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Characteristics and clinical outcomes of index versus non-index hospital readmissions in Australian hospitals: a cohort study*

Yogesh Sharma[1,2,6] MBBS, MD, FRACP, PhD, Senior Consultant and Senior Lecturer

Chris Horwood[3] BSc, MPH, Clinical Epidemiologist

Paul Hakendorf[3] BSc, MPH, Clinical Epidemiologist

John Au[4] MBBS(Hons), Intern and Clinical Associate Lecturer

Campbell Thompson[5] MD, DPhil, FRACP, FRCP, Professor of Medicine

[1]Department of General Medicine, Flinders Medical Centre, 1 Flinders Drive, Bedford Park, SA 5042, Australia.
[2]College of Medicine and Public Health, Flinders University, Sturt Road, Bedford Park, SA 5042, Australia.
[3]Department of Clinical Epidemiology, Flinders Medical Centre, 1 Flinders Drive, Bedford Park, SA 5042, Australia.
Email: chris.horwood@sa.gov.au; paul.hakendorf@sa.gov.au
[4]Department of General Medicine, Royal Adelaide Hospital, Port Road, Adelaide, SA 5000, Australia.
Email: johnauos@gmail.com
[5]Discipline of Medicine, University of Adelaide, Adelaide, SA 5005, Australia.
Email: campbell.thompson@adelaide.edu.au
[6]Corresponding author. Email: Yogesh.Sharma@sa.gov.au

Abstract

Objective. Risk factors and clinical outcomes of non-index hospital readmissions (readmissions to a hospital different from the previous admission) have not been studied in Australia. The present study compared characteristics and clinical outcomes between index and non-index hospital readmissions in the Australian healthcare setting.

Methods. This retrospective cohort study included medical admissions from 2012 to 2016 across all major public hospitals in South Australia. Readmissions within 30 day to all public hospitals were captured using electronic health information system. In-hospital mortality and readmission length of hospital stay (LOS) were compared, along with 30-day mortality and subsequent readmissions among patients readmitted to index or non-index hospitals.

Results. Of 114 105 index admissions, there were 20 539 (18.0%) readmissions. Of these, 17 519 (85.3%) were index readmissions and 3020 (14.7%) were non-index readmissions. Compared with index readmissions, patients in the non-index readmissions group had a lower Charlson comorbidity index, shorter LOS and fewer complications during the index admission and were more likely to be readmitted with a different diagnosis to the index admission. No difference in in-hospital mortality was observed, but readmission LOS was shorter and 30-day mortality was higher among patients with non-index readmissions.

Conclusion. A substantial proportion of patients experienced non-index hospital readmissions. Non-index hospital readmitted patients had no immediate adverse outcomes, but experienced worse 30-day outcomes.

What is known about the topic? A significant proportion of unplanned hospital readmissions occur to non-index hospitals. North American studies suggest that non-index hospital readmissions are associated with worse outcomes for patients due to discontinuity of care, medical reconciliation and delayed treatment. Limited studies have determined factors associated with non-index hospital readmissions in Australia, but whether such readmissions lead to adverse clinical outcomes is unknown.

What does this paper add? In the Australian healthcare setting, 14.7% of patients were readmitted to non-index hospitals. Compared with index hospital readmissions, patients admitted to non-index hospitals had a lower Charlson comorbidity index, a shorter index LOS and fewer complications during the index admission. At the time of readmission there was no differences in discharge summary completion rates between the two groups. Unlike other studies, the present study found no immediate adverse outcomes for patients readmitted to non-index hospitals, but 30-day outcomes were worse than for patients who had an index hospital readmission.

*This study was registered with Australia and New Zealand clinical trials registry (ANZCTRN 12617001362381).

What are the implications for practitioners? Non-index hospital readmissions may not be totally preventable due to factors such as ambulance diversions stemming from emergency department overcrowding and prolonged emergency department waiting times. Patients should be advised to re-present to hospital in case they experience recurrence or relapse of a medical condition, and preferably should be readmitted to the same hospital to prevent discontinuity of care.

Additional keywords: in-hospital mortality, length of hospital stay.

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Introduction

The rates of readmission are often used to assess care quality provided by institutions because unplanned hospital readmissions can be costly and some are avoidable.[1] Unplanned readmissions usually occur to the same hospital that discharged the patient ('index hospital readmissions'), but approximately 20–30% of unplanned readmissions are to a different hospital ('non-index hospital readmissions').[2,3] A report from the Bureau of Health Information suggests that in New South Wales, between 14% and 20% of patients discharged with four common clinical conditions (congestive heart failure, pneumonia, acute myocardial infarction and stroke) were readmitted to a different hospital.[4] In fact, non-index hospital readmission rates can exceed 60%;[5] therefore, readmission rates are more meaningful when calculated on unplanned readmissions to all hospitals in a region rather than just the index hospital.

In North America, factors associated with increased rates of non-index hospital readmissions include the index hospital being a for-profit institution, being affiliated with a major medical school and being a low-volume hospital, or relate to the patient having a Medicare-defined disability.[2,6,7] Other reasons offered for non-index-hospital readmissions include hospital proximity, capacity constraints, ambulance diversions, specialist availability and complexity of disease.[2,7,8]

Within Australia, when a hospital is 'full' and access block is present in the emergency department (ED), ambulances ferrying imminent admissions can be diverted to another institution. This can result in a patient, habitually cared for at one institution, being readmitted to an alternative hospital, potentially compromising the efficiency and quality of care. Non-index hospital cases may be disadvantaged in terms of discontinuity of care, lack of ready access to medical records and duplication of investigations, which may delay treatment.[9–11] Conversely, non-index hospital readmission may lead to an unbiased second opinion with possible rectification of prior faulty diagnoses, and the patient may be seen by a new team not dispirited by an individual's multiple admissions. These counterpoising factors may have an uncertain effect on patients' clinical outcomes.

The North American literature is relatively clear on the consequences of non-index hospital readmissions. A large US study of over 20 million admissions reported higher in-hospital mortality and length of stay (LOS) if patients were readmitted to a non-index hospital.[12] Other studies confirmed the greater LOS and a higher 30-day mortality, and found higher costs with non-index hospital readmissions.[2,3,13] These adverse consequences could be due to inadequate exchange of health information, inaccurate medication reconciliation and lack of coordination across sites of care.[12,14]

The corresponding situation in Australia has not yet been studied thoroughly. Therefore in the present study we retrospectively compared the characteristics and outcomes of patients who had index and non-index hospital readmissions. We hypothesised that non-index hospital readmissions are associated with higher mortality and increased LOS than index hospital readmissions; such a finding would suggest that discharge processes should encourage patients to re-present to the discharging institution if readmission seems likely, and would also suggest that we should discourage, where possible, the diversion of ambulances at times of access block, because diversions may facilitate discontinuous, potentially unsafe and inefficient care.

Methods

Study location and participants

Data for this study were collected for all unplanned adult medical admissions aged ≥18 years, admitted to eight public hospitals in Adelaide, South Australia, between July 2012 and June 2017. The hospitals included in this study were the Flinders Medical Centre (FMC), Royal Adelaide Hospital (RAH), Lyell McEwin Hospital, Modbury Hospital, Queen Elizabeth Hospital, Repatriation General Hospital, Noarlunga Hospital and Women's and Children's Hospital. Subsequent unplanned readmissions within 30 days to any of the major public hospitals of South Australia were included. Patients who only had an index admission under surgical, gynaecological or psychiatric departments of the participating hospitals were excluded. Ethics approval was obtained from Southern Adelaide Clinical Human Research Ethics Committee (SAC HREC; No. 216.17) on 4 August 2017, and the study was registered with Australia and New Zealand clinical trials registry (ANZCTRN 12617001362381).

Data collection and variables of interest

Electronic records were retained if the admission consisted of a single acute episode of care within the one hospital (i.e. no transfers), the admitting clinical unit was a medical unit and the patient was discharged home or to an aged care facility (Stage 1). Stage 2 of the case selection process was to identify the next (if any) unplanned readmission for each of the cases selected in Stage 1; if a subsequent unplanned readmission occurred to any of Adelaide's eight major public hospitals (which provide complex medical, surgical and diagnostic support services) within 30 days of discharge, then the index admission record was retained, otherwise it was discarded. An unplanned readmission was defined as any readmission that was not a scheduled admission for some procedure (e.g. endoscopy, biopsy etc.), transfusion (e.g. blood, iron infusion) or administration of planned chemotherapy. This does not include hospital presentations who

were never admitted and hence were discharged directly from the ED. Identifying readmissions to hospitals different from the index admission was made possible by way of a patient master index lookup table available from the central office of the South Australian Department of Health. The final stage of the case selection process involved limiting the dataset such that no patient ID could appear in the case list more than once, so the first chronological admission record for any given patient was retained and the rest discarded.

The dataset contained the following fields relating to the index admission: hospital ID, patient ID, age, sex, date and time of admission and discharge, expected LOS, discharge destination, discharge summary completion date, principal and secondary diagnoses (coded using International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) diagnosis codes), principal and secondary procedures (coded using ICD-10 procedure codes) and the major diagnostic category (MDC), based on the principal diagnosis. Using these data we were able to determine the inpatient LOS and derive a Charlson comorbidity index (CCI)[15] based on the coded diagnoses and procedures; the diagnoses data were also searched for conditions flagged as nosocomial, which we classified as complications of the index admission, leading to a count of complications for each case. The relative stay index (RSI)[16] was calculated by dividing actual LOS by expected LOS. Expected LOS is a value made available by central office and is derived from a combination of patient age, the diagnosis-related group (DRG)[17] assigned to the separation and the DRG-specific coefficients provided by the Australian Institute of Health and Welfare.[18]

For the subsequent unplanned admission, the data items captured were hospital ID, date and time of admission and discharge, expected LOS, discharge destination, MDC and death date. Using these data, we were able to determine the number of days from discharge to readmission and the subsequent LOS, and, in conjunction with the expected LOS, derive an RSI. By comparing the hospital ID of the index admission with that of the subsequent admission we were able to categorise each readmission as either to the same hospital or to an alternative hospital; similarly, we compared the MDC of the index admission with that of the subsequent admission to derive a yes/no variable for 'same MDC'. The readmission was presumed to be related to the index admission if the MDC of the two admissions was the same. Only unplanned admissions were included, and all planned admissions were excluded. Similarly, palliative care and same-day episodes of care were excluded. We also searched for a second planned readmission within 30 days of discharge from the first unplanned readmission.

The final process was to count, for each case, unplanned admissions to any of the Adelaide's eight major public hospitals in the 6 months before the index admission; these counts were then converted into a three-category variable: no prior admissions, one prior admission and more than one prior admission.

Statistical analyses

The dataset was divided into two groups: those for whom the readmission was to the same hospital and those who were readmitted to a different hospital. We converted the continuous variable CCI into a two-category variable: CCI <2 versus CCI ≥2. Similarly, we converted the count of complications into a two-category variable: complications count = 0 versus complications count > 0. The discharge summary completion date was compared with the readmission date to generate a yes/no variable that indicated whether or not a discharge summary had been completed before the readmission.

Comparisons between the two groups were then conducted for the continuous variables age and RSI using a Wilcoxon rank-sum test, whereas Pearson's Chi-squared test was used for comparisons of the following categorical variables: any admissions in the 6 months prior, sex, same MDC, CCI, complications, discharge summary completion, death in hospital, death within 30 days of unplanned readmission (starting at admission and including in-patient deaths) and a second unplanned readmission within 30 days. We combined the two variables 'second unplanned readmission within 30 days' and 'death within 30 days of unplanned readmission' into a single yes/no variable 'adverse outcome within 30 days'; this variable was given a value label 'yes' if there was either another unplanned readmission or death.

We assessed the effect of readmission site on RSI by way of linear regression, adjusting for age, sex and CCI because all three have been shown to be associated with in-patient LOS.[19,20]

All statistical analyses were performed using Stata version 15.1 (StataCorp, College Station, TX, USA).

Results

There were 24 185 readmissions within 30 days of hospital discharge, of which 20 539 (84.9%) were unplanned and 3646 (15.1%) were planned. Eighteen per cent of hospitalised patients had an unplanned readmission within 30 days of hospital discharge from the index hospital. Of these, 17 519 (85.3%) were readmitted to the index hospital and 3020 (14.7%) were readmitted to a non-index hospital (Table 1). Compared with those admitted to the index hospital, patients admitted to a non-index hospital were of similar age and sex but had a lower CCI score, a shorter LOS during index hospitalisation and had a higher number of unplanned admissions in the 6 months preceding the index hospitalisation (Table 1). The average number of days from the index discharge to the first unplanned readmission was 1 day greater in the non-index hospital group. There was no difference between the two groups with regard to the day of the week of the next hospital readmission. Of the patients readmitted to the index hospital rather than to any non-index hospital, a significantly higher proportion had the same principal diagnosis as during their previous admission. Of the patients who had an index rather than non-index hospital readmission, a significantly higher proportion had experienced at least one complication during their index hospitalisation (Table 1). There was no difference in the separation summary completion rate between the two groups by the time of the next hospital readmission.

The median readmission LOS was significantly shorter (~10%) if patients were readmitted to a non-index than to an index hospital. There was no difference in in-hospital mortality between patients readmitted to a non-index versus index hospital (Table 2). Unadjusted mortality within 30 days after readmission was not significantly different between the two groups, although patients who had a non-index hospital readmission were at a significantly higher (22%) risk of death after adjustment for age,

Table 1. Characteristics of index and non-index readmissions

Of a total of 114 105 admissions, there were 20 539 (18%) readmissions. Unless indicated otherwise, data are given as *n* (%) or as the median (interquartile range). CCI, Charlson comorbidity index; LOS, length of hospital stay; RSI, relative stay index; MDC, major diagnostic category

Variable	Index hospital readmission	Non-index hospital readmission	*P*-value
No. patients	17 519 (85.3)	3020 (14.7)	
Age (years)	72 (57–82)	72 (56–82)	0.82
Sex			
Female	8414 (48.0)	1484 (49.1)	
Male	9105 (52.0)	1536 (50.9)	0.26
CCI	1 (0–3)	1 (0–2)	<0.001
CCI group[A]			
0	9619 (54.9)	1862 (61.7)	
1	7900 (45.1)	1158 (38.3)	<0.001
LOS of index admission (days)	3.8 (1.9–7.4)	3.5 (1.7–6.8)	<0.001
RSI	0.77 (0.44–1.31)	0.73 (0.39–1.25)	<0.001
Complications during index admission	3772 (21.5)	577 (19.1)	0.003
Previous admissions[B]	2419 (13.8)	496 (16.4)	<0.001
Weekend readmission	2194 (12.5)	389 (12.9)	0.46
Time to first readmission (days)	10 (4–19)	11 (4–20)	<0.001
Completion of index admission separation summary	4091 (82.8)	494 (81.4)	0.38
MDC same as previous admission	7540 (45.4)	1075 (38.0)	<0.001

[A]CCI was converted to a two-parameter variable: Group 0, CCI <2; Group 1, CCI ≥2.
[B]Two or more readmissions in the 6 months before the index admission.

Table 2. Clinical outcomes for index versus non-index hospital readmissions

Unless indicated otherwise, data are given as *n* (%) or the median [interquartile range]. aOR, adjusted odds ratio; CI, confidence interval; LOS, length of hospital stay; RSI, relative stay index

Outcome	Index hospital readmission (*n* = 17 519)	Non-index hospital readmission (*n* = 3020)	*P*-value
Readmission LOS (days)	3.3 [1.1–7.5]	3.0 [0.3–7.7]	<0.001
RSI of index admission	0.71 [0.35–1.30]	0.61 [0.27–1.21]	<0.001
In-hospital mortality[A]	1020 (5.8)	177 (5.9)	0.933
aOR (95% CI) for in-hospital mortality[B]		1.09 (0.92–1.29)	0.306
Mortality within 30 days of readmission[C]	1469 (8.4)	278 (9.2)	0.14
aOR (95% CI) for mortality within 30 days of readmission[B]		1.22 (1.06–1.40)	0.006
Unplanned readmissions within 30 days[D]	4415 (26.8)	790 (27.8)	0.25
aOR (95% CI) for unplanned readmissions[B,D]		1.08 (0.98–1.18)	0.086
Combined adverse end-point within 30 days of readmission[E]	5657 (32.3)	1020 (33.8)	0.11
aOR (95% CI) for combined adverse end-point[B]		1.12 (1.03–1.22)	0.006

[A]Mortality during readmission.
[B]Model adjusted for age, sex and Charlson comorbidity index.
[C]Mortality within 30 days of first readmission, including in-hospital deaths.
[D]Readmissions within 30 days of discharge after the first readmission.
[E]Mortality or readmission within 30 days of the first readmission.

sex and CCI. No difference was found in the subsequent 30-day readmission rate between the two groups (Table 2). After adjustment for age, sex and CCI, patients in the non-index hospital group had a 12% higher risk of having a combined clinical outcome of readmission or death within 30 days after their first readmission (Table 2).

Discussion

Unplanned hospital readmissions represent an adverse health service outcome and pose a serious economic challenge to society. In the present observational cohort study, we found that the overall 30-day readmission rate was 18%, and a substantial proportion of these readmissions were to a different hospital to that of the index admission. This study identified predictors such as lower CCI, shorter LOS and a higher number of readmissions in the 6 months before the index admission to be associated with non-index hospital readmissions. In addition, patients who had a non-index hospital readmission did not suffer significantly worse clinical outcomes during that readmission compared with those who had an index hospital readmission. However, within 30 days of that initial readmission date, the adverse event rate, in particular the mortality rate, was significantly higher for those who were readmitted to a non-index rather than an index hospital.

In the present study, the overall 30-day readmission rate was higher than that reported in previous studies.[21,22] This could be

because, unlike other studies[8,22] that included patients admitted under all specialties, we included only unplanned index medical admissions, which are generally more complicated admissions with a high risk of readmission.[23] Relative to the number of readmissions to the index hospital, the proportion of patients readmitted to a different hospital was less than reported in other studies,[9,12] and presumably local factors have some relevance in the size of this proportion. One reason for lower non-index hospital readmissions in this study could be related to the publicly funded healthcare system in Australia versus a greater reliance on private health insurance in some other countries. It is possible that due to the availability of private health insurance, patients have a broader choice, including readmission to a different hospital in order to seek alternative specialist services. Another reason could be related to the lower number of rural patients in this study, because previous studies have suggested that patients with a rural background bear a greater burden to travel to the index hospital, which, in turn, leads to higher non-index hospital readmissions.[24,25] Another reason for a low rate of non-index hospital readmissions in the present study could be due to the lesser influence of for-profit hospitals in Australia.[26] For-profit hospitals have a sizeable influence in some countries like the US, and studies have indicated that for-profit hospitals may get financial incentives by diverting known high-cost patients with impending rehospitalisation to other hospitals to minimise costs and increase profits.[27,28]

Characteristics

Similar to other studies,[2,3] the present study found no difference in age and sex between the two groups, but a higher number of previous admissions in patients who had a non-index hospital readmission. Unlike other studies,[29,30] CCI was significantly lower in the non-index readmission group, indicating that these patients had fewer comorbidities and possibly had a less complicated illness explaining the shorter LOS during their index admission. Recurrence of the illness provoking the index admission and the occurrence of complications during the index admission affected the likelihood of the patient being readmitted to the index hospital rather than to a non-index hospital. These factors may affect the preferences of patients when they choose to return to a hospital for reassessment.

Outcomes

The LOS of the readmission was significantly shorter for non-index readmissions in this study, even after adjustment for significant differences in comorbidity. Similarly, the RSI of non-index readmissions was significantly shorter than the RSI for index readmissions. These findings contradict other studies that found that non-index readmission was associated with a longer LOS for that readmission.[12,31] Unlike other studies,[32-34] and possibly explaining that shorter LOS in the present study, we found a high rate (>80%) of completion of electronically accessible discharge summaries at the time of next hospital readmission. This could have led to better communication of patients' clinical problems even when their readmission was to a different hospital. The literature suggests that delayed discharge summary completion is associated with suboptimal dissemination of critical information to care providers, resulting in poor clinical outcomes for the patients.[35] The other reason for a shorter LOS could be related to the lower complexity of patients who had non-index readmissions, because these patients had a significantly lower CCI and suffered fewer complications during their index hospitalisation than patients in the index hospital readmission group.

The present study found that readmissions to a non-index hospital were followed by a higher 30-day mortality compared with index hospital readmissions. These Australian findings are, in part, supportive of some large North American studies. In Canadian hospitals, there was also a higher 30-day mortality if patients were readmitted to a different hospital after index admission.[9] The present study did not reproduce the findings of a larger study conducted in US hospitals that reported higher in-patient mortality for those readmitted to a non-index hospital.[12] The dataset of the present study was limited to a population of patients admitted under medical teams for the index admission. This is unlikely to be the reason for the lack of a difference in in-patient mortality, because a North American study of heart failure patients,[13] also presumably admitted under medical teams, reported not only a greater risk of in-patient death during non-index admissions, but also a longer LOS compared with index-admitted counterparts.

The present study suggests the possibility of poorer clinical outcomes if there was a discontinuity of care with readmission to a different healthcare facility. Although in-patient care was not immediately observed as inferior during the non-index hospital readmission, poor clinical outcomes emerged later following discharge from a non-index hospital. One explanation for these results could be that the exchange of health information was subsequently compromised by the addition of at least one more hospital in the coordination of health care for any individual patient recently discharged twice from hospital.

Readmission of patients to the same hospital as their recent discharge may not be possible due to system factors promoting alternative hospital admissions. For example, ambulance diversion due to ED overcrowding may result in a patient receiving more timely care at a non-index hospital and publicly accessible real-time data on ED waiting times may divert an otherwise index hospital re-presentation. However, re-entering the same or a different hospital as a readmission may create an important distinction that takes a little time to become obvious. Among in-patients who had been readmitted within 30 days of an index hospitalisation, non-index hospital readmissions were not immediately associated with adverse clinical outcomes compared with index hospital readmissions. As time progressed to 30 days after the end of that admission, the present study found significantly higher rates of adverse outcomes for those patients readmitted to non-index hospitals.

Limitations

This study has several limitations. We were unable to gather details of patient history, clinical examination and laboratory parameters, any of which could influence subsequent readmission risk and hospital choice. Our results could be biased because the two major hospitals (RAH and FMC) involved in this study are also the major tertiary care hospitals in Adelaide, admitting the most complex patients and providing services unavailable at

other hospitals. It is possible that due to lack of facilities in other hospitals, patients were readmitted to either of these two hospitals. Another limitation of this study is the exclusion of country hospitals because, in South Australia, a high proportion of country patients attend major public hospitals for specialist services unavailable in country hospitals.

Moreover, information about factors that may promote readmission to an alternative hospital, such as patient preferences, dissatisfaction with care, ambulance diversions and specialist availability, was not available. Our results may not be generalisable to other healthcare settings or regions because this study focused only on metropolitan hospitals. Furthermore, the results of this study should be interpreted with caution because this was an observational study and included a diverse population of patients, and it is possible that the risk difference between the two groups was not matched.

It would be useful if a readmission could be reliably attributed to the index admission, but this issue is poorly solved in hospital practice anywhere. In the present study, a readmission with the same diagnosis as the index admission was the closest we could come to identifying the two admissions as being clinically related. These clinically related admissions were more likely to be to the same hospital as the index admission rather than to a different hospital.

Conclusion

This study has important implications for both patients and healthcare providers. Patients, upon discharge from hospital, are usually instructed to seek medical advice if they experience recurrence or relapse of a medical condition. Those instructions could also encourage return to the same hospital as the index admission without necessarily explicitly stating that admission to an alternative health facility may compromise patient care. Those in management seeking methods to reduce ED congestion may wish to think twice before diverting ambulances away from hospitals that would otherwise receive index hospital readmissions, because such discontinuity can adversely affect patient care. Perhaps some selectivity regarding which patients are diverted may be germane. It is worth emphasising the importance of achieving a 100% completion of discharge summaries, because this will ensure a timely communication of patients' problems in the event they are readmitted to a different hospital. Further research in different healthcare settings is needed to confirm our findings.

Competing interests

The authors declare no competing interests.

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