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Hospital readmissions to internal medicine departments: a higher risk for females?

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Abstract. – OBJECTIVE: Readmissions to hospital after discharge are considered adverse, serious and costly outcomes. In the last years, two new scores have been proposed to identify patients at high risk of hospital readmission, the HOSPITAL and the Elders Risk Assessment (ERA) indexes. The aim of this study was to evaluate these two scores and the risk of death among internal medicine readmitted patients.

PATIENTS AND METHODS: During a 30-month period, we identified 613 readmitted patients out of 13,237 admissions. Age, sex, length-of-hospital stay (LOS), and deaths were retrospectively analyzed. Readmissions with diagnosis coincident with the index hospitalization were classified as avoidable, whilst those with a different diagnosis were defined as non-avoidable. HOSPITAL score for 30-day potentially avoidable readmission and ERA indexes were calculated.

RESULTS: Readmitted patients (56.6% women), were aged 79±10.4 years. The incidence of 30-day readmission was 20.4 patients/month. Re-hospitalization could be classified as avoidable in 286 cases (46.7%), and death at the end of follow-up was recorded in 366 (59.7%). HOSPITAL score ≥ 7 and ERA score ≥ 16, both able to identify high risk patients for readmission, were present in 108 (17.6%) and 385 (64.4%) of cases, respectively. Patients with non-avoidable readmissions were older, more frequently female, diabetic, and had higher ERA score than subjects with avoidable readmission. Multivariate logistic regression analysis showed that non-avoidable readmissions were independently associated with female gender (OR 1.410 [95% CI 1.012-1.964], p=0.042), and age (OR 1.025 [95% CI 1.006-1.043], p=0.01), while only age (OR 1.034 [95% CI 1.015-1.054], p<0.001) and ERA score (OR 1.047 [95% CI 1.001-1.095], p=0.047) were independently associated with death at the end of follow-up.

CONCLUSIONS: Although re-hospitalization represents frequent phenomenon related to age, non-avoidable readmissions mainly involve female patients. ERA score appears to be an useful practical tool, able to identify high risk patients.

Key Words
Hospital readmissions, Gender, HOSPITAL score, ERA score.

Introduction

In an efficient hospital organization, readmission after discharge is considered as adverse serious and costly outcome[1]. It is well known that chronic diseases affect the health status of aging population, and their exacerbations are the leading causes of mortality in the world representing 60% of all deaths[2]. Increased prevalence of aged subjects with several medical problems is one of the causes of hospital admission and readmission, and the prevalence of readmission changes in the different health system settings, depending also on hospital volume[3]. In a previous study[4], we evaluated readmitted patients on the basis of the emergency department admission diagnosis, and classified readmissions differently on the basis of a concordant (i.e. avoidable) or discordant (i.e. non-avoidable) diagnosis in respect to an index hospitalization. Comorbid patients were at higher risk for 30-day readmission, and age, cardiovascular diseases and pulmonary diseases were independently associated with 30-day readmission for concordant diagnosis whereas kidney disease for discordant one. Prediction of re-hospitalization would allow health care workers to organize post-discharge interventions in order to prevent early readmission in high risk patients. On the other hand, up to now no universally recognized methods have been found for identification of high risk patients in order to reduce high rates of readmissions[5]. Different scores have been proposed, but none of them has been shown to overtake the others. In the last five years,

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two new scores have been proposed[6,7]. Thus, the aim of this study was to apply and calculate the two scores in a cohort of consecutively readmitted patients to an Italian medical setting, in order to verify their performance in predicting unplanned readmissions and risk of death.

Patients and methods

A retrospective, observational, cross-sectional study, was conducted with the approval of the local Institutional Committee for Human Research between January 2010 and July 2012. The study involved only readmitted subjects selected from all patients admitted to the Department of Medicine of University Hospital of Ferrara, Italy. The Department of Medicine, included into a 626-bed teaching hospital with all facilities, excluding only cardiothoracic surgery, consists of four Internal Medicine units, two Infectious disease units, and one each of Geriatrics, and Gastroenterology (165 total beds, 24/24 hours and 7/7 days open to the ED admissions). About one-third of all hospital admissions are directed to the Department of Medicine. The great part of medical and nursing staff is permanent, covering also festive days or holidays. The majority of admissions derives from the province of Ferrara (about 350,000 inhabitants). The annual flow of patients by the emergency department (ED) is approximately 76,000, with a high percentage of elderly subjects due to the fact that the area is characterized by a high percentage of elderly subjects. In fact, the province of Ferrara is characterized by an elderly population, where approximately 25% of subjects are over 65 years), and 3,000 subjects are aged more than 90 years. Age, sex, and reason for hospitalization of all patients admitted to the Department of Medicine were analyzed. Length-of-hospital stay (LOS) and in-hospital mortality (IHM) were also calculated. Medical diseases leading to hospitalization were arbitrarily defined by classifying diseases symptoms into several subgroups, such as hematologic/oncologic, cardiovascular, pulmonary, neurologic, renal, and gastrointestinal. Moreover, the presence of a positive history of surgery was also considered, whereas musculoskeletal, cutaneous and other diseases were classified as 'miscellaneous'. The details of considered diseases have been reported in a previous paper from our group[4]. We performed a retrospective 30-month observational study focusing on two groups of subjects, based on the dichotomic classification of avoidable or non-avoidable 30-day readmission. Patients re-hospitalized with admission diagnosis coincident with the index hospitalization were considered as belonging to the 'avoidable' group, whilst those with ED diagnosis different from the previous diagnosis of the index hospitalization were considered as belonging to the non-avoidable group. Therefore, the primary classification was based on the second admission diagnosis: concordant or discordant in respect with the previous diagnosis. First, the HOSPITAL score for 30-day potentially avoidable readmission was calculated[7]. For its calculation, low hemoglobin level at discharge, previous discharge from an oncology service, low sodium at discharge, procedures during hospital stay, type of index readmissions, number of hospital admission during the previous year and length of stay ≥5 days were taken into consideration.

Moreover, Elders Risk Assessment (ERA) index[6] was also calculated. For its calculation age, mental status, length of hospital stay, history of diabetes, heart disease, stroke, chronic obstructive pulmonary disease (COPD), neoplasia and dementia were evaluated from clinical notes. All considered factors were related with non-avoidable and avoidable readmissions. Also, death at the end of follow-up was evaluated, being our main outcome.

Statistical Analysis

Results are shown as mean ± SD or percentage. Patients' features, such as age, sex, history of diabetes, coronary artery disease, stroke, COPD, neoplasia and dementia, were compared in 'avoidable' and 'non-avoidable' readmission groups, as well in deceased and survivors, by *t*-test, chi-squared and Mann-Whitney U test, as appropriate. Logistic regression analysis was also conducted to evaluate the characteristics related to the type of readmission and the mortality during the 30-month period. Age was considered as a continuous variable, and sex, LOS, HOSPITAL and ERA scores were the independent variables. The analysis of male and female patients' survival during follow-up was conducted by Kaplan-Meier analysis. Statistical analysis was performed by using the software SPSS 13.0 (SPSS Inc., Chicago, IL, USA).

Results

The total sample population consisted of 613 subjects (56.6% women) aged 79±10.4 years, and octogenarians exceeded 55% (Table I). The incidence of 30-day readmission was 20.4 patients/month, and the time interval between the index

Table I. Characteristics of the 613 readmitted patients.

Incidence		20.4 patients/ month
Sex	Males (n [%])	266 (43.4%)
	Females (n [%])	347 (56.6%)
Age (years)		79 ± 10.4
	≤ 40	5 (0.8%)
	41-50	11 (1.8%)
	51-60	12 (2%)
	61-70	46 (7.5%)
	71-80	200 (32.6%)
	> 80	339 (55.3%)
Readmissions avoidable (n [%])		286 (46.7%)
In-hospital death (n [%])		110 (17.9%)
Death at the end of follow-up (n [%])		366 (59.7%)
Length of stay (days)		8.8 ± 7
HOSPITAL Score		5.65 ± 2.26
ERA Score		16.9 ± 4.26

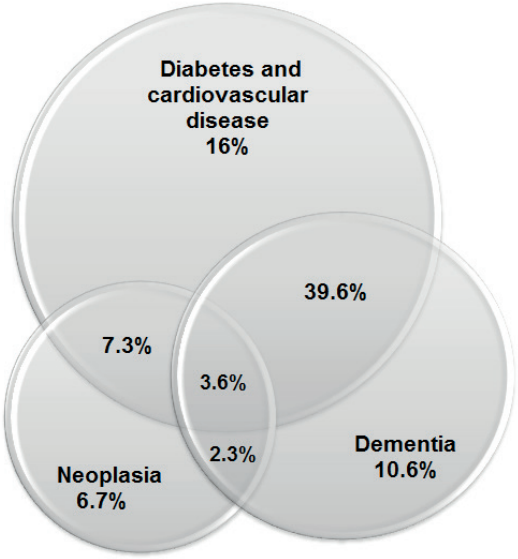

Figure 1. Venn diagram with association of the different comorbidities in the 613 readmitted patients.

hospitalization and the new re-hospitalization had a median of 12 days. LOS during readmission was 8.8±7 days. Re-hospitalization could be classified as avoidable in 286 cases (46.7%). Analysis of comorbidity showed that 20.4% of patients were diabetic, 21% had coronary artery disease, 37.5% cerebrovascular disease, 13.5% COPD, 19.9% had neoplasia, and 54.1% dementia (Figure 1). Death during readmission was recorded in 110 patients (17.9%), and death at the end of follow-up in 366 (59.7%). Mean HOSPITAL score was 5.65±2.26, whilst mean ERA score was 16.9±4.26. HOSPITAL score and ERA score with a respective cut-off of ≥ 7 and ≥ 16, both able to identify high risk patients for readmission, were calculated in 108 (17.6%) and 385 (64.4%) of cases, respectively.

Patients with non-avoidable readmissions were older, more frequently female, diabetic; they had a higher ERA score than subjects with avoidable readmission (Table II). Deceased patients at the end of follow-up were older, more frequently suffering from neoplasia; they had a higher ERA score than survivors (Table III).

Multivariate logistic regression analysis demonstrated that non-avoidable readmissions were independently associated with female sex (OR 1.410 [95% CI 1.012-1.964], p=0.042) and age (OR 1.025 [95% CI 1.006-1.043], p=0.01), while only age (OR 1.034 [95% CI 1.015-1.054], p<0.001) and ERA score (OR [1.047 95% CI 1.001-1.095], p=0.047) were independently associated with death at the

Table II. Comparison between avoidable and non-avoidable readmissions.

	Non-avoidable readmission (n=327)	Avoidable readmission (n=286)	p
Age (years)	80.7±7.8	77.1±12.5	<0.001
Females (n [%])	200 (61.2%)	147 (51.4%)	0.015
Males (n [%])	127 (38.8%)	139 (48.6%)	
Diabetes mellitus (n [%])	78 (23.9%)	47 (16.4%)	0.023
Coronary artery disease (n [%])	75 (22.9%)	54 (18.9%)	NS
Stroke (n [%])	123 (37.6%)	107 (37.4%)	NS
COPD (n [%])	43 (13.1%)	40 (14%)	NS
Neoplasia (n [%])	64 (19.6%)	58 (20.3%)	NS
Dementia (n [%])	189 (57.8%)	155 (54.2%)	NS
HOSPITAL score	5.56±2	5.76±2.5	NS
ERA score	17.5±4.1	16.3±4.3	0.003

COPD = chronic obstructive pulmonary disease.

Table III. Comparison between avoidable and non-avoidable readmissions.

	Survivors (n=247)	Deceased (n=366)	p
Age (years)	76.3±12.3	80.8±8.4	<0.001
Females (n (%))	142 (40.9%)	205 (59.1%)	NS
Males (n (%))	105 (39.5%)	161 (60.5%)	
Diabetes mellitus (n (%))	51 (20.6%)	74 (20.2%)	NS
Coronary artery disease (n (%))	51 (20.6%)	78 (21.3%)	NS
Stroke (n (%))	98 (39.7%)	132 (36.1%)	NS
COPD (n (%))	29 (11.7%)	54 (14.8%)	NS
Neoplasia (n (%))	30 (12.1%)	92 (25.1%)	<0.001
Dementia (n (%))	136 (55.1%)	208 (56.8%)	NS
HOSPITAL score	5.46±1.5	5.42±1.4	NS
ERA score	16±4.4	17.5±4.1	<0.001

COPD= chronic obstructive pulmonary disease.

end of follow-up. Kaplan-Meier survival analysis of subgroups by sex is shown in Figure 2.

Discussion

In our sample population of 613 readmissions during a 30-month follow-up, the calculated incidence was 20.4 patients/month. Only ERA index was independently associated with death at the end of follow-up. On the other hand, both scores used in this study did not show an impressive performance in our selected population of readmitted subjects.

The meaning of readmissions is still a matter of debate, and early re-hospitalizations have been ascribed to substandard care or high quality of care depending on the point of view of researchers[8]. On the other hand, poor resolution of the main problem, unstable therapy at discharge, and inadequate post-discharge care during the index hospitalization have been reported to be the cause of 9-48% of all preventable readmissions[9]. However, this series of parameters were not available in our study as well as data about death in patients discharged in a post-acute care facility or home care. Costs due to early readmission are important, estimated as $17.4billions in the Unit-

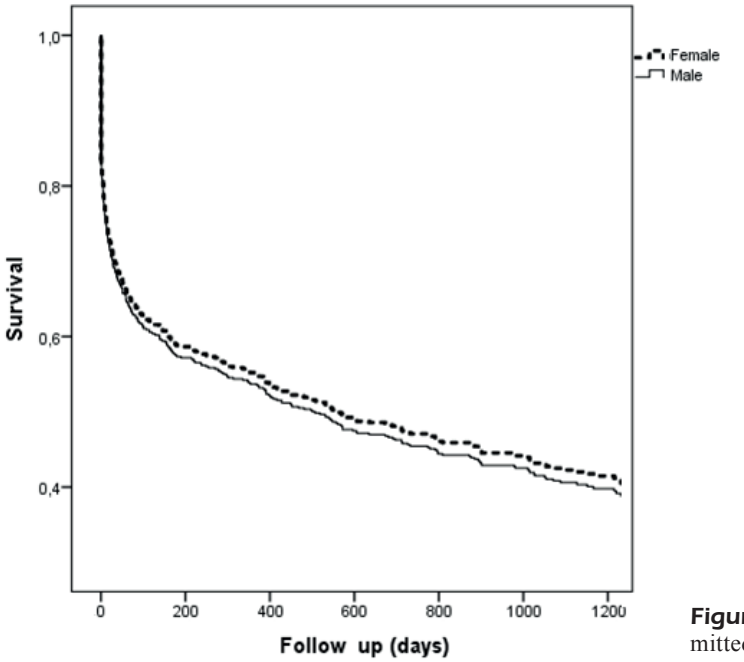

Figure 2 . Survival curves of female and male readmitted patients.

ed States[10]. In a review of twelve selected studies, socio-demographic factors, prior admissions and LOS, morbidity and functional disability were found to be the most common risk factors for re-admissions. The authors suggested the need of increasing vigilance of elderly comorbid patients admitted to hospital in whom previous hospital admissions, long duration of hospital stay, and functional disability could be identified[11]. Bogaisky and Dezieck[12] retrospectively investigated the rate and risk factors for 30-day re-hospitalization, comparing nursing home residents and community-dwelling older adults and, as well as in our study, comorbidity was a crucial factor. They found that 30-day readmission rate was higher in subjects discharged to a nursing home than in those discharged to the community, and chronic kidney disease and pressure ulcers were associated with a greater risk of readmission in both groups. COPD was a risk factor for readmission only in community-dwelling individuals, while congestive heart failure and dementia were associated with greater risk of readmission only in nursing home residents. Finally, they reported that risk of re-hospitalization was 30% lower in nursing home residents cared for by hospitalist than non-hospitalist geriatricians.

Re-hospitalization is a complex phenomenon that should be limited in order to increase health system efficiency. Prediction of re-hospitalization could be important and readmission score calculation could be a simple and inexpensive instrument. Evaluation of risk of hospital readmission should be a tool that physicians and nurses could use in every day clinical practice in order to target the efforts to avoid re-hospitalization. The ideal model should be able to identify high risk patients early during hospitalization, suggesting a personalized discharge plan before discharging. In their systematic review, Kansagara et al[13] classified readmission risk prediction models into (i) those relying on retrospective administrative data, (ii) those using real-time administrative data, and (iii) those incorporating primary data collection. However, the authors concluded that the majority of models had poor prediction ability[13]. Even if ERA and HOSPITAL indexes, used in our study, did not perform efficiently, we did not aim at evaluating their performance but rather at assessing patients' clinical picture. In fact, we did not use administrative data, but reviewed electronic charts of each single patient, and this method could be considered a strength of our work. In fact, administrative data are often collected for billing purpose, with consequent obvious limitations in accuracy[14].

An ideal clinical score for predicting readmissions would classify patients as low and high-risk ones, would be easily calculated before discharge, and would be validated in a clinical setting in which it would be used.

Donzé et al[7] developed a prediction model for potentially avoidable 30-day readmission derived from Brigham and Women's Hospital data in Boston, USA. They developed a 7-factor prediction score, defined HOSPITAL score, including hemoglobin at discharge, discharge from an oncology service, sodium level at discharge, procedure during the index admission, index type of admission (non-elective vs elective), number of admission during the past 12 months, and LOS. Low risk patients were defined by 0 to 4 points, intermediate risk ones by 5-6 points and high risk ones by $\geq$ 7 points. The authors concluded that the model enabled physicians to identify 27% of patients as high risk.

In our population, HOSPITAL score was $\geq$7 only in 17.6% of cases, and it was not able to discriminate avoidable and non-avoidable readmissions. On the other hand, patients' selection is determinant for the evaluation of a clinical instrument. In the work by Donzé et al[7], injection or infusion of cancer chemotherapeutics was the most frequent procedure, involving 8.8% of their population, whilst we investigated patients readmitted in our Internal Medicine Department and none of our patients was treated with chemotherapeutics. In our setting, in fact, these type of drugs are exclusively handled in the Oncology Department.

Crane at al[6] evaluated retrospectively more than 12,000 adults aged 60 years or more, abstracting electronic medical records and administrative databases. They developed a score called ERA index, including age, marital status, LOS, and history of diabetes, coronary artery disease, congestive heart failure, stroke, COPD, neoplasia, and dementia. The range of the score varied from -7 to 32, patients with a score $\geq$ 16 had the highest risk of visits, emergency room visits/hospital admissions and hospital stay[6].

In our patients, nearly 65% of cases had an ERA score $\geq$16, suggesting a better performance than HOSPITAL score. Moreover, ERA score was higher in non-avoidable readmissions and deceased patients. Probably ERA score described better than HOSPITAL score patients' clinical conditions and predicted negative outcome. The inclusion of comorbidities in the

score plays a crucial role. In a prospective cohort study evaluating nearly 5,000 patients for validating an index to predict the risk of death or unplanned readmission within 30 days after discharge from the hospital, it was found that LOS, acuity of admission, comorbidity assessed by Charlson comorbidity index and emergency department use were related to the outcome. Authors calculated the LACE index to quantify the risk of death or unplanned readmission within 30 days[15].

Also, the amount of potentially preventable readmissions varied in different studies. For example, Halfon et al[16] calculated that only about 25% of readmissions were avoidable, a percentage lower than the one reported in our study. The best model to predict 30-day readmission risk in general medical patients is still a matter of debate, and models able to detect avoidable and non-avoidable re-hospitalization could allow identification of subjects who most likely would benefit from intervention.

Readmissions could be defined as avoidable if different actions such as premature discharge, erroneous diagnosis, inappropriate treatment, inadequate patient education have been undertaken.

To the best of our knowledge, this is the first study reporting the relationship between non-avoidable readmission and female sex, at least in the Italian patients readmitted to Internal Medicine Departments. More than 800,000 patients recorded in the American College of Cardiology–National Cardiovascular Data Registry, were evaluated in order to examine gender and ethnic differences in coronary artery disease (CAD) prevalence and IHM after angiographic evaluation because of stable angina or acute coronary syndromes (ACS)[17]. The risk-adjusted OR for significant CAD was lower for women compared with men, on the other hand, higher IHM was reported for white women. It was suggested that lower utilization of elective coronary revascularization, aspirin, and glycoprotein IIb/IIIa inhibitors could have contributed to higher IHM[17].

Furthermore, in a population-based cohort study involving nearly 50,000 adults with ACS or stable angina, the 2-year composite outcome including all-cause death and hospital readmissions for myocardial infarction, heart failure, cerebrovascular accident, or angina was evaluated. Regardless of ethnicity, women were more likely than men to have adverse outcomes, angina readmission accounted for 45% of the composite outcome and women were more likely than men to be readmitted for angina[18]. It is possible that older women had more complications than men. In our sample, however, although sex significantly impacted on the type of readmission, i.e., female patients had a higher risk of non-avoidable readmission, female and male patients did not show any difference in survival during the study period.

We think that interventions aiming at avoiding emergency department visits and hospitalizations are useful because the latter could increase morbidity, functional decline, and institutionalization [19]. In this perspective, looking at the organization of our regional health system, ERA score seems to perform better than HOSPITAL score probably because the HOSPITAL score does not consider age.

The main limitation of this study is due to patients' selection. In fact, we investigated only readmitted subjects, and arbitrarily defined hospital readmissions within 30 days as potentially avoidable, if the admission diagnosis was the same in respect of a previous index hospitalization (i.e., concordant), or non-avoidable, if admission diagnosis was different from a previous one. Moreover, this cohort study was conducted on a selection of subjects who had been already re-hospitalized, aiming at verify the usefulness of two different readmission indexes. Data obtained from a retrospective study performed in a single department of a single hospital system, including only Caucasian patients, could not be generalizable. Again, we did not consider all socioeconomic factors, including only marital status, neither we analyzed functional status measures nor medications or adverse drug reactions (ADRs). Recent studies concluded that race/ethnicity, marital status[20], and ADRs were associated with increased hospitalizations in elderly subjects[21]. However, models for predicting the risk of readmission after hospital discharge taking into consideration socioeconomic models could be difficult to perform by clinicians, due to the need of specific information and special software as well.

Conclusions

It has been reported that in Italy cost analysis is crucially important from the perspective of the provider and also in view of rationalizing health system[22]. Re-hospitalizations represents heavy

social burden due the increasing number of elderly and comorbid patients. The use of practical tools based on data collected during every day clinical practice could be very helpful, and ERA score could allow physicians to identify patients with high risk for a negative outcome. However, prospective studies based on different local health systems organizations are needed. The presence of a difference by sex, characterized by a higher proportion of non-avoidable re-hospitalizations in females, need further larger scale confirmation and probably deserve specific tailored measures of prevention.

Conflicts of interest

Authors declare that there are not any potential conflicts of interests that are directly or indirectly related to the data presented in the paper.

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