Original Article

Differences in risk factors among early and late readmission of elderly patients from convalescence care unit and 30 and 90 days outcome: A cohort study

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ABSTRACT

Background/Purpose: The aim of this study is to identify the risk factors for readmission to acute hospital from convalescence care and compare the differences between early and late readmission and evaluate the impact of readmission on patients' outcome.

Methods: Cases transferred from acute hospital to a convalescent care unit during the period of 1st July 2016 to 30th June 2017 were retrieved. Inclusion criteria were age >65 with unplanned readmission back to the index acute hospital. Primary outcome was early readmission (0-7 days after transferal) compare with late readmission (8-30 days after transferal) on basic demographic variables, principal diagnosis for transferal, comorbidity and length of acute hospital stay. Secondary outcomes were discharge destination, 30 and 90 days readmission and mortality.

Results: Among the 5,447 admission episodes, 286 elderly subjects with a mean age of 81 (SD 9) have at least 1 unplanned hospital readmission. Patients with early readmission were mainly referred from medical unit with shorter acute hospital length of stay (4 vs. 12 days, p <0.001). There was high in-hospital mortality (34.7% vs. 35.7%) although there was no between group difference. There was no difference between early and late readmission on discharge destination, 30 and 90 days readmission and mortality.

Conclusion: Shorter acute length of stay is a risk factor for early readmission and medical patients are more likely to be transferred back. Interventions which focus on acute in-patient management with better transitional care processes help to ensure better patient management and readiness for convalescence and rehabilitation care.

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INTRODUCTION

In recent years, there is a progressive increase in demand of hospital services in elderly people with a dramatic decline in the average length of stay from 8.5 days in the year 2007/08 to 7.5 days in the year 2012/13.[1] This may lead to more clinically unstable patients being discharged and also a significant increase in transferal to post-acute care hospital. Post-acute care hospital provides convalescence care for these groups of patients who are unable to care for themselves at home, and/or which their medical problems have not been completely settled in acute

hospitals. It also provides rehabilitation service to those who become disabled due to their acute medical problem with the aim of getting these patients to integrate back into society more independently. In Taiwan, it has been estimated that around 25% of elderly patients need post-acute care service.[2] In Hong Kong, around 10% of all acute hospital admissions will be transferred to a convalescence hospital for continuation of care.[1] However, there is no information on the outcome of these groups of patients. In the States, it has been reported that 22% of all hospitalized Medicare beneficiaries who were discharged to a post-acute care facilities experienced an adverse event resulting in them during their post-acute care stay, in which most commonly, hospital readmission.[3] Those admitted to a post-acute care facility was found to have an increased risk of hospital readmission[4] and that more than 20% of post-acute care episodes end in rehospitalization within 30 days of hospital discharge.[5] These post-acute care facilities with high readmission rate also have lower rates of patients being able to return to the community.[6] Therefore, it is important to identify which patients are at risk for readmission and which readmission is preventable.[7] A more recent study in Taiwan showed that 13% of patients in the post-acute care unit experienced acute ward readmission and 90% of them were due to medical conditions.[8] A study[9] found that up to one-third of readmissions from post-acute care facility occurred within the first week, thus indicating that early readmission is a sizable problem. It is well described from literature[4] the impact of hospital readmission from home, however, little is known about the risk factor for readmission from convalescence care unit and its impact on the outcome. Identification of the timing and risk factors for readmission may provide insight into the underlying causes and can help to implement strategies for future intervention to the target. Studies[10] suggested that there are differences between those patients discharged back home and those transferred to a convalescence unit on readmission within the first week compared with late readmission. It is suggested that early readmission may reflect inadequate transition processes of care between the acute hospital and post-acute care facility or a mismatch between patient needs and the post-acute care facility resources while late readmission may reflect inadequate post-acute care unit processes or resources to identify and treat a worsening condition.[2]

The aim of this study is to identify the risk factors for readmission from a convalescence unit back to the acute hospital and to compare the differences between early and late readmission and evaluate the impact of readmission on patients' outcome. Identification of the factors associated with readmission can help to improve patient management and impose of remedial action to reduce unplanned readmission.

MATERIALS AND METHOD

All cases data transferred from acute hospital to the convalescent unit of a rehabilitation hospital during the period of 1st July 2016 to 30th June 2017 were retrieved. Inclusion criteria were >65 years of age, admitted from an acute hospital and readmitted back to the index acute hospital within 30 days of the index acute hospitalization. Exclusion criteria were those that do not have a readmission or had a readmission after 30

days of transferal or planned readmission.

Patients were eligible to be included for more than one hospitalization as long as their acute-convalescent episode ended 30 days prior to the next hospitalization. However, we only analyze the first readmission during the same convalescence stay.

Basic demographic variables include age, sex, mobility status as defined as walking independently, walk with aids or chair/bed bound and pre-admission place of residence was recorded. The primary outcome was readmission during the convalescence stay. Subjects were categorized into 2 groups based on the day of readmission. Early is defined as unplanned readmission within 7 days of transferal from the acute hospital while late readmission is defined as 8-30 days post-transferal.[9] Other variables collected include the number of hospitalizations in the previous 12 months, primary diagnosis upon transferal from the acute hospital and comorbidity as measured by Charlson Comorbidity Index (CCI).[11] The main reason for readmission back to the index acute hospital was also recorded. The length of stay in the acute hospital was calculated as the period of time between day 1 of acute hospital admission to the day of transferal to the convalescence unit. Duration of stay in the convalescence unit was defined as the number of days between acute hospital transferal to the day of readmission back to the index acute hospital unit. All patients were followed up till they were discharged from the hospital and the final discharge destinations were recorded. Secondary outcome includes mortality and the number of hospital admissions at 30 and 90 days post-discharge.

This study is approved by the Hong Kong Hospital Authority Kowloon Central Cluster research ethics committee.

Statistical analysis

Descriptive statistics on basic demographic information were analyzed by t-test or Mann Whitney U test for continuous data and chi-square test for categorical data for bivariate between group comparisons of early vs. late readmission back to the acute hospital. In-patient mortality, 30-day and 90-day mortality were compared by chi-square test. Logistic regression was set up to identify the independent risk factor for early readmission after adjusting for factors that were statistically significance in the univariate analysis. A p-value <0.05 was considered as statistically significant. SPSS 20.0 was used for statistical analysis.

RESULTS

During the period of 1st July 2016 to 30th June 2017, there were 5,447 admission episodes. There were 635 readmission episodes which include both planned and unplanned readmissions. Two hundred and fifty six readmission episodes were excluded. A total of 286 subjects met the inclusion criteria and their hospital records were retrieved (Figure 1). Table 1 shows the basic demographic information. Figure 2 shows the major reason for transferal

for convalescent care. The median length of stay in the acute unit is 7.5 days (interquartile range, IQR 4-11.5) while the median length of stay in the convalescent unit is 8 days (IQR 4-12). The median length of stay is 5 days (IQR 4-9) in medical and geriatrics unit, 9.5 days (IQR 4-13) in the surgical unit, 8.75 days (IQR 6.25-15) in the orthopaedic unit and 15 days (IQR 10-15) in the neurosurgical unit (p <0.001). When we categorize the subjects into early and late readmission group, there were 149 (52.1%) in the early readmission group and 137 (47.9%) in the late readmission group. There was no statistical difference between age, sex, place of residence before admission, prior hospital admission, CCI and mobility status with early or late readmission. In-patient mortality was high in both groups (34.7% vs. 35.7%, p=0.85). The median length of stay in acute hospital is much shorter in the early readmission group (4 (IQR 3-6) days vs. 12 (IQR 9-19) days, p <0.001). Patients transferred from the medical unit have earlier readmission then non-medical unit (Table 1). There was no between-group difference on the reason for transfer back (p=0.234). There was also no statistically significant difference between early and late readmission on discharge placement, 30 days and 90 days hospital admission and mortality (Table 2). Only acute hospital length of stay and transferal from the medical unit was associated with early readmission, however, in logistic regression, none of these reach statistical significance.

DISCUSSION

In our sample of elderly acute hospital readmission episodes, around 10% of patients were transferred back to the acute unit for various reasons. Fifty two percent of them were transferred back within 1 week of convalescent stay and the remaining half were transferred back at day 8 or later. Patients transferred from medical specialty tend to have a higher early readmission rate when compared to other specialties. Subgroup analysis of specialty status did not reveal any significant difference in age, functional status, comorbidity and previous health care utilization. Nonetheless, patients from the medical unit may represent a group with problems that cannot be reflected by comorbidity and functional state. For example, acute and chronic illness burden is difficult to assess by review of medical records. There is no information on the usage of health care services besides hospital admission. Furthermore, social factors also contribute a significant proportion of patients transferred to the convalescent unit. It appears that for surgical and orthopaedics patients, they are transferred for post-operative care and rehabilitation while for medical patients; they are transferred for a variety of reasons. It is well known that medical patients are cared not only for the medical problems, social problems such as placement arrangement; financial assistance and home support were also the reason for hospitalization. These 'non-

Table 2. Outcome of early and late readmission

	Early Readmission	Late Readmission	P value
Home placement, n (%)			
On discharge	56 (57.7%)	50 (56.2%)	0.883
At 30 days	53 (58.9%)	37 (56.6%)	0.567
At 90 days	48 (59.3%)	42 (56.8%)	0.871
Rehospitalization, n (%)			
At 30 days	38 (39.2%)	32 (35.9%)	0.651
At 90 days	43 (46.7%)	42 (51.2%)	0.555
Mortality, n (%)			
In-patients	51 (34.7%)	49 (35.7%)	0.9
At 30 days	35 (28%)	24 (22%)	0.365
At 90 days	9 (10%)	9 (10.8%)	1

Table 1. Univariate analysis of early vs late readmission

	Total (N=286)	Early (N=149)	Late (N=137)	P value
Age, year (standard deviation, SD)	81 (SD 8.9)	81.9 (SD 8.7)	80.1 (SD 9.1)	0.09
Male sex, n (%)	149 (52.1%)	33 (55.7%)	46 (62.8%)	0.203
CCI, median (IQR)	3 (IQR 1-5)	3 (IQR 1-5)	3 (IQR 1-5)	0.89
Previous hospital admission, median (IQR)	1.5 (IQR 0-4)	2 (IQR 0-4)	1 (IQR 0-3.75)	0.185
Living at home before admission, n (%)	206 (72%)	104 (69.8%)	102 (77.5%)	0.381
Mobility status				
Independent, n (%)	94 (32.9%)	44 (29.5%)	50 (36.5%)	
Walk with aids, n (%)	133 (46.5%)	68 (45.6%)	65 (47.4%)	
Chair/bed bound, n (%)	59 (20.6%)	37 (24.8%)	22 (16.1%)	0.152
Median length of stay in acute ward, day (IQR)	7 (IQR 4-12)	4 (IQR 3-6)	12 (IQR 9-19)	<0.001
Original specialty in acute hospital				
Medical & geriatrics, n (%)	179 (62.6%)	108 (60.3%)	71 (39.7%)	
Surgery, n (%)	60 (21%)	26 (43.3%)	34 (56.6%)	
Orthopaedics, n (%)	41 (14.3%)	15 (36.6%)	41 (63.3%)	
Neurosurgical, n (%)	6 (2.1%)	0	6 (100%)	0.001
In-patients mortality, %	35%	34.7%	35.7%	0.85
CCI=Charlson Comorbidity Index; IQR=interquartile range.				

medical' factors can explain the complexity of these groups of medical patients and may account for the relatively high proportion of unplanned readmission. Non-medical patients were generally readmitted back to their acute ward after a longer stay in the convalescent unit. It is postulated that these patients may develop complications such as sepsis or gastrointestinal bleeding during their long period of convalescent stay while for medical patients; the early readmission may reflect the unstable medical conditions which may not be fully treated before they were transferred to convalescent beds. The association between shorter length of stay in the acute ward with early readmission may represent an area where intervention and reform in medical practice could potentially impact the rates of readmission. Study[12] have shown that there is an association between decreasing length of stay and increasing rates of discharge to post-acute care facilities for some diagnosis, including pneumonia. It is suggested that there may be a substitution of post-acute care facility for a prolonged in-patient stay.

Our study is the first local study to examine the association between timing of acute hospital readmission and hospital length of stay among patients transferred to a convalescent hospital. This has a significant implication for both acute and convalescent hospitals when one intended to reduce unplanned acute unit readmission. Acute hospital and convalescent care unit are closely interconnected. For early readmission, target intervention should be focused on in-hospital care prior to transferal while for late unplanned readmission; other factors such as chronic illness may be involved.

Our finding of a shorter length of stay is associated with early readmission is contrasted with findings from prior work,[13] although the setting of post-acute facility is different. It is suggested that early discharge from the acute unit may be detrimental in these groups of frail old population. The population included in our study reported a group with high rate of comorbidity and dependency in which nearly two-thirds of them were either walk with aids or bed-chair bound and high readmission risk. We speculate that these groups of patients with a relatively short length of stay in acute wards were more acutely ill at the time of transferal or had less time spent to manage their decompensated chronic illness and thus lead to high rate of early readmission. On the contrary, the group with longer length of stay in the acute ward may have their chronic illness better managed and less acutely ill at the time of transferal.

However, these groups of patients still remained at high risk of readmission due to the accumulation of complications from their comorbid illness and eventually lead to late readmission. Actually, many factors can contribute to this phenomenon. Besides

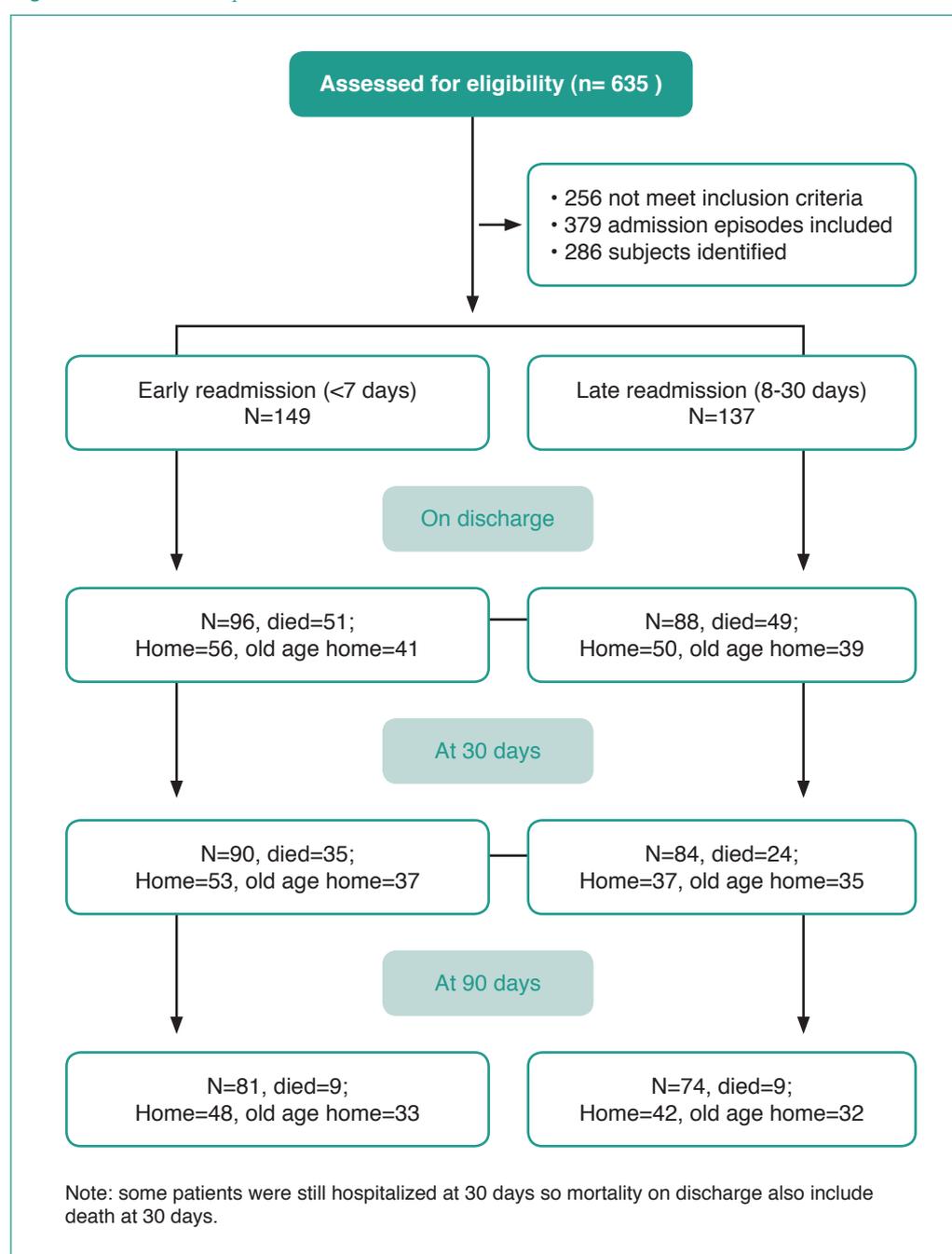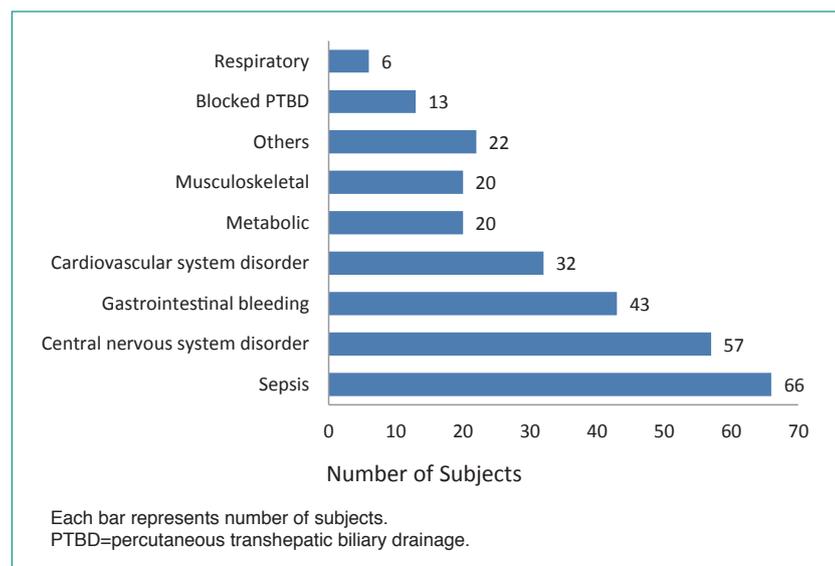**Figure 1.** Flow chart on patients' readmission

Assessed for eligibility (n= 635)

- 256 not meet inclusion criteria
- 379 admission episodes included
- 286 subjects identified

Early readmission (<7 days) N=149

Late readmission (8-30 days) N=137

On discharge

N=96, died=51; Home=56, old age home=41

N=88, died=49; Home=50, old age home=39

At 30 days

N=90, died=35; Home=53, old age home=37

N=84, died=24; Home=37, old age home=35

At 90 days

N=81, died=9; Home=48, old age home=33

N=74, died=9; Home=42, old age home=32

Note: some patients were still hospitalized at 30 days so mortality on discharge also include death at 30 days.

Figure 2. Principal diagnosis for transferal from acute to convalescence beds

Each bar represents number of subjects.
PTBD=percutaneous transhepatic biliary drainage.

accumulation of comorbidities, development of hospital-acquired infections, patients' falls and fractures or change in patients' characteristics[12] and the limitation on the level of care that can be provided by post-acute care facilities[14] also play a part. Association between clinical instability and risk of readmission has been shown in patients admitted with pneumonia and hip fracture, although these studies did not concentrate on patients discharged to post-acute care facilities.[15,16] In a large population study by Halm,[15] he has found that patients discharged to post-acute facilities are more likely to be unstable clinically, but they cannot find any association between hospital length of stay and clinical instability at discharge. It is thus important to investigate whether a shorter length of stay could reflect that the patients are transferred out while they are still unstable or the effects of medication changes have not been observed adequately, thus putting them at higher risk of readmission.

In contrast to this, a study by Graham[10] found that a longer length of stay was associated with early readmission, but not late readmission for patients discharged to home and post-acute care facilities from a single large teaching hospital. We cannot make a direct comparison with this. The settings of different post-acute care facilities were not the same. The manpower and medical input cannot be directly compared. The population group in our study was more frail and old and thus the adverse outcome related to the shorter length of stay in the acute ward is unique. Therefore, future studies are necessary to confirm these associations between length of stay and early readmission and also an exploration of the association of clinical instability upon transferal is important.

Multiple medical comorbidities have been shown by previous studies[7] to be a major risk factor for hospital readmission following discharge to a post-acute facility. A recent study[16] supported the finding of a higher rate of comorbidity was associated with a risk of later readmission. However, we did not show any positive association between comorbidity with either early or late readmission. Patients

were transferred for convalescence and/or rehabilitation with medical, nursing and allied health support. Those with a deterioration of clinical condition can be treated within the convalescent unit unless the patient gets into a stage which requires a higher level of care with intense monitoring which require transferal back to the acute hospital.

A study by Horney[17] found that the different primary diagnosis was associated with the likelihood of early vs. late readmission. Myocardial infarct and pneumonia were associated with early readmission while hip fracture and urinary tract infection were associated with later readmission. Lee[8] also reported that the 30-day acute ward readmissions of patients from convalescence care units in Taiwan was 12.9%, and that cognitive impairment was the only independent risk factor for acute ward readmissions. Acute medical conditions were associated with early readmission within 30 days while late readmissions were due to surgically related problems such as fall injuries. However, in our study, there was no between-group difference on the reason for transfer back to the acute ward. We were only able to categorize the principal diagnosis for transfer back based on information from medical records, misclassification do exist. The retrospective collection of information from case records makes a detailed assessment of comorbidity and mental and functional state difficult. We need further study to identify if certain diagnoses lead to a difference in readmission risk and whether they are related to care process factors or patients' characteristics.

Measurements of disease burden including CCI and number of previous hospitalizations have been shown to be related to re-hospitalization after discharge.[10] However, in our study, we aim to identify unplanned readmission back to the acute hospital from convalescence care. In this case, patients were not discharged, but were transferred to an extended care unit for the continuation of care. Thus, factors related to clinical instability at discharge and readmission was not applicable to our study.[18] The major diagnosis for transfer to an extended care unit from acute beds is sepsis, followed by musculoskeletal problems including hip fracture. While the major reason for transfer back to the acute ward from convalescence care is sepsis, and central nervous system disorder as the second most common reason. The principal diagnosis of sepsis is the leading cause of both transferals to convalescence care and transfer back to the acute ward reflect the disease nature. Chest infection is the leading cause of death in Hong Kong.[19] It is naturally the major reason for transferal from acute to convalescence care. Poorly controlled sepsis or the development of hospital-acquired infection will then lead to an increased risk of readmission. The second common etiology for readmission is central nervous system disorder in which suspected stroke is the major diagnosis. This requires an urgent CT scan of the brain which is only available in

acute hospitals. Since our population group is old with a mean age >80, it is thus not uncommon for these groups of patients to develop cerebrovascular accident which deems necessary to transfer back to the acute hospital for CT brain and further management.

The in-patients mortality for both early and late readmission group is high. It is postulated that we are serving a population of old and frail elderly with multiple commodities and complex medical problem that may have contribute a significant effect on mortality. However, we do not have information on the cause of death, detail review on the cause of death in future study may help to investigate the etiology of mortality and help better management of our patients.

Our study has several strengths. It is a first study to identify risk factors for early and late readmission from an extended care unit. It includes both medical and surgical stream in-patients. The study finding should, therefore, can be generalized to most of the local public hospital setting. The covariates available in the hospital data include demographic factors of age, sex, clinical conditions and comorbidities help to identify both acute and chronic illness burden. Discharge destination, utilization of health care services in term of hospital admission at 30 and 90 days reflect the progress of patients after discharge.

Limitations also exist in our study. Factors that may influence the risk of readmissions, such as psychosocial factors and functional status upon transferal are not included. We are unable to assess the appropriateness of early vs. late readmission. Administrative data based on codes from medical records review are less accurate than prospective data collection.

CONCLUSION

Among elderly patients transferred to a convalescence unit, shorter acute length of stay is a risk factor for early readmission back to the acute ward and medical patients are more likely to be transferred back. Interventions which focus on acute in-patient management with better transitional care processes help to ensure better patient management and readiness for convalescence and rehabilitation care.

CONFLICTS OF INTEREST STATEMENT

No potential conflicts of interest were disclosed.

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