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HOSPITAL ADMISSIONS DUE TO DIABETIC FOOT COMPLICATIONS IN CEARÁ

INTERNAÇÕES HOSPITALARES POR COMPLICAÇÕES DO PÉ DIABÉTICO NO CEARÁ

HOSPITALIZACIONES POR COMPLICACIONES DEL PIE DIABÉTICO EN CEARÁ

Carlos Vinicius Moreira Lima[1], *Joice Fabrício de Souza*[2], *Mirna Neyara Alexandre de Sá Barreto Marinho*[3] e *Sarah Ellen da Paz Fabricio*[4]

ABSTRACT
To analyze hospitalizations and costs due to diabetic foot complications in the state of Ceará between 2020 and 2024. Ecological, quantitative study, with secondary data extracted from hospital information system. Hospitalizations, length of stay, mortality, and costs were analyzed, according to health regions. During the analyzed period, 7,764 hospitalizations were recorded, an increase of 44%. The Fortaleza region concentrated the highest number (3,886). The average length of stay was higher in this region (10 days). The highest mortality rate occurred in the Cariri region (3.27). Total costs increased by 71%, reaching R$ 1,066,662.84 in 2024. Hospitalizations due to diabetic foot complications in Ceará have been increasing, generating a high clinical and economic impact. Primary Health Care must strengthen preventive actions and early care, contributing to the reduction of complications, hospitalizations, and costs in the Single health system.
Keywords: *Diabetes Mellitus; Diabetic Foot; Primary Health Care; Hospitalization; Hospital Costs.*

RESUMO
Analisar as internações e os custos com complicações do pé diabético no estado do Ceará entre 2020 e 2024. Estudo ecológico, quantitativo, com dados secundários extraídos do sistema de informação hospitalar. Foram analisadas internações, tempo de permanência, mortalidade e custos, segundo regiões de saúde. No período analisado, foram registradas 7.764 internações, com aumento de 44%. A região de Fortaleza concentrou o maior número (3.886). A média de permanência foi mais elevada nessa região (10 dias). A maior taxa de mortalidade ocorreu na região do Cariri (3,27). Os custos totais cresceram 71%, alcançando R$ 1.066.662,84 em 2024. As internações por complicações do pé diabético no Ceará vêm aumentando, gerando elevado impacto clínico e econômico. A Atenção Primária à Saúde (APS) deve fortalecer ações preventivas e o cuidado precoce, contribuindo para a redução das complicações, das internações e dos custos no sistema único de saúde.
Descritores: *Diabetes Mellitus; Pé Diabético; Atenção Primária à Saúde; Internação Hospitalar; Custos Hospitalares.*

RESUMEN
Analizar las hospitalizaciones y los costos de las complicaciones del pie diabético en el estado de Ceará entre 2020 y 2024. Estudio ecológico, cuantitativo, con datos secundarios extraídos del sistema de información hospitalaria. Se analizaron hospitalizaciones, estancia hospitalaria, mortalidad y costes según regiones sanitarias. En el período analizado se registraron 7.764 hospitalizaciones, un incremento del 44%. La región de Fortaleza presentó el mayor número (3.886). La duración media de la estancia fue mayor en esta región (10 días). La tasa de mortalidad más alta se registró en la región de Cariri (3,27). Los costos totales crecieron un 71%, alcanzando R$ 1.066.662,84 en 2024. Las hospitalizaciones por complicaciones del pie diabético en Ceará vienen aumentando, generando un alto impacto clínico y

1 Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.
2 Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.
3 Universidade Regional do Cariri, Iguatu/CE – Brasil.
4 Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.

Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.
[2] Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.
[3] Universidade Regional do Cariri, Iguatu/CE – Brasil.
[4] Escola de Saúde Pública do Ceará, Fortaleza/CE – Brasil.

económico. La Atención Primaria de Salud debe fortalecer las acciones preventivas y la atención precoz, contribuyendo a la reducción de complicaciones, hospitalizaciones y costos en el Sistema Único de Salud.
Descriptores: *Diabetes Mellitus; Pie Diabético; Atención Primaria de Salud; Hospitalización; Costos de Hospital.*

INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease, characterized by high blood glucose levels, resulting from impairment in the production and/or use of insulin, whose etiology is multifactorial. It is estimated that, in 2021, there were 537 million people living with DM in the world, and that by 2050 we will have 1.31 billion diabetics. In Brazil, it is estimated that there are 16 million people with DM, and global spending on the disease already totals 966 billion dollars and may reach more than 1.054 billion dollars in 2045, demonstrating the epidemiological and economic impacts that the disease has on the population and the health system[1-3].

DM is an important cause of mortality and disability worldwide, usually caused by its complications, which are associated with lack of knowledge of the disease, late diagnosis, lack of adherence to treatment and control of risk factors. The complications of DM are subdivided into acute – ketoacidosis, hyperosmolar hyperglycemic syndrome, and hypoglycemia – and chronic, such as ischemic cardiovascular diseases, retinopathy, nephropathy, neuropathy, and diabetic foot[4-5].

Among the complications associated with DM, diabetic foot stands out, as it is the main cause of hospital admissions, compared to other long-term complications. Diabetic foot is defined as the presence of infection, ulceration and/or destruction of deep tissues, in association with neurological abnormalities and peripheral vascular disease in diabetic individuals, resulting in reduced tissue perfusion and difficulty in healing lesions[6-7].

Systematic reviews estimate the global prevalence of diabetic foot at 6.3%, while in Brazil it is estimated at 6.1% and 6.3% in the Brazilian Northeast. The increase in the prevalence of DM, associated with the increase in life expectancy of diabetic patients, corroborates the high incidence of diabetic foot cases. About 15% of patients with DM develop a foot ulcer throughout their lives, and they have a 2.5 times higher risk of death in five years, compared to diabetic patients without ulcers[5,7].

Despite the complications resulting from diabetic foot, about 50% of injuries could be avoided with the adoption of simple prevention and early care measures, thus reducing hospitalizations and amputations resulting from diabetic foot, reducing the social and economic impacts arising from disabilities[2].

Primary Health Care (PHC), as it is the gateway to the Unified Health System (SUS), developing longitudinal follow-up of people with diabetic and assuming health responsibility over the enrolled population, should be the first point of attention in the care of diabetic feet, and it is also responsible for organizing and ordering the flows and the line of care for diabetics when they need to go through it. within the scope of the health care network, services with higher levels of complexity and technological density for comprehensive care[8].

Therefore, despite the complexity involving complications resulting from diabetic foot, it is observed that there are simple and low-cost strategies that can be

carried out in PHC, with the co-responsibility of users. Such measures can contribute to the reduction of these complications, promoting an improvement in quality of life and enabling the direct and indirect reduction of health costs related to the care of diabetic feet[9].

However, it is relevant to analyze hospitalizations due to diabetic foot complications and the health costs of these hospitalizations by health regions in Ceará, in order to outline strategies to mitigate the risk of complications associated with DM and to reduce hospitalizations and, consequently, health expenditures, in addition to pointing out strategies for the care of people with diabetes in PHC. In this sense, this study sought to analyze the rates of hospital admissions and the costs related to diabetic foot complications in the state of Ceará.

METHODS

It is an ecological research, with secondary data and a quantitative approach.

The data were extracted from the Hospital Information System (SIH/SUS) of the Ministry of Health, which contains all the records of care from hospital admissions that were financed by the SUS, inserted into the database of the Department of Informatics of the Unified Health System (DATASUS). The data collected referred to hospitalizations due to diabetic foot complications that occurred in Ceará between 2020 and 2024. Data collection took place in March 2025.

The population of this study was composed of all records of hospitalizations due to complications of the diabetic foot that occurred in Ceará from January 2020 to December 2024 and that are contained in the SIH/SUS. In order to meet the regionalization guideline, Ceará has five health regions: Fortaleza, North, Cariri, Central Hinterland and East Coast/Jaguaribe. Hospitalizations due to diabetic foot complications occurring in the state of Ceará by health regions, total costs of hospitalizations, length of stay, and mortality rate due to the disease were selected from the SIH/SUS database.

As it is a database in which the researcher already selects the variables he wants to work with, the system filters only the data referring to the chosen variables, and no other data are available that may be susceptible to exclusion because they do not meet the objectives of the research, thus, there are no established exclusion criteria for the study.

The quantitative data collected were exported to an electronic spreadsheet in the Microsoft Office Excel® program, which was analyzed by peers, in order to verify the presence of inconsistency. Subsequently, a descriptive statistical analysis was performed, and the data were expressed in tables.

The study complies with Resolution No. 510/2016 of the National Health Council (2016), which also deals with research that uses information in the public domain, dispensing with registration and evaluation by the systems of Research Ethics Committees and the National Research Ethics Commission (CONEP).

RESULTS

During the years 2020 and 2024, there were 7,764 hospitalizations in Ceará due to diabetic foot complications, with a 44% increase in hospitalizations during the period.

All five health regions (HR) of the state showed an increase, with HR Fortaleza having the highest number of hospitalizations in the period (3,886), followed by HR Norte, with 1,356, and HR Cariri, with 1,162 hospitalizations.

Table 1 – Hospitalizations due to diabetic foot complications by year of care and according to health region. Ceará, Brazil, 2020-2024.

Health Region	2020	2021	2022	2023	2024
Fortaleza	663	686	790	800	902
North	214	267	237	339	296
Cariri	177	208	248	261	252
Central Hinterland	161	145	152	152	211
East Coast/Jaguaribe	53	69	118	130	162

Source: Prepared by the authors, 2025.

Considering the average length of stay of hospitalizations due to diabetic foot complications, during the study period there were fluctuations over the years in the different regions. However, HR Fortaleza had the highest average, with 10 days of hospitalization, followed by HR Central Hinterland, with an average of 8.2 days, and HR Cariri, with 7.6 days.

Table 2 – Average length of stay of hospitalizations due to complications of the diabetic foot by year of care and according to health region. Ceará, Brazil, 2020-2024.

Health Region	2020	2021	2022	2023	2024
Fortaleza	9,0	9,3	10,9	10,3	9,5
North	4,8	5,3	5,6	6,4	7,0
Cariri	6,9	7,3	8,8	7,2	7,5
Central Hinterland	7,7	7,9	8,3	9,9	7,3
East Coast/Jaguaribe	4,9	5,7	6,1	8,4	6,8

Source: Prepared by the authors, 2025.

Regarding the mortality rate due to diabetic foot complications among hospitalized patients, HR Cariri reached the highest rate (3.27), followed by HR Fortaleza, with 2.93, and HR Central Hinterland, with 1.94.

Table 3 – Mortality rate of hospitalizations due to diabetic foot complications by year of care and according to health region. Ceará, Brazil, 2020-2024.

Health Region	2020	2021	2022	2023	2024
Fortaleza	3,47	2,92	3,42	1,88	2,88

North	0,47	1,5	1,27	2,06	1,69
Cariri	5,65	2,88	3,23	3,83	1,59
Central Hinterland	3,11	2,76	0,66	2,63	0,95
East Coast/Jaguaribe	1,89	0,0	2,54	1,54	0,0

Source: Prepared by the authors, 2025.

Regarding the total annual cost of hospitalizations due to diabetic foot complications in Ceará, there was an increase of 71%, from R$ 622,833.00 in 2020 to R$ 1,066,662.84 in 2024. The sum of expenditures among all the HR in the state in the period reached the amount of R$ 4,307,187.38. Among the regions, HR Fortaleza has the highest expenses in the period studied, R$ 2,539,753.04, while HR East Coast/Jaguaribe showed the highest increase, 273%, between 2020 and 2024.

Table 4 – Total value in R$ of hospitalizations due to diabetic foot complications by year of care and according to health region. Ceará, Brazil, 2020-2024.

Health Region	2020	2021	2022	2023	2024
Fortaleza	387.970,26	450.719,39	569.660,92	487.980,50	602.465,17
North	79.353,83	100.450,79	91.042,67	157.131,48	127.350,12
Cariri	68.389,53	78.508,57	101.293,88	127.315,36	138.312,55
Central Hinterland	66.593,58	68.685,54	99.829,90	92.112,61	121.884,56
East Coast/Jaguaribe	20.525,80	28.943,86	51.894,34	59.991,90	76.650,44

Source: Prepared by the authors, 2025.

Considering the average value of hospitalization due to diabetic foot complications, the HRs that had the highest values were: HR Fortaleza (R$ 653.56), followed by HR Central Hinterland (R$ 545.99) and RH Cariri (447.83).

Table 5 – Average value in R$ of hospitalizations due to diabetic foot complications by year of care and according to health region. Ceará, Brazil, 2020-2024.

Health Region	2020	2021	2022	2023	2024
Fortaleza	585,17	657,03	721,09	609,98	667,92
North	370,81	376,22	384,15	463,51	430,24
Cariri	386,38	377,45	408,44	487,80	548,86
Central Hinterland	413,62	473,69	656,78	606,00	577,65

East Coast/Jaguaribe	387,28	419,48	439,78	461,48	473,15

Source: Prepared by the authors, 2025.

DISCUSSION

During the study period, there was a high incidence of hospitalizations due to complications of diabetic foot in Ceará, which may be associated with the increase in life expectancy and the epidemiological and nutritional transition that occurred in recent years, in addition to the increase in the incidence of DM. The findings of this study corroborate another study, which found an increase in complications due to diabetic foot in Brazilian capitals between 2008 and 2018. The three most populous regions coincided with those with the highest number of hospitalizations (Fortaleza, North and Cariri), which may be associated with their higher population density[10].

The increase in hospitalizations also occurred even during the period of the Covid-19 Pandemic (2020 to 2022), in all health regions, except Central Hinterland, which had a reduction. It should be noted that Ceará came to be considered the epicenter of the disease in the Northeast, and like other states, it had to reorganize its health services to face the pandemic. The findings of this study differ from other studies that identified a reduction in hospitalizations of patients with chronic diseases during the pandemic. However, it is possible that patients hospitalized in this context had severe complications of diabetic foot, whose treatment could not be postponed[11-12].

As for the average number of hospitalizations, HR Fortaleza had a longer time, while the other regions had a shorter time. This phenomenon may be associated with hospitalizations of more complex cases since the region has the highest technological density in the state. When comparing with other studies, the data differ, as it was observed that the average length of stay in other states is higher than the findings of this study, with averages of 20 to 35 days. This variation may be associated with the fact that the studies were carried out in a single center, involving tertiary level hospitals[13-14].

The Cariri region reached the highest mortality rate in patients hospitalized for diabetic foot complications among all regions of the state, demonstrating such an existing gap and the need for intervention as soon as possible. Data from the Ceará State Health Department[15] indicate that, in 2022, the Cariri region had the highest amputation rate among diabetic patients in the state. It is known that high rates of amputations have a direct impact on mortality outcome, which may justify the findings of this study.

The region of Fortaleza has the highest expenditure on hospitalizations compared to the others, which may be associated with both the number and length of stay of patients. The significant increase in costs in the East Coast/Jaguaribe region is accompanied by the increase in hospitalizations, both of which may be related to the creation of new health devices in the period studied and, consequently, to the greater supply of services in the region.

The significant increase of 71% in hospitalization costs due to diabetic foot complications signals the need to implement strategies to mitigate these complications and, consequently, reduce hospitalizations. According to the literature, about half of these complications can be avoided through promotion and prevention actions. In this sense, the strengthening and expansion of Primary Health Care coverage has contributed

to preventing the increase in complications related to diabetic foot in Brazil. Ceará has the fourth best PHC coverage in Brazil, with more than 95%, in addition to a dense regionalized network of specialized outpatient and hospital care that offers services at all levels of care in the care of diabetes *mellitus*[10,15,16].

The region of Fortaleza has the highest expenditure on hospitalization compared to the others, which may be associated with the number and length of hospitalization of patients. The significant increase in costs in the East Coast/Jaguaribe region is accompanied by an increase in hospitalizations, both of which may be associated with the creation of new health devices in the period studied and, consequently, a greater supply of services in the region.

Regarding the average value of hospitalization for complications of the diabetic foot, the regions with the highest averages were Fortaleza, Central Hinterland and Cariri, respectively. It is observed that the mean value of hospitalizations was directly associated with the average length of stay of patients during hospitalization, so that the longer the time, the higher the mean value – which corroborates the findings of another study[17].

These findings highlight the need to strengthen the care network for people with diabetes *mellitus* and the implementation of the diabetes care line with a focus on regional specificities, ensuring access to health services at all levels of complexity and in a timely manner. In view of the robust PHC in Ceará, it is necessary to increase its effectiveness to ensure the strengthening of the bond, the development of preventive actions, screening, and therapeutic adherence, so that it is possible to reduce hospitalizations and mortality from the disease.

The "De Braços Abertos" project, for example, has been developed in Ceará with a focus on improving health care in the state, seeking to organize and qualify PHC care for high complexity, based on three axes: permanent education plan for PHC, health care planning, and organization of a network of articulators in the five health regions of the state. It is hoped that this project will be able to correct the existing gaps and lead to improvements in care and access, especially for diabetic patients[18].

CONCLUSION

The study made it possible to analyze hospitalizations due to diabetic foot complications by health region of Ceará between the years 2020 and 2024, highlighting a 44% increase in the number of hospitalizations and 71% in hospitalization costs. This exponential growth reflects a growing trend, if mitigation measures are not adopted, which may cause excessive direct and indirect spending on the public system, which has already been suffering from the freezing of health spending, in addition to compromising the quality of life of users.

This study has limitations inherent to ecological studies, such as the risk of incompleteness or underestimation of secondary data, in addition to the fact that the findings refer only to SUS hospitalizations, and do not contain data from the supplementary health system. It should also be noted that it was not possible to extract data on the epidemiological profile.

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