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Original Article

Characteristics and temporal pattern of the readmissions of patients with multiple hospital admissions in the medical departments of a general hospital

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ABSTRACT

Introduction: Patients with multiple hospital admissions represent a small percentage of total hospitalizations but result in a considerable proportion of the healthcare expenditure. There are no studies that have analyzed their long-term clinical evolution.
Objectives: To study the characteristics, temporal patterns of readmissions and clinical evolution of patients with multiple hospital admission in the long term.
Methods: A retrospective study was conducted of all hospital admissions in the medical area of the Hospital of Lugo (Spain) between January 1, 2000 and December 31, 2012, based on data from the center's minimum basic data set.
Results: A total of 139,249 hospital admissions for 62,515 patients were studied. Six hospital admissions were recorded for 6.4% of the patients. The overall mortality rate was 16% (9982 patients). The readmissions rate steadily increased with each new admission, from 48% after the first event to 74.6% after the fifth. The rate of hospital readmission before 30 days increased from 18.3% in the second admission to 36.3% in the sixth. The number of chronic diseases increased from 3.1 (SD, 2) in the first hospital admission up to 4.9 (2.8) in the sixth. The Department of Internal Medicine treated a third of all hospital admissions. In the sixth hospitalization, conditions associated with admission in Internal Medicine were CIRS score, age, heart failure, COPD, dementia, diabetes, atrial fibrillation and anemia.
Conclusions: Patients with multiple hospital admissions are complex patients whose temporal pattern of readmissions changes with time, such that each hospital admission constitutes a factor facilitating the next.

1. Background

A hospital readmission is the hospitalization of a patient that occurs within a specific period after a previous hospital admission referred to as the index. Most studies refer to the concept of hospital readmission within the 30 days following discharge as an indicator of the activity and quality of health care [1–3]. However, it is not clear how we should use hospital readmissions as indicators of quality, given that their causes are not always attributable to problems with medical care [4]. Otherwise, less than a quarter of readmissions seem to be preventable [5]. It is estimated that the rate of hospital readmissions within 30 days is between 5–25% and 20–35% at 3–6 months [5–10].

Recently, the concept of patients with multiple hospital admissions has been introduced, which applies when a patient is hospitalized on several occasions within a specific period of time. As with the definition for readmission, there is no consensus as to the time period (between 1 and several years) or number of hospital admissions (more than 2 or 3). Patients with multiple hospital admissions can represent 20% of patients hospitalized in a department of internal medicine [8]. Their clinical profile is that of elderly individuals with complex chronic diseases and a high mortality rate [8,9,11,12], all of which predict a likely increase in the number of these types of readmissions in the coming years. Although these patients represent only a small percentage of total hospital admissions, they represent a considerable proportion of the healthcare expenditure and are therefore considered "high-cost patients" [12,13].

There are studies that have identified some factors associated with hospital readmissions and with multiple hospital admissions: male sex, previous hospital admissions, comorbidity, chronic disease, functional state, vascular diseases, adverse events during the index hospitalization, etc. [7,8,14,15]. Also, attempts have been made to establish risk scales for predicting readmission [3,15,16], but their reproducibility and

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predictive capacity are moderate. However, there are no studies that have analyzed the pattern in which admissions of patients with multiple hospital admissions occur, their timing and characteristics over a long period. The study of their features can help facilitate planning for resources directed to the care of this type of chronically ill patients who need highly complex care.

The aim of our study was to study the clinical characteristics and pattern of readmissions overtime in patients with multiple hospital admissions in a Spanish general hospital.

2. Method

A retrospective study was conducted on the overall population admitted to the hospital that occurred in the departments of the medical area of Hospital Complex Xeral-Calde of Lugo between January 1, 2000 and December 31, 2012. During the study, this center had 769 beds distributed among 3 hospital centers and provided care for a population of 240,000 inhabitants. This hospital complex was closed in December 2010. All resources and equipment from the 3 hospital centers were transferred to a new building, University Hospital Lucus Augusti, which has 879 beds and the same care coverage. The medical area during both periods was formed by the following 12 departments: Cardiology, Endocrinology, Rheumatology, Oncology, Respiratory Medicine, Gastroenterology, Neurology, Nephrology, Geriatric Medicine, Infectious Diseases and Internal Medicine.

The data source was the center's minimum basic data set (MBDS). The analyzed variables were: department where the patient was hospitalized, sex (male/female), date of birth, date of hospital admission and discharge, length of stay (days), destination at discharge (including death), diagnosis-related group (DRG), primary diagnosis (according to the ICD-9-CM classification), and secondary diagnoses, with their corresponding ICD-9-CM codes (up to 10) in the order in which they appear in the hospital documentation. It is mandatory for all hospitals in Spain to include in their database all of these variables extracted from each admission and discharge. So, data were available in all cases and no patients were excluded from the study.

The database was reviewed, searching for errors (incomplete data, classification errors, typing errors, etc.). To this end, we verified all cases individually, checking the medical history when necessary, until the database was considered error free. Subsequently, each of the diagnoses included in each of the hospital admission episodes was classified as acute or chronic, considering as such those from the list from the German Multicare Study [17]. We employed the criterion established by the World Health Organization (http://www.who.int/topics/noncommunicable_diseases/en/). The diagnoses classified in subsections of large diagnostic categories were grouped according to the researchers' clinical criterion (e.g., dominant-side hemiplegia, aphasia and brain embolism with infarction were grouped within the stroke category), searching for internal consensus for questionable cases. The distinct hospitalization episodes were then classified according to the Cumulative Illness Rating Scale criteria (CIRS) [18].

At a later time, the database of hospital admission episodes was converted into a patient database. To this end, we created a matrix in which each row included a single patient, with their successive hospitalizations; each column had a separate variable. This matrix enabled us to calculate other secondary variables (e.g., time between hospital admissions). From the patient database, we selected those who were readmitted at least once and up to 6 times during the study period in any medical department and with any diagnosis. Finally, we performed a check for errors in the search for inconsistency or for impossible data, which were corrected successively until a complete data cleaning was achieved.

In order to identify the clinical profile of patients admitted to the Internal Medicine Department in the subgroup of patients with more readmissions, we compared the characteristics of admissions to IM with the rest of the departments of the medical area in the sixth hospitalization.

For the statistical analysis, the Chi-squared test was used to evaluate differences between two qualitative variables and the Kolmogorov–Smirnov test for distribution comparison. After previous assessment of homoscedasticity, Student's T test was used to compare quantitative variables between two groups. A logistic regression model was utilized for multivariate analysis to ascertain the factors associated with admission in the IM department in the sixth hospitalization. In the univariate analysis, a 5% significance was required for inclusion of variables, although we decided to include non-significant but clinically relevant variables that might influence results in the maxim model. The collinearity of the maximum model was assessed with the criteria proposed by Belsley. A backward procedure was used as a modeling strategy; the log likelihood ratio test was used for model comparison and goodness-of-fit assessment. Interaction factors were analyzed but were not included in the final model, as they were not found to be significant. Adjusted odds risk ratios and 95% confidence intervals for each independent covariate were calculated from the estimated beta-coefficients derived from the logistic regression model. For the data analysis, we used the statistical package SPSS 17. The level of statistical significance was set at $p < 0.05$.

3. Results

We studied 139,249 hospital admission episodes for 62,515 patients during the study period. Fig. 1 details the patients' evolution in the series in terms of the number and rate of readmissions, with the mortality for each episode. Some 25.2% of the patients were readmitted on at least 2 occasions after the index hospitalization, and 6 hospital admissions were recorded for 6.4% of the patients. The overall mortality rate was 16% (9982 patients). The percentage of readmitted patients steadily increased with each new admission, from 48% after the first event to 74.6% after the fifth.

Table 1 lists the variables related to the patients' clinical characteristics based on the order of the analyzed hospital admission. The mean age increased from 69.4 years (SD, 18.9) to 74.2 years (10.1) by the third hospital admission and decreased slightly in the subsequent admissions. The number of chronic diseases increased progressively from 3.1 (2) in the first admission to 4.9 (2.8) in the sixth. Similarly, scores on the CIRS went from 9.4 (4.8) to 12.1 (5.7). The mortality rate increased from 5.9% in the first admission to the maximum of 11.2% in the fifth. A progressive reduction was observed in the length of hospital stay in successive hospitalizations, from 11.4 days (26.8) in the first hospital admission to 9.9 (14.7) in the sixth.

In Table 2, it is shown how the admission services were distributed in the subsequent readmissions. The Department of Internal Medicine had the largest healthcare load, with approximately a third of all hospital admissions in the series. The percentage of patients who were admitted to Respiratory Medicine, Oncology and Internal Medicine steadily increased in subsequent readmissions. In the other medical departments, however, this percentage remained stable (Rheumatology), initially increased and then slightly decreased (Geriatric Medicine) or decreased over time (Cardiology, Neurology, Gastroenterology and Endocrinology).

Table 3 shows the most common causes for hospital admission in each hospital admission episode, grouped according to their primary diagnosis (ICD-9-CM). The most common reasons for the first hospitalization were stroke (7.5%) and ischemic heart disease (7%), whose relative importance decreased in the sixth hospital admission to 2% and 2.7%, respectively. In the sixth hospitalization, the most common primary diagnoses were the scheduled administration of chemotherapy (11.3%), chronic obstructive pulmonary disease (10.4%) and heart failure (8.7%).

The rate of hospital readmissions within 7 days of the prior index admission increased from 6.4% in the second hospital admission to 13.6% in the sixth. The same tendency was observed in the readmissions within 30 days, with a progressive increase from 18.3% to 36.3%. The median delay between hospital admissions dropped from 332 days