UNPLANNED HOSPITAL READMISSION AND ITS PREDICTORS IN PATIENTS WITH CHRONIC CONDITIONS

Yu-Tzu Dai, Shwu Chong Wu,[1] and Redhelm Weng[2]

Background and Purpose: Unplanned hospital readmission is a devastating experience for patients and is costly for society. This study determined the 60-day unplanned readmission rate and its predicting factors in patients with chronic conditions.
Methods: A total of 334 patients discharged from five hospitals were followed for 2 months after discharge. Patients enrolled in the study were disabled and had a diagnosis of progressive chronic disease (congestive heart failure, chronic pulmonary disease, cancer) or chronic impairment following an acute episode (stroke, traumatic brain injury, hip fracture). Patients were assessed before discharge to collect in-hospital variables. Telephone interviews with patients and families were used to collect data on hospital readmission.
Results: Of the 334 patients followed, 76 had unplanned readmission (24.4%). Patients with progressive chronic disease had a higher readmission rate (40.9%) than those with chronic impairment following an acute episode (15.1%). Frailty and abnormal respiratory pattern were significant predictors of readmission for patients with progressive chronic disease. The predictors of readmission for patients with chronic impairment following an acute episode included frailty, clinical instability and discharge from a regional hospital. The major reasons for hospital readmission were exacerbation of the initial major disease (33/76, 43.4%) and infection (21/76, 27.7%).
Conclusions: Exacerbation of chronic diseases and infection are the two major reasons for unplanned readmission. Patients with a progressive chronic disease are more likely to be readmitted.

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A high readmission rate following hospital discharge has been reported in patients with certain chronic diseases [1]. Recurrent hospitalization is a devastating experience for patients and family [2] and is costly for society as a whole [3]. In various patient populations, the 90-day readmission rate has been reported to range from 13.7 to 47% [2, 4–6]. Anderson and Steinberg reported that 22.5% of Medicare hospitalizations were followed by a readmission within 60 days of discharge [3]. The cost of these readmissions accounted for 24% of Medicare inpatient expenditure [3]. Researchers have also warned of the risk of increasing premature discharge and unplanned readmission rate in some healthcare settings adopting prospective payment systems or managed care programs [7–12]. The issues surrounding readmission after discharge have drawn much attention [2–14]. A recent study in Taiwan showed that the 90-day readmission rate for patients receiving total hip replacement had increased from 19.81 to 22.42% since the implementation of a case-based prospective payment system by the National Health Insurance (NHI) Bureau [11]. However, little is known about the incidence and predicting factors in patients who are discharged with various chronic conditions and continuing care needs. The purpose of this study was to determine the 60-day unplanned readmission rate in patients with chronic conditions and to identify the factors predicting readmissions in these patients.

Department of Nursing, College of Medicine, National Taiwan University, and Department of Nursing, National Taiwan University Hospital; [1]Graduate Institute of Health Policy and Management, College of Public Health, National Taiwan University; [2]Bureau of Health Promotion, Department of Health, Taipei.
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Reprint requests and correspondence to: Dr. Yu-Tzu Dai, Department of Nursing, College of Medicine National Taiwan University, 1 Jen-Ai Road, Section 1, Taipei 100, Taiwan.

In this study, a chronic condition was defined as a diagnosis of a progressive chronic disease or an acute episode that resulted in long-term structural or functional abnormality.

Methods

Sample and setting

Patients who were admitted with one of the six selected chronic conditions and received discharge planning from one of the five selected teaching hospitals in the Taipei metropolitan area between April 2000 and February 2001 were invited to participate in the study when they were ready for discharge. These hospitals were selected to represent patient samples in institutions with different accreditation status (medical center or regional hospital) and different ownership (public or private). Two hospitals were classified as medical centers and three as regional hospitals. In these hospitals, patients who were disabled and had the potential need for intensive continuing care were given priority to receive discharge planning services. The six selected chronic conditions were stroke, traumatic brain injury (TBI), hip fracture, congestive heart failure (CHF), chronic pulmonary diseases (CPD), and cancer. CPD consisted of chronic obstructive pulmonary disease and other chronic lung diseases. In addition to the major diagnosis, patients were disabled in at least one of the 10 activities of daily living (ADLs) of the Barthel Index [15]. Approvals for data collection were obtained from the administrative departments of all hospitals. If subjects were unable to comprehend and answer questions, family members gave their informed consent for the subject to participate in this study. All invited subjects gave their informed consent. Of 360 patients interviewed during their hospitalization, 10 patients died before hospital discharge. A total of 350 patients were recruited for the study.

Instruments

The dependent variable in this study was unplanned hospital readmission. According to MacLeod, if a patient is not readmitted with the same diagnosis or related complications within 2 months of discharge, the discharge can be regarded as successful [16]. Based on this statement, unplanned readmission in this study referred to the occurrence of unexpected readmission to the same or a different hospital within 60 days of the initial discharge. Planned or scheduled readmissions, such as an admission for chemotherapy in cancer patients, cranioplasty in TBI patients, or elective eye surgery in stroke patients, were excluded. The readmission rate was defined as follows:

$$100[sr \div (sa - 1/2\ sd)]$$

where sr is the number of unplanned readmissions, sa is the number of subjects discharged, and sd is the number of subjects who died within 2 months after discharge. Based on the survival analysis of the life table, patients who died within 2 months after discharge were counted as having lived for half of the observation period. Therefore, half of the number of subjects who died was deducted from the denominator.

Independent variables constituted demographic, clinical and functional variables. Demographic variables in this study included age and gender. Age was categorized as older or younger than 65 years. Clinical variables included number of coexisting chronic diseases (comorbidities), instability index of disease, pattern of respiration, length of hospital stay, category of hospital and placement after hospital discharge. The instability index of disease had five levels: 1 = no symptoms exist and no further treatment is needed; 2 = patient's condition is well controlled; 3 = patient's condition is stable but needs to be continuously monitored to prevent complications or exacerbation; 4 = patient's condition is not uneventful and the treatment or medication needs to be modified or adjusted constantly; 5 = patient's condition is difficult to control and the patient has a history of hospital readmission. The higher the score, the less stable the patient's condition. The inter-rater agreement for this index was 91.67%, and the Kappa value was 0.82. Scores were recoded as categoric, 2 or less, or at least 3. The pattern of respiration was indicated as normal or abnormal. Dyspnea, orthopnea and tachypnea were categorized as abnormal respiratory patterns. Hospitals were categorized as medical centers or regional hospitals based on the accreditation of the quality of teaching hospitals by the Taiwan Joint Commission in Hospital Accreditation. A medical center is accredited as better in quality of teaching and services than a regional hospital [17]. Placement after hospital discharge was categorized as discharged to a long-term care institution or discharged home. Functional variables included dependence in performing ADLs and cognitive function. Dependence in ADLs was measured using the Barthel Index [15]. The internal consistency (Cronbach's α) of the Barthel Index was 0.93 and the inter-rater agreement was 94%. Patients with an ADL score of lower than 20 were considered totally dependent [18]. Cognitive function was measured using a 10-item short portable mental-status questionnaire (SPMSQ) [19]. The internal consistency (KR-20) was 0.89 and the inter-rater agreement was 97%. Cognitive impairment was identified based on the number of errors in the SPMSQ test adjusted by education level. The Chinese-language version of the Barthel Index has

been tested on the Taiwanese population and found to have acceptable psychometric properties [20].

Data collection

Data collection was conducted by one research assistant and 24 discharge planners in the five participating hospitals. In each hospital, one to nine discharge planners were invited to be data collectors. Discharge planners collected each subject's in-hospital data before discharge using face-to-face interviews, and follow-up data 60 days after discharge using telephone interviews. The research assistant was responsible for monitoring the quality of the data collected and the timeliness of the follow-up interview. In order to achieve adequate reliability, a structured questionnaire was used. In addition, all discharge planners and the research assistant received two 4-hour training sessions on patient assessment and standardized interview techniques. A manual for data collection was compiled and provided to all discharge planners as a written guideline.

All subjects received discharge-planning services from these data collectors. Subjects received an initial assessment as part of discharge planning within 1 week of hospital admission. Once the subject was ready for discharge, data collectors interviewed the subject to collect data on in-hospital variables using the questionnaire.

On the 60th day after hospital discharge, data collectors conducted telephone interviews with the subjects, or their proxy (primary caregiver) if the patient was not able to answer the questions. Patients or proxies were asked if the patient had had any unplanned readmission within the 2 months after discharge. If the subject had a readmission, the data collector asked the reason that the physician gave for readmission.

Statistical analysis

SPSS Interactive Graphics 8.0 (SPSS Inc., Chicago, IL, USA) software was used to analyze the data. A two-tailed test was used to determine the probability value. The predicting models of readmission were tested using multiple logistic regression analysis. Nine variables that were reported as predictors in previous studies were included as independent variables [13, 14, 20–26]. To identify the collinearity among independent variables, associations between independent variables were tested using the Chi-square test. We found two pairs of variables, age and comorbidities and ADL and cognitive function, that were significantly associated. These were reintegrated and formed two variables: frailty and functional status. Subjects who were 65 years or older and had three or more comorbidities were considered frail. Subjects who had a Barthel index score of 20 or less and had cognitive impairment were classified as having poor functional status. Seven other variables were included as independent variables. Two models were tested. Model 1 included patients with progressive chronic disease and model 2 included patients with an acute episode followed by chronic impairment. Odds ratios and 95% confidence intervals (95% CI) were calculated for each independent variable; p values of less than 0.05 were considered statistically significant.

Results

Sample characteristics

A total of 350 subjects were recruited before their discharge, among whom 31.7% had a major diagnosis of stroke, 22.3% had hip fractures and 19.1% had cancer. Less than 10% of subjects had each of the other three diagnoses (Table 1). Most subjects (76.9%) were at least 65 years old, with a mean age of 71.1 years. Most subjects (66.9%) had education through primary school or less, and 62.3% were married or had a partner. Almost all subjects (98.6%) were covered by NHI that reimbursed 90% of their hospital expenditure. In addition to their major diagnosis, subjects had an average of 1.9 coexisting chronic diseases. Functionally, most subjects were heavily dependent in basic ADLs (mean Barthel Index, 34.3). Upon discharge, 29.4% of subjects were consciously disturbed and 24.8% needed nasogastric tube feeding (Table 1).

Readmission rate

Sixteen patients could not be reached by telephone for follow-up interview 2 months after discharge — an attrition rate of 4.80%. Of the 334 subjects followed, 246 went home and 88 were admitted to long-term care facilities after hospital discharge. Of 90 subjects readmitted to the hospital, 76 had unplanned readmissions. Within 2 months of hospital discharge, 46 subjects died. The readmission rate was 24.44% (95%CI, 19.83–29.05%) in the total sample, 40.88% (95%CI, 32.35–49.41%) in patients with progressive chronic diseases, and 15.11% (95%CI, 10.22–20.00%) in patients with chronic impairment following an acute episode. Patients with CHF had the highest readmission rate (44.83%; 95%CI, 27.32–62.34%), followed by patients suffering from cancer (41.44%; 95%CI, 29.65–53.23%) and CPD (35.71%; 95%CI, 18.57–52.85%) (Figure).

Reasons for readmission

Subject-reported diagnoses for unplanned readmis-

Table 1. Demographic and clinical characteristics (N = 350)

Variables	n (%)
Age (yr)	
≤ 64	81 (23.1)
≥ 65	269 (76.9)
Gender	
Female	181 (51.7)
Male	169 (48.3)
Education	
No school education	144 (41.2)
Primary school	90 (25.7)
Middle school	80 (22.8)
College or above	36 (10.3)
Marital status	
Married or have partner	218 (62.3)
No partner	132 (37.7)
Major diagnosis	
Stroke	111 (31.7)
Traumatic brain injury	31 (8.9)
Hip fracture	78 (22.3)
Cancer	67 (19.1)
Chronic pulmonary disease	31 (8.9)
Congestive heart failure	32 (9.1)
Consciousness	
Normal	247 (70.6)
Impaired	103 (29.4)
Catheter use	
Nasogastric tube	87 (24.8)
Urinary catheter	41 (11.7)
Tracheotomy tube	26 (7.4)
Number of comorbidities	
≤ 2	233 (66.6)
≥ 3	117 (33.4)
Dependency in ADLs	
Total or severe dependence	152 (43.4)
Moderate or mild dependence	198 (56.6)
Cognitive function	
Normal	175 (50.0)
Impaired	175 (50.0)

ADLs = activities of daily living.

sions were classified into seven categories (Table 2). Of the 76 unplanned readmissions, 33 (43.4%) were due to an exacerbation of their major diagnosed disease or its sequelae. The second most common reason for readmission was infection (21/76, 27.7%). Among these infections, about half were pneumonia (10/21).

Predictors of readmission

In Model 1, in which only subjects with a diagnosis of stroke, TBI or hip fracture were included (Table 3), frailty (OR = 2.43) and respiratory pattern (OR = 4.46) were identified as significant predictors of unplanned readmission. Subjects who were frail or had an abnormal respiratory pattern were more likely to be readmitted

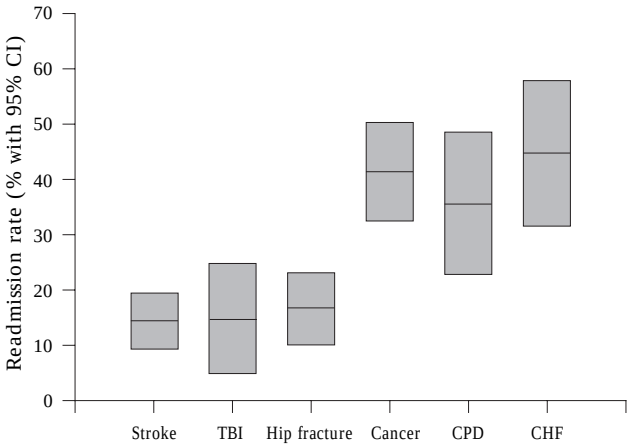

Figure. *Distribution of unplanned readmission rate 2 months after discharge according to diagnosis. CPD = chronic pulmonary disease; CHF = congestive heart failure; TBI = traumatic brain injury. CI = confidence interval.*

within the 2 months following hospital discharge. In Model 2, in which only subjects with a diagnosis of CHF, CPD or cancer were included, frailty (OR = 2.83), instability of disease (OR = 4.48), and category of hospital (OR = 2.47) were identified as significant predictors. Subjects who were frail, had a high instability index, or were discharged from a regional hospital tended to have a higher risk of being readmitted.

Discussion

In this study, 24.44% of subjects had unplanned readmission to the initial hospital or a different acute hospital within 2 months of discharge. Previous studies have found great differences in readmission rates in different patient populations using various definitions of readmission. These studies lacked a standard definition of readmission and agreement on the factors that define readmission, such as the duration of follow-up and type of readmission (planned or unplanned). The time for recognizing readmission in previous studies ranged from 5 days to 1 year after discharge [3, 14, 16, 21, 22]. In analyzing the predictors of readmission, some authors have excluded while others have included planned readmission [21, 23]. Some studies counted patient readmission to the initial hospital only, while other studies included patients readmitted to acute hospitals other than the initial hospital [21, 24]. Two studies reported that nearly half of patients were readmitted to hospitals other than the initial hospital [25, 26]. Some studies included patients who died during hospitalization as part of the discharge sample, while others did not [3, 4, 27]. Clearly, the use

Table 2. Reasons for unplanned readmission in selective major diagnoses (n = 334)

	Stroke (n = 108)	TBI (n = 28)	Hip fracture (n = 71)	Cancer (n = 66)	CPD (n = 30)	CHF (n = 31)	Total	%
Exacerbation or sequela of major disease	3	3	1	17	2	7†	33	43.4
Exacerbation of comorbidity	4	0	1	0	0	2	7	9.2
Pneumonia	3	1	2	2	2	0	10	13.2
Non-pneumonia infection	3	0	3	3	1	1	11	14.5
Pulmonary edema	0	0	0	0	0	3	3	3.9
Heart failure	0	0	2	1	0	0	3	3.9
Miscellaneous	4	0	2	1	2	0	9	11.8
Total	17	4	11	24	7	13	76	100

TBI = traumatic brain injury; CPD = chronic pulmonary disease; CHF = congestive heart failure. If subjects with CHF were readmitted due to heart failure, the reason was attributed to exacerbation of initial disease.

Table 3. Predictors of readmission in the 2 months after discharge (n = 334)

Variables	Model 1 (n = 206)			Model 2 (n = 128)		
	Odds ratio	95% CI	p	Odds ratio	95% CI	p
Gender	2.23	0.95 – 5.26	0.07	0.77	0.34 – 1.76	0.54
Frailty	2.43	1.05 – 5.62	0.004	2.83	1.11 – 7.20	0.03
Disease instability	0.75	0.13 – 4.30	0.74	4.48	1.34 – 14.93	0.02
Respiratory pattern	4.46	1.48 – 13.46	0.01	0.65	0.23 – 1.85	0.42
Functional status	0.70	0.27 – 1.80	0.46	0.85	0.35 – 2.04	0.71
Length of hospital study	0.63	0.24 – 1.68	0.36	1.14	0.45 – 2.93	0.78
Category of hospital	1.17	0.47 – 2.90	0.73	2.47	1.05 – 5.80	0.04
Placement after discharge	1.20	0.40 – 3.61	0.74	0.55	0.17 – 1.78	0.32

Model 1: sample of subjects with stroke, traumatic brain injury, and hip fracture. Model 2: sample of subjects with congestive heart failure, chronic pulmonary diseases, and cancer. CI = confidence interval.

of different definitions will affect the readmission rate and predictors. In order to facilitate comparison across studies, a standard definition of readmission needs to be adopted. Anderson and Steinberg included planned readmissions and in-hospital death in their national sample [3]. Their study showed a similar 60-day readmission rate (22.5%) to this study. However, with the use of various definitions and differences in care systems, it is hard to tell whether these findings imply a similar quality of care.

In this study, the two main reasons for readmission were exacerbation of the initial major diagnosis and infection. We cannot expect to avoid all readmission. However, Graham and Livesley reported that 48% of readmissions are preventable [10]. A recent study found that Medicare health maintenance organization (HMO) enrollees were 3.5 to 5.8 times more likely than Medicare fee-for-service enrollees to have potentially preventable hospital readmission [4]. Analyzing the data from the NHI Program of Taiwan, Chien also found that patients receiving total hip replacement who were reimbursed by the case payment system were 1.3 times more likely to be readmitted to the hospital than those who were reimbursed by a fee-for-service scheme [11]. The current study showed that nearly one-fourth of patients who were discharged in a disabled condition had an unplanned readmission within 60 days. The readmission pattern to acute care hospitals should be monitored and preventable readmissions should be identified. Further study to identify the preventable causes of readmission and prevention strategies is needed.

In this study, the major diagnosis of the patient was associated with unplanned readmission. Patients with chronic progressive diseases had a higher rate of readmission, with CHF patients having the highest readmission rate, followed by patients with cancer and CPD. In comparison to patients with chronic impairment such as stroke, TBI or hip fractures, patients who had chronic progressive diseases were more likely to have an exacerbation or develop complications. The finding that patients with CHF and CPD in this study

had a high readmission rate was in agreement with those of previous studies [1, 6, 8].

In addition to diagnosis, the patient's clinical characteristics and manifestations before discharge such as old age, multiple comorbidities, less stable disease, and abnormal respiratory pattern contributed to a higher risk of unplanned readmission. These findings corresponded to those of previous studies [1, 7, 21, 26]. Patients with progressive chronic diseases who were discharged from a regional hospital tended to have a higher risk of readmission. This finding confirmed Chien's result that patients receiving a total hip replacement and discharged from a regional hospital had a higher risk of readmission than those discharged from a medical center [11].

This study found no association between readmission and gender, functional status, length of hospital stay, and placement after discharge, unlike some previous studies [1, 3, 5, 21, 22]. Our study employed only small, nonrandomized samples, and thus was not able to analyze the model based on whether each major diagnosis may have biased data or minimized the power of the statistical analysis.

An important intention of this study was to generate information that may be helpful to professionals involved in discharge planning (physicians, nurses and others) in improving the quality of continuing care. A small reduction in the unplanned readmission rate can lead to tremendous savings in healthcare expenditure [3]. This study found that discharged patients with a diagnosis of a chronic progressive disease such as cancer, CHF or CPD, or those who are old and severely dependent, or have a high instability index or abnormal respiratory pattern, were more likely to be readmitted. Some in-hospital and post-hospital care strategies such as discharge planning, comprehensive education, medication management, community support, and intensive follow-up have been shown to reduce the unplanned readmission rate in CHF and some medical patients [11, 28, 29]. Studies employing innovative strategies to reduce the readmission rate are needed.

This study had several shortcomings. When we collected data about the reasons for readmission from subjects, we did not confirm the physician's diagnosis on all subjects' medical records. Even discharge planners who knew the subjects well may still have obtained data that were inconsistent with the physician's diagnosis. In addition, the predictive power of the model could have been improved by randomization and by increasing the size of the sample and the number of independent variables. With a larger sample, gender might have become a significant predictor and the models could have been tested to identify the predictors in patients with specific diagnoses. Schwartz found that patients with stronger social support in a group of disabled elderly with chronic diseases were more likely to have a lower 90-day readmission [2]. Adding some independent variables from social and caregiving aspects such as knowledge, skills, and willingness of caregivers to provide post-hospital care may also improve the predictive power of the model.

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