

ORIGINAL ARTICLE

Incidence, Causes, and Predictors of 30-Day Hospital Readmission Following Surgical Procedures: A prospective Cohort study

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ABSTRACT:

Background: Hospital readmission rates within 30 days of surgery are a key quality indicator associated with postoperative complications, slower recovery, and higher healthcare costs. This study evaluated the incidence, causes and risk factors associated with early (30-day) hospital readmissions following common surgical procedures. **Methods:** This study was conducted with 250 consecutive patients who were discharged after elective or emergency surgery. Medical records and 30-day follow-up (unplanned hospitalization within 30 days after discharge) documentation were used to obtain demographic, clinical, and operative and postoperative data. The data were analysed using SPSS version 26.0. Independent-samples t-test, chi-square test or Fisher's exact test were used to compare groups and multivariable logistic regression was used to identify factors independently associated with 30-day readmission, with adjusted odds ratios (OR) and 95% confidence intervals (CI). A $p < 0.05$ was considered statistically significant. **Results:** There were 47 patients (18.8%) who were readmitted in 30 days. The most frequent causes were surgical site infection 15 (31.9%), uncontrolled postoperative pain 11 (23.4%) and wound dehiscence 8 (17.0%). Patients who were readmitted were hospitalized for a longer time period than patients who were not readmitted (8.2 ± 3.6 days vs. 5.4 ± 2.3 days, $p < 0.001$). Postoperative complications (AOR=3.68), hospital stay > 7 days (AOR=3.12), emergency surgery (AOR=2.76), diabetes mellitus (AOR=2.41), and age ≥ 60 years (AOR=2.18) were independent predictors. **Conclusion:** Nearly 20% of surgical patients were readmitted within 30 days. Improved infection prevention, discharge planning, postoperative pain management, and early detection and management of complications may reduce avoidable readmissions and improve postoperative outcomes.

Keywords: Length of Stay; Patient Readmission; Postoperative Complications; Risk Factors; Surgical Procedures, Operative; Surgical Wound Infection

INTRODUCTION

A 30-day hospitalization after surgery is a common measure of the safety, continuity of care and quality of healthcare provided ¹. Unplanned readmission is clinically important as it can signify post-operative issues that have not been resolved, slow down recovery, drive up resource consumption and influence subsequent morbidity and mortality ². These reported rates have been shown to depend on surgical specialty, urgency and complexity of the surgery, patient comorbidity and post-discharge support ³.

Recent studies have identified that readmissions are not uniform and often associated with postoperative complications ⁴. Early return to hospital is recognized as a significant reason for surgical-site infection, sepsis, wound disruption, gastrointestinal issues and uncontrolled pain ^{5,6}. Research in emergency and ambulatory surgical patients reveals that the majority of readmissions happen within the first two weeks following discharge, emphasizing the need for early surveillance, adequate pain management, wound monitoring and prompt follow-up ⁷.

Risk of readmission is related to interactions between patient, procedure and hospital-related factors ⁸. The higher risk of readmission has been linked to advanced age, higher American Society of Anesthesiologists class, diabetes mellitus, cardiovascular disease, renal disease, nutritional risk, functional dependence, emergency surgery, high-risk surgery, postoperative complications, prolonged initial hospitalization, and discharge ^{9,10}. Postoperative complications are relatively stable predictors in systematic reviews, while the reduction of readmission associated with discharge education and improved recovery pathways varied across procedures and settings ¹¹. The evidence available is procedure-specific and patterns may vary according to the case mix, peri-operative management and follow-up systems in place. Therefore, assessment of common procedures across the region is required to establish local causes and high-risk groups ¹².

The purpose of this study was to identify the proportion of patients readmitted to hospital within 30 days of surgery for each of 30 selected types of surgery. It also aimed to identify the main causes and patterns of readmission, and determine independent patient- and procedure-specific predictors of readmission.

METHODOLOGY

This prospective observational cohort study was carried (May 2021-October 2021) in the Department of General Surgery, Orthopedic Surgery, Gastrointestinal Surgery, and Urology of the tertiary care hospital, Lahore, to evaluate the rates of hospital readmission for some frequently performed surgeries (LT22/77/2021). A total of 250 adult patients with surgery and were discharged from the hospital after their admission to hospital for the first time were sampled consecutively. The sample size was calculated using OpenEpi version 3.0.1 (Atlanta, GA, USA) based on a single population proportion. The calculation used $n = Z^2 P(1-P)/d^2$, where n is the required sample size, Z is the standard normal deviate for the selected confidence level, P is the anticipated proportion, and d is the desired absolute precision. Assuming an expected 30-day postoperative readmission proportion of 20%, a 95% confidence level, and an absolute precision of 5%, the minimum required sample size was approximately 246 patients. The final sample was rounded to 250 patients, who were consecutively recruited during the study period¹³.

Patients that are 18 years or older and had either elective or emergency surgery and were followed up for at least 30 days after surgery were included. Patients who were transferred to another healthcare facility, left against medical advice, died during the initial hospitalization, or had incomplete clinical records were excluded from the study. Data were collected through a standardized data collection form by reviewing a patient's hospital medical records, operative notes, discharge summary, and follow-up records. Demographic variables included age and gender and clinical variables included comorbidities, ASA physical status classification, type and specialty of surgery, indication for surgery, and elective vs emergency surgery. Postoperative variables were: hospital stay, admission to the intensive care unit, postoperative complications, reoperation, drains/catheters on discharge and postoperative recovery.

The main outcome was 30-day re-hospitalization. Readmission was defined as an unplanned hospitalization within 30 days after the index surgical procedure, which was related to the index procedure. Patients were subsequently classified into two groups: readmitted within 30 days and not readmitted within 30 days. Surgical site infection, postoperative pain, wound dehiscence, gastrointestinal complications, urinary complications, and other clinically important entities were categorized as readmissions. The rates of readmission and the reasons were compared with the rates of non-readmission and non-readmission reasons.

Confidentiality of all information collected was ensured by anonymization and the study was carried out in accordance with the ethical principles of the Declaration of Helsinki¹⁴. The Statistical Package for the Social Sciences (SPSS) version 27.0 (Armonk, NY, USA), was used to analyze the data. All the continuous variables were reported as mean and standard deviation while all the categorical variables were reported as frequency and percentage. Independent-samples t-test or Chi-square test/ Fisher's exact test were used to make comparisons between groups as appropriate. The factors that were significant in the univariate analysis were included in a multivariable logistic regression model to determine factors associated with readmission. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated and p-values < 0.05 were considered statistically significant (two-tailed).

RESULTS

The total of 250 patients with common surgical procedures were included in the study. The mean age was 49.7 ± 15.2 years, and 56.4% were male. In all, 18.8% (47/250) of patients were admitted again within 30 days of discharge. Surgical site infection 15 (31.9%) was the most common reason for readmission, followed by postoperative pain 11 (23.4%) and wound complications 8 (17.0%). In univariable analyses, several demographic, clinical, and postoperative characteristics differed between patients who were and who were not readmitted. Multivariable logistic regression was subsequently performed to identify factors independently associated with 30-day readmission. As shown in **Table I**, the most frequently used procedure was general surgery 82 (32.8%) and 76 (30.4%) of procedures were performed under emergency conditions.

Table I: Baseline Characteristics and Surgical Profile of the Study Population (N=250)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–39	72	28.8
40–59	103	41.2
≥60	75	30.0
Gender		
Male	141	56.4
Female	109	43.6
Type of Surgery		
General surgery	82	32.8
Orthopedic surgery	64	25.6
Gastrointestinal surgery	48	19.2
Urological surgery	31	12.4
Other procedures	25	10.0
Nature of Surgery		
Elective	174	69.6
Emergency	76	30.4
Mean age (years)	49.7 ± 15.2	

The overall 30-day readmission rate was 47 (18.8%). Surgical site infection 15 (31.9%), uncontrolled postoperative pain 11 (23.4%), and wound dehiscence 8 (17.0%) were the top three readmission reasons. The results of this study suggested that problems related to surgical wounds continued to be the most common cause of early rehospitalization, as shown in **Table II**.

Table II. Thirty-Day Readmission Characteristics in patients with common surgical procedure(N=250)

Variable	Frequency (n)	Percentage (%)
Readmitted within 30 days	47	18.8
Not readmitted	203	81.2
Primary Cause of Readmission (n=47)		
Surgical site infection	15	31.9
Uncontrolled postoperative pain	11	23.4

Wound dehiscence	8	17.0
Gastrointestinal complications	6	12.8
Urinary complications	4	8.5
Other causes	3	6.4

Their total postoperative hospitalizations were significantly longer (8.2 ± 3.6 vs. 5.4 ± 2.3 days; $p<0.001$) and they were more likely to have surgical drains or catheters at the time of discharge, to have postoperative complications (23 (48.9%) vs. 34 (16.7%)), to be admitted to the ICU (12 (25.5%) vs. 19 (9.4%)), or require reoperation, reflecting a more complicated postoperative course, as shown in **Table III**.

Table III: Postoperative Recovery Indicators According to Readmission Status(N=250)

Variable	Readmitted (n=47)	Not Readmitted (n=203)	p-value
Mean initial hospital stay (days)	8.2 ± 3.6	5.4 ± 2.3	<0.001
Postoperative complication during index admission	23 (48.9%)	34 (16.7%)	<0.001
ICU stay required	12 (25.5%)	19 (9.4%)	0.003
Reoperation during index admission	7 (14.9%)	10 (4.9%)	0.018
Discharge with drain/catheter	14 (29.8%)	24 (11.8%)	0.002

Readmitted patients were more frequently advanced age (23 (48.9%) vs. 52 (25.6%), $p=0.002$), diabetes mellitus (20 (42.6%) vs. 46 (22.7%), $p=0.006$), emergency surgery (23 (48.9%) vs. 53 (26.1%), $p=0.002$), and higher ASA physical status classification (26 (55.3%) vs. 63 (31.0%), $p=0.001$). No significant association was observed between the two outcomes of hypertension and readmission, as presented in **Table IV**.

Table IV: Clinical Factors Associated with Thirty-Day Hospital Readmission(N=250)

Variable	Readmitted (n=47)	Not Readmitted (n=203)	p-value
Age ≥ 60 years	23 (48.9%)	52 (25.6%)	0.002
Diabetes mellitus	20 (42.6%)	46 (22.7%)	0.006
Hypertension	24 (51.1%)	77 (37.9%)	0.097
Emergency surgery	23 (48.9%)	53 (26.1%)	0.002
ASA Class III–IV	26 (55.3%)	63 (31.0%)	0.001

Postoperative complications were independently associated with 30-day readmission (AOR=3.68, 95% CI: 1.81–7.48, $p<0.001$). Other factors independently associated with readmission were long-term hospitalization (AOR=3.12), emergency surgery (AOR=2.76), diabetes mellitus (AOR=2.41) and age ≥ 60 years (AOR=2.18), as shown in **Table V**.

Table V: Multivariable Logistic Regression Analysis of Predictors of Thirty-Day Readmission

Predictor	Adjusted OR	95% CI	p-value
Postoperative complication	3.68	1.81–7.48	<0.001
Initial hospital stay >7 days	3.12	1.55–6.28	0.002
Emergency surgery	2.76	1.36–5.58	0.005
Diabetes mellitus	2.41	1.18–4.91	0.015
Age ≥ 60 years	2.18	1.08–4.38	0.029

Figure 1 presents the adjusted odds ratios and 95% confidence intervals for factors independently associated with 30-day hospital readmission. Postoperative complications showed the strongest association with readmission (AOR=3.68, 95% CI: 1.81–7.48). Initial hospital stay >7 days, emergency surgery, diabetes mellitus, and age ≥ 60 years were also independently associated with increased odds of readmission.

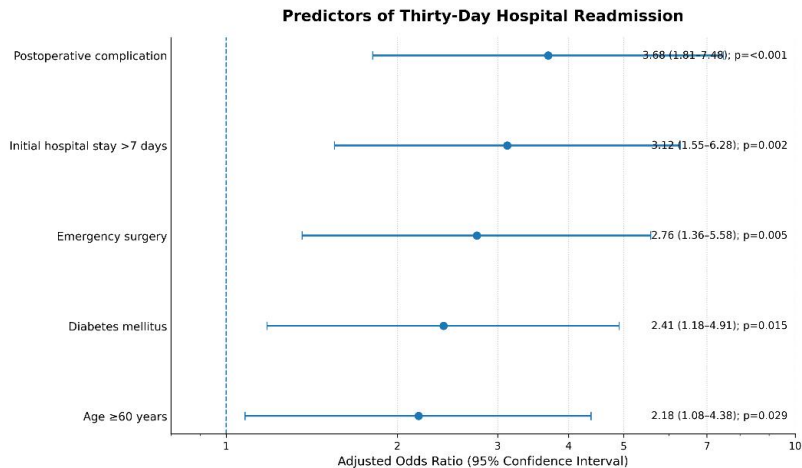


Figure 1: Multivariable logistic regression analysis of predictors of 30-day hospital readmission. Points represent adjusted odds ratios, and horizontal lines represent 95% confidence intervals

Thirty-day readmission rates varied descriptively across surgical specialties, with observed rates of 18 (22.0%) in general surgery, 10 (20.8%) in gastrointestinal surgery, 11 (17.2%) in orthopedic surgery, 5 (16.1%) in urology, and 3 (12.0%) in other procedures, as presented in **Table VI**.

Table VI: Readmission Rates According to Surgical Specialty(N=250)

Surgical Specialty	Total Cases	Readmissions n (%)	Most Common Reason
General Surgery	82	18 (22.0%)	Surgical site infection
Orthopedic Surgery	64	11 (17.2%)	Pain and wound complications
Gastrointestinal Surgery	48	10 (20.8%)	Anastomotic/GI complications

Urology	31	5 (16.1%)	Urinary complications
Other Procedures	25	3 (12.0%)	Miscellaneous

Overall, the findings indicate that early postoperative readmission was relatively common and was associated with both patient- and procedure-related factors. Postoperative complications, prolonged initial hospitalization, emergency surgery, diabetes, and older age were identified as important predictors of readmission. These findings provide a basis for further consideration of the clinical factors underlying early postoperative readmission.

DISCUSSION

The findings of this study revealed that 18.8% of patients were readmitted within 30 days of the common surgical procedures. This rate is higher than the 7.5% observed in a cohort of older surgical patients in northern Italy or the 28-center international noncardiac surgical cohort, but should be interpreted in relation to the different study populations and settings reported in these studies^{15,16}. The main causes were surgical site infection, uncontrolled postoperative pain and wound dehiscence, and postoperative complications had the largest estimated association with readmission in the adjusted analysis. Age ≥ 60 years, diabetes mellitus, emergency surgery, and prolonged hospitalization were also associated with higher odds of readmission.

Surgical site infection is the most common diagnosis, which indicates that it was the most frequently documented reason for early readmission in this study, rather than accounting for the majority of readmissions. In a large ACS-NSQIP analysis, wound types of infection and contamination were associated with increased risk of readmission, where organ-space infection and sepsis were among the frequent infection types¹⁷. Surgical site infection also emerged as the primary reason in a recent spine surgery meta-analysis and national cardiac data reinforced the significance of wound infection and dehiscence^{18,19}. Uncontrolled pain is the second most common, and reported following ambulatory spine surgery and lumbar spine surgery²⁰. Return due to pain may be a sign of inadequate individualized analgesia, inadequate pain tolerance, lack of understanding of pain symptoms, or delayed recognition of complications^{21,22}.

The index recovery course was associated with a higher probability of readmission; postoperative complications were associated with 3.68-fold higher odds of readmission after adjustment (AOR=3.68, 95% CI: 1.81–7.48)²³. Emergency general surgery studies also reveal that complications such as sepsis, wound disruption, thromboembolism, and other complications are more common in readmitted patients²⁴. Operative complexity, slow recovery, or inadequately managed morbidity are likely confounders of prolonged hospitalization, but not necessarily a cause of readmissions²⁵. While there was some evidence from recent spine surgery that this was also the case, and national revision knee arthroplasty modelling, both showed that longer stay was a major predictor²⁶.

Advanced age remained independently associated with readmission after adjustment, suggesting that patient vulnerability may partly contribute to differences in readmission risk. Older people often experience frailty, multimorbidity, poor mobility and reduced physiological reserve²⁷. In spine surgery, hip fracture surgery and vascular surgery, meta-analyses report comparable results of increased risk due to impaired healing, susceptibility to infection, renal vulnerability and unstable postoperative glucose levels²⁸. Risk-stratified discharge planning that focuses on older adults, emergency cases, patients with complications or extended length of stay may be a potential strategy to improve postoperative follow-up; however, its effectiveness in reducing readmission was not assessed in the present study²⁹.

The limitations of this study are that it is single-center, observational, has a limited sample size, and a limited number of readmission events, decreasing the precision and generalizability. Multicenter prospective studies are needed in the future to document all healthcare contacts, improve the uniformity of definitions, validate these associations, and explore the timing and preventability of readmission. Structured wound and pain education, enhanced recovery transition bundles, remote monitoring and targeted follow up should be evaluated in intervention trials, as the evidence of the effectiveness of discharge education is still unclear, but the evidence of risk-directed outpatient review is strong.

CONCLUSION

A total of 47 (18.8%) of surgical patients were readmitted within 30 days, most frequently due to surgical site infection, uncontrolled postoperative pain, and wound dehiscence. Higher odds of readmission were independently associated with postoperative complications, an initial hospital stay exceeding seven days, emergency surgery, diabetes mellitus, and age ≥ 60 years. These findings identify patient and perioperative factors associated with 30-day readmission in this surgical population. Targeted discharge planning, infection prevention, and structured follow-up programs should be evaluated in future prospective studies to determine their potential to reduce avoidable postoperative readmissions.

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