

Risk Factors for Early Unplanned Hospital Readmission in the Elderly

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Study objective: To determine the prevalence of early (in 14 days or less) readmissions to the hospital, and to identify risk factors for readmission.

Design: Matched case-control. Cases (n = 155) were readmitted to the hospital within 14 days of a hospital discharge, while controls (n = 155) were not. Controls and cases were matched by week of hospital discharge.

Patients: Two-year sequential sample of male veterans aged 65 years and over admitted to the Seattle Veterans Affairs (VA) Medical Center.

Measurements: Data about 31 potential risk factors were abstracted from the medical records.

Results: Three risk factors associated with readmission risk were identified and include two or more hospital admissions in the previous year [odds ratio (OR) = 3.06], any medication dosage change in the 48 hours prior to discharge (OR = 2.34), and a visiting nurse referral for follow-up (OR = 2.78). One protective factor—discharge from the geriatric evaluation unit (GEU) (OR = 0.09)—was also determined.

Conclusions: Early unplanned readmissions were frequent at this VA facility. Since the strongest risk factor for readmission was the number of admissions in the previous year, readmissions appeared most commonly among high utilizers of inpatient VA care. This risk factor and others may be useful in identifying a group at high readmission risk, which could be targeted in intervention studies. The reduced readmission rate associated with the GEU suggests one potential intervention to decrease readmission risk.

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READMISSION to the hospital soon after hospital discharge is an important and frequent event in the health care of the elderly.¹⁻⁷ Studies of Medicare data indicate that 5% of elderly patients are readmitted to the hospital within five days of hospital discharge, and 22%, within 60 days.¹ The costs of readmissions are considerable. Patients who are readmitted within 60 days are estimated to account for 24% of the Medicare inpatient expenditures.¹

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Underlying the interest in hospital readmissions is the assumption that early unplanned readmissions are, in some cases, the result of suboptimal health care delivery and hence are preventable. Indeed, such reasoning has led to routine review by physician review organizations (PROs) of all readmissions experienced by Medicare patients within 30 days of discharge.

Studies in this area have focused primarily on risk factor data available from large demographic and administrative databases.¹⁻⁶ However, prior research in hospital utilization, particularly the theoretical framework of Andersen's behavioral model of health services utilization, suggests that medical factors, which may not be reliably measured or included in such databases, are the major predisposing factors for hospital utilization.^{8,9}

This study was undertaken to identify medical and other risk factors for early readmission. These risk factors could be used to target individuals at highest risk for readmission in preparation for an intervention trial to decrease this risk.

METHODS

Study Design

The study was conducted at the Seattle Veterans Affairs Medical Center (SVAMC), a 428-bed teaching hospital affiliated with the University of Washington. A case-control study design was used. Both cases and controls met three eligibility criteria: 1) age of 65 years or older; 2) hospitalization at the SVAMC in the two-year period between October 1, 1984, and October 1, 1986; and 3) at least one hospital discharge from an internal medicine service. Female patients and black patients were excluded from the study because they constituted very small proportions of the veteran population at SVAMC. The study protocol was approved by the University of Washington Human Subjects Committee.

Definition of Early Readmission. An early readmission was defined as an admission to the SVAMC within 14 days of discharge from an internal medicine inpatient service. Of this pair of hospitalizations, the first admission is referred to as the "index admission," while the second admission is referred to as the "readmission." The 14-day interval was chosen because it was thought to be a time period that would include the largest number of preventable readmissions, and was similar to the 15-day readmission time period used for

PRO review at the time the study data were collected. The reliability of readmission status using the VA computer system was determined by examining the daily admission lists determined separately on admission to the hospital. No discordant coding on these lists was noted over a 30-day period when compared with the computerized listing. Admission of some patients to non-VA hospitals may have occurred. However, this utilization was outside the scope of this study, which focused on risk factors for VA readmissions only.

Definition of Cases. A case was defined as a patient with at least one unplanned readmission to the hospital in the study period. Cases were identified using the computerized Veterans Affairs Patient Treatment File. Readmissions were classified as either "planned" or "unplanned" by review of medical records. An unplanned readmission was defined as an admission that showed no evidence of having been previously scheduled. Information sources reviewed for evidence of planning included the discharge summary of the hospitalization occurring just prior to the index admission, the entire record of the index admission, the entire record of the readmission, all outpatient records for 90 days prior to the index admission, all outpatient records between the admission and the readmission, and all outpatient records for 30 days after the readmission. After completion of the data review, a review of the discharge summaries showed that all unplanned admissions were for either a diagnosis usually associated with an emergent admission or a noted worsening of clinical status. When a case had more than one unplanned readmission during the two-year period of the study, one of the admission-readmission pairings was selected randomly for the analysis. This enabled the unit of analysis to be the patient and not the readmission. Potential cases with readmissions that were subsequently classified as planned were placed into the pool of potential controls.

Definition of Controls. A control was defined as a patient having at least one hospital admission concluding with discharge from the medicine service, but having no unplanned readmission during the two-year study period. Controls were randomly selected and matched to cases by the week of discharge from the index admission. If the control subject was admitted more than once during the study period, one admission was randomly selected for analysis.

Risk Factors

Prior to the initiation of the study, approximately 35 items frequently recorded in the medical record were selected as potential risk factors for unplanned readmission. However, some of these risk factors were not always available in the medical records. Variables not available individually in at least 80% of the medical records were excluded from the study. Data were ab-

stracted by a trained medical records technician. One investigator duplicated data abstractions from 15 medical records. Reliability was satisfactory since only 3% of items had discordant coding.

Demographic Factors

Demographic factors included age and living situation. Patients living alone and who were among the old-old (i.e., those aged 75 years and older) were hypothesized a priori to be at increased risk of readmission.

Prior Health Care Utilization

Health care utilization prior to the index admission was recorded, including number of hospitalizations in the previous year, number of emergency room visits, and number of outpatient clinic visits. Higher utilization was hypothesized to be associated with readmission status.

Risk Factors during Index Hospitalization

Diagnoses were recorded from review of the ICD-9-CM codes¹⁰ noted on the discharge summary obtained by VA coders. In addition to the primary diagnosis, secondary and tertiary diagnoses were recorded. The ten most frequent diagnoses were analyzed as risk factors both as the primary diagnosis and as any of the first three diagnoses noted on the summary that directly contributed to the hospital length of stay. Severity of illness was assessed using the Horn Severity of Illness Scale.¹¹ Use of the intensive care units (ICUs) and coronary care units (CCUs) was recorded as an additional measure of disease severity.

Only two measures of functional disability were consistently recorded in the medical record. Ambulation status was obtained from the nursing section of the standardized admission form obtained on all patients. Ambulation was coded as either no impairment or impaired (e.g., having a need for a walking aid or nursing assistance, being limited in distance, or being nonambulatory). Orientation information was obtained from the neurologic examination section of the admission physical recorded by the admitting resident(s) and the standardized nursing assessment. Orientation was coded as normal (oriented to person, place, and time) or abnormal. Vision, hearing, and other functional status measures were inconsistently described in the medical record and could not be analyzed.

Prior to the study, the authors had noted clinically that patients whose therapeutic regimens were modified just prior to discharge were often readmitted to the hospital. Thus, two indicators of medication instability were coded. The first was the number of regular medications added in 48 hours prior to discharge. A "regular medication" was defined as any prescription medication given on a regular schedule. The second indicator

was the number of regular medication dosage changes in the 48 hours prior to discharge.

The diagnosis-related group (DRG) weights [recorded as weighted work units (WWU)] were obtained from the DRG assigned to the patient by VA coders using tables available from the Veterans Affairs Central Office. The WWU is used to determine payment for hospital services. The highest quartile was determined as the risk factor prior to the initiation of the study.

Post-discharge Planning

Certain types of post-discharge care may also affect readmission risk. For example, a home setting was felt to represent a higher risk than institutional settings, where medical care may be more readily available. Three types of scheduled outpatient visits were evaluated, including follow-up in a medical subspecialty clinic (e.g., cardiology clinic, pulmonary clinic, or oncology clinic), follow-up in the surgery clinic, or a planned home visit by a home health nurse. The two types of clinics coded were hypothesized to be associated with readmission risk because of the specific medical needs of the patients served, and because of the limited ability of these clinics to respond to acute problems due to the high demand for clinic appointments.

Protective Factors

Potential protective factors were also identified prior to the initiation of the study. Admission to the inpatient geriatric evaluation unit (GEU) and consultation performed by the geriatric medicine service were noted. Use of rehabilitation and nutritional consultations on the hospital wards was also recorded.

Statistical Analysis

For those variables that were not dichotomous, the levels of risk were divided approximately into quartiles. However, complete units were maintained to enhance ease of interpretation, and division into quartiles was not possible with some variables (e.g., medication dosage changes).

Statistical techniques appropriate for the analysis of matched case-control studies were used.¹² For clarity of presentation, percentages were tabulated for case patients and control patients separately rather than as matched pairs. However, odds ratios (ORs) were computed on the basis of matched pairs.

Stepwise conditional logistic regression was performed to determine a multivariate summary model of risk factors for readmission.¹³ The analysis strategy involved initially selecting all dichotomous variables whose associated chi-square statistics had *p* values below 0.25. Stepwise regression was performed, once with forward selection, and once with backward elimi-

nation, using a *p* value to enter of 0.05 and a *p* value to remove of 0.10. With this approach, the model generated by forward selection was the same as that generated by backward elimination.

RESULTS

Frequency of Readmission

There were 1,136 elderly patients discharged from the internal medicine inpatient service in the two-year study period. These 1,136 patients accounted for 2,692 discharges. There were 232 patients (20.4%) with readmissions; the total number of readmissions was 323. Of the patients with readmissions, 155 (13.6% of patients with admissions) had at least one unplanned readmission and were classified as cases, while 77 (6.8% of patients with admissions) had planned readmissions. Patients with readmissions were almost always readmitted to the medical service (93.7% of cases). Other readmission services were psychiatry (2.6%), orthopedics (1.9%), surgery (1.2%), and neurology (0.6%).

Demographic Risk Factors

The mean age of the veterans in this study was 73 years. Cases were significantly younger than controls, though the difference in age (about two years) was not large (72.4 years vs. 74.5 years, respectively, *p* = 0.014). The readmission rate was lower for patients aged 75 and older compared with those 65-74 years of age (OR = 0.59; 95% CI = 0.35-0.95) (Table 1). Living alone was not statistically associated with readmission status.

Health Care Utilization Prior to Index Admission

Prior hospital use was strongly associated with increased risk of readmission (OR = 2.76; 95% CI = 1.59-5.20) (Table 1). Other prior (preadmission) outpatient utilization (outpatient and emergency visits) was not significantly associated with increased readmission rates.

Post-discharge Planning and Follow-up

Referral to a visiting nurse was associated with an increased readmission risk (OR = 2.71; 95% CI = 1.14-7.74) (Table 1). Patients who were discharged to their homes were at higher risk for readmission than were those who had other discharge settings (OR = 1.86; 95% CI = 1.09-3.16). Follow-up in the medical subspecialty clinics was associated with an increased readmission risk (OR = 2.00; 95% CI = 1.29-3.21). Referral to surgical clinic was associated with an increased readmission risk than did not reach statistical significance (OR = 3.50; 95% CI = 0.73-28.16).

TABLE 1

Percentages of Cases and Controls Having Demographic, Prior Health Services Utilization, and Post-discharge Planning Risk Factors for Readmission

	Cases	Controls	Odds Ratio	95% Confidence Interval
Demographic factor				
Age \geq 75 years	25.8%	36.8%	0.59	0.35–0.95
Living alone	26.7%	22.2%	1.26	0.73–2.24
Health care utilization prior to index admission				
Two or more hospital admissions in previous year	36.4%	15.4%	2.76	1.59–5.20
Two or more emergency room visits in 90 days prior to index hospitalization	15.9%	17.2%	0.90	0.40–1.69
Three or more outpatient visits in 90 days prior to index hospitalization	25.5%	22.8%	1.16	0.68–2.02
Post-discharge planning and follow-up				
Visiting nurse referral	12.3%	4.5%	2.71	1.14–7.74
Discharge to home	74.0%	59.4%	1.86	1.09–3.16
Medical subspecialty follow-up	62.3%	42.9%	2.00	1.29–3.21
Surgical clinic follow-up	5.2%	2.0%	3.50	0.73–28.16

TABLE 2

Percentages of Cases and Controls Having Medical Risk Factors for Readmission

	Cases	Controls	Odds Ratio	95% Confidence Interval
Diagnosis				
Coronary artery disease	23.2%	18.7%	1.32	0.76–2.36
Chronic obstructive pulmonary disease	16.1%	18.7%	0.83	0.45–1.51
Congestive heart failure	17.4%	12.3%	1.53	0.80–3.11
Severity of illness				
Most severe illness score of Severity of Illness Scale (#4)	9.8%	5.9%	1.67	0.73–4.23
Use of coronary care unit	20.0%	16.8%	1.21	0.70–2.12
Use of intensive care unit	11.0%	5.8%	2.00	0.86–5.35
Functional disability				
Impaired mobility	76.4%	64.2%	1.87	1.00–3.74
Impaired orientation	20.0%	23.3%	0.85	0.48–1.49
Pharmacologic factors				
New medications in 48 hours prior to discharge	36.8%	36.8%	1.00	0.62–1.62
Medication dosage changes in 48 hours prior to discharge	25.8%	15.5%	1.80	1.04–3.27
Reimbursement				
Highest quartile of hospital reimbursement	26.0%	24.0%	1.12	0.65–1.98

TABLE 3

Percentages of Cases and Controls Having Potential Protective Factors for Readmission

	Cases	Controls	Odds Ratio	95% Confidence Interval
Admission to inpatient geriatric evaluation unit	1.3%	5.8%	0.22	0.05–0.66
Geriatric medicine consultation	7.7%	9.7%	0.77	0.34–1.74
Rehabilitation medicine consultation	12.3%	12.9%	0.95	0.50–1.82
Nutritional consultation	67.1%	64.5%	1.12	0.70–1.80

Risk Factors during Index Hospitalization

No significant association was noted with the ten most frequent diagnoses when evaluated as either the primary diagnosis or any of the primary, secondary, or tertiary diagnoses recorded on the hospital discharge summary. The three most frequent diagnoses noted on

the discharge summaries are listed in Table 2. The highest level of the severity of illness scale had a modest but statistically insignificant increased risk of readmission (OR = 1.67; 95% CI = 0.73–4.23). Use of ICU or CCU care was not significantly associated with readmission. Mobility impairment was associated with an increased readmission risk (OR = 1.87; 95% CI =

1.00–3.74) that approached significance. Impaired orientation was not a significant risk factor for readmission (OR = 0.85; 95% CI = 0.48–1.49).

Medication dosage changes in the 48 hours prior to discharge were associated with an increased readmission risk (OR = 1.80; 95% CI = 1.04–3.27). New medications were not associated with increased risk, nor was being in the highest quartile for hospital reimbursement.

Protective Factors

Use of the inpatient GEU was significantly associated with a decreased rate of readmission (OR = 0.22; 95% CI = 0.05–0.66) (Table 3). Use of nutritional, rehabilitative, and geriatric consultations was not associated with a significantly decreased risk of readmission.

Multivariate Analysis

Stepwise logistic regression was performed to determine a summary model. Four factors were determined for the final model: Two or more prior admissions to the hospital in the preceding 12 months (adjusted OR = 3.06; 95% CI = 1.68–5.57), any medication dosage change in the 48 hours prior to discharge (adjusted OR = 2.34; 95% CI = 1.23–4.48), and referral for visiting nurse follow-up (adjusted OR = 2.78; 95% CI = 1.06–7.33) were all risk factors for readmission. One protective factor, use of the inpatient GEU, also entered the model (adjusted OR = 0.09; 95% CI = 0.01–0.76).

DISCUSSION

This study was initiated to determine the prevalence of early unplanned readmissions in a VA setting and to determine methods for identifying high-risk patients for a randomized trial to decrease early unplanned readmissions. Early unplanned readmissions in the VA setting are an extremely important and common problem. In this large, university-affiliated VA medical center, almost 14% of all medicine discharges were followed by an unplanned 14-day readmission over a two-year period. There is no comparable published VA study. However, a study at the Veterans Medical Center in Indianapolis, Indiana, demonstrated a 14.6% rate for all 14-day readmissions (planned and unplanned) from the internal medicine service for patients over the age of 55 years.¹⁴ This suggests a problem of similar magnitude in other veterans medical centers. However, this level of readmission risk is considerably higher than levels reported in other settings. For example, ten-day readmission rates for general medical patients at Beth Israel Hospital in Boston as low as 4.9% are reported.⁶

The study identified several factors associated with increased risk for early return to the hospital. The

strongest association with readmission risk identified was the number of hospital admissions in the previous year. This single predictor may be the only risk factor necessary for assessing prior risk and has the additional advantage of being easily accessible from computerized medical records without requiring other medical record review. This finding is similar to that of Anderson and Steinberg, who noted that hospitalization in the 60 days prior to the index admission was the most powerful predictor of readmission.^{1, 2}

The second variable to enter the model, use of the special geriatric inpatient unit, was associated with a significantly decreased rate of readmission. Because the criteria for admission to the geriatric inpatient unit include that the patient not be terminal and have a reasonable chance for improvement, this may in part reflect selection bias. Yet, the rate of decrease was substantial. In addition, multivariate adjustment for prior utilization and other factors actually strengthened the association, suggesting a significant role for readmission prevention.

The findings related to medication use within 48 hours prior to discharge were somewhat conflicting. Changes in medication dosage were associated with an increased risk of readmission (OR = 1.80; 95% CI = 1.04–3.27), while addition of new medications was not (OR = 1.00, 95% CI = 0.62–1.62). It appears that therapeutic instability was not a strong risk factor for early readmission, but possibly some aspects of medication use affect readmission risk.

The finding that referral to the visiting nurse service was a risk factor for readmission in both univariate and multivariate analyses was unexpected, since it was anticipated that home visits would decrease readmission risk. However, individuals at highest risk may have been selected for follow-up in part because they had illnesses that were thought to require close observation and that might put them at risk for rehospitalization. Using these referrals as a selection mechanism may be especially useful for interventions not involving intensive home follow-up.

The failure of diagnosis and severity of illness to predict readmission status was unexpected. However, certain high-risk diagnoses noted in other studies,¹⁵ such as coronary artery disease and congestive heart failure, had elevated although statistically insignificant risk. This finding may have been due to the wide range of diagnoses found in this study. In addition, the severity-of-illness scale in this study has recently been improved and may now be a more valid measure that could be used in further studies.¹⁶ Alternatively, acuity of the present illness, which is primarily what this scale measures, may not be as important as chronicity of the medical problems of the patient, which may be more adequately measured by two or more prior hospital admissions.

This study, which used available data recorded in

the medical record, has certain weaknesses. Some non-significant findings may have been due to measurement imprecision. The validity and reliability of many measures derived retrospectively by medical record review had not been extensively evaluated. This is especially true for functional status data such as dichotomized assessments of orientation (yes/no) and mobility (normal/abnormal). However, recording of abnormal orientation has some validation, particularly when noted by nurses, whose assessment was a major source of the orientation and mobility data in this study. In a recent study of confusion in the elderly, there was a 78% agreement between scoring categories on the Short Portable Mental Status Questionnaire and nursing staff assessments.¹⁷ Mobility problems are also likely to be classified accurately by nurses, who need this information to determine the degree of assistance necessary for their nursing care plans. However, data using more sophisticated measurements of functional status may detect increased risk not noted in this study.

The timing of collection of functional data may also have influenced the degrees of risk noted for orientation and mobility problems. Both variables, which were recorded upon admission to the hospital, are potentially influenced by acute medical illnesses. Discharge status may be more predictive of post-discharge functional levels, but such data are not routinely collected or recorded.

Another potential weakness of the study is that multiple predictor variables were analyzed. Examining several variables increases the risk that some associations may have occurred by chance. However, because this was primarily an exploratory study, this risk was accepted in favor of identifying some potentially overlooked factors, such as medication instability, that could be predictors of readmission.

In spite of these limitations, we identified two risk factors (two or more admissions and follow-up by visiting nurses) that could be used to identify a high-risk group. We also identified one protective factor, GEU involvement, which is a potential intervention to decrease readmissions that is increasingly available. An-

other risk factor, the number of medication dosage changes in 48 hours prior to discharge, will need further study but suggests another potential means of modifying readmission risk. If these risk factors are validated, they should be useful for identifying elderly patients at high risk of readmission for use in clinical trials for prevention of early readmission.

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