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Unadjusted Unplanned 30-Day Hospital Readmission Rates are Not a Useful Quality Measure for Planned or Urgent Orthopaedic Inpatient Care

A Retrospective Cohort Study

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Background: We examined the number of patients who experienced an unplanned hospital readmission following an episode of inpatient care in a tertiary level trauma and orthopaedic service, the reasons for readmission and whether these reasons related to lapses in care, care and service delivery problems, and missed healthcare intervention opportunities and whether they were or should have been prevented and anticipated. We hypothesized that most 30-day readmissions would be unrelated to the original complaint and admission, and the reasons for readmission would not be truly avoidable or attributable to the index hospital admission. We further hypothesized that socioeconomic factors would be predictive of the likelihood of unplanned hospital readmission within 30 days of hospital discharge.

Methods: Over a 5-year study period, we identified all adult patients discharged from our unit and those who had an unplanned readmission within 30 days of discharge. We evaluated the reasons for readmission and assessed the impact of socioeconomic deprivation and social determinants of health on the likelihood of unplanned 30-day readmission using multivariable logistic regression.

Results: Fifteen thousand three hundred thirteen patients were discharged from our unit over the study period. 690 patients (4.5%) were readmitted within 30 days of discharge as an unplanned episode of care. 58.4% of unplanned readmissions were directly related to the index admission, but only 9% of readmissions were preventable. The single most frequent reason for readmission was an unrelated noninfective medical complaint, 244 patients (35.4%). Social determinants of health influenced the risk of an unplanned readmission, particularly the Index of Multiple Deprivation and the subdomains related to housing, the living environment, social services, and support.

Conclusions: The 30-day readmission rate as a marker of quality for inpatient care should be questioned. It is not useful as an unadjusted metric and can be misleading. Adjusting for socioeconomic influences, preventability of readmissions, and missed opportunities to improve whole health may improve its usefulness.

Level of Evidence: Level III. See Instructions for Authors for a complete description of levels of evidence.

Introduction

The unplanned 30-day hospital readmission rate is a recognized and widely used indicator for the quality of inpatient hospital care[1-4]. A number of studies have explored the reasons why patients are readmitted to hospital soon after an episode of inpatient care[4-6]. Many of these have found that the reasons for readmission are often avoidable and may relate to lapses in care, an avoidable complication of treatment or inadequate preparation of the patient for hospital discharge[6]. Unplanned readmissions are viewed as a negative marker of quality of care, and as a result, a number of healthcare systems impose financial or performance sanctions on hospitals with

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high levels of unplanned 30-day readmissions as a quality improvement and cost reduction measure[7]. This approach has been shown to reduce readmissions for specific groups[8].

We hypothesized that most 30-day readmissions for patients in the trauma and orthopaedic service would be unrelated to the original orthopaedic complaint and were not truly avoidable or indicative of a failing related to the index hospital admission. We further hypothesized that socioeconomic factors would be strongly predictive of the likelihood of unplanned hospital readmission within 30 days.

Methods

We retrospectively identified all patients discharged from the trauma and orthopaedic surgery service in a large urban tertiary center. The unit serves a large metropolitan area providing routine trauma and orthopaedic surgical care and also hosts the major trauma center. We identified patients from hospital electronic records and included adult patients aged 18 years and older who were discharged from an index admission to our trauma and orthopaedic surgery service between 1 January 2019 and 31 December 2023. We identified all those patients discharged from our unit during this study period and evaluated our hospital data and patient records to identify those who had an unplanned readmission within 30 days of discharge.

Our tertiary academic unit serves a metropolitan population of 1.5 million and includes a regional major trauma center alongside specialized services for complex trauma, trauma reconstruction, and bone/soft tissue infection. The socioeconomic profile of our patient cohort varies widely, encompassing some of the most deprived areas (Index of Multiple Deprivation [IMD] rank 3035) in close proximity to some of the most affluent (IMD rank 28,407). The unit is served by 2 emergency departments where all urgent and emergent cases are initially assessed. In addition, a large volume of planned elective outpatient and inpatient surgery is performed across all orthopaedic subspecialties, with the exception of tumor surgery.

The electronic patient record for each patient who had an unplanned readmission was reviewed in detail by one of the authors, an orthopaedic surgeon, to determine the reasons for and the timing of readmission. An assessment was made as to whether the readmission was directly related to the index admission. To make this determination, we adapted the criteria defined by Goldfield, McCullough, and Hughes[9]. A patient readmission was judged to be related to the index admission if it was

- A readmission for a continuation or recurrence of the reason for the initial admission, or for a closely related condition.
- A readmission for an acute decompensation of a chronic problem that was not the reason for the initial admission but was possibly related to care either during or immediately after the initial admission.
- A readmission for an acute complication or symptom management possibly related to care during the initial admission.
- A readmission for a surgical procedure to address a continuation or a recurrence of the problem causing the initial admission.
- A readmission for a surgical procedure to address a complication resulting from care during the initial admission.

The electronic patient record was reviewed by 2 additional expert reviewers, a senior nurse and an acute physician. Each of the 3 reviewers independently examined the patient records to identify any lapses in care or standards, care and service delivery problems, or whether the readmission could or should have been anticipated and prevented. If any of the 3 reviewers identified such an issue, then the readmission was considered to be preventable.

Socioeconomic deprivation was defined using the Index of Multiple Deprivation (IMD), a nationally validated and geographically based measure of deprivation[10]. This combines information from 7 domains: income, employment, education, health, crime, housing, and living environment. Geographic areas across the country, defined by the postcode, are assigned a rank for the IMD, between 1 and 32,844. Lower ranks indicate greater socioeconomic deprivation, and ranks are commonly grouped into deciles to allow group analysis. Each rank includes approximately 1,500 people.

Each patient was assigned a rank and percentile for the IMD, based on data from the Office of National Statistics. These patients were grouped into deciles where the first (lowest) decile represents patients in the most socially disadvantaged group, and the tenth (highest) decile represents the least socially disadvantaged group.

Further statistical analysis was undertaken to assess the influence of 2 of the subdomains: barriers to housing and services and the living environment. These subdomains of the IMD represent levels of community housing, social service accessibility, and support as well as the internal and outdoor living environment.

The primary outcomes for our study were the number and predictors for unplanned 30-day patient readmissions following an index hospital admission. Secondary outcomes included the number of hospital admissions that were attributable to the index admission and, therefore, potentially avoidable. We examined the reasons for unplanned hospital readmissions and looked for any associations with socioeconomic deprivation.

Statistical Analysis

Continuous data were checked for normality with histograms. We undertook a univariate analysis to identify predictors for those patients who would have an unplanned hospital readmission within 30 days of discharge from their index hospital admission. The Mann-Whitney U test was used to compare nonparametric continuous data including patient age and length of stay (index admission). χ^2 tests were used to compare data for categorical data including sex, type of admission (index), American Society of Anesthesiology (ASA) grade, IMD decile, barriers to housing and services decile, and living environment decile. Variables which were predictive for 30-day hospital

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readmission after univariate analysis were included in a multivariate logistic regression analysis to assess these variables as independent predictors of 30-day hospital readmission. Data analysis was performed using SPSS 29.0 software (SPSS Inc). Statistical significance was assumed where a p of < 0.05 was obtained. Two-tailed p values are quoted.

Results

Over the 5-year study period, 15,313 patients were admitted to the trauma and orthopaedic surgery service. 6,431 (41.9%) patients were men. 690 patients (4.5%) were readmitted for unplanned care within 30 days of discharge. These patients formed the study group. No patient was readmitted more than once within 30 days of hospital discharge.

Of the 690 patients readmitted within 30 days, 345 patients (50%) were women. The median patient age in this group was 64 (SD 21) years. Patient demographic data are summarized in Table I. The distribution of measures of deprivation for readmitted patients is shown in Figs. 1-A, 1-B and 1-C.

Univariate analysis indicated that several factors were predictive for an unplanned hospital admission within 30 days of the index admission: increasing patient age; male sex; urgent, trauma, or emergency index admission; lower (more disadvantaged) patient group decile for IMD; barriers to housing and services; and the living environment. Length of stay for the index admission and ASA grade were not predictive for an unplanned readmission (Table I). After multivariable logistic regression analysis, a reduced number of variables remained predictive: increasing patient age; urgent, trauma, or emergency index admission; lower (more disadvantaged) patient group decile for IMD; barriers to housing and services; and living environment (Table II).

Older patients were more likely to be readmitted compared with younger patients. The IMD decile was inversely associated with readmission odds. Specifically, for each unit increase in the IMD decile, the odds of readmission decreased by 28% (OR = 0.72, 95% CI: 0.70-0.74, p < 0.001). Higher deciles for barriers to housing were associated with a 35% reduction in the odds of readmission (OR = 0.65, 95% CI: 0.62-0.68, p < 0.001). Patients with fewer barriers to housing, social services, support and a less deprived living environment were significantly less likely to be readmitted (Table II).

Patients admitted on an urgent, trauma, or emergency pathway had significantly higher odds of readmission compared with those admitted on a planned elective pathway (OR = 2.72, 95% CI: 2.55-2.90, p < 0.001).

The interval between index orthopaedic admission and unplanned readmission was a median of 7 (8.4) days. 70.6% of patients who were readmitted in an unplanned way were readmitted following an urgent or emergency episode of care (Table III). The most common reason for an unplanned readmission was a noninfective medical complaint, unrelated to the index admission (Table IV). One hundred and eight patients (15.7%) were readmitted because of a nonsurgical site infection. Of these, 64 patients had a nonsurgical site infection which was attributable to the index orthopaedic admission.

In total, 403 patients (58.4%) who had an unplanned readmission within 30 days of the index admission were readmitted for a reason, which was directly related to the index admission. 62 patient readmissions (9%) were related to an identifiable lapse in care, care and service delivery failing, or a cause that could have been predicted or anticipated during the index admission. The median length of stay for a readmission was 2 (11.3) days.

Discussion

Unplanned hospital readmissions have an obvious financial impact but are also potentially harmful for patients:

TABLE I Patient Demographics and Univariate Analysis

	Total 15,313 (100%)	Readmitted 690 (4.5%)	Not Readmitted 14,623 (95.5%)	p	
Age *years*	54 (15.2)	64 (21)	53 (15.3)	p < 0.001	Mann-Whitney U test
Men *n*	6,431 (41.9%)	345 (50%)	6,086 (41.6%)	p < 0.001	χ^2 test
Urgent, trauma, or emergency index admission *n*	9,494 (62%)	487 (70.6%)	9,007 (61.6%)	p < 0.001	χ^2 test
Length of stay (index admission) *days*	5 (7.5)	5 (11)	5 (7.3)	p = 0.442	Mann-Whitney U test
ASA				**p = 0.322**	**χ^2 test**
I	**2,611 (17.1)**	**98 (14.2)**	**2,513 (17.2)**		
II	**7,104 (46.4)**	**221 (32)**	**6,883 (47.1)**		
III	**3,388 (22.1)**	**257 (37.2)**	**3,131 (21.4)**		
IV	**2,210 (14.4)**	**114 (16.5)**	**2096 (14.3)**		
Socioeconomic Deprivation					
Index of multiple deprivation decile	6 (2.7)	6 (2.3)	6 (2.7)	p < 0.05	χ^2 test
Barriers to housing and services	6 (2.9)	4 (1.7)	6 (2.9)	p < 0.001	χ^2 test
Living environment	5 (2.7)	2 (1.3)	5 (2.7)	p < 0.001	χ^2 test

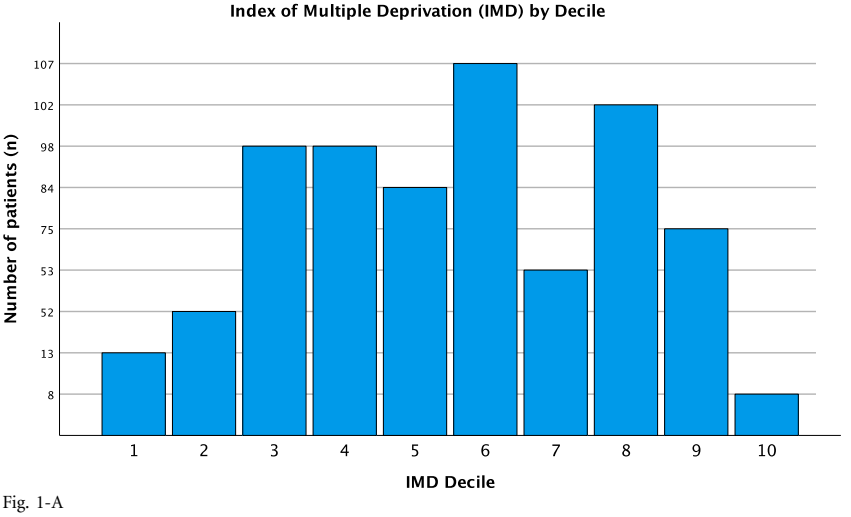

Fig. 1-A

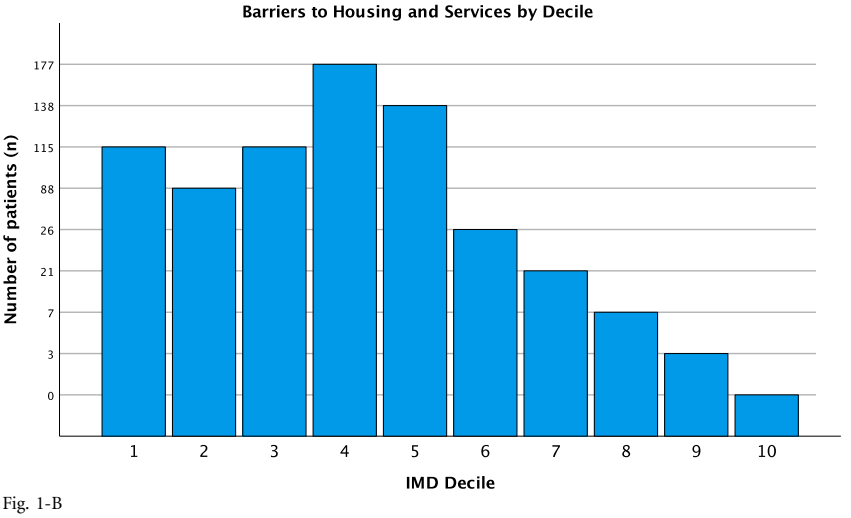

Fig. 1-B

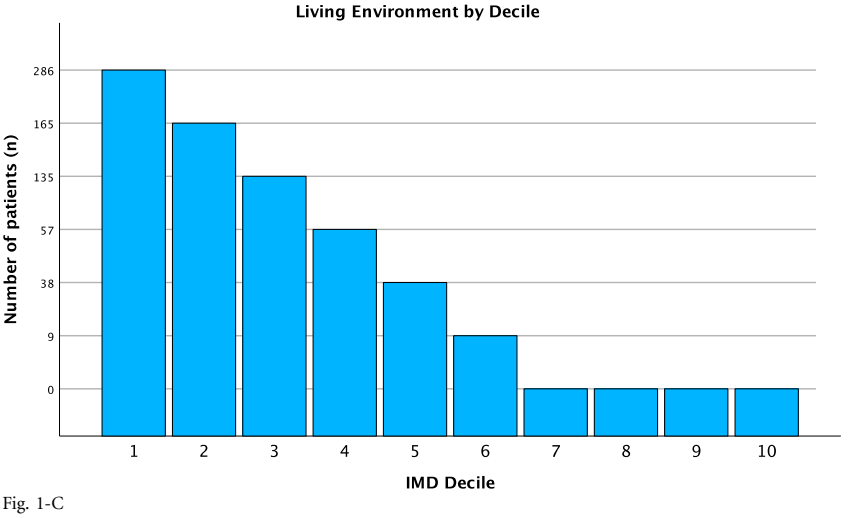

Fig. 1-C

Fig. 1-A Distribution of readmitted patients by IMD decile. Lower deciles reflect worse socioeconomic deprivation. **Fig. 1-B** Distribution of readmitted patients by barriers to housing and services subdomain decile. Lower deciles reflect worse socioeconomic deprivation. **Fig. 1-C** Distribution of readmitted patients by living environment subdomain decile. Lower deciles reflect worse socioeconomic deprivation. IMD = Index of Multiple Deprivation.

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TABLE II Multivariable Logistic Regression Analysis of Significant Factors for Unplanned Readmission Within 30 Days

Predictor	Coefficient (B)	Odds Ratio	95% CI	p
Age	0.04	1.04	1.03-1.05	<0.05
IMD decile	−0.33	0.72	0.70-0.74	<0.001
Living environment decile	−0.29	0.75	0.73-0.77	<0.001
Barriers to housing decile	−0.43	0.65	0.62-0.68	<0.001
Urgent, trauma, or emergency index admission	1.00	2.72	2.55-2.90	<0.001

delaying recovery, resumption of normal activities, and the ability to contribute to the community, socially and economically[11]. The use of rates of 30-day unplanned readmission as a marker of performance or quality of hospital care is well established[2,3], and, in some cases, this is associated with financial penalties[3,4]. The premise is that these readmissions are related to lapses of care or failings in the index admission and so with high-quality care and appropriate discharge planning, many of these readmissions should be avoidable, care quality is improved, and costs are reduced.

Previous studies provide support the premise that in many cases, the reasons for an unplanned readmission are indeed related to the index admission[12-14]. Our study also supports this but also shows that the proportions of patients readmitted for reasons related to their original admission and those where the reason was unrelated, are more closely matched than has previously been reported. In addition, the detailed review undertaken by our clinical assessors indicated that a much smaller proportion of the readmissions were related to identifiable lapse in care, failure to meet a clinical standard or a care, and service delivery problem such as a delay in care or treatment. Such a failing was identified in only 9% of readmitted cases, which calls into question whether the remaining readmitted cases were truly preventable. For these cases, the influence of socioeconomic deprivation and wider socioeconomic determinants of health may be important and so financial and other sanctions applied to healthcare providers may not be appropriate in these cases and may deter providers from providing high-quality health care to the most vulnerable populations.

TABLE III Categorized Reasons for Index Admission for Those Patients Who Had an Unplanned Readmission Within 30 Days

Reason for Readmission	n (%)
Planned/elective care	**203 (29.4)**
Elective joint replacement and other procedures	110 (15.9)
Soft tissue reconstruction/procedure	36 (5.2)
Limb reconstruction for deformity/trauma/infection	57 (8.3)
Urgent/emergency pathway	**487 (70.6)**
Lower limb and pelvic fracture/dislocation	199 (28.8)
Hip fracture	101 (14.6)
Upper limb fracture/dislocation	70 (10.1)
Infection	43 (6.2)
Soft tissue injury	16 (2.3)
Periprosthetic fracture/dislocation	21 (3.0)
Gout/arthritis/radiculopathy	26 (3.8)
Malignancy	2 (0.3)
Spinal fracture	9 (1.3)

The most common reason for an unplanned readmission was an unrelated noninfective medical complaint such as a cardiac event, cerebrovascular accident, or thromboembolism. Nevertheless, this metric is important and should not be completely discounted. Even where the reason for readmission is not easily and obviously related to the index admission, a high rate of readmissions, even for seemingly unrelated reasons, may be an indication of care and discharge planning that is not well joined up or integrated, to meet the whole-health needs of the patient and where opportunities to improve patient health are missed. Nevertheless, it is important to recognize that only 9% of the unplanned readmissions in our cohort were judged to be preventable or related to care or the omission of care during the index admission. Reporting and models which use this unadjusted metric as a marker of quality should therefore be questioned.

Socioeconomic deprivation has been clearly shown to affect the access to and outcomes from trauma and orthopaedic surgery[15-17]. There has been increasing recognition and a public health focus on the importance of social determinants of health (SDOH). The influence of critical social influencing factors on health is now more generally recognized, and key priority areas have been set out to positively affect population and individual health through public health interventions. These seek to address safe housing, transportation, and neighborhoods; racism, discrimination, and violence; education, job opportunities, and income; access to nutritious foods and physical activity; polluted air and water; language; and literacy skills[18].

The data from our study would support these areas of focus. Our study showed that better socioeconomic status, improved living environments, and fewer barriers to housing, social care, and social supports are associated with reduced odds of readmission. Our data demonstrate that socioeconomic disadvantage increases the likelihood of an unplanned readmission within 30 days after inpatient episode of trauma and orthopaedic surgery care. It was noticeable that there was a marked difference when comparing the subdomains of the IMD which reflect housing, living environment, and access to

TABLE IV Categorized Reasons for Unplanned Readmission Within 30 Days

Reason for Unplanned Readmission	n (%)	Preventable Readmissions n (%)
Noninfective medical complaint	244 (35.4)	5 (0.7)
Lower respiratory infection/pneumonia/aspiration	**32 (4.6)**	**6 (0.9)**
Urinary tract infection/catheter problem	**22 (3.2)**	**0 (0)**
Suspected sepsis/infection of unknown origin	**6 (0.9)**	**6 (0.9)**
Septic arthritis	**5 (0.7)**	**5 (0.7)**
Surgical site–related infection/complication	108 (15.7)	36 (5.2)
Fall/trauma/fracture/dislocation	194 (28.1)	0 (0)
Pain	54 (7.8)	3 (0.4)
Social reason	25 (3.6)	1 (0.1)

social care and support for these patient groups. Our study suggests what seems intuitive, that successful discharge from hospital relies on effective and accessible community support and services.

There are a number of limitations to our study. As a retrospective analysis, the risks of accurate data capture and recording must be acknowledged. There is also a potential risk that patients may have obtained treatment and been readmitted elsewhere. In mitigation, the electronic patient record is a shared system among the 4 central hospitals providing acute care, so we were able to review all relevant admissions within our metropolitan area.

The reasons for unplanned readmission after hospital care are complex. The findings from our study reflect this complexity and the important influence of SDOH and socioeconomic disadvantage. It is also noteworthy that while the majority of readmissions were directly related to the index orthopaedic admission, only 62 patient readmissions (9%) were truly preventable. This mirrors the findings of a large and well-designed whole population study[19].

In this context, the unadjusted rate of 30-day unplanned readmissions as a marker of quality for trauma and orthopaedic care can be misleading and its value should be questioned. Hospital providers which serve areas of marked socioeconomic deprivation may be disadvantaged by this measure, and financial penalties may be disproportionately leveraged against hospitals serving disadvantaged communities. A revised approach that includes socioeconomic adjustments and considers broader health determinants is recommended to reflect hospital performance more accurately and to promote equitable healthcare planning and practices. Specifically, the question of preventability should be considered and missed opportunities to intervene and improve whole health. It should be considered whether, instead of a blanket approach where financial penalties are applied to hospitals where 30-day readmission rates are high, additional resources and support should be offered for those hospital providers which serve populations with the greatest socioeconomic deprivation and where socioeconomic and social service support is limited. ■

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