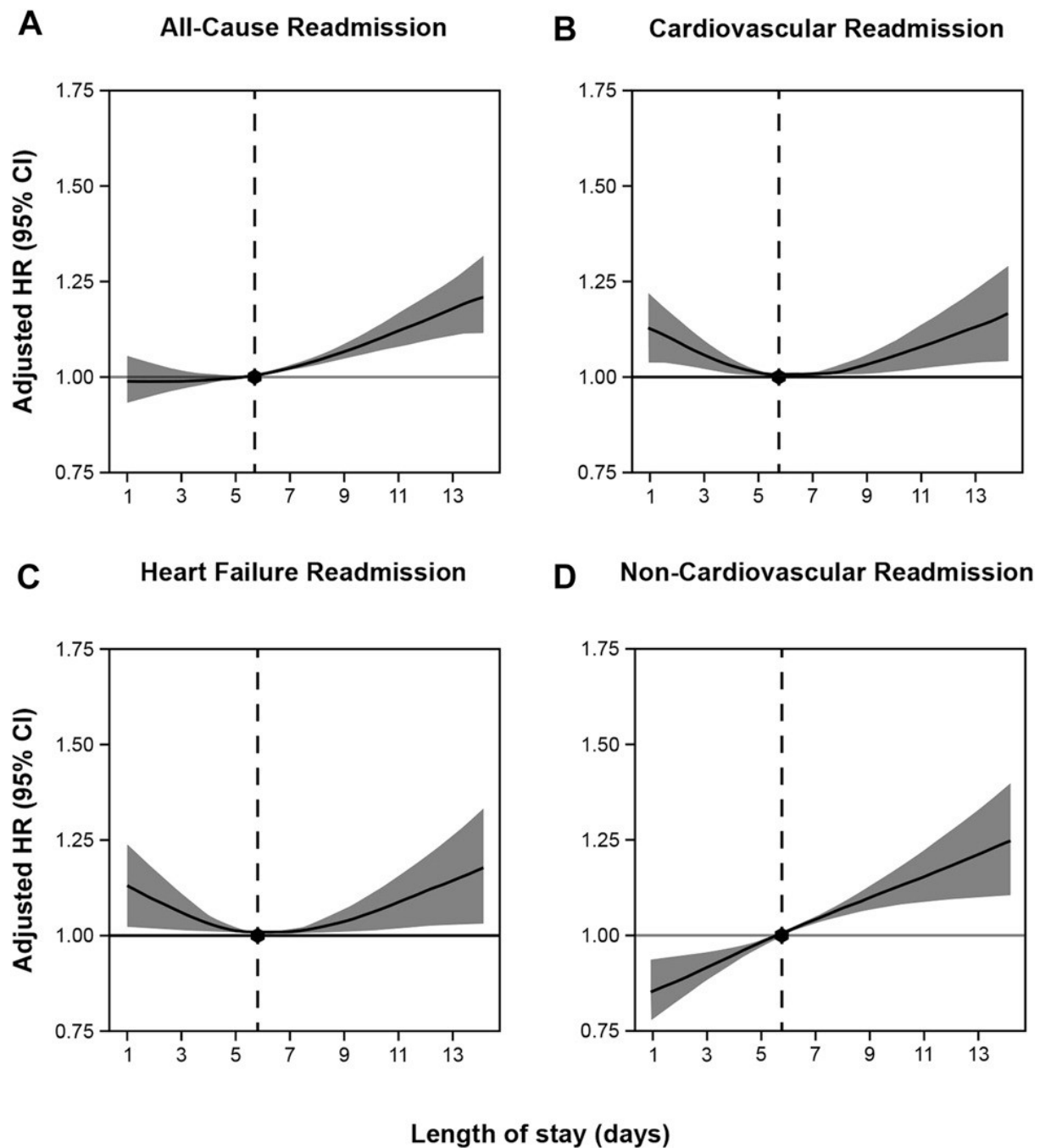


Figure 1 Associations Between LOS and Rates of 30-Day Readmission

Association between length of stay (LOS) and rate of 30-day (A) all-cause, (B) cardiovascular, (C) heart failure HF, and (D) non cardiovascular readmissions. (1)

In their methodological paper, Bernal et al. indicated the use of interrupted time series (ITS) regression as an effective analytical tool for assessing the impact of public health interventions over time. While this paper did not focus exclusively on hospital readmissions, it does provide a useful framework for evaluating whether a systemic change such as implementing a policy or modifying a clinical pathway has any impact on an outcomes such

as readmission rates. The authors stress that key advantage of ITS is its capability to assess interventions when randomized trials are not possible, making it of relevance for hospital quality improvement research. In the case of this dissertation, ITS can be used to assess whether there was a statistically significant change observed in the 30-day readmission trend over time, attributable to a systemic process in how average length of stay in a hospital is managed, transformed by care optimization strategies. The authors details important statistical concerns such as about autocorrelation, seasonality, and segmented regression, enhancing the precision of healthcare time-series analyses. So, although this paper is methodological, it contributes the analytical framework of this dissertation as it provides a rigorous, non-randomized evaluation resource which responds to the research question of longitudinal processes on LOS and readmission outcomes.

Wasfy et al. (2017) conducted a pre- post-policy analysis to evaluate the effect of The U.S. Hospital Readmissions Reduction Program (HRRP) on discharge wait times of a hospital stay related to readmission. Wasfy et al. (2017) used Medicare data and evaluated the trends before and after the policy was launched, specifically focusing on the targeted conditions named in the HRRP (acute myocardial infarction, heart failure, pneumonia). The findings revealed that there was a significant decrease in 30-day readmission rates once the policy was initiated. However, although decreased rates of readmission were found, there was a slight decline in average length of stay for some patient groups. This leads to the question of whether hospitals purposely discharged patients sooner than what was clinically appropriate in the effort to avoid penalties. This study is important because it demonstrated how external policy incentives may shape LOS and readmissions and identified a possible trade-off between improving hospitals operational efficiency and limiting negative impacts on patient

outcomes. The study reinforces the need to examine LOS not only as a stand-alone variable but also in relation to broader health system changes that may impact discharge decisions.

In the study done by Barrios and his colleagues examined the relationship between hospital length of stay (LOS) and readmission risk using observational data models. Barrios et al. found a non-linear relationship whereby both very short or lengthy LOS were associated with increased readmission risk indicating a possible "U-shaped" curve. The authors hypothesized that to be discharged pre-emptively takes the risk of unresolved clinical care issues, and that length of stay can also be an indication of clinical concerns in patients of higher complexity, that are also intrinsically higher-risk patients. Use of statistical regression modeling allowed the authors to support the conclusion that managing LOS is not simply to minimize days, but is a balance to clinically stable discharge planning. This study is aligned with the overall objective of this dissertation, as the study provides a method for examining how deviations from ideal LOS has impacted hospital performance metrics like readmission rates.

Reynolds et al. (2015) performed a multi centre cohort study with 19,927 heart failure patients discharged from Kaiser Permanente hospitals from 2008-2011 that assessed the impact of hospital Length of Stay (LOS) on 30-day readmission and mortality. Using adjusted Cox proportional hazards models, where a LOS of 3-4 days served as the reference group, they reported patients with a LOS 5-10 days had a 17% higher chance of being readmitted within 30-days (HR 1.17; 95% CI, 1.07-1.28), while those with a LOS of 11-29 days had a 52% higher risk of readmission (HR 1.52; 95% CI 1.30-1.76). A LOS shorter than 3-4 days became even more interesting; a LOS of 1 day was associated with lower 30-day mortality (HR 0.53; 95% CI, 0.43-0.65). The authors highlight a convoluted relationship where extended hospital LOS has implications for patient outcomes since it is a marker of the

clinical complexity of the case, as well as greater resource utilization, and the lower LOS is a reflection of efficient recovery or possible under treating of the complication. The research further highlights how vital individualized discharge planning and LOS can be while trying to stabilize patients to minimize 30-day readmission or worse outcomes.

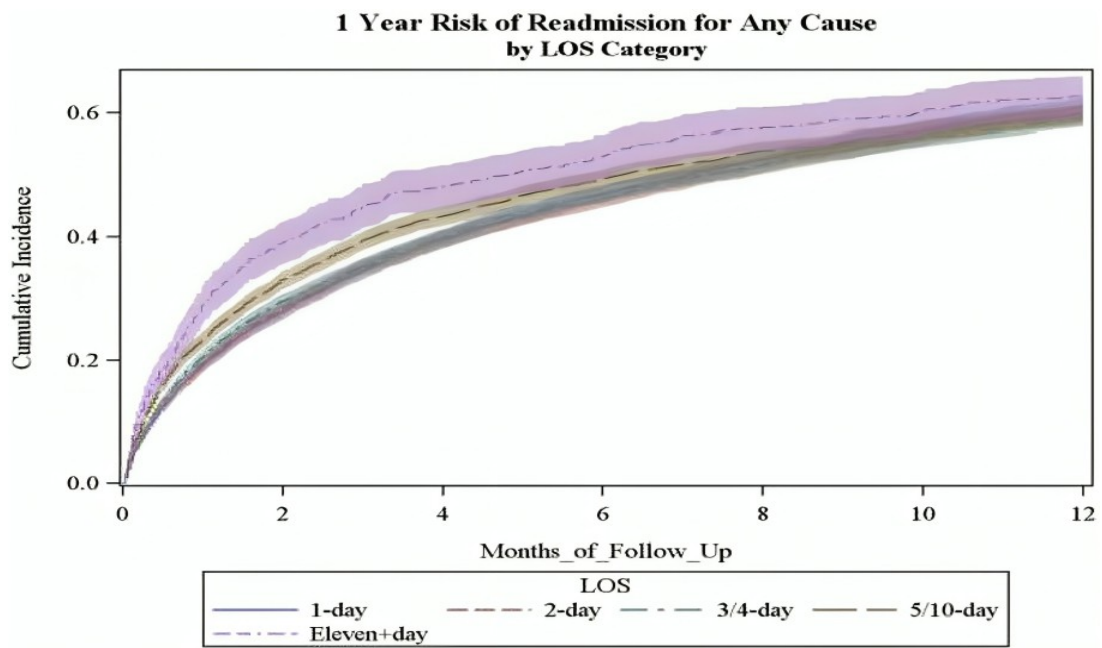


Figure 2 Cumulative incidence of hospital readmission for any reason, accounting for mortality as a competing risk. Shaded areas represent 55% confidence intervals. (3)

Ouwerkerk et al. (2017) completed a large multicenter cohort study in Ontario, Canada that included 58,230 patients over 65 years of age that were hospitalized for heart failure over a ten year period from 2003 to 2012. In this study the authors applied advanced regression modeling to examine the relationship between length of stay (LOS) and 30 day cardiovascular readmissions and mortality, allowing for a nonlinear (U-shaped) relationship. They found 0% was confirmed as a reference LOS, either shorter or prolonged hospital stays were associated with adverse outcomes, with short LOS (1-2 days), associated with a 12% increased rate of cardiovascular readmissions (adjusted hazard ratio [HR] 1.12; 95% confidence interval [CI]: 1.04-1.21), and prolonged stays (9-14 days) increased rate of cardiovascular readmissions (HR 1.11; OCI 1.04-1.19). The same relationship pattern was

observed in heart failure specific readmissions (short LOS HR 1.15; long LOS HR 1.14) and for all-cause mortality rates, which were higher after long LOS (HR 1.28; 95 CI: 1.14-1.43). Through this study evidence is provided to support the argument that early discharge and prolonged hospitalizations can independently increase the risk of adverse outcomes supporting the essential concept of an optimal “LOS window” of staying for heart failure admissions and having subsequent discharge planning.

In a large cohort study, Ranasinghe et al. examined 30-day readmission rates among young and middle-aged adults (aged 18 to 64 years) after an inpatient hospitalization for acute myocardial infarction (AMI), heart failure or pneumonia. Unlike almost all prior studies which focused on older adults, this study focused on young adults and provides new insight into the LOS-readmission relationship. Shorter lengths of stay (under the cohort median LOS) for all three conditions were associated with significantly higher early readmission rates. For heart failure patients discharged in the lowest LOS quartile (lowest length of stay), they had 25% higher readmission risk (adjusted hazard ratio [HR] 1.25; 95% CI 1.15 to 1.35) than patients discharged at a mid-range LOS. The authors concluded that even among young adults, LOS is an important predictor of readmission. Their findings also illustrated that LOS and discharge planning is an important concern for discharge timing, regardless of the age of the patient.

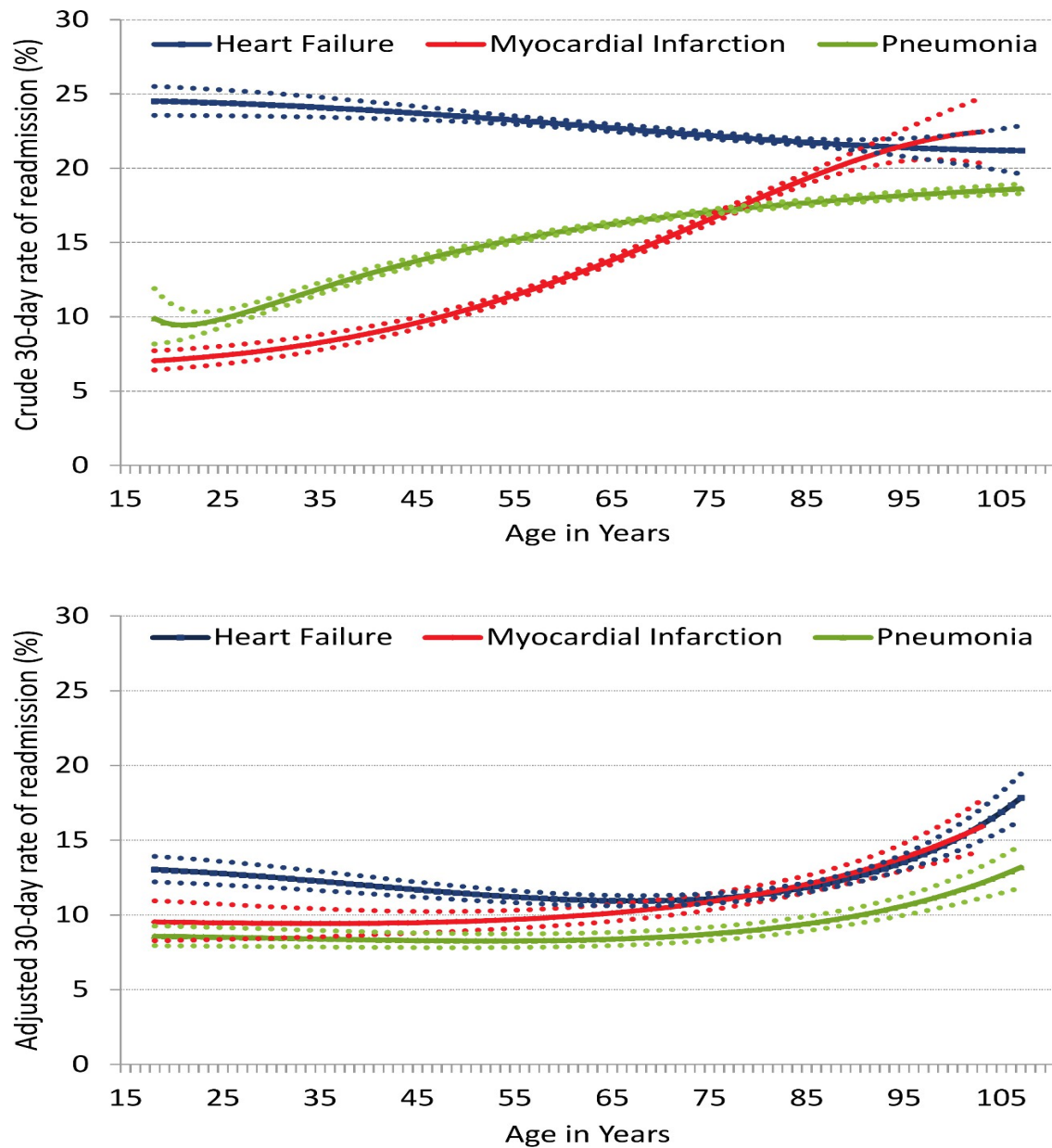


Figure 3 30-day rate of readmission across different diseases, comparing with age of individuals. (5)

Keenan et al. (2008) applied a hierarchical logistic regression model utilizing Medicare claims in order to profile hospital level 30-day all-cause readmission rates of heart failure patients. Their study drew specifically on data from 2004 for Medicare fee-for-service beneficiaries. The study tested and validated the model on both claims and medical record data and produced a c-statistic of 0.60; this indicated substantial variation in readmission rates across 4,669 hospitals (25th-75th percentile: 23.1%-24.0%; 5th-95th percentile: 22.2%-

25.1%). In the study, the average unadjusted readmission rate was 23.6%, and this was found valid, although key variable length of stay (LOS) was not the primary variable of interest. However, LOS was added in an earlier expansion of the model and was also found to have moderate predictive value. The authors' findings support the administrative data's suitability and validity to compare performance of hospitals, as most hospitals experience variation in readmission rates. LOS was found valid and relevant for understanding the nature of readmissions despite only showing modest predictive value. The study supported an overall moderated regression risk-adjusted model for reporting readmission patterns.

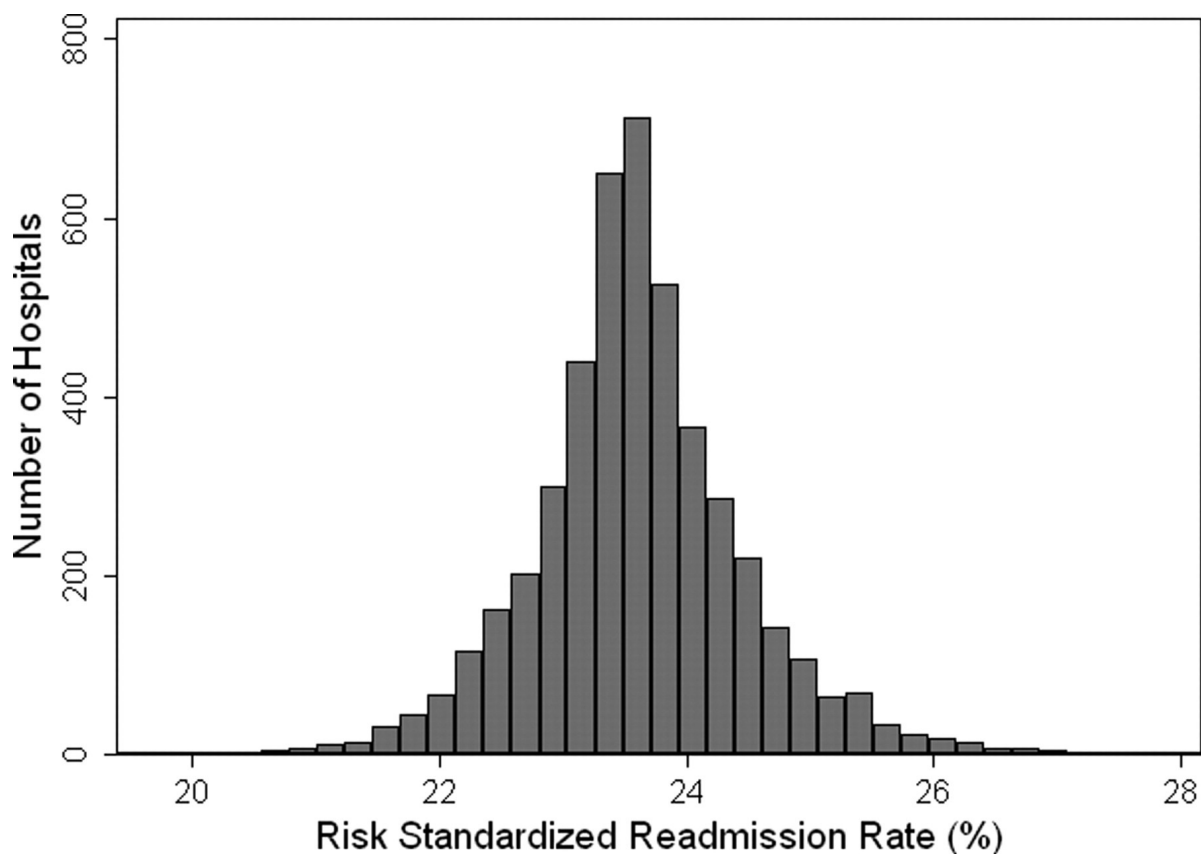


Figure 4 Distribution of hospital-level risk-standardized 30-day heart failure readmission rates according to the administrative model based on 2004 derivation data. (C)

Horwitz et al. created and tested the reliability and validity of a comprehensive hospitals-wide all-cause 30-day unplanned hospital readmission measure, within a framework provided

by the Centers for Medicare & Medicaid Services (CMS) and published in the Final Technical Report, by Yale CORE. This Final Technical Report contains information about the methodology of how to identify index hospitalizations, procedures for applying exclusion criteria (e.g., psychiatric cases, rehab cases), and risk-adjustment (e.g., hierarchical/logistic regression modeling). It is worth noting that while Length of Stay (LOS) was not explicitly meant to be assessed by the measure, it was considered in terms of risk-adjustment covariates, along with socio-demographics, comorbidity, and clinical presentation. Overall, LOS came into play through the measure's findings: acceptable discrimination (C-statistics ~0.66-0.67) and substantial inter-hospital variation in risk-adjusted readmission rates. These findings suggest that LOS has an indirect but important role in understanding hospital performance. The study provides added value to the dissertation's analytic framework, demonstrating how LOS has the potential to be leveraged and utilized in hospital-level evaluations, expanding conversations about benchmarking, equity in comparison, and the inherent challenges in interpreting LOS as related to quality measures.

The work of Desai et al. (2016) presents a short yet important commentary on the limitations of existing models predicting 30-day hospital readmission rates, noting the relatively low discriminative power of commonly used measures such as the CMS Hospital-Wide Readmission Measure (c-statistic ~0.63).

Desai et al. noted that many models fail to capture contextual and post-discharge characteristics such as social determinants of health, transitions of care, and adherence to outpatient follow-up, which have a substantial influence on readmission rates. While even in some cases LOS is addressed as a covariate, they emphasized that LOS alone does not predict readmissions, unless accompanied by much richer clinical and psychosocial data. The authors argued more for personalized, and contemporaneous, predictive analytics that build on the capabilities of EHR embedded platforms and machine learning for improved predictive

analytics. In the context of your dissertation, the study reinforces that LOS plays a contributory (not an independent) factor in understanding risk of readmission without regard to wider systemic and patient-level determinants.

Mortazavi et al. (2016) examined the predictive performance of common machine learning algorithms—logistic regression, decision trees, and random forests—for 30-day readmissions for heart failure patients from large-scale EHR datasets. Their study found that models using length of stay (LOS) along with clinical features (e.g., natriuretic peptide concentrations, comorbidity score) had the best predictive accuracy, and the random forest models had an AUC of 0.78. LOS was identified as one of the five most important features in the highest performing models. The authors concluded that while more complex algorithms for predicting heart failure readmission improved predictions, LOS was a valuable, easily-obtained feature which contributed to better prediction accuracy when considered alongside clinical and lab data. This paper adds additional methodological rigor to your dissertation by showing how LOS can serve as a valuable moderator when used in a machine learning context to help identify patients at high risk of readmission.

Futoma and others completed a comprehensive assessment of predictive modeling techniques for forecasting early (30 day) hospital readmissions by analyzing a large electronic health record dataset from New Zealand. They compared traditional logistic regression with other methods that are more advanced, including penalized regression, random forests, support vector machines (SVM), and deep learning architectures across 280 diagnosis related groups (DRGs). The authors noted random forests and penalized logistic regression consistently outperformed simple regression models, with an approximate mean area Under receiver operating curve - AUC at ~ 0.68 for DRG specific models. In global cohorts of patients, AUCs at ~ 0.83 were achieved using stochastic gradient descent based methods. Importantly, LOS - length of stay - was one feature among many that was consistently retained in machine

learning feature selection processes and this should add confidence to the use of LOS in readmission prediction. This study supports the approach in your dissertation by demonstrating the gain in predictive accuracy using LOS, especially when together with algorithms able to capture non-linear and patient-specific patterns.

Coleman et al. (2006) produced one of the initial randomized controlled trials of the Care Transitions Intervention (CTI), a patient-centered coaching model designed to decrease readmissions through structured support in the discharge process. The study included 750 Medicare patients aged 65 years or older and randomized them to receive either CTI (transition coach and self-care tools) or usual care. The study reported a significant reduction of 30-day readmissions from 11.9% to 8.3% ($p = 0.048$) and 90-day readmissions decreased from 22.5% to 16.7% ($p = 0.04$). Cost analysis determined that cumulative hospital costs were lower in the intervention arm at 180 days (\$2,058 vs \$2,546; $p = 0.049$). Critically, average lengths-of-stay remained similar in both study arms, indicating that care could be improved with quality discharge, independent of LOS. The overall almost 30% reduction in readmissions indicates the effectiveness of targeted transitional care and serves as a tactical adjunct to LOS reduction strategies in improving patient outcomes.

Boutwell et al. (2016) published a comprehensive Toolkit from the AHRQ that seeks to prevent avoidable readmissions among Medicaid beneficiaries through a structured, multidisciplinary transitional care approach and contain evidence-based actions across six domains (example: focusing on patient education, medication reconciliation, care coordination, and post-discharge follow-up) to encourage intervention from hospitals and primary care to reduce readmission as risk. The Toolkit reminds users that a length of stay (LOS) should not be considered as an assessment in isolation of a larger effort where transitional care quality and quality of systems could have a substance effect on readmission outcome. Although it does not provide statistical modeling to directly link LOS to

readmission, the Toolkit includes some dashboards and data tools that may encourage hospitals to include LOS among performance metrics used to reduce readmissions. This furthers your dissertation topic by reaffirming the the assumption that LOS optimization is, at the very least, relevant to proper care transitions as a fundamental requirement to significantly reduce avoidable readmissions.

Bahl et al. (2017) leveraged a nationally-representative surgical database to evaluate whether elective inpatient surgery discharges on the weekend are associated with higher readmission rates. This investigation included the study of > 500,000 surgical cases which were performed from 2012-2014. Their results indicated that patients who were discharged on the weekend had a marginally higher 30-day readmission rate (OR 1.05; 95% CI 1.01 - 1.09) compared with patients who were discharged on the weekday, after controlling for age, comorbidity, surgical complexity, and length of stay (LOS). The association persisted even when LOS was the same between groups, implying that hospital staffing and availability of resources when discharging patients on the weekend may somehow influence what happens to them after they are discharged from the hospital. The authors emphasize the need to consider the timing of discharge and other systemic factors in addition to LOS when investigating the patterns of readmission; this is valuable information for hospitals looking to improve quality and considering future discharge planning.

Chapter 5 : Findings and Discussion

A robust review of the literature indicates a complex yet strong relationship between length of stay (LOS) and 30-day readmission rates. Across medical and surgical cohorts, a majority of high-quality observational studies demonstrated a statistically significant, independent association between LOS and rehospitalisation, even after adjustment for comorbidity and illness severity [2-4, 8]. These data reinforce that LOS is neither a simple risk factor nor a universal quality indicator; rather, its impact varies with clinical condition, discharge practices, health-system factors and the availability of post-discharge supports.

One consistently observed pattern is a U-shaped association in which both very short and very long hospitalisations confer excess readmission risk. Patients discharged prematurely often return with unresolved clinical issues or insufficient community supports [4, 9, 11], whereas prolonged admissions frequently mark complications, frailty or sub-optimal discharge planning [3, 10, 13]. Importantly, several studies quantified an “optimal” mid-range LOS that minimised 30-day returns—typically 4–5 days for pneumonia and 6–7 days for common cardiac diagnoses [5, 10, 12]. Thus, the goal is not simply to minimise LOS, but to achieve a diagnosis-specific window that balances clinical stability with timely transition.

Cardiovascular and surgical cohorts illustrate the dangers of focusing on LOS in isolation. Early discharge in heart-failure or post-myocardial-infarction patients was often driven by throughput targets rather than symptom resolution, and was repeatedly linked to early readmissions [2, 5, 6]. Conversely, extended stays reflected complex medical trajectories and generated their own hazards once patients eventually left hospital. These findings underscore that shortening LOS without concurrently assuring discharge readiness can yield unintended increases in readmission.

Modern predictive-analytics studies echo this nuance: machine-learning models (random-forest, gradient-boosting, logistic-regression) ranked LOS among the strongest predictors of readmission only when interpreted alongside demographic, clinical and utilisation variables, confirming that LOS is best viewed as a proxy for underlying risk rather than a causal agent.

Transitional-care interventions are critical modifiers of the LOS–readmission nexus. Programmes incorporating structured discharge education, medication reconciliation, electronic discharge check-lists and early post-discharge telephone reviews consistently reduced 30-day readmissions, even among patients with comparatively brief stays [7, 8, 15]. Parallel use of validated risk-stratification tools helped clinicians judge discharge readiness more accurately than LOS alone and prompted tailored follow-up intensity [3, 10, 14]. Multidisciplinary discharge teams—physicians, case-managers, pharmacists and social-workers—were particularly effective in high-risk groups such as cardiac and COPD patients [6, 11, 15].

System-level variables further shape outcomes. Weekend or after-hours discharges, when staffing and community services are limited, continued to predict unfavourable returns despite “appropriate” LOS targets. Provider experience and workload also mattered: seasoned clinicians were more likely to time discharge appropriately and to mobilise team-based supports, whereas inexperienced or over-burdened physicians tended toward premature discharge and higher readmissions.

Notably, population-level efforts to shorten LOS without parallel investment in community-based care have coincided with rising readmission rates. Several investigators

therefore advocate dynamic rather than rigid LOS management; length of stay should flex with individual clinical progress, using discharge-readiness indicators such as mobility, stable vitals and caregiver capacity instead of purely numeric LOS benchmarks [1, 5, 9]. Where early discharge is unavoidable, proactive follow-up—telephone calls within 48 h, rapid outpatient review or home-visiting nurses—mitigates risk [2, 6, 13].

A minority of trials demonstrated that readmission reductions are achievable without altering LOS at all, provided the discharge process itself is strengthened (comprehensive education, scheduled follow-up, community linkage) [13, 14]. Such findings reinforce that LOS is meaningful yet insufficient on its own.

In summary, LOS remains a valuable but context-dependent indicator of readmission risk. Both extremes—premature discharge and unnecessarily prolonged admission—signal vulnerability, albeit for different reasons. Optimising outcomes therefore requires a holistic approach that aligns diagnosis-specific LOS targets with robust, team-based discharge planning, patient-centred readiness criteria and reliable post-discharge support pathways.

Chapter 6: Conclusion and Recommendations

Conclusion

This dissertation was conducted to investigate the connection between the length of stay and readmissions through a narrative review of existing literature. Overall, there is evidence to suggest that the length of stay is a variable associated with the probability of patient readmissions, and this relationship is clearly non-linear. The research suggests that both exceedingly short and exceedingly long hospital stays are associated with increased risk for readmission, often described as a U-shaped relationship.

Shorter stays may frequently, though not always, be a symbol of efficiency, and cost-conscience discharges. However, shorter stays may also be a result of discharging patients prematurely before proper clinical stabilization has occurred, adequate patient education is possible, or because of proper discharge planning. In these situations, patients are returning home before they have fully recovered from their hospital illness or before they have appropriate services arranged. Similarly, when discharges span excessively long periods, they typically identify underlying medical issues, degree of comorbidity, or in-hospital complications, which may predispose patients to poor outcomes such as a quick return to the hospital after discharge.

Although the clear association between length of stay (LOS) and readmissions has been pointed out, this dissertation argues that LOS is only one component of a complex problem. The differences between how and when to discharge patients, in addition to quality of care during inpatient admission, patient-specific risk factors (age, burden of disease, or socio-economic status) and post-discharge support will all contribute to increasing or decreasing the

likelihood of patient readmission. Studies suggest that while LOS, in and of itself, is not a strong predictor, it does have utility when assessing hospital performance and quality of care, especially when considered with other stratified risk metrics.

The emergence of advanced predictive modeling has more closely illustrated that LOS is most useful when interpreted with clinical factors, socio-behavioral variables and transitional care factors. While clinical risk factors are most important, machine learning models such as Watson's other models include LOS as one of the top predictors of readmissions, especially in conjunction with codes for diagnosis, medications on discharge, trends in labs and social determinants of health.

Another key learning from this review is that readmission prevention cannot not be achieved by limiting the length of stay only. Comprehensive discharge processes—a process that includes clear communication, coordinated follow-up, medication reconciliation and the involvement of the patient—may minimize the risks associated with both short and long length of stay. Prepared approaches with structured transitional care and access to community health support have resulted in significantly lower rates of readmission even in high risk populations.

This literature has ultimately undermined the reliance on length of stay being used as a singular performance indicator in assessing hospital performance or provider quality. Length of stay, if used as a performance indicator, must be better evaluated in the context of conveying patient-centered care. Therefore, we conclude here that it should not only be about when you discharge patients but being clear about when patients are ready to be discharged.

Recommendations

The following recommendations are made from the synthesis of findings to assist healthcare organizations, clinicians, and policy developers for managing LOS and avoidable hospital readmissions:

1. Use Standardized Discharge Readiness Tools

Hospitals should utilize standardized discharge readiness tools that measure clinical stability, functional status, and psychosocial readiness as a part of the discharge planning process. Standardized tools assist in ensuring discharges are timely, safe, and individualized; for hospitals, there is no better goal prior to discharge than for patients to be clinically stable, functionally well-prepared, and psychosocially prepared.

2. Enhance Transitional Care Services

The development of post-discharge transitional care services — such as home health visits, chief telephone follow-ups, transitional and nurse navigator — has demonstrated success in reducing readmissions through various clinical niches. Ultimately, it is important to provide transitional care beyond the hospital to patients, particularly those leaving the hospital early.

3. Employing LOS in Composite Quality Measures

Length of stay should not be considered in isolation from other factors; it should be included in composite quality measures which include readmission rates, in-hospital complications,

and patient satisfaction. This composite tool provides a more diverse look at quality of care and use of resources.

4. Utilize Predictive Analytics to Include LOS in Discharge Planning

Health systems should be using data driven models that include LOS in conjunction with clinical and demographic information to stratify patients by readmission risk. These models help care teams prioritize the care of high-risk patients for improved discharge planning and follow up support.

5. Avoid Arbitrary Length of Stay Reduction Goals

Policymakers and hospital leaders need to watch for organizations promoting reductions in LOS alone, without investments in discharge processes and community resources. Arbitrarily reducing LOS without industry recalibration may increase readmissions and worse patient care.

6. Increase physician awareness and training

Physicians should be educated on the complex relationship between LOS and readmission. Emphasizing holistic and shared decision-making to balance discharge decisions and encourage collaboration with multidisciplinary teams could enhance the discharge process and discharge planning, particularly for new or inexperienced physicians.

7. Establish guidelines for weekend and after-hours discharges

Particular care should be taken in discharges on weekends and after hours. Weekends and after hours are often characterized by fewer staff and/or staff with limited access to ancillary services, which could impact the quality of discharge. Hospitals should develop process maps with safeguards and checklists to facilitate these discharges effectively.

8. Individualize discharge processes according to patient subgroup

Not all patient populations have the same LOS-readmission behaviors, and discharge and care coordination processes should be tailored to clinical category. For instance, heart failure patients may require more extended hospital stays with follow-up care, whereas low-risk surgical patients may be discharged earlier with little follow-up.

9. Track and Audit Reasons for Readmissions

Routine monitoring of patients who are readmitted, including the analysis of LOS and discharge processes, can identify trends and opportunities for improvement. Hospitals should create feedback loops for inpatient, outpatient, and administrative groups to bridge gaps in the system.

10. Involve Patients and Caregivers Early

Patients and caregivers should be invited to participate in the discharge planning process as early as possible. Research demonstrates that involvement improves both adherence to discharge instructions, avoids confusion, and limits unnecessary readmissions.

In closing, length of stay (LOS) in the hospital continues to be an important, yet complex, factor that influences readmission risk. LOS can and should continue to be minimized for many reasons: accountability for limited resources, limited hospital beds to treat new patients, and the possibility of improving patient care. However, LOS must be coupled with quality discharge planning, individualized patient care, and ongoing community follow-up. This dissertation has emphasized the importance of reframing how we think about LOS – not as a 'goal' of performance, but as a clinical marker of discharge readiness and the safety of the patient. Coordinated, data informed, and patient-centric efforts from systems of care can lower rates of avoidable readmissions to hospitals, without sacrificing quality and efficiency of services.

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