Original Article

Unplanned 90-day readmissions in a specialty orthopaedic unit—A prospective analysis of consecutive 12729 admissions

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ARTICLE INFO

Article history:

Received 21 February 2017

Accepted 5 March 2017

Available online 12 March 2017

Keywords:

Readmissions

Quality of health care

Complications

Surgical site infections

Total joint arthroplasty

Trauma

ABSTRACT

Introduction: Unplanned readmissions are an undesirable and expensive outcome of clinical practice. Previous reported literature is limited by retrospective study designs and 30 day study intervals. We analyzed causes for 90-day unplanned readmission, temporal occurrence of major causes, possible predisposing factors, bed days lost and economic impact.

Materials & methods: A prospective analysis of 12729 admissions was performed over 1 year in an Orthopaedic unit. Consecutive readmissions for unplanned circumstances within 90-days of discharge following the index procedure were included. Open injuries, polytrauma, primary osseous infections and planned readmissions were excluded.

Results: We noted an overall readmission rate of 2.07% and subspecialty rate of 1.43%, 3.32%, 2.9% in trauma, spine and total joint arthroplasty (TJA) respectively. The leading cause was wound complications accounting for 49.62%, followed by medical causes (trauma –18.37%; TJA –27.5%) and aseptic pain (spine–31.6%). Though 87.1% of superficial surgical site infections (SSIs) occurred within 30 days, 21.1%, 41.2% and 60% of the deep SSIs in spine, trauma and TJA respectively occurred beyond 30 days. The financial burden amounted to INR 1,01,55,770 and mean bed days lost was 7.6 per readmission. Age ≥ 70 years, indoor-stay ≥ 10 days, health insurance and co-morbid illnesses were associated with readmissions ($p < 0.05$).

Conclusions: Our study showed that limiting analysis to 30 day unplanned readmissions would lead to failure in identification of 34.85% of readmissions especially deep surgical site infections in TJA and trauma.

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1. Introduction

Unplanned readmissions are an expensive and undesired outcome for the patient, the treating physician and the health care system. Several studies noted that within 30 days of discharge, as many as one in four patients will return to the hospital^{1,2} and estimated costs for unplanned readmissions in Medicare spending were over \$17.6 billion in 2004.^{1,3} Reported 30-day readmission rates in Orthopedics have ranged from 2 to 14%.^{4,5} The most frequently reported factors relating to hospital readmissions were infection, unstable respiratory illness, development of a new problem, and male sex.^{6,7,8} Readmissions are an important factor in evaluating the cost-effectiveness of surgical procedures, and establishing a system to reduce risk of readmission can help to

successfully reduce costs for the healthcare system.^{9,10} Several studies^{2,11} have suggested that better inpatient care is associated with a lower risk of readmission and they are now being considered to be an indicator of health care quality.

Most studies on Orthopaedic readmissions are limited to a specific procedure/diagnosis.^{4,12–16} Analysis is frequently based on 30 day readmissions, and there is little data available for 90 day readmission rates.^{9,17} Reports on economic impact analysis are rare and focus on Medicare based spending, without giving a perspective on out of pocket expenditures.¹² This out of pocket expenditure is common in developing countries, where health care insurance coverage is negligible and can prove to be a substantial financial burden to the patient.^{18,19} Additionally, to the best of our knowledge, there are no studies analyzing readmissions and its economic impact in developing countries. With this as a background, we performed an analysis of 90 day unplanned readmissions in an Orthopaedic specialty unit consisting of all subspecialties without restriction on the type of surgical procedure

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performed. We analyzed (1) causes for 90-day unplanned readmission (2) temporal occurrence of major causes of readmissions (3) bed days lost and economic impact of readmissions (4) analysis of possible predisposing factors.

2. Materials and methods

A prospective consecutive analysis (cohort study) of patients readmitted in an Orthopaedic specialty hospital in India, from 1st January 2015 to 1st January 2016 was performed. The study was approved by the Institutional Review Board and informed consent was obtained from all readmitted patients. All readmissions for unplanned outcomes within 90 days of discharge following the index procedure were included. We excluded readmissions for planned staged procedures, open injuries, polytrauma and patients admitted with primary osseous infections (without previous surgical procedure). The readmissions were identified on a daily basis by an Orthopaedic surgeon (first author) in each of the subspecialties of Trauma, Spine, Total Joint Arthroplasty (TJA), Paediatric Orthopaedics and Arthroscopy from the hospital admission register. Readmissions were evaluated for causes under the categories of- wound infections, medical complications, persistence of pain, implant related and surgical complications. We evaluated the total bed days lost due to unplanned readmissions and the resulting economic impact. Length of in-hospital stay was obtained for each readmission, the sum total of which was used to calculate Total bed days lost. The economic impact was assessed using the direct expenses incurred by the patient during the period of readmission, which was obtained from the hospital bills. This was inclusive of room charges, surgeon fees, nursing charges and surgical procedure costs of the readmission alone. The analysis however did not include indirect expenses arising out of readmissions such as loss of productivity and employment. We analyzed timing of readmissions comparing 30 day versus 60 day and 90 day occurrence of readmissions. We attempted to identify probable predisposing factors for unplanned

Table 1

Causes of readmission for the Orthopaedic unit.

CAUSES	No. Of Readmissions
Wound Related	131
Medical causes	47
Aseptic pain	31 (spine 30)
Implant related	11
Repeat trauma	10
Physiotherapy	8
Fracture related (delayed union/loss of reduction)	6
Deterioration/recurrence of neurodeficit in spine	3
Reactive Synovitis	2
Miscellaneous	15

readmissions using Health Object™ extraction software (Manufacturer: Idea objects, Chennai, India).

Statistical analysis of probable risk factors was performed. Categorical variables were expressed as percentages or total numbers. Statistical analysis of categorical variables was done via the chi square test. Statistical significance was considered if *p*-value was less than 0.05 (confidence interval 95%).

3. Results

3.1. Rates and causes of 90 day readmissions

A total of 12,729 consecutive admissions were prospectively analyzed. We noted 264 (2.07%) unplanned 90- day readmissions in 251 patients (5 patients had multiple readmissions). The leading causes of readmissions were wound related causes (*N* = 131) with equal distribution between superficial surgical site infections (SSIs) (*N* = 62) and deep SSIs (*N* = 63). The second most common cause was medical causes (*N* = 47) and this was followed by readmission for aseptic pain (*N* = 31) (Table 1).

Table 2

Distribution of readmissions under major subspecialties.

Subspecialty	Causes	No. and percentages of readmissions	Percentage of total admissions	
Trauma (<i>N</i> = 6830, Readmissions = 98)	Wound Related	57 (SSI Superficial 21 + Deep SSI 34 + Surgical site hematoma 2)	58.16%	0.83%
	Medical causes	18	18.37%	0.26%
	Implant related	7	7.14%	0.1%
	Repeat trauma	5	5.1%	0.07%
	Fracture related complications	5	5.1%	0.07%
	Physiotherapy	2	2.04%	.029%
	Pain management	1	1.02%	.015%
	Miscellaneous	3	3.06%	.044%
Arthroplasty (<i>N</i> = 1757, Readmissions = 51)	Wound related	20 (SSI Superficial 13 + deep SSI 5 + hematoma 2)	39.22%	1.14%
	Medical	14	27.45%	0.79%
	Physiotherapy	6	11.76%	0.34%
	Trauma	5	9.8%	0.28%
	Reactive synovitis	2	3.92%	0.11%
	Fracture related complication	1	1.96%	0.05%
	Miscellaneous	3	5.88%	0.17%
Spine (<i>N</i> = 2860, Readmissions = 95)	Wound Related	42 (SSI Superficial 23 + Deep 11 + organ space 8)	44.21%	1.47%
	Aseptic pain	30 (10 for recurrent disc)	31.58%	1.05%
	Medical	13	13.68%	0.45%
	Implant related	4	4.21%	0.14%
	Recurrence/worsening of neurodeficit	3	3.16%	0.1%
	Miscellaneous	3	3.16%	0.1%

Note: SSI surgical site infection.

Table 3

Temporal distribution of leading causes of readmissions under each subspecialty.

Readmission interval	Trauma	Spine	Arthroplasty	Others
<30 days (65.15%)	Wound related 42 [SSI superficial 20, deep 20, hematoma 2] Medical causes 8 [DVT 1,UTI 4]	Wound related 35 [SSI superficial 20, deep 9, organ space 6] Aseptic pain 15 Medical causes 8 [UTI 2]	Wound Related 14 [SSI superficial 10, deep 2, hematoma 2] Medical causes 10 [UTI 3,DVT 1]	Wound related 10 [SSI superficial 4, deep 4, hematoma 2] Medical causes 2 [DVT 1]
30–60 days (22.73%)	Wound related 9 [SSI superficial 1, deep 8] Medical causes 7 [DVT 5,UTI 1]	Wound related 7 [SSI superficial 3, deep 2, organ space 2] Aseptic pain 9 Medical causes 3 [UTI 1, DVT 1]	Wound related 4 [SSI superficial 2, deep 2] Medical causes 3 [UTI 1,]	Wound related 1 [SSI deep1]
60–90 days (12.12%)	Wound related 6 [SSI deep 6] Medical 3 [DVT 3]	Aseptic pain 6 Wound related nil Medical 2 [UTI 2]	Wound related 2 [SSI superficial 1, deep 1] Medical 1 [UTI 1]	Wound related 1 [SSI superficial 1]

Note: SSI surgical site infection, DVT deep vein thrombosis, UTI urinary tract infection.

3.2. Causes for readmissions in subspecialties

A summary of the causes in each subspecialty can be seen in (Table 2).

In trauma 98 (1.43%) out of 6830 patients were readmitted. Of the 18 medical causes there were 9 readmissions for deep vein thrombosis (DVT). Five of these were in fractures of the proximal femur, 2 in tibia fractures, one in a femur shaft fracture and one in an iliac wing fracture. Urinary tract infections (UTIs) were the second leading medical cause for readmissions (N=5). Implant related causes (N=7) included buried K wires, implant failures, prominent implants, and implant loosening. Fracture related complications included re-displacement of fracture and delayed union (N=5).

In spine surgery, 95 (3.32%) out of 2860 admissions were readmitted, which was the highest among all specialties. There were 30 readmissions for aseptic pain of which 10 were due to early recurrent disc prolapse. Among the medical causes (N=13), 5 were for UTIs. Four patients were readmitted for implant related causes which included malpositioned pedicle screws, posterior migration of interbody cages and pedicle screw back out.

51 (2.9%) out of 1757 patients in TJA were readmitted. Of the medical causes (N=14) in the TJA group, readmissions for UTIs (N=5) were the most frequent.

20 out of 1282 patients were readmitted in other subspecialties of paediatrics, arthroscopy, foot and ankle and skeletal oncology. This gave a readmission proportion of 1.56% with wound related causes (N=12) being the leading factor for readmissions.

Table 4

Total and mean direct costs for readmissions.

Department	Financial impact in INR	Mean cost in INR (range in INR)
Trauma	37,09,275	37849.74 (740–298700)
Spine	41,93,660	44143.79 (2625–223955)
Arthroplasty	17,70,150	34708.82 (2245–165210)
Others	4,82,685	24134.25 (3670–72150)
OVERALL	1,01,55,770	38468.82 (740–298700)

Note: INR Indian Rupee.

3.3. Temporal occurrence of readmissions

We divided the readmissions into those occurring within 30 days, between 30 days to 60 days and between 60 days to 90 days. 65.15% (N=172) of the readmissions occurred within 30 days of discharge, 22.73% (N=60) between 30 and 60 days and 12.12% (N=32) between 60 and 90 days. A summary of the temporal distribution of the major causes can be seen in (Table 3).

3.4. Number of bed days lost and financial impact

The total bed days lost to readmissions were 2010 overall and the mean bed days lost was 7.6 per patient (range one to 59 days) (8.97 days in trauma, 6.47 days in TJA and 7.33 days in spine). Direct costs' arising out of 90 day readmissions was INR 101,55,770 (\$151,936). Mean expenditures and subspecialty wise economic impact is summarized in (Table 4).

3.5. Analysis of probable risk factors

This study documented that age ≥ 70 years, prolonged hospital stay (≥ 10 days), female gender, health insurance coverage and co-morbid illnesses including ischemic heart disease, hypothyroidism and liver disease were significant risk factors for readmission ($p < 0.05$ for all). The detailed result for statistical analysis for each subspecialty is illustrated in (Table 5).

4. Discussion

Unplanned readmissions are currently an accepted tool to gauge the standard of health care at many centers.^{1,7} Though several studies exist regarding unplanned readmissions, they are frequently limited to retrospective data analysis and involve multispecialty hospital analysis.^{9,20,21} Orthopaedic studies are often restricted to 30-day analysis of readmissions following a particular procedure and thus do not offer a comprehensive analysis.^{4,9,12–17} Our study is unique due to the fact that it was a consecutive and prospective evaluation of 90 day unplanned

Table 5

Analysis of probable Risk Factors.

Risk Factor	Overall (p value)	Trauma (p value)	Spine (p value)	Arthroplasty (p value)
Age >= 70 yrs	* <0.001	* <0.001	0.93	0.29
Length of stay >= 10 days	* <0.001	* <0.001	* <0.001	* <0.001
Female gender	*0.0062	0.57	0.24	0.43
Health insurance	* <0.001	*0.008	*0.007	*0.038
Co –morbidity illnesses	IHD (* <0.001) Hypothyroidism (*0.002) Liver Disease (* <0.001)	Diabetes (*0.001) IHD (*0.001) Hypothyroidism (*0.016) Liver Disease(*0.002)	Diabetes (*0.035) Hypertension (*0.001) Liver disease (* <0.001)	Liver disease (*0.016)

Note: IHD Ischemic heart disease; "*" indicates statistically significant results $p < 0.05$.

readmissions and included an analysis of all subspecialties under an Orthopaedic unit.

The study however was limited by the fact that a multivariable logistic regression analysis was not performed to determine risk factors for readmissions.

The lowest readmission rates reported by Issa (2%) and Lovechchio (2.6%) were following readmission analysis for total knee arthroplasty and anterior cervical discectomy respectively.^{4,13} The low readmission rate of 2.07% in our study could be due to the exclusion of open injuries and polytrauma patients from trauma readmissions (Read mission rate in trauma-1.43%).

The leading cause of readmission in our study was wound related causes which accounted for 49.6% (N=131) of the readmissions. Bernatz and colleagues in their meta-analysis also showed surgical site infections (SSIs) (46.2%) as the leading cause of readmissions.²⁰ Dailey analyzed 3264 Orthopaedic admissions over 2 years and also noted surgical site complications to be the leading cause of readmissions (40.1%).²¹ Analyzing all subspecialties together, both superficial (N = 62, 23.5%) and deep SSIs (N = 63, 23.9%) accounted for almost the same number of readmissions. We noted 17.8% readmissions relating to medical causes as compared to 26.4% in the meta analysis by Bernatz et al. and 26% in the study by Dailey et al.,^{20,21} Lower rates of our medical readmissions could be attributed to the fact that the study was conducted in a specialty orthopaedic unit.

Hageman et al. reported on 3452 skeletal trauma patients and showed a 30 day readmission rate of 5.4%. Among the readmitted patients, 120 (64.5%) patients experienced a surgical adverse event and 66 (35.4%) were readmitted for a nonsurgical adverse event. The frequent adverse events were infection (N=52, 43%) and fixation failure (N = 18, 15%).²² We noted a trauma subspecialty readmission rate of 1.43% in our series, with infection and medical causes being the most common cause for readmissions. Fixation failure (implant related causes and fracture related complications) accounted for (12.24%, N = 12) and was the third leading cause of trauma readmissions.

Readmissions in lumbar spine surgery were analyzed by Pugley et al. and they found the top causes for readmissions were wound-related (38.6%), pain-related (22.4%), thromboembolic (9.4%), and systemic infections (8.0%).²³ We noted spine surgery readmissions were frequently due to SSIs (N=42, 44.21%) followed by readmission for persistent pain (N = 30, 31.58%).

Readmissions following TJA are often related to wound complications and medical causes.^{4,10,11,12,16,24} Similar results were observed in the analysis of readmissions following TJA in this study.

We noted that 87.1% of the superficial SSIs occurred within 30 days in all subspecialties. Deep SSIs however had a more varied distribution for temporal occurrence. 78.9% of deep SSIs in spine occurred within 30 days, whereas only 58.8% of the deep SSIs in trauma and 40% of deep SSIs in TJA occurred within 30 days. Thus, the 90-day model picked up an additional of 22 readmissions for

deep SSIs. Similarly, Nacke et al. noted 80.4% of spine readmissions for SSIs were readmitted within 30 days of discharge whereas only 62.2% SSIs in arthroplasty were readmitted within 30 days. However, only readmissions for deep SSIs were considered in their study.¹⁷

Among medical readmissions 75% of DVT occurred after 30 days of discharge. Readmissions for urinary tract infection showed a varied distribution across all three time periods in all subspecialties (Table 3).

Considering all readmissions, 65.15% of them occurred within 30 days of discharge. This still implies that a significant 34.85% occur beyond this interval (22.73%, N=60 in the 30 to 60 day interval and 12.12% N = 32 in the 60 to 90 day interval). Further in a tertiary care center like ours, review appointments are given four to six weeks from the date of discharge. Hence a 90-day model would be better suited to assess hospital performance.

It has been estimated that unplanned readmissions were responsible for \$17.6 billion in Medicare spending in 2004.^{1,3} With 2010 bed days being lost to readmissions with a mean of 7.6 days per readmission, a substantial number of beds essential for other elective and emergency admissions are taken up. Readmissions accounted for a financial impact of INR 1,01,55,770 during the study period with a mean of INR 38,469 (range INR 740 to INR 2,98,700) being spent per patient. Substantial numbers of inpatients were from low socio economic strata as is evident from the fact that mean per capita income was INR 13,400 in our study population. Additionally Central Statistics Office (CSO) on Advance Estimate of National Income, 2012–13 showed that India's per capita monthly income was only Rs 5729, further reiterating the substantial economic burden posed by readmissions to the patient. It was also noted that only 22.32% of patients had health insurance coverage and none of them covered the cost of readmissions. So in a population where the majority belongs to the lower income group and a vast majority pays for healthcare from their own pockets,^{18,19} unplanned readmissions prove to be a costly financial burden for the patient. Clement et al. was the only published literature to analyze the economic impact of readmissions, but only following total hip arthroplasty. They found that if Medicare stops reimbursing total hip arthroplasty readmissions, the institution under review would sustain an average net loss of \$11,494 for episodes of care with readmissions.¹²

Bernatz et al. found that in their meta-analyses; age, length of stay, discharge to skilled nursing facility, increased body mass index, ASA score greater than 3 and Medicare/Medicaid insurance showed statistically positive correlation with increased 30-day readmissions in greater than 75% of studies.²⁰ Voskuil et al. showed that every point increase in Charlson co morbidity index score adds an additional 0.45% risk for readmission in patients undergoing TJA, 0.63% for patients undergoing trauma surgery and 0.90% for spine surgery. They concluded that Charlson Comorbidity Index can be used to estimate the risk of readmission after Orthopaedic surgery.²⁵

Hageman et al. showed a significant association between readmission within 30 days of surgery and higher Charlson co morbidity index, older age and marital status (widowed) in trauma.²² Trauma readmissions in our study showed a statistically significant association with old age (≥ 70 years), prolonged hospital stay (≥ 10 days) and health insurance ($p < 0.05$ for all). Co-morbid illnesses also showed a significant risk for readmissions (diabetes mellitus $p = 0.001$, Ischemic heart disease $p = 0.001$, hypothyroidism $p = 0.016$ and liver disease $p = 0.002$) (Table 5).

Pugley et al. in their analysis of readmissions after lumbar spine surgery showed that predictors of readmission included advanced patient age more than 80 years ($p = 0.03$), African American race ($p = 0.03$), recent weight loss ($p = 0.04$), chronic obstructive pulmonary disorder ($p < 0.01$), history of cancer ($p = 0.04$), creatinine more than 1.2 ($p < 0.01$), elevated ASA class ($p = 0.01$), operative time more than 4 hours ($p = 0.01$), prolonged hospital stay more than 4 days ($p < 0.01$).²³ Readmissions in the Spine specialty in our series showed a statistically significant association with prolonged hospital stay (≥ 10 days), health insurance ($p < 0.05$ for all) and co-morbid illnesses (diabetes mellitus $p = 0.035$, Hypertension $p = 0.001$ and liver disease $p < 0.001$) (Table 5).

Clement RC et al. in their analysis of readmissions following total hip arthroplasty found that increased age, length of stay, and body mass index were associated with significantly higher readmission rates.¹² In our study readmissions in TJA showed a statistically significant association with prolonged hospital stay (≥ 10 years) ($p < 0.001$), health insurance ($p = 0.038$) and liver disease ($p = 0.016$) (Table 5).

In summary our study offers a unique perspective on 90-day unplanned readmissions which were analyzed prospectively in the setting of a tertiary care orthopaedic unit in a developing nation.

5. Conclusion

This study showed wound related problems to be the leading cause of readmissions. The 90-day model picked up an additional 92 (34.85%) readmissions. Analysis of deep SSIs in each subspecialty documented that 21.1% in spine, 41.2% in trauma and 60% in TJA presented after the 30 day interval thus reemphasizing the importance of a 90 day study in future analysis. Readmissions resulted from complications occurring during pre-operative, intra-operative and post-operative period, reinforcing the need for eternal vigilance to ensure quality health care delivery and reduce the financial burden to the patient.

Conflict of interest

Each author certifies that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

All ICMJE Conflict of Interest Forms for authors have been submitted online with the manuscript.

Funding

The study was funded by (GOREF) Ganga Orthopaedic Research and Education Foundation. The funding was to the institution and not directly paid to any author.

Ethical approval

The study was approved by the Institutional review board.

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