Hospitalizations, deaths and hospital costs due to Diabetes Mellitus in Northeastern Brazil between 2013 and 2017.

Objective: to describe hospitalizations, deaths and public hospital costs for Diabetes Mellitus in Northeastern Brazil between 2013 and 2017. Method: this is a quantitative, descriptive and ecological study with secondary data collection from the Hospital Information System. Data was collected regarding hospitalizations, deaths, hospital costs, average hospitalization value and average length of stay. Data was analyzed using simple descriptive statistics, presenting them using tables prepared using Excel software. Results: 136,504 hospitalizations and 7,424 deaths from diabetes mellitus were recorded in the Brazilian Northeast. Also noteworthy were the public hospital costs over R$ 65 million, with an average hospitalization value of R$ 545.08 and an average length of stay of 5.4 days. Conclusion: it can be concluded that hospitalizations, deaths and public hospital costs for Diabetes Mellitus showed a slight reduction and, even so, they significantly implied the public budget, in addition to the personal and family repercussions imposed by the disease. Descriptors: Public Health; Epidemiology; Endocrinology; Health Care Costs;

How to cite this article
Non-communicable Chronic Diseases (NCDs) are known to be the leading cause of death and disability worldwide, establishing themselves as one of the greatest public health challenges of the 21st century. Among the NCDs, Diabetes Mellitus (DM) stands out, defined as a complex set of metabolic alterations represented by chronic hyperglycemia and disorders in protein, lipid and carbohydrate metabolism.

DM is classified as type 1 (DM1), type 2 (DM2), gestational and, among other specificities, being the second type of greater magnitude. It is estimated that DM1 is present in 5% to 10% of the population affected by the disease and results from the intense destruction of pancreatic beta cells, which in turn promotes absolute insulin deficiency in the body. It is reported that DM2 affects about 90% to 95% of individuals and is the result of decreased insulin production or ineffective response of the body to its use.

Worldwide, in the 2000s, around 151 million people were diagnosed with DM. In 2015, the gross number of people with the disease reached 415 million, corresponding to a prevalence of 8.8%. In Brazil, there are 14.3 million people with the disease, ranking fourth among the countries with the highest prevalence of DM, second only to China, India and the United States.

It is noteworthy that, in addition to the increasing mortality behavior, DM promotes challenges regarding the economic costs associated with pathology. From this perspective, it is warned that if the global epidemiology of DM continues to be progressive, there will be a massive increase in financial impacts on health in the coming years. It should also be noted that 12% of global health revenues currently go to the care of people with DM and its complications, generating a great economic responsibility for those affected, their families, health systems and countries.

It is reported that DM is a risk factor for vascular diseases, renal diseases and other pathologies, generating socioeconomic repercussions, increasing health inequities and compromising the quality of life (QoL) of patients. Nevertheless, it is stated that the prevention of complications in the short, medium and long term depends on the self-management of the pathology and the follow-up in basic health service.

Among these services, we highlight the actions developed by Primary Health Care (PHC), considered the population’s gateway to the services. It is pointed out that PHC has a resolution capacity of 85% of the population demands, resulting in lower health expenses and a decrease in morbidity and mortality rates, mainly due to cardio and cerebrovascular complications. Moreover, DM is considered a sensitive condition for primary care, and the increase in its morbidity and mortality rates may indicate low effectiveness of the service in terms of access, coverage and quality.

From this perspective, epidemiological studies of this nature constitute an indirect indicator of health services evaluation. However, it is mentioned that studies on health expenses help in the survey of characteristics that may contribute to the reduction of pathological complications and, consequently, the reduction of hospitalizations and their respective costs.

### OBJECTIVE

- To describe the hospitalizations, deaths and public hospital costs for Diabetes Mellitus in Northeast Brazil between 2013 and 2017.

### METHOD

This is a quantitative, descriptive and ecological study conducted with data collected from the Hospital Information System (HIS). HIS is an administrative tool of the Department of Informatics of the Unified Health System (DATASUS) that contains data on hospitalizations performed in public health institutions throughout the Brazilian territory.

From this perspective, data were collected from the Northeast region of Brazil, considered the second region with the largest number of inhabitants, which is equivalent to approximately 56.7 million people distributed in nine Federative Units (FU), according to table 1.
The variables were collected in September 2018, considering the time limit between 2013 and 2017. Thus, one selected the option of “Diabetes Mellitus treatments”, protocolled with the code: 03.03.03.003-8 throughout the national territory. These are medium complexity clinical procedures that require urgent care in hospitals and home care, according to the National List of Actions and Health Services (Renesas).

Data was then stratified by hospitalizations and hospital deaths, values of hospital services offered to users, average hospitalization value and average length of stay. It is noteworthy that all data collected are described in chapter IV (Endocrine, nutritional and metabolic diseases) of the 10th International Classification of Diseases and Related Health Problems (ICD-10), covering categories E100 - E149.

It is informed that, due to the source of data collection being in the public domain, free access and without identification of the participants, there was no need to submit the study to the Research Ethics Committee, according to Resolution 466/2012 of the National Health Council.

## RESULTS

During the study period, there were 136,504 hospitalizations and 7,424 deaths from DM in the Northeast of Brazil, as shown in Table 2. The state of Bahia with the highest prevalence of hospitalizations was highlighted, with 42,306 (31.0%) and deaths, with 2,717 (36.6%). In addition, the decreasing behavior of hospitalization and death records throughout the study period was observed.

### Table 2. Hospitalizations and deaths from diabetes mellitus in northeastern Brazil according to year of care. Jequie (BA), Brazil, 2018.

<table>
<thead>
<tr>
<th>Variables</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>TOTAL</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HOSPITALIZATIONS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maranhão</td>
<td>266</td>
<td>6,800</td>
<td>7,084</td>
<td>5,969</td>
<td>6,856</td>
<td>26,975</td>
<td>19.8</td>
</tr>
<tr>
<td>Piauí</td>
<td>112</td>
<td>3,962</td>
<td>4,112</td>
<td>3,671</td>
<td>3,099</td>
<td>14,956</td>
<td>11.0</td>
</tr>
<tr>
<td>Ceará</td>
<td>187</td>
<td>3,207</td>
<td>2,856</td>
<td>2,565</td>
<td>2,217</td>
<td>11,032</td>
<td>8.1</td>
</tr>
<tr>
<td>Rio Grande do Norte</td>
<td>105</td>
<td>1,340</td>
<td>1,191</td>
<td>1,097</td>
<td>970</td>
<td>4,703</td>
<td>3.4</td>
</tr>
<tr>
<td>Paraíba</td>
<td>96</td>
<td>2,456</td>
<td>2,487</td>
<td>2,161</td>
<td>2,074</td>
<td>9,274</td>
<td>6.8</td>
</tr>
<tr>
<td>Pernambuco</td>
<td>296</td>
<td>4,774</td>
<td>4,451</td>
<td>4,157</td>
<td>4,069</td>
<td>17,747</td>
<td>13.0</td>
</tr>
<tr>
<td>Alagoas</td>
<td>122</td>
<td>1,778</td>
<td>1,696</td>
<td>1,702</td>
<td>1,562</td>
<td>6,860</td>
<td>5.0</td>
</tr>
<tr>
<td>Sergipe</td>
<td>45</td>
<td>610</td>
<td>690</td>
<td>650</td>
<td>656</td>
<td>2,651</td>
<td>1.9</td>
</tr>
<tr>
<td>Bahia</td>
<td>582</td>
<td>12,596</td>
<td>12,573</td>
<td>8,478</td>
<td>8,077</td>
<td>42,306</td>
<td>31.0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>1,811</td>
<td>37,523</td>
<td>37,140</td>
<td>30,450</td>
<td>29,580</td>
<td>136,504</td>
<td>100</td>
</tr>
</tbody>
</table>

**OBITOS**

<table>
<thead>
<tr>
<th>Variables</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>TOTAL</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maranhão</td>
<td>9</td>
<td>229</td>
<td>220</td>
<td>212</td>
<td>193</td>
<td>863</td>
<td>11.6</td>
</tr>
<tr>
<td>Piauí</td>
<td>9</td>
<td>121</td>
<td>130</td>
<td>101</td>
<td>91</td>
<td>452</td>
<td>6.1</td>
</tr>
<tr>
<td>Ceará</td>
<td>15</td>
<td>182</td>
<td>165</td>
<td>148</td>
<td>133</td>
<td>643</td>
<td>8.7</td>
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<tr>
<td>Rio Grande do Norte</td>
<td>16</td>
<td>135</td>
<td>112</td>
<td>102</td>
<td>88</td>
<td>453</td>
<td>6.1</td>
</tr>
<tr>
<td>Paraíba</td>
<td>9</td>
<td>159</td>
<td>149</td>
<td>115</td>
<td>108</td>
<td>540</td>
<td>7.3</td>
</tr>
<tr>
<td>Pernambuco</td>
<td>17</td>
<td>239</td>
<td>227</td>
<td>190</td>
<td>162</td>
<td>835</td>
<td>11.2</td>
</tr>
<tr>
<td>Alagoas</td>
<td>10</td>
<td>162</td>
<td>176</td>
<td>189</td>
<td>130</td>
<td>667</td>
<td>9.0</td>
</tr>
<tr>
<td>Sergipe</td>
<td>3</td>
<td>44</td>
<td>60</td>
<td>70</td>
<td>77</td>
<td>254</td>
<td>3.4</td>
</tr>
<tr>
<td>Bahia</td>
<td>47</td>
<td>723</td>
<td>728</td>
<td>595</td>
<td>624</td>
<td>2,717</td>
<td>36.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>135</td>
<td>1,994</td>
<td>1,967</td>
<td>1,722</td>
<td>1,606</td>
<td>7,424</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Ministry of Health - UHS Hospital Information System (HIS / UHS)

In table 3, we highlight what concerns the values of hospital services, that the DM generated a financial impact of over R$ 65 million to the public coffers. Nevertheless, the largest burden was generated in the State of Bahia, with R$ 19,249,087.69 (29.6%).

According to Table 4, the average value of hospitalization in the Northeast was R$ 545.08 and Alagoas had the highest average value among the Northeastern States, with R$ 718.59. Regarding the average length of stay in the hospital, Rio Grande do Norte stood out with 7.8 days, while the overall average of the region was 5.4 days.

<table>
<thead>
<tr>
<th>Federative Units</th>
<th>Average value of hospitalization (R$)</th>
<th>Average length of stay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maranhão</td>
<td>436.49</td>
<td>4.2</td>
</tr>
<tr>
<td>Piauí</td>
<td>419.05</td>
<td>4.3</td>
</tr>
<tr>
<td>Ceará</td>
<td>564.74</td>
<td>6.2</td>
</tr>
<tr>
<td>Rio Grande do Norte</td>
<td>636.14</td>
<td>7.8</td>
</tr>
<tr>
<td>Paraíba</td>
<td>614.41</td>
<td>6.3</td>
</tr>
<tr>
<td>Pernambuco</td>
<td>714.12</td>
<td>6.4</td>
</tr>
<tr>
<td>Alagoas</td>
<td>718.59</td>
<td>6.1</td>
</tr>
<tr>
<td>Sergipe</td>
<td>665.87</td>
<td>6.7</td>
</tr>
<tr>
<td>Bahia</td>
<td>521.81</td>
<td>5.3</td>
</tr>
<tr>
<td>Total</td>
<td>545.08</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Source: Ministry of Health - UHS Hospital Information System (HIS / UHS)

**DISCUSSION**

In recent decades, the epidemiological pattern of DM has changed throughout the world, mainly due to behavioral changes, increased life expectancy and the urbanization process that favor the increase in the diagnostic rates and complications of the pathology. The Ministry of Health recently published the Strategic Action Plan to Confront Non-communicable Chronic Diseases (NCDs) in Brazil, 2011-2022, in order to prepare the country to address and stop them in the future. The Ministry of Health also continues to work on the Comprehensive Health System, which showed intense dissatisfaction among users and health professionals regarding the obtaining of medicines, tests, access to the specialized network and long queues at PHC units, factors that may influence the increase in hospital morbidity.

In addition, another study of global burden of type 2 DM, presented in Brazil, which shows the Northeast region as having the highest rates of life years lost due to premature death, is presented. The authors emphasize that this result may be correlated with the low rate of early diagnosis and difficulties in obtaining pharmacological therapy, which in turn increases mortality from the disease.

It is emphasized that another point that must be taken into consideration is the insufficient living conditions of Brazilian society that contribute to the emergence of individuals or groups with greater social vulnerability, as there is a feeling of exclusion from the system and basic rights such as health, education, work and leisure, evolving to the loss of freedom of choice in view of the narrow range of opportunities.

It is noteworthy that the increase in morbidity and mortality due to DM is directly proportional to the average length of stay in the hospital, Rio Grande do Norte. This data is reinforced by the results of a study carried out in a northeastern capital, which showed intense dissatisfaction among users and health professionals regarding the obtaining of medicines, tests, access to the specialized network and long queues at PHC units, factors that may influence the increase in hospital morbidity.

According to Table 2, 136,504 hospitalizations and 7,424 (5.43%) deaths from DM in the 2013-2017 period were recorded in the Northeast. From this perspective, it is noted that comparing these values for the three-year period 2013-2015, with a study conducted in the three-year period 1999-2001, an increase in hospitalizations by 37%, jumping from 28,349 (1999-2001) to 76,474 (2013-2015). On the other hand, a proportional reduction of 1.8 in hospital deaths was obtained, from 2,016 deaths (7.1%) in 1999-2001 to 4,096 (5.3%) deaths in 2013-2015.

It is warned that the Northeast region of Brazil has the highest incidence of poverty and its inhabitants are twice as likely to die during hospitalization for DM. This data is reinforced by the results of a study carried out in a northeastern capital, which showed intense dissatisfaction among users and health professionals regarding the obtaining of medicines, tests, access to the specialized network and long queues at PHC units, factors that may influence the increase in hospital morbidity.

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the increased vulnerability, therefore, it is necessary to direct health actions to prioritize individuals who fit this category in order to achieve success in interventions.27

However, although the Northeast region is marked by the economic characteristics mentioned, the scenario of hospitalizations and deaths presented a decreasing behavior over the years of study. It is suggested that these results may reflect a possible effectiveness of PHC in controlling the disease.

Notwithstanding, the State of Bahia stands out, as it shows a higher prevalence of hospitalizations, with 42,306 (31.0%) and deaths with 2,717 (36.6%). It is inferred that such results may reflect the largest population contingent observed in the state. It is also mentioned that the population of Bahia has a higher prevalence of risk factors for DM such as degree and type of obesity, physical inactivity, low socioeconomic conditions and greater predominance of people of African descent, since only the state capital is composed by 22% black and 60% mulatto.25

It is also evidenced that the DM generated a financial impact of over R $ 65 million to the public coffers and the State of Bahia generated the largest burden with R$ 19,249,087.69 (29.6%), as shown in table 3. It is warned that the financial repercussions of DM are costly for today's society.8 From this perspective, it was revealed in one study23 that hospitalizations for DM and its chronic complications in Brazil accounted, respectively, for 6.7% and 51.4% of annual expenditures in the three-year period 1999-2001. In addition, DM as the underlying cause corresponds to 55% of direct costs on the European continent, 44% in the United States and 10% in Latin America.20

However, it is noted that the average value of hospitalizations attributable to DM was 36% higher than non-attributable hospitalizations, besides generating a governmental financial impact of 2.2% of the resources of the Ministry of Health.22 In this study, it was verified an average value of hospitalization in the Northeast of R$ 545.08 and Alagoas had the highest value among the Northeastern States, with R$ 718.59. It is also mentioned that Rio Grande do Norte stood out with an average permanence of 7.8 days, according to table 4.

It is mentioned that, since the regulation of the Unified Health System (UHS), the interior of the country and regions with lower socioeconomic development present difficulties for its implementation,24 such as the North and Northeast regions. This fact is explained mainly due to the physical organizational precariousness and insufficient human and monetary resources observed in municipalities with small population contingent.24

Deaths in hospitals are configured as a variable to evaluate the patient care process as to the outcome.20 It is also emphasized that hospitalizations with deaths are more expensive even when they have the same average length of stay without hospitalizations. Such burdening is justified due to the use of intensive treatments that occurs at an average frequency of more than 6.5 times when there is death. Additionally, it is cited that laboratory services, which indicate higher consumption of technological resources,20 which may be correlated with the State of Bahia, which showed a higher prevalence of deaths and hospital costs.

In this sense, the accelerated change in the Brazilian age pyramid, which clearly shows the process of population aging and, consequently, the increase in the prevalence of NCDs, is worrying. It is evidenced in the literature that the highest expenses with hospitalizations are registered among elderly individuals and constitute a reality on an international level. This is explained by the greater consumption of material, human and financial resources.26

Nevertheless, this phenomenon can be observed in all countries, regardless of their economic development, since the elderly need the assistance of specialists and higher technological resources of high complexity. It is also mentioned the immunological fragility observed in the elderly, which, in turn, increases the risk of complications and, consequently, increases the length of stay.26

This data is strengthened by a survey27 conducted in the city of Londrina, Paraná, which revealed that the elderly corresponded to 9.3% of the municipal population in 2000, accounting for 22.1% and 29%, respectively, of the total days of stay and hospital costs, values higher than those found in the population under 15 years. These results are emphasized by the high economic burden that the elderly demand in tertiary care.27

Considering economic studies in the health field, the approval of Constitutional Amendment 55, which freezes public spending for 20 years in Brazil, should be considered. The Amendment was approved in 2016 and warns that it will not bring economic growth and will substantially reduce investments in public health and education in the country.28

Economic simulations show that, with the freezing of public spending, the 4% of GDP in 2015 for health and education will drastically decrease to 2.7% in 20 years of the new fiscal regime, a time where the Brazilian population will grow by up to 10%. It is thus stated that the Amendment precludes any improvements in these two social areas and creates a loophole for scrapping and extinction of universality.24
Therefore, it is worrying that this spending limit interferes with the decreasing behavior of hospitalizations and hospital deaths due to DM, as investments in health will not accompany population growth and aging. It is warned that most factors associated with the higher prevalence of T2DM, affecting due to this typology, are being sufficient to ensure a reduction in mortality:facts and fallacies. Nat rev endocrinol. 2016 July;12(10):616-22. DOI: http://dx.doi.org/10.1038/nrendo.2016.105

It is noteworthy that such actions should elucidate general information about the disease, enabling the improvement of self-care skills, which facilitates coping with the pathology of both patients and their families. Furthermore, it is pointed out that among the factors that have the potential to influence the implementation of health-promoting actions, social vulnerabilities, media, industrial and pharmaceutical influence, governmental commitment and the existence of other care categories stand out.12

However, it is mentioned that the Brazilian context shows significant socioeconomic and cultural diversity that significantly reflects on health needs in different regions. Therefore, it should be pointed out that among the factors that have the potential to influence the implementation of health-promoting actions, social vulnerabilities, media, industrial and pharmaceutical influence, governmental commitment and the existence of other care categories stand out.12

**CONCLUSION**

Hospitalizations, deaths and hospital costs were found to be slightly reduced and yet generated significant impacts on the public budget. It is worrying that this situation may be reversed with the approval of Constitutional Amendment 55, which freezes public spending for 20 years and, as a result, health investments may not keep up with population growth and aging.

It should be noted, however, that PHC efforts are being sufficient to ensure a reduction in hospitalizations and deaths in the Northeast. However, it should be noted that such efforts should be redoubled to continue ensuring such a scenario amid the containment of public spending, especially in Bahia, as it shows a higher prevalence of hospitalizations and hospital deaths.

A limitation of the study is highlighted regarding the impossibility of stratifying the type of DM in the HIS and, therefore, the data are presented in general. It is inferred, however, that due to the higher prevalence of T2DM, affecting up to 95% of cases, most hospitalizations and hospitalizations, deaths and hospital costs due to... financial resources spent during hospital stay is due to this typology.

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Corresponding author
Edison Vitório de Souza Júnior
Email: edison.vitorio@gmail.com

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