

Impact of physician training level on emergency readmission within internal medicine

Grazyna Teresa Adamiak

Ingvar Karlberg

Stockholm, Sweden

Objectives: The research question was whether training level of admitting physicians and referrals from practitioners in primary health care (PHC) are risk factors for emergency readmission within 30 days to internal medicine.

Methods: This report is a prospective multicenter study carried out during 1 month in 1997 in seven departments of internal medicine in the County of Stockholm, Sweden. Two of the units were at university hospitals, three at county hospitals and two in district hospitals. The study area is metropolitan–suburban with 1,762,924 residents. Data were analyzed by multiple logistic regression.

Results: A total of 5,131 admissions, thereby 408 unplanned readmissions (8 percent) were registered (69.8 percent of 7,348 true inpatient episodes). The risk of emergency readmission increased with patient's age and independently 1.40 times (95 percent confidence interval [CI], 1.13–1.74) when residents decided on hospitalization.

Congestive heart failure as primary or comorbid condition was the main reason for unplanned readmission. Referrals from PHC were associated with risk decrease (odds ratio, 0.53; 95 percent CI, 0.38–0.73).

Conclusion: The causes of unplanned hospital readmissions are mixed. Patient contact with primary health care appears to reduce the recurrence. In addition to the diagnoses of cardiac failure, training level of admitting physicians in emergency departments was an independent risk factor for early readmission. Our conclusion is that it is cost-effective to have all decisions on admission to hospital care confirmed by senior doctors. Inappropriate selection of patients to inpatient care contributes to poor patient outcomes and reduces cost-effectiveness and quality of care.

Keywords: Emergency readmission, Clinical experience, Training level, Internal medicine, Referrals

Today, much is known on demographic, socioeconomic, and disease-specific factors affecting emergency readmissions in internal medicine but little evidence exists on the impact of

organizational features of health-care delivery on the early, acute reoccurrence (1;4;7;26). The etiology of readmission rates is heterogeneous. Readmissions are related to a wide range of system-dependent factors in patient care. This aspect makes them especially valuable performance measures. Investigation of particular underlying causes may lead to important conclusions (18). Structural measures are assumed to be associated with quality, because structures promote appropriate actions by providers and these actions, in turn, lead to better outcomes for patients (14). The aim of this prospective study was to examine effects of the training level of physicians and admissions from primary care on patient outcomes measured as emergency readmissions into hospital care within 30 days within internal medicine in

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Stockholm, Sweden. Discovery of structural risk factors or a causal link between the educational level or clinical experience of the admitting physician, referrals from primary care, and early emergency readmission may enable interventions to secure appropriateness of inpatient-care utilization and cost-containment.

Hospital size, teaching status, and extent of specialization, number, and skill mix as well as volume and case mix of patients have significant association with quality of care that might be studied using established performance indicators, for example, unplanned readmissions (18;26;28;34;35). One of the basic sources of variations in quality of care is the physician and her or his training and experience, the hospital as a workshop, and finally health-care organizations as complex organizations influencing work through processes such as coordination and communication. Experience, training, and skill of the physician are the most crucial factors in ensuring good clinical decisions, which in turn, are the most important variables for determining quality of care as reflected in outcomes (14).

Emergency Care Services and Physician Training in Sweden

In Sweden, the always accessible emergency departments (EDs) in acute-care hospitals are staffed by hospital departments, that is, senior physicians and trainees mainly from departments of internal medicine, surgery, and orthopedics that concomitantly have responsibility for patient care in hospital wards and outpatient clinics. University hospitals offer ordinary emergency-care services and serve as tertiary referral centers mainly for elective procedures. However, the scope of emergency-care services in EDs varies along specialization level of hospitals, that is, the number of subspecialties. Primary health care offers emergency room appointments in almost all health centers during office hours. A few primary health-care units also provide out of hours acute services with varying temporal access. These centers are staffed by general and nurse practitioners. However, gate-keeping in Sweden is absent, as there is no requirement of referral before visiting an emergency room in a hospital.

All hospitals—regardless of status as university affiliated—carry the same responsibilities for training of students and junior doctors. After completing their theoretical education, all medical students have to take 2 years of internship and—voluntary—5 to 6 years of residency to become board-certified specialists. Interns in Sweden are not permitted to make independent admission decisions.

MATERIALS AND METHODS

Study Population and Settings

The study area consists of mixed metropolitan, suburban, and urban settings. Stockholm is a large city, and twenty-one of

twenty-five municipalities in the county are suburban, that is, at least 50 percent of residents' daily work in another community or above 25 percent of the population have a work place in the city area (27). The remaining communities are larger and smaller towns and one large municipality. The investigated departments of internal medicine in seven acute hospitals in the County of Stockholm served a population of 1,762,924 people, of which 7.4 percent are 75 years or older (12). Two hospitals were university affiliated and tertiary referral centers, three were county hospitals, and two were district hospitals.

Study Design and Data Collection

We used a prospective, cross-sectional design, because study of early readmissions as an indices of performance and quality of care requires additional information not available in administrative data. In addition, a retrospective design may reduce the ability to identify risk factors for readmission (4;22). We did not collect data on the initial admission, as there is increasing evidence that a protracted initial hospital stay rather than premature discharge is a risk factor for acute readmission into inpatient care (1;6;19;20). Also, as the time progresses, it is increasingly difficult to temporally attribute an emergency readmission occurring one week or later to causes within hospitals.

Data on all admitted cases were collected consecutively during 1 month, April 1997. Oncology, medical rehabilitation, dermatology, and medical research did not participate in the study. The exclusion of those subspecialties aimed to focus acute settings and increase data homogeneity.

The data form was completed on the day of admission by department physicians (clinical data) and a chief nurse (nursing data). The variables examined could be divided into those data describing demographic and clinical characteristics of patients, contribution of primary care to patient's visit, and educational attainment of the admitting physician that largely coincides with clinical experience. The questionnaire comprised information on patient's demographic characteristics, that is, age and sex, living alone, information on principal symptom diagnosis and comorbidities at the time of admission according to the International Classification of Diseases, (ICD10), whether the patient was referred from primary health care, and if the readmission occurred in the same diagnosis as during the initial hospitalization. Skill mix of staff is a human resource variable (34). Data were reported on the level of training of the admitting physician (board-certified specialist, resident, or intern).

Unplanned or emergency readmission was defined as rehospitalization not scheduled at the time of discharge from previous hospital stay, occurring within 30 days at the same department of internal medicine that discharged the patient. The following diagnostic groups were chosen for investigation of primary diagnosis (symptom condition) and comorbidities present at admission. The latter served as

indices of case mix complexity or severity (16):

- chronic obstructive pulmonary disease (COPD) or asthma, ICD-10 codes J41-46
- Cardiac-related conditions such as acute myocardial infarction (AMI), unstable angina, etc., ICD-10 codes I21, I20.0, R07, Z03.4, Z03.5
- Auricular fibrillation, ICD-10 code I48
- Congestive heart failure (CHF), ICD-10 code I50
- Diabetes, ICD-10 code E10-14
- Dizziness, swoon, headache, ICD-10 codes R42, R55, R51
- Observation or clinical investigation, ICD-10 code Z00-04 (denotes investigation on healthy patients, for example, potential organ donors, participants in population studies or psychiatric observation, etc.; these codes were also included in heart-related conditions above).

Statistical Analysis

Data were analyzed by means of descriptive statistics and multivariable logistic regression. The reference group was the nonreadmitted patients. Correlation matrix was created to test for multicollinearity. Because some variables partly lacked values, dummy variables were created and the impact of missing values on the response variable was examined. Subsequently, only variables not significantly affecting the outcome variable by lacking values were investigated. The final choice of explanatory variables (age, principal diagnoses, comorbidities, specialization level of hospital, and training level of admitting physician) was guided by evidence on clinical conditions associated with unplanned readmissions within internal medicine (1;4). Empirical findings of superiority of specialization regarding outcomes of hospital care and a professional model developed by sociologists provided the theoretical basis for analysis (14;18;26;34). The global goodness of fit of the model was measured by likelihood ratio test and C-index. Validation procedures were omitted, as the goal of the study was to examine prognostic factors hypothesized to be associated with emergency readmission in a defined population, that is, not to predict diagnosis or prognosis for an individual patient. Improving risk factor profiles may have substantial effect on the development of disease or rates of morbidity in a large population even if the absolute effect for an individual is small (17). We tested for effect modification by adding the interaction term of the variables “age” and “resident’s decision to admit the patient” to the model. Significant bivariate association suggested that organization of work, for example, division of tasks between senior and junior physicians in the ED could influence the frequency of admissions of elderly patients decided by junior doctors.

RESULTS

Data on 5 131 admissions, thereby on 408 unplanned readmissions, were registered during April 1997. Early unplanned

readmissions within 30 days from initial hospitalization accounted for 8 percent of all admissions. The admissions represented 69.8 percent of all 7,348 admissions at the participating departments registered in the county’s hospital discharge register. (The county is responsible for 99 percent of all inpatient medical care in the region.) The data were assessed to be representative of the actual hospitalized subjects regarding age distribution.

Descriptive statistics on the readmitted compared with nonreadmitted cases are provided in Table 1. Residents decided on admission of 42.5 percent of all patients, and on 50 percent of readmissions compared with 42 percent of nonreadmissions. Interns’ decisions on all admissions composed 21 percent of inpatients, 22 percent of readmissions, and 21 percent of nonreadmissions, respectively.

The inpatients most frequently arrived to the hospital without referral from any caregiver, and the percentage of self-referrals was higher among the readmitted cases compared with nonreadmitted. Referrals from primary health care (PHC) were next most common among both the readmitted (13 percent) and nonreadmitted (21 percent) patients, followed by outpatient clinics in hospitals providing planned care. The proportion of acute readmissions from communal establishments was higher as compared with nonreadmissions, but these cases only composed 7 percent of the readmitted and some were included among PHC cases.

Thirteen variables, of which ten were diagnoses and the remaining age and measures of specialization, were entered to a logistic regression model (Table 2). The model was highly significant (likelihood ratio test: Chi-squared test, 62.08; $p < .0001$) and predicted 60.3 percent of outcomes (C-index). Increasing age of patients was independently associated with the risk of rehospitalization. The largest risk increase was related to the presence of CHF and indicated strong influence of CHF comorbidity on unplanned readmission. The next clinical variable denoting primary symptom diagnosis that significantly affected the likelihood of readmission was AMI or unstable angina and related conditions. The decisions of residents to admit patients increased independently the risk 1.40 times. The product term of variables “age” and “resident decision to admit” was not significantly associated with the outcome. The results of the regression suggested that other factors than division of tasks between senior and junior physicians in the ED influenced the increased risk of readmissions when doctors in residency training decided on hospitalizations.

The influence of referrals from PHC on the risk of acute readmission was assessed by addition of a dichotomous variable denoting PHC-referrals to the otherwise preserved model. If the readmitted patient contacted practitioners in primary health care before the acute visit in ED or a hospital clinic preceding subsequent, acute rehospitalization, the risk independently decreased 0.53 times (95 percent CI, 0.381 – 0.728, estimate -0.6408 ; SE, 0.1649). The strong association of PHC referrals with a risk decrease was only followed

Table 1. Descriptive Statistics on the Readmitted and Non-readmitted Cases

Characteristic	Readmitted		Non-readmitted	
	N (%)	±SD ^a	N (%)	±SD
<i>Demography and patient's living situation</i>				
Male	200 (52.6)	0.50	2,224 (50.4)	0.50
Age (years)	403 (68.6)	15.1	4,607 (65.0)	17.8
Age 65–79	171 (42.4)	0.50	1,672 (36.3)	0.48
Age 80 years or older	103 (25.6)	0.44	1,043 (22.6)	0.42
<i>Principal diagnosis</i>				
CHF	40 (10.0)	0.30	278 (6.1)	0.24
COPD or asthma	18 (4.5)	0.21	147 (3.2)	0.18
Dizziness or swoon, etc.	9 (2.2)	0.15	204 (4.5)	0.21
Diabetes	4 (1.0)	0.10	78 (1.7)	0.13
Observation, examination, etc.	7 (1.7)	0.13	85 (1.9)	0.14
AMI, unstable angina and related conditions	104 (25.9)	0.44	933 (20.5)	0.40
Auricular fibrillation	21 (5.2)	0.23	190 (40.0)	0.20
<i>Comorbid conditions</i>				
CHF	39 (9.7)	0.30	161 (3.5)	0.19
COPD or asthma	12 (3.0)	0.17	107 (2.4)	0.15
Diabetes	20 (5.0)	0.22	153 (3.4)	0.18
<i>Structure</i>				
Admission by a resident	196 (50.4)	0.50	1,867 (41.9)	0.49
Admission by an intern	84 (21.6)	0.41	933 (20.9)	0.41
<i>Demand—various sources to referrals</i>				
Self-referred	272 (68.3)	0.47	2,491 (55.7)	0.50
Proxy to the patient	48 (12.1)	0.33	602 (13.5)	0.34
Hospital outpatient clinic	40 (10.1)	0.30	672 (15.0)	0.36
Primary health care	51 (12.8)	0.34	938 (21.0)	0.41
Communal establishment	27 (6.8)	0.25	168 (3.8)	0.19

^a N (mean) for continuous variables.

COPD, chronic obstructive pulmonary disease; CHF, congestive heart failure; AMI, acute myocardial infarction.

by minor changes in the remaining variables and did not alter the above-mentioned findings, although the C-index and Chi squared value rose in this model to 62.6 percent and 79.81 percent, respectively.

DISCUSSION

The objective of the study was to investigate effects of physician level of training on the risk of unplanned readmission

Table 2. Risk of Acute Readmission into Hospital as Outcome Variable in a Multivariable Logistic Regression

Effect	Odds ratio	95% Confidence limit	Wald estimate (SE)
Intercept			−3.2814 (0.2423) ^a
Age (years)	1.007	1.001–1.014	0.00745 (0.00345)
Auricular fibrillation	1.348	0.826–2.197	0.2983 (0.2494)
AMI, unstable angina or related condition	1.323	1.017–1.722	0.2802 (0.1343)
Observation or investigation	0.873	0.392–1.944	−0.1356 (0.4084)
Diabetes	0.774	0.279–2.149	−0.2563 (0.5210)
Dizziness, swoon, headache, COPD or asthma	0.605	0.304–1.201	−0.5031 (0.3500)
CHF	1.429	0.843–2.424	0.3572 (0.2696)
Comorbidity of diabetes	1.781	1.216–2.609	0.5773 (0.1946)
Comorbidity of CHF	1.395	0.851–2.289	0.3332 (0.2525)
Comorbidity of CHF	2.555	1.727–3.779	0.9379 (0.1998)
Comorbidity of COPD or asthma	1.223	0.661–2.264	0.2016 (0.3140)
Admission by a resident	1.403	1.134–1.735	0.3384 (0.1084)

^a *p* value < .0001.

AMI, acute myocardial infarction; COPD, chronic obstructive pulmonary disease; CHF, congestive heart failure.

within 30 days of the previous hospital stay. The temporal sequence preceding any unplanned readmission or admission allows various factors to influence the risk. The possibility that premature discharge or complications during an earlier hospitalization contributes to early readmissions within internal medicine cannot be excluded. However, as time from discharge from the index hospital stay increases, so does the contribution of other, for instance organizational, factors. Donabedian (9) argued that health care is doubly rationed, first by different accessibility and then by different management after the access is achieved. Our findings demonstrate that sources to poor outcomes measured as unplanned readmissions are also present in hospitals at the time of re-occurrence. We found that, in addition to clinical variables already known to significantly covary with readmissions (4), the risk increase was associated with the training level of the admitting physician.

The finding of the independent association of decision making by physicians in training suggests that the risk of false negatives, that is, patients discharged home from hospital ED, despite the need of rehospitalization, was lower than the risk of false positives due to the apparently high sensitivity of inexperienced physicians to the demands of elderly patients. The impact of the training level of the admitting physician on potentially avoidable recurrence has important policy consequences as it relates to aspects under the control of hospitals. Patient care provided mostly by residents with only distant supervision cannot achieve both high quality and cost-effectiveness (30). A full analysis of avoidable costs and alternative costs for other providers, had the patient not been admitted, has not been done within this field. However, the direct hospital cost for one "false positive" admission is of the same magnitude as 1 working day for a senior specialist in internal medicine. The assessment is based on a 1 (50 percent) to 2 (50 percent) days of in-hospital care and a national means for hospital costs, including reimbursement to physicians. From a societal perspective, it would be cost-effective to have a senior specialist support *all* admission decisions made by junior doctors, provided the rate of false-positive admissions generally is of the same frequency as demonstrated in this study.

Eriksen et al. (11) found in a department of internal medicine that 24 percent of all admissions were "inappropriate" and accounted for 12 percent of total costs. Inappropriateness was defined as admission that did not result in any significant health benefit for the patient or that resulted in benefit that could have been obtained at another level of care (11). The increased risk of inappropriate readmission identified in the present study was most likely attributable to physician inexperience and lack of sufficient clinical support. According to Flood (14) specialization tends to predict better care in terms of more appropriate hospitalizations and uses of services. The more specialized occupations become, the more room there is for error, unless systems for coordina-

tion, communication, and cooperation are functioning well (34;35).

We found that the risk of early readmission increased independently with diagnosis of CHF. The prevalence of CHF continues to rise. This increase occurs in industrialized societies as a result of several medical and demographic factors such as aging population, decreasing mortality due to myocardial infarction, and improved treatment of patients with angina pectoris and hypertension (7;13;24). Of CHF patients discharged from hospitals in Sweden, 25 percent have been hospitalized two times or more (31). The possibility to attribute the outcome in CHF patients to poor patient-care management is easier to make compared with patient suffering from other chronic conditions. For many chronic diseases, the time between performance of the key processes of care and the outcome of that care may be quite long, for example, for diabetic patients (5). In the case of CHF, the outcome window is more limited and acute relapse may occur quickly. CHF is characterized by acute episodes of clinical deterioration and need of regular adjustments in treatment. Most preventable readmissions occur early, within 1 month of discharge (4).

As McKee and Black (23) argue, a greater proportion of care must be provided by more experienced doctors. The working environment in EDs may be hectic. Consultants are called out of formal teaching sessions, and the activity of departments is ever changing. In small hospitals, the pressure of routine work can lead to conditions in which consultants cannot provide adequate supervision during evenings and overnight. This finding is a serious problem if a specialty is represented by only one consultant. Lack of supervision is clearly associated with mistakes, some of which have serious outcomes. According to McKee and Black, geographical concentration of services would enable one doctor to provide emergency cover for more patients by bringing together larger groups of junior staff within a smaller total pool (23).

As Wu et al. (36) point out, the causes of the mistakes that occur within the specialty of internal medicine are often multiple and include lack of knowledge or experience, failure of supervision, faulty or delayed decision making, job overload, and fatigue. For instance, Cardin et al. (6) studied early unplanned readmissions as effects of ED crowding. The number of visits at EDs in hospitals in Stockholm increased considerably during 1997 and forward, which could negatively influence decision making by physicians in training (2).

Because the readmissions in the present study were independently associated with chronic comorbid condition, it is likely that many of the readmitted cases were extremely complex. Greater readmission risk is generally associated with higher levels of severity or case complexity (33). As life expectancy increases, higher numbers of patients with complex underlying medical problems present to the ED. These patients take more time to diagnose and treat (8).

Inexperienced trainees should be actively supervised, especially in complex cases, by their seniors. Miles and Lowe (25) found 5.5 percent of all unplanned readmissions technically preventable. After review, a senior clinician identified these as extremely difficult cases, indicating that better outcomes may not have been possible. Increasing subspecialization in medicine produces physicians unable to deal with the complexity of multiple diseases found in older people (10). The complexity of illness in old age emerging as multiple pathological states necessitates access to specialist expertise traditionally provided by geriatricians and psychogeriatricians and lacking in many physicians in training (10;32). Atypical presentations among elderly patients suffering from AMI or COPD are common, which may require experience among doctors who decide on hospitalizations (3;15).

The majority of patients were readmitted through emergency departments. Only if patients were admitted to inpatient care during office hours of potentially available general practices could the readmission be classified inappropriate (21;33). If the patient has no place to go other than the ED, we cannot categorize use of the only remaining safety net as inappropriate (21). We did not register day and time of patients' arrival to the hospital ED (29). The need for emergency care services in hospitals depends on the availability of substitute services somewhere (21). The inappropriateness of settings varies depending on criteria for judgment that may be absolute (for example, all cases not in need of hospital resources) or relative (for example, cases not in need of hospital resources *and* able to access available source of emergency care service somewhere). Thus, it is sensible that a part of emergency visits resulting in readmissions in this study reflected poor access to primary care.

According to McKee and Black (23) with few exceptions, most junior staff receive very little nighttime and weekend training, which is related to financial politics in hospitals. Junior doctors have lower basic rate of pay when on-call and provide a pool of low-cost labor. Junior staff in a range of specialties is sometimes expected to undertake tasks with insufficient training and inadequate support (23).

As argued above, most likely the same factor, such as lack of a sufficient clinical experience, accounted for the fact that both decision making by interns and residents was associated with increased risk of emergency readmission among elderly patients. This independent effect was probably less related to the variable accessibility to substitute sources of emergency care for patients and more to the intrinsic difficulty of appropriate selection to inpatient care of complex, geriatric cases by junior physicians.

This study has several limitations. The size of missing values hindered investigation of interesting aspects such as influence of patient's sex or hospital specialization on the

acute recurrence. Also, the remaining findings are to be evaluated with caution as the missing values could confound the data in a way that we could not control. However, the strength of the analysis is that it is based on a relatively large sample from a mixed urban-suburban population; it comprises a large reference group of nonreadmitted cases and unique data on, for example, referrals, the admitting physician's educational level, and symptom diagnosis not available in administrative discharge databases. The latter increases the study's internal validity with respect to temporality problems commonly present in analyses of readmissions based on discharge data.

We measured case mix complexity as the presence of predefined comorbid conditions. This indirect measure of disease severity has a limited sensitivity, as it does not accurately describe the functional status or disease stage in a patient. However, the presence of comorbidity was clinically evaluated during the earlier hospital stay, contrary to primary symptom diagnoses as the immediate reason for readmission. Symptom conditions were conceptualized to serve as indicators of variations in clinical practice, as they likely were more sensitive to the training level of staff in emergency departments, provided that the participating departments did not differ in coding procedures.

A limitation was that information on the number of years in internship and residency was not available, and the effects of inexperience could not be measured in these terms. Also, the frequency of decisions by residents has to be seen in comparison to those by interns. It is likely that the effects of clinical experience would change if the comparison group were solely expert physicians, that is, board-certified specialists. The inclusion of interns among specialists could dilute the effects of specialization, despite that we could not find any difference in the risk of readmission between interns and those of specialists and residents as a reference group.

The investigated diagnostic groups, CHF in particular, have been demonstrated to be risk factors for readmission within internal medicine (4;7;16;31). Association between readmissions and respiratory symptoms such as COPD or asthma was probably affected by season (18). During April, emergency visits in EDs are on "normal level" as compared with May–June when the hospitals in the county experience excess acute demands of patients with respiratory symptoms due to seasonal variations every year (2).

In summary, we identified independent effects of symptom diagnoses and comorbid conditions on selection of patients into inpatient care and emergency readmissions. The cross-section of cases enables generalization of study findings to health-care systems with universal health insurance coverage. Our findings are in agreement with the conclusions of Mitchell and Shortell (26) that patients with multiple chronic illnesses are more likely to have their outcomes affected by organizational factors.

Policy Implications

Inappropriate selection of patients to inpatient care contributes to poor patient outcomes and reduces cost-effectiveness and quality of care. Inexperienced physicians in emergency departments cannot be left alone to make decisions with consequences for cost-effectiveness and quality of inpatient care. It is cost-effective to have all decisions on admission to hospital care confirmed by senior doctors.

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