

## Original Paper

# Characterization of patients using insulin in a pharmacotherapeutic service and identification of hospital readmissions

Jessica SOARES MALTA  
Josiane MOREIRA DA COSTA  
Carla JORGE MACHADO  
Maria Auxiliadora PARREIRAS MARTINS

### Abstract

**Objective:** To characterize patients with insulin-dependent Diabetes Mellitus (DM) accompanied by a PF service in a teaching hospital, as well as to identify the occurrence of hospital readmissions and associated factors. **Methods:** This is a cross-sectional study carried out in a general teaching hospital, being included patients above 18 years old, of both genders, with type 1 or 2 DM diagnosis were admitted from April 2015 to April 2016, accompanied by the Pharmaceutical Follow-up Service of the hospital, who used insulin during hospitalization and received indication for using this drug in the hospital discharge prescription. Data were collected through consultation in electronic medical records and telephone contact after the hospital discharge. Data were recorded in a Microsoft Excel spreadsheet, with the patients subdivided into groups with and without readmission, followed by univariate analysis of associated factors by means of proportion comparison and logistic model with penalized likelihood. **Results:** Patients who were re-admitted had higher blood sugar values, fewer pharmaceutical interventions regarding insulin use, and longer average hospitalization time. The analysis of the association between variables and readmission did not present statistical significance. **Conclusions:** The study points out to weaknesses related to the offer of care to the patients under study, such as weaknesses in the coverage for offering actions related to health education in the periods before and after hospital discharge, difficulty in accessing the specialist physician and non-achievement of blood sugar measurement by some patients. There was no association between any of the analyzed variables and hospital readmission.

**Keywords:** Diabetes Mellitus; Elderly, hospitalization, pharmaceutical services.

## Caracterização de pacientes em uso de insulina em um serviço de Acompanhamento Farmacoterapêutico e identificação de reinternações hospitalares

### Resumo

**Objetivo:** caracterizar pacientes com Diabetes Mellitus (DM) em uso de insulina acompanhados por um serviço de AF em um hospital de ensino, assim como identificar a ocorrência de reinternações hospitalares e fatores associados. **Métodos:** Trata-se de um estudo transversal, realizado em um hospital geral de ensino, sendo incluídos pacientes acima de 18 anos, de ambos os sexos, com diagnóstico de DM tipo 1 ou 2, internados no período de abril de 2015 a abril de 2016, acompanhados pelo serviço de Acompanhamento Farmacoterapêutico do hospital, que utilizaram insulina durante a internação e receberam indicação de uso desse medicamento na prescrição da alta hospitalar. Os dados foram coletados por meio de consulta em prontuário eletrônico e realização de contato telefônico após a alta hospitalar. Os dados foram registrados em planilha do programa Microsoft Excel, sendo os pacientes subdivididos em grupos com e sem reinternação, seguido de realização de análise univariada de fatores associados por meio de comparação de proporções e modelo logístico com verossimilhança penalizada. **Resultados:** Pacientes que reinternaram apresentaram maiores valores de glicemia, menor número de intervenções farmacêuticas quanto ao uso de insulina, e maior tempo médio de internação. A análise da associação entre as variáveis e reinternação não apresentou significância estatística. **Conclusões:** O estudo aponta para fragilidades relacionadas ao oferecimento de cuidado aos pacientes em estudo e ações relacionadas à educação em saúde nos períodos pré e pós alta hospitalar, dificuldade de acesso ao médico especialista e não realização de mensuração glicêmica por alguns pacientes. Não identificou-se associação entre quaisquer das variáveis analisadas e a reinternação hospitalar.

**Palavras-chave:** Diabetes Mellitus, idoso, hospitalização, serviços farmacêuticos.

Universidade Federal de Minas Gerais

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Corresponding Author:  
Josiane Moreira da Costa  
josycostta2@yahoo.com.br

## Introduction

The functioning and maintenance of the body depends on the performance and balance related to the various hormones and substances that meet the needs of the tissue and systems. One of these hormones is insulin, which is secreted by the pancreas and promotes the entry of glucose into the cells. The occurrence of deficiencies in the secretion or action of this hormone is associated with the Diabetes Mellitus (DM) metabolic syndrome.<sup>1,2</sup>

Insulin resistance is considered to be the precipitating factor for the metabolic syndrome, characterized by a set of concomitant changes in the body, such as, dyslipidemia, atherosclerotic cardiovascular disease, glucose intolerance and compensatory hyperinsulinemia.<sup>3</sup> This disease usually shows an initially silent progression, but may result in severe clinical conditions, such as ketoacidosis, and hyperosmolar hyperglycemic state, which can lead to death. Due to its high population prevalence and complications resulting from its aggravation, the metabolic syndrome is considered to be a major public health problem.<sup>4,5</sup>

According to the seventh atlas published by the International Diabetes Federation (IDF), there were about 14.3 and 415 million people diagnosed with this disease in Brazil and the world, respectively, in the year 2015.<sup>4</sup> Studies show that the number of cases is constantly increasing and it is estimated that in 25 years there is may be approximately 63% increase in the number of diagnosed patients.<sup>4</sup>

It is emphasized that diabetes is an isolated risk factor in the hospitalization processes, and patients with this health problem are more likely to have hospital infections and other complications during hospitalization, which is associated with a higher mortality risk.<sup>1,4</sup>

In addition to hospitalization, it is understood that the moment after hospital discharge may be constituted of failures in the communication processes between health professionals, and health professionals and patients. This weakens several actions related to care, among them the use of medicines,<sup>6</sup> which may also contribute to the occurrence of hospital readmission.<sup>7,8</sup>

Despite identifying the contributions of the pharmaceutical care services directed to hospitalized patients,<sup>9,10</sup> there is no identification of contributions of these services for preventing hospital readmissions. A systematic review that proposed to identify contributions of the pharmaceutical services in hospital readmissions concluded that the studies had limitations and did not identify contributions in preventing elderly re-hospitalization.<sup>11</sup> This same study did not show Brazilian experiences, which points out to the lack of studies on this subject in Brazil.

When considering DM impact on the public health system context, one identified the need for better knowledge on the occurrence of readmissions in this profile of patients and contributions of pharmacotherapeutic follow-up (PF) in this process. This study aims at characterizing patients with insulin-dependent Diabetes Mellitus (DM) accompanied by a PF service in a teaching hospital, as well as to identify the occurrence of hospital readmissions and associated factors.

## Method

### Design and studied site

This is a cross-sectional study, carried out in a general teaching hospital, funded by the Unified Health System (Sistema Único de Saúde - SUS). This hospital works as a training center for multiprofessional residency programs in the elderly health, with the involvement of nurses, pharmacists, physiotherapists, speech therapists, nutritionists, occupational therapists and psychologists.

### Criteria of inclusion and exclusion

The study included patients over 18 years old, of both genders, diagnosed with type 1 or 2 DM, hospitalized from April 2015 to April 2016, accompanied by the hospital's PF service, who used insulin during the hospitalization and received an indication for the using this drug in the prescription of the hospital discharge. For data collection, telephone contact was also made with the patients after hospital discharge, and the patients whose telephone contacts were unsuccessful after two attempts by the absence of telephone service, were excluded from the study.

### Data collection and analysis

This study considered socio-demographic, lifestyle, and clinical variables, being them (i) socio-demographic: age, gender and reports of family insufficiency (ii) lifestyle: illiteracy and habits of alcoholism and smoking (iii) clinical: classification

of risk profile according to the institutional protocol, adherence problems in the period prior to hospitalization (pre-hospitalization), measurement of blood sugar level upon hospital admission, occurrence of hyperglycemia and hypoglycemia during hospitalization, occurrence of amputation during hospitalization and type of insulin prescribed upon hospital discharge.

Data were extracted from registers in medical records, and records on reports of family insufficiency were obtained through social service evolutions. Family insufficiency is characterized by impaired family tie and low social support, which can lead to the social vulnerability of the elderly, to a decline in psychological and functional health, to poorer quality of life and to unsuccessful aging.<sup>12</sup> The interest in the family insufficiency variable was due to the fact that elderly patients may require more support from the family, especially when using insulin, which may interfere with the re-hospitalization process. On the other hand, the illiteracy, alcoholism, smoking variables, and all the clinical variables were obtained through the records in the medical form document Pharmaceutical Evolution (FE).

The risk profile variable consists of a classification performed by the institution under study and it considers the clinical specificity of each individual during hospitalization. The risk profiles are named according to the multiprofessional reference teams in providing care to the elderly patients, which are: Stroke, Fragile Elderly, Vascular Impairment, Femur Fracture, Intensive Care (IC) and Palliative Care. In addition to these classifications, the variable named "others" was also used, which corresponds to patients who do not fall into the classification of risk profiles defined by the hospital, being cared in hospitalization units without a reference multiprofessional team. The patients under study were directed to the PF Service by an active search in the multiprofessional teams, or in case of the "others" classification, sent by health professionals of the other hospitalization units. When capturing the patients, pharmacists recorded the risk profile of the patient in the FE document.

Adherence was measured from the self-report register of adherence problems by patients during the pharmaceutical approach. The self-report on the adherence most often consists of the sole method that health professionals have for the clinical approach of the patients<sup>13</sup> and constitutes a strategy that has relevance in scientific research.<sup>14,15</sup>

Still the registers of medical records, we identified the pharmaceutical interventions performed during hospitalization and hospital readmission records.

### Hospital readmission

The literature has different definitions for the hospital readmission concept. In some cases, subsequent hospitalizations related to the first hospitalization are considered. In others, hospital readmissions occurring in the same service, irrespective of diagnosis, are considered.<sup>16</sup> There are also divergences in relation to the time interval, which can be delimited by the number of hospitalizations in a certain time period.<sup>17</sup> As the data collection occurred one year after the study period, the identification of the re-hospitalization occurred through a consultation to the computerized system of the institution, where the registry of new hospitalization for the patients was evaluated in the maximum period of up to five months after hospital discharge. This This option was based on the longer re-hospitalization time identified in the patients who were treated in the first six months of the study.

### Telephonic contact

To complement the data collection process, telephone contacts were made with the patients about five months after discharge. The aim was to identify information regarding access to the endocrinologist; existence of a glucometer at home; blood sugar measurement periodicity; patient ability to inform on the last blood sugar measurement, person responsible for the blood sugar measurement, schedules and measurement values; report on receipt of educational information about the use of insulin during hospitalization, as well as the existence of possible doubts.

In case the patient could not answer the questions, the primary caregiver was interviewed.

### Data analysis

The collected data were recorded in Microsoft Excel spreadsheet, followed by performing univariate statistical analysis. The used stratification variable

was hospital readmission. The dispersion of the collected variables was analyzed considering the occurrence or not primary outcome of hospital readmission. Descriptive analysis was initially performed using absolute and relative frequencies. A description on the variables found through the subdivision of patients between Group 1 (no hospital readmission) and Group 2 (hospital readmission record) was carried out, followed by identifying the differences in proportions between the variables collected and the occurrence or not of re-hospitalization. Then, since that the quasi-separation phenomenon in the data was observed, that is, some variables predicted almost completely the interest outcome (hospital readmission) and that for small samples, the traditional logistic model may be a bias origin in the results, the logistic model with a penalized likelihood was used, allowing us to estimate the odds ratios with more stability and advances in relation to the logistical traditional model, working with convergences based on likelihood ratios.<sup>18</sup> The obtained estimator was the *odds ratio* (OR) for re-hospitalization (compared to no hospital readmission).

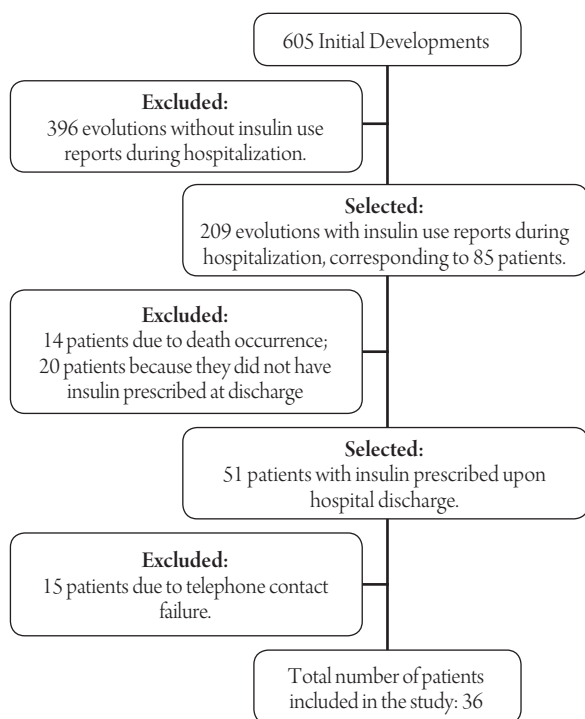
Two levels of statistical significance were considered, taking into account the small sample size and the possibility for type II errors: 5% ( $p < 0.05$ ; statistically significant 10% ( $p < 0.10$ ; trend to statistical significance), always considering a 95% confidence interval (CI).

This work counts with approval of the Research Ethics Committee of the Institution receiving the written opinion CAAE 42681215,5,0000,5149.

## Results

A total of 605 pharmaceutical evolutions were analyzed, and 36 patients were included in the study. The process of capturing and excluding the patients involved in the study is shown in figure 1.

**Figure 1.** Explanatory flowchart of the subjects included in the study.



Of the total number of patients (36), 18 (50%) were male. The median age was 68.5 years, the minimum age was 41 years and the maximum was 85, the mean hospitalization length was 28.4 days (standard deviation: 24.2 days), the minimum time being 7 and the maximum time being 102 days. Quartiles 25, 50 and 75 corresponded to 12, 16,5 and 40 days, respectively. Table 1 shows the other socio-demographic characteristics of the individuals included in the study.

**Table 1.** Socio-demographic profile, life habits and clinical variables identified upon hospital admission.

Specification	Result. N (%) N = 36
Median age (years) N (%)	68.5
Gender n (%)	
Male	18 (50.0)
Family insufficiency n (%)	
Yes	2 (5.6)
No	27 (75.0)
Not informed	7 (19.4)
Illiteracy n (%)	
Yes	4 (11.1)
No	26 (72.2)
Not informed	6 (16.7)
Alcoholism n (%)	
Yes	10 (27.8)
No	20 (55.6)
Not informed	6 (16.7)
Smoking n (%)	
Yes	6 (16.7)
No	24 (66.7)
Not informed	6 (16.7)
Risk profile n (%)	
Vascular	14 (38.9)
Stroke unit	6 (16.7)
Femur Fracture	4 (11.1)
Fragile Elderly	3 (8.3)
IC	1 (2.8)
Others	2 (5.6)
Not informed	6 (16.7)
Pre-hospitalization adherence problem n (%)	
Yes	16 (44.4)
No	13 (36.1)
Not informed	7 (19.4)
Measurement of blood sugar upon hospital admission n (%)	
Yes	27 (75.0)
No	9 (25.0)
Occurrence of hyperglycemia during hospitalization n (%)	
Yes	29 (80.6)
No	7 (19.4)
Occurrence of hypoglycemia during hospitalization n (%)	
Yes	10 (27.8)
No	26 (72.2)
Patient submitted to amputation n (%)	
Yes	13 (36.1)
No	23 (63.9)

**Legend:** Stroke: Cerebral Vascular accident; IC: Intensive Cares.

The majority (63%) of the patients reported not having access to the endocrinologist after hospitalization and were not able to report the value of blood sugar level in fasting (66%) of the last measurement, as specified in table 2.

**Table 2.** Information obtained during the telephone contact

Specifications	Periodicity, N (%)
<b>Information provider</b>	
Caregiver	29 (80.6)
Patient	7 (19.4)
<b>Report of access to the endocrinologist after discharge</b>	13 (36.1)
<b>Report of owning a glucometer</b>	27 (75.0)
<b>Report on carrying out blood sugar measurement with often</b>	25 (69.4)
<b>Report of last glycemic measurement less than one month.</b>	20 (55.6)
<b>Report of who carries out blood sugar measurement</b>	
Caregiver	23 (63.9)
Patient	7 (19.4)
Healthcare service	4 (11.1)
Not accomplishing	2 (5.6)
<b>Report of measuring blood sugar level in fasting or randomly</b>	
Fasting	12 (33.3)
Random	11 (30.6)
No report	13 (36.1)
<b>Report on measured blood sugar value in fasting</b>	
≥ 50 mg/dL to < 100 mg/dL	5 (13.9)
≥ 100 mg/dL to < 140 mg/dL	3 (8.3)
≥ 140 mg/dL to < 240 mg/dL	2 (5.6)
Not knowing the value	2 (5.6)
No report	24 (66.6)
<b>Report on randomly measured blood sugar value</b>	
≥ 50 mg/dL to < 100 mg/dL	1 (2.8)
≥ 100 mg/dL to < 140 mg/dL	3 (8.3)
≥ 140 mg/dL to < 240 mg/dL	4 (11.1)
> 240 mg/dL	2 (5.6)
Not knowing the value	1 (2.8)
No report	25 (69.4)
<b>Received hospital discharge advice on insulin use</b>	21 (58.3)
<b>Report on doubt about DM</b>	11 (30.6)
<b>Report on doubt about insulin use</b>	11 (30.5)
<b>Report on doubt about insulin use</b>	11 (30.5)

When identifying the insulin types prescribed on discharge, it was observed that 17 (47.2%) patients were discharged with a recommendation for just using NPH insulin, and for 17 (47.2%) patients, NPH and Regular insulin, were prescribed. Regarding other patients, there was 1 (2.7%) prescription only with Regular insulin, and 1 (2.7%) prescription of NPH insulin and insulin glargine.

Regarding the occurrence of hospital readmission, it was found that 12 (33.3%) patients had at least one re-hospitalization at the study institution, and 24 (66.7%) were not re-hospitalized. When identifying the characteristics of the patients without re-hospitalization (group 1), those who show it (group 2) identified a median age of 65.5 years old and 67.2 years old, and mean time for the first hospitalization of 24.6 (standard deviation: 19.3) and 36.1 (standard deviation: 3.4) days, respectively.

Tables 3 to 5 indicate the odds ratio for re-hospitalization, according to selected characteristics. There was no association among any of the characteristics and the hospital readmission.

The information obtained by telephone contact subdivided by group, as well as the odds ratio for re-hospitalization occurrence are described in table 4.

Table 5 exhibits clinical information regarding the hospitalization time and post-hospital discharge according to the group.

## Discussion

Gender predominance was not identified among the studied patients. The median age observed is related to the elderly population subgroup, probably due to the fact that the captured patients were accompanied by a team of pharmacists resident in a residency program with emphasis on the elderly care.

Regarding hospitalization time, a large variation between the minimum and maximum time (7 and 102 days) is identified, which may be related to the different clinical complexities of the patients. In other studies that approached the hospitalization time, a great variation is also observed. It is identified that the hospitalization is influenced by the causes-related to the hospitalization and complexity regarding the clinical condition of each patient, among other factors.<sup>19</sup>

The majority of patients (75%) did not exhibit a medical report on family insufficiency. This information is seen as positive in the context of follow-up and assistance for the pharmacological treatment adequate accomplishment, since that those elderly patients need more aid for drug administration, especially insulin. However, it is understood that for the percentage of patients with family insufficiency, specific strategies should be drawn up.<sup>20</sup>

One also notes a major report on the non-existence of reports on alcoholism and smoking, being 55.6% and 66.7%, respectively. Regarding the illiteracy reports, although it was denied by the majority of the patients, a higher percentage of this variable was observed in the group of patients who did not demonstrated hospital readmission, when compared to the group that was readmitted (12% versus 8%, P: 0.114).

Problems related to literacy are still prevalent in the Brazilian and world scenario, being a social barrier to be transposed in health interventions,<sup>21-22</sup>. In the study conducted in 2012 by Elliot *et al.*, it was demonstrated that the complexity of treatment in the elderly makes it difficult to understand, which reflects in the adherence to the treatment. A larger report of failure to adhere to the treatment in the period prior to hospitalization (44.4%) was observed, and it may be suspected that understanding and adherence interfere in the development of complications of the disease and in the hospitalization occurrence.<sup>23</sup>

Regarding the risk profile of the followed up patients, a higher prevalence of patients with vascular problems (38.9%) and stroke (16.7%) profile was observed. It can be inferred that the higher prevalence in the vascular unit is related to the studied group being made of patients with insulin use indication, which may have as a reason for hospitalization, vascular complications arising from diabetes.<sup>24</sup> One did not identify patients with the Palliative Care risk profile, which can be justified by the fact that the hospital discharge occurrence is a criterion for inclusion in the study. Hospital discharges are not frequently observed among the elderly patients with the Palliative Care profile treated at the studied institution.

Most patients underwent blood sugar measurement upon hospital admission (75%), which is essential to define the therapeutic course to be adopted during the hospitalization. In addition, it was observed that hyperglycemia occurred during hospitalization in 80.6% of the studied patients, which demonstrates the need for adequate use of hypoglycemic agents, especially insulin. Hypoglycemia occurrence (27.8%) may be a reflection of using high insulin doses during hospitalization. This finding is seen as shocking considering that the hypoglycemic state is a precipitating factor for symptoms, such as seizures, tremor, sweating and chills, unconsciousness and others.<sup>25</sup> In a study carried out in the same Institution, it has been demonstrated that the clinical care actions of the pharmacist may promote more safety and direction in relation to drug use.<sup>26</sup>

It was observed that 36.1% of patients underwent some amputation type of part of the lower limb or in the entire limb. Considering the profile of the patients in this study, this result is close to those demonstrated in the study carried out in Minas Gerais, where it was identified that patients undergoing amputation are mainly elderly.<sup>27</sup> Another study in the United States has identified that diabetic foot complications and, consequently, amputations, are more common in patients with advanced age, as well as being a great burden for the resources involved in health.<sup>28</sup>

In the second phase of the study, information was obtained by telephone contact after hospital discharge, and the caregiver was the main provider for the information (80.6%). In the studied hospital, the role of the caregiver is often assumed by family members, information previously registered in other publications related to the studied hospital.<sup>29-30</sup>

**Table 3.** Socio-demographic variables, life habits and clinical variables identified upon hospital admission, in relation to the groups of patients without re-hospitalization and with re-hospitalization records

Specification	Without re-hospitalization (N=24) N;%	With re-hospitalization (N=12) N;%	Odds ratio	Confidence interval	Pvalue
<b>Male gender</b>	11; 45.8	7; 58.3	1.6	0.4 - 6.2	0.49
<b>Family insufficiency</b>					
Yes	1; 4.2	1; 8.3	1.4	0.1 - 15.6	0.77
Not informed.	7; 29.2	0; 0.0	0.1	0.0 - 1.8	0.12
No	16; 66.7	11; 91.7	Ref.*	Ref.*	Ref.*
<b>Illiteracy</b>					
Yes	3; 12.5	1; 8.3	0.6	0.1 - 4.5	0.60
Not informed	6; 25.0	0; 0.0	0.1	0.0 - 2.0	0.14
No	15; 62.5	11; 91.7	Ref.*	Ref.*	Ref.*
<b>Alcoholism</b>					
Yes	7; 29.2	03; 25.0	0.6	0.1 - 2.6	0.14
Not informed	6; 25.0	00; 0.0	0.1	0.3 - 2.0	0.12
No	11; 45.8	09; 75.0	Ref.*	Ref.*	Ref.*
<b>Smoking</b>					
Yes	4; 16.7	2; 16.7	0.8	0.1 - 4.4	0.76
Not informed	6; 25.0	0; 0.0	0.1	0.0 - 2.1	0.14
No	14; 58.3	10; 83.3	Ref.*	Ref.*	Ref.*
<b>Median hospitalization time &gt;16 days</b>	12; 50.0	6; 50.0	1	0.3 - 3.8	>0.99
<b>Hypoglycemia upon hospital admission</b>	7; 29.2	03; 25.0	1.2	0.3 - 5.2	0.84
<b>Hypoglycemia upon hospital admission</b>	19; 79.2	10; 83.3	0.8	0.2 - 4.5	0.84
<b>Risk profile</b>					
Stroke unit	4; 16.7	2; 16.7	Ref.*	Ref.*	Ref.*
Vascular	8; 33.3	6; 50.0	1.4	0.2 - 8.8	0.73
Fragile Elderly	1; 4.2	2; 16.7	3	0.2 - 38.3	0.40
Femur Fracture	3; 12.5	1; 8.3	0.8	0.1 - 9.0	0.84
IC	1; 4.2	0; 0.0	0.6	0.0 - 21.0	0.78
Others	1; 4.2	1; 8.3	1.8	0.1 - 27.9	0.67
	6; 25.0	0; 0.0	0.1	0.0 - 3.6	0.24
<b>Adherence problem before the 1st hospital admission</b>					
Yes	11; 45.8	5; 41.7	0.4	0.1 - 1.8	0.24
Not knowing	7; 29.2	0; 0.0	0.1	0.0 - 1.2	0.07
No	6; 25.0	7; 58.3	Ref.*	Ref.*	Ref.*
<b>Amputation</b>	9; 37.5	4; 33.3	1.2	0.3 - 4.7	0.84
<b>Blood sugar level test upon hospital admission</b>	19; 79.2	8; 66.6	1.9	0.4 - 8.3	0.40

\*Ref. reference variable in the statistical calculation



**Table 4.** Information obtained by telephone contact in relation to groups without hospital readmission record and with hospital readmission record

Specification	Without readmission (N = 24) N; %	With readmission (N = 12) N; %	Odds ratio	Confidence interval	P value
<b>Information provider</b>					
Patient	7; 29.2	0; 0	Ref.*	Ref.*	Ref.*
Caregiver	17; 70.8	12; 100.0	10.7	0.6 - 205.0	0.12
<b>Report of consultation with endocrinologist</b>	9; 37.5	4; 33.3	.2	0.3 - 4.7	0.84
<b>Report of owning a glucometer</b>	18; 75.0	9; 75.0	1	0.2 - 4.8	0.95
<b>Report on frequent blood sugar monitoring</b>	17; 70.8	8; 66.6	1.2	0.3 - 5.1	0.77
<b>Report of whom performs blood sugar monitoring</b>					
Patient	4; 16.7	3; 25.0	Ref.*	Ref.*	Ref.*
Caregiver	15; 62.5	8; 66.7	0.7	0.1 - 3.6	0.67
Healthcare service	4; 16.7	0; 0.0	0.1	0.0 - 3.6	0.24
Not accomplishing	1; 4.2	1; 8.3	1.3	0.1 - 18.4	0.85
Glycemic measurement time > 1 month	9; 37.5	7; 58.3	0.4	0.1 - 1.8	0.45
<b>Report of measuring blood sugar in fasting or randomly after discharge</b>					
Fasting	9; 37.5	3; 25.0	Ref.*	Ref.*	Ref.*
Random	6; 25.0	5; 41.7	2.3	0.4 - 2.3	0.33
Not informed	9; 37.5	4; 33.3	1.3	0.2 - 2.8	0.77
<b>Blood sugar level at random</b>					
≥ 50 mg/dL to < 100 mg/dL	1; 4.2	0; 0.0	Ref.*	Ref.*	Ref.*
≥ 100 mg/dL to < 140 mg/dL	2; 8.3	1; 8.3	1.8	0.0 - 79.4	0.76
≥ 140 mg/dL to < 240 mg/dL	2; 8.3	2; 16.7	3	0.1 - 115.3	0.55
> 240 mg/dL	1; 4.2	1; 8.3	3	0.1 - 151.2	0.58
Did not know the value	0; 0.0	1; 8.3	9	0.1 - 831.8	0.34
Not informed	18; 75.0	7; 58.3	1.2	0.0 - 33.3	0.91
<b>Blood sugar level in fasting</b>					
≥ 50 mg/dL to < 100 mg/dL	4; 16.7	1; 8.3	Ref.*	Ref.*	Ref.*
≥ 100 mg/dL to < 140 mg/dL	3; 12.5	0; 0.0	0.4	0.0 - 14.1	0.63
≥ 140 mg/dL to < 240 mg/dL	1; 4.2	1; 8.3	3	0.2 - 55.7	0.46
Did not know the value	1; 4.2	1; 8.3	3	0.2 - 55.7	0.46
Not informed	15; 62.5	9; 75.0	1.8	0.2 - 13.8	0.55
<b>Doubt about diabetes</b>	8; 33.3	3; 25.0	1.4	0.6 - 6.1	0.66
<b>Doubt about insulin use</b>					
Yes	8; 33.3	3; 25.0	Ref.*	Ref.*	Ref.*
No	16; 66.7	9; 75.0	1.6	0.4 - 7.1	0.54
<b>Received guidance by the institution on the use of insulin upon hospital discharge</b>					
Yes	16; 66.7	5; 41.7	Ref.*	Ref.*	Ref.*
No	8; 33.3	7; 58.3	2.6	0.7 - 10.5	0.17

\*Ref. reference variable in the statistical calculation

**Table 5.** Specificities of blood sugar monitoring in the groups with presence and absence of hospital readmission

Specification	N; %	N; %	ratio		
Number of patients with blood sugar measurement fasting upon hospital admission to hospital (Ref.*no)	9; 37.5	3; 25.0	0.5	(0.1; 2.3)	0.4
Number of patients with blood sugar measurement randomly on admission to hospital (Ref.*no)	6; 25.0	5; 41.7	0.7	(0.2; 2.8)	0.64
Blood sugar level in fasting upon hospital admission (mg/dL)**	9; 37.5	4; 33.3	1	(1.0;1.0)	0.58
Blood sugar level at random upon hospital charge (mg/dL)**	218	308	1	(1.0; 1.0)	0.54
Blood sugar level in fasting on post - discharge contact (mg/dL)**	225	199	1	(1.0; 1.0)	0.56
Post-discharge contact random blood sugar level (mg/dL)**	132	198	1	(1.0; 1.0)	0.69
Pharmaceutical interventions related to the insulin use	14; 58.3	02; 16.7	0.8	(0.3; 4.2)	0.97

\*Ref. reference variable; \*\*statistical analysis considering blood sugar value as a continuous variable

For patients with dependency and disability, the perception of the main caregivers or the family about the disease constitutes an important part of the care, and this factor should be considered by the health professionals.<sup>31</sup>

Regarding access to a specialist physician after the hospital discharge, 63.9% of the patients reported not having access to the endocrinologist. It is considered interesting to implement strategies that guarantee access to the other care levels after the discharge, so that discrepancies related to errors of medication, health deterioration and possible hospital readmission cease to occur.<sup>30,32</sup>

It was observed that 75% of the contacted individuals reported having the glucometer, while 25% did not. In addition, 69.4% reported performing weekly blood sugar measurement. The caregiver (63.9%) followed by the patient (19.4%) and health professionals (1.1%) was the main person responsible for this activity. This finding reinforces the idea that family members generally assume the role of caregiver also being responsible for handling and administering the drugs.<sup>33-25</sup> In addition to the existence of the glucometer not being reported by all interviewees, nor did everyone with this device report performing frequent blood sugar measurements. This indicates the need to improve strategies that stimulate self-care in the profile of patients under study.

It is observed that 44.4% of the reports on the last measurement referred to the minimum period of one month prior to the telephone contact. Regarding the usual time for the measurement, 33.3% of the patients reported measuring in fasting, and 30.6% reported measuring at random. Absence of a routine mensuration report occurred in 36.1% of the patients.

Hospital readmissions can be classified as planned and contingent. The planned ones would be those necessary for therapeutic follow-up and the eventual, those that are avoidable. Possible re-hospitalizations could be avoided with better management of the patient's clinical condition, through the improvement of technologies, such as adequate discharge planning, identification of the potential for self-care of the patient, and provision of resources at home to meet their demands.<sup>34</sup>

It is understood that providing minimal resources to the adequate monitoring, such as a glucometer, tapes, educational actions that stimulate self-monitoring, and access to the endocrinologist would contribute to preventing the worsening of the patient clinical status, which would trigger hospital readmission possibilities.

When identifying the main therapeutic insulin regimens prescribed upon hospital discharge, it was identified that the main prescribed regimens were NPH insulin and association between NPH and Regular, being represented, each scheme, by 47.22% of the prescriptions. This is in line with international documents.<sup>1-2</sup>

Despite the evidence on insulin use effectiveness in adult diabetic patients, these schemes are considered complex for understanding in elderly individuals.<sup>35-36</sup> When analyzing the comparative data between the groups that demonstrated or not readmission, it is identified that in relation to the hospitalization time, the group 2 showed a major mean time when compared to the group 1. Such data may be related to the fact that patients with longer hospitalization time showed more complex clinical conditions. In relation to the post-discharge blood sugar values, both groups had a decrease in fasting and randomized blood sugar values when compared to hospitalization and post-hospital discharge periods. It is inferred that the negative experience of hospitalization contributes to change in the patient habits after hospital discharge, and the adoption of behaviors that contribute to self-care and prevent the occurrence of complications.

One identified in the group that did not have hospital readmission occurrence, the highest number of reports on blood sugar values in the range of  $\geq 100$  mg/dL to  $< 240$  mg/dL in the measurement of blood sugar at random. When analyzing the same parameter for the hospital readmission group, one observes the prevalence of reports in the range of  $\geq 140$  mg/dL to  $> 240$  mg/dL. Although identifying differences in proportions between groups, the association analysis did not identify statistical significance among the analyzed variables and the occurrence or not of hospital readmission.

It is observed that the group that had hospital readmission received fewer pharmaceutical interventions although all patients were linked to a pharmacotherapeutic follow-up service. Considering that health education takes place at the time of hospital discharge, and that the pharmacist needs to be informed about the discharge approximately 24 hours before its occurrence, it can be inferred that the group that was re-hospitalized was discharged in a less planned manner during the first hospitalization, which may have prevented the pharmaceutical professional from carrying out the orientation. This indicates the need to improve the process of discharge and referencing the patient, so that the discharge is carried out with a multiprofessional approach and in an effective way.

The re-hospitalizations bring out a great burden to the health system, in addition to discomfort to the patient and their families, it is important to know the profile of the population involved in this process, with the purpose of qualifying the hospital care and, mainly, to plan efficiently the necessary care after the discharge.<sup>37</sup> Raval and group pointed out that intervention strategies that reduce the risk for re-hospitalization of the elderly, should consider the needs and complexities of this patient profile.<sup>38</sup> The establishment of strategies for mapping patients with a higher re-hospitalization profile and implementing specific educational actions for this public are also recommended for the studied institution.

One understands as limitations of this study, the fact that the initial collection was performed by means of register in medical records, occurring absence of registration related to some information, and lack of prior standardization for the records of the same by the involved professionals. However, there were few medical records without the collected information, as specified in the tables in the results topic.

The provision of information through telephone contact, without the possibility for validating the same by the researchers, and the small sample size are also seen as limiting factors. In addition, when considering the number of subjects included in the study and the characteristics of the analyzed service, data extrapolation is not allowed.

Also considering as limitation of the study, is the non-identification of possible occurrence of hospital readmissions for the studied patients in other institutions. However, it is noteworthy that the studied hospital is located in a peripheral region in the city of Belo Horizonte, and the cared patients are residents in regions for which the hospital is a reference in tertiary care. As the hospital is the only one located in the scope region, it is believed that the possibility of patient re-hospitalization in other institutions is remote. In addition, other studies that address the identification of re-hospitalization generally consider just one sole hospital.<sup>37-39</sup>

It is considered interesting to carry out studies with broader delineations, related to the approach of this theme.

## Conclusion

Patients who were re-admitted had higher blood sugar values, fewer pharmaceutical interventions regarding insulin use, and longer average hospitalization time. The study points out to weaknesses related to the offer of care to the patients under study, such as weaknesses in the coverage for offering actions related to health education in the periods before and after hospital discharge, difficulty in accessing the specialist physician and non-achievement of blood sugar measurement by some patients. There was no association between any of the analyzed variables and hospital readmission.

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## Contributors

JSM collected, interpreted study data and written this paper. JMC interpreted study data, written this paper and supervised the study. CJM interpreted study data. MAPM interpreted study data, written this paper and supervised the study. All authors are responsible for the article information and have approved the final version for publication.

## Conflict of Interest

The authors declare that there is no conflict of interest for the work.

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## References

1. WHO. Global Report on Diabetes. 2016;88. "Disponível em: [http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/204871/1/9789241565257_eng.pdf), Ago, 2016, 88p.
2. WHO. Definition, Diagnosis and Classification of DM and its complications. "Disponível em: <http://apps.who.int/iris/handle/10665/66040>. 1999, 66p.
3. Gupta A, Gupta V. Metabolic syndrome: What are the risks for humans? *Biosci Trends*, 2010, 4(5):204–12.
4. Cho NH, Whiting D, Forouhi N. IDF Diabetes Atlas, ed 7. Bruxelas, IDF, 2015: 144p.
5. Pozzobon A, Hoerlle JL, Carreno I. Prevalência e perfil sociodemográfico de diabetes e hipertensão em indivíduos do sistema de informação da atenção básica. *Fortaleza, Rev Bras Promoç Saúde*, 2014, 27(3): 295-302.
6. Kripalani S, Jackson AT, Schnipper JL, *et al.* Promoting effective transitions of care at hospital discharge: A review of key issues for hospitalists. *J Hosp Med*. 2007, 2(5):314–23.
7. Rubin DJ. Hospital readmission of patients with diabetes. *Curr Diab Rep*. 2015 Apr; 15(4):17.
8. Kripalani S, Theobald CN, Anctil B, Vasilevskis EE. Reducing hospital readmission rates: current strategies and future directions. *Annu Rev Med*. 2014; 65: 471-85,9.
9. Sakeena MHF, Bennett AA, McLachlan AJ. Enhancing pharmacists'role in developing countries to overcome the challenge of antimicrobial resistance: a narrative review. *Antimicrob Resist Infect Control*. 2018; 7(63):2-11.
10. Thomas R, Huntley AL, Mann M, Huws D, Elwyn G, Paranjothy S, Purdy S. Pharmacist-led interventions to reduce unplanned admissions for older people: a systematic review and meta-analysis of randomised controlled trials. *Age Ageing*, 2014; 43(2): 174-187.
11. Anderson SL, Marrs JC. A review of the role of the pharmacist in heart failure transition of care. *Adv Ther*. 2018;35(3):311-323.
12. Souza A, Pelegrini TS, Ribeiro JHM, *et al.* Conceito de Insuficiência familiar na pessoa idosa: análise crítica da literatura. *Rev Bras Enferm*, 2015, 68(6):864-873.
13. Gellad WF, Thorpe CT, Steiner JF, *et al.* The myths of medication adherence. *Pharmacoepidemiol Drug Saf*, 2017, 26(12): 1437–1441.
14. Stirratt MJ, Dunbar-Jacob J, Crane HM, *et al.* Self-report measures of medication adherence behavior: recommendations on optimal use. *Transl Behav Med*, 2015, 5(4): 470–482.
15. Vrijens B, Geest S, Hughes DA, *et al.* A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol*, 2012, 73(5): 691–705.
16. Moura CS de, Tavares LS, Acurcio F de A. Hospital readmissions related to drug interactions: a retrospective study in a hospital setting. *Rev Saude Publica*, 2012, 46(6):1082–9.
17. Machado V, dos Santos MA. Taxa de permanência hospitalar de pacientes reinternados em hospital psiquiátrico. *J Bras Psiquiatr*, 2011, 60(1):16–22.
18. Gonçalves JM. Soluções para o problema de separação quase completa em regressão logística (dissertação). Belo Horizonte (MG): Universidade Federal de Minas Gerais; 2008.
19. Da Silva GS, De Sousa AG, Soares D, *et al.* Avaliação do tempo de permanência hospitalar em cirurgia de revascularização miocárdica segundo a fonte pagadora. *Rev Assoc Med Bras*, 2013, 59(3): 248–53.
20. Stephan LS, Almeida ED, Guimaraes RB, Ley AG, Mathias RG, Assis MV, Leiria TLL. Processes and Recommendations for Creating mHealth Apps for Low-Income Populations. *JMIR Mhealth Uhealth*, 2017, 5(4):1-9.
21. Adams RJ *et al.* Health literacy: a new concept for general practice? *Aust. Fam. Physician*, 2009, 38 (3): 144-7.
22. Seliverstov I. Practical management approaches to anticoagulation non-compliance, health literacy, and limited English proficiency in the outpatient clinic setting. *J Thromb Thrombolysis*, 2011, 31 (3): 321-5.
23. Elliott RA. Reducing medication regimen complexity for older patients prior to discharge from hospital: Feasibility and barriers. *J Clin Pharm Ther*, 2012, 37(6): 637–42.
24. Pan HC, Chou KM, Lee CC, Yang NI, Sun CY. Circulating Klotho levels can predict long-term macrovascular outcomes in type 2 diabetic patients. *Atherosclerosis*, 2018, 276:83-90.
25. Costa JM, Junior NM do C, Pereira RCC, *et al.* Implantação de um serviço de contato telefônico pós alta hospitalar para acompanhamento farmacoterapêutico: relato de experiência. São Paulo. *Rev. Bras. Farm. Hosp. Serv. Saúde*, 2015, 6(4): 23-29.
26. Costa JM, Martins JM, Pedrosa LA, *et al.* Acompanhamento farmacoterapêutico em um programa de residência multiprofissional: contribuições para a segurança de idosos hospitalizados. São Paulo. *Rev. Bras. Farm. Hosp. Serv. Saúde*, 2014, 5(2): 39-44.
27. Tavares DMDS, Dias FA, Araújo LR, *et al.* Perfil de clientes submetidos a amputações relacionadas ao diabetes mellitus. *Rev Bras Enferm*, 2009, 62:825–30.



28. Skrepnek GH, Mills JL, Armstrong DG. A diabetic emergency one million feet long: Disparities and burdens of illness among diabetic foot ulcer cases within emergency departments in the United States, 2006-2010. *PLoS One* [Internet], 2015,10(8):1–15. “Disponível em: <http://dx.doi.org/10.1371/journal.pone.0134914>, Ago, 2017”.
29. Inouye K, Pedrazzani ES, Pavarini SCI. Octogenários e cuidadores: perfil sócio-demográfico e correlação da variável qualidade de vida. *Florianópolis. Texto Context - Enfermagem*, 2008, 17(2):350–7.
30. Costa JM, Martins JM, Pedroso LA, *et al.* Otimização dos cuidados farmacêuticos na alta hospitalar : implantação de um serviço de orientação e referenciamento farmacoterapêutico. São Paulo. *Rev. Bras. Farm. Hosp. Serv. Saúde*, 2014, 5(1): 38-41.
31. Adrián-arrieta L, Casas-fernández de tejerina JM. Autopercepción de enfermedad en pacientes con enfermedades crónicas. *Semergen*, 2017, 17: S1138-3593.
32. Geurts MME, Van Der Flier M, De Vries-Bots AMB, *et al.* Medication reconciliation to solve discrepancies in discharge documents after discharge from the hospital. *Int J Clin Pharm*. 2013, 35(4):600–7.
33. Guimarães FDAM, De Lima RR, Souza ADC, *et al.* Avaliação da qualidade de vida em pacientes idosos um ano após o tratamento cirúrgico de fraturas transtrocanterianas do fêmur. *Rev Bras Ortop*, 2011, 46(1):48–54.
34. Borges MF, Turrini RNT. Readmissão em serviço de emergência: perfil de morbidade dos pacientes. *Rev Rene*, 2011, 12(3):453–61.
35. Milech A, *et al.* Diretrizes da Sociedade Brasileira de Diabetes (2015-2016). *Sociedade Brasileira de Diabetes (SBD)*, 2016, 5(3):709–17.
36. Farshchi A, Oskuee M, Rashed M, *et al.* Biphasic insulin aspart 30 vs. NPH plus regular human insulin in type 2 diabetic patients: A cost-effectiveness study. *Diabetes Technol Ther-BMC Endocrine Disorders*, 2014, 16:90-91. “Disponível em <http://onlinelibrary.wiley.com/o/cochrane/clcentral/articles/393/CN-01058393/frame.html>, Ago, 2017.
37. Borges FK, Soliman F, Pires DO, *et al.* Reinternação hospitalar precoce: avaliação de um indicador de qualidade assistencial. *Rev HCPA*, 2008, 28(3):147–52.
38. Raval AD, Zhou S, Wei W, *et al.* 30-Day Readmission Among Elderly Medicare Beneficiaries with Type 2 Diabetes. *Popul Health Manag*, 2015, 18(4):256–64.
39. Osler T, Yuan D, Holden J, Huang Z, Cook A, Glance LG, Buzas JS, Hosmer DW. Variation in readmission rates among hospitals following admission for traumatic. *Injury*, 2018, S0020-1383.