

Clinical and Epidemiological Profile of Hospital Admissions in a Tertiary Center in the Brazilian Amazon: A 10-Year Analysis

Short title: Hospitalization Profile in the Brazilian Amazon

Authors:

Zaira Fernanda Martinho Nicolau, MD, MSc, Mateus Nery de Oliveira, Jerlainy Pinto dos Anjos, RN, Rachel Neves Nicolau, MD, Luiza Fernanda Mendonça Nicolau, MD, Fernando Chiodini Machado, MD.

Hospital Samel, Manaus, State of Amazonas, Brazil.

Corresponding Author:

Zaira Fernanda Martinho Nicolau, MD, Avenida Joaquim Nabuco 1755, 69020-030, Manaus, Amazonas, Brazil

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ABSTRACT

Introduction: Hospital-level epidemiological data from the Brazilian Amazon remain scarce, limiting understanding of long-term patterns of healthcare utilization and clinical outcomes in the region. **Objective:** This study aimed to characterize 10 years of hospital utilization, diagnostic profiles, and clinical outcomes at a tertiary-care center in the Western Brazilian Amazon. **Methods:** Retrospective observational cohort study including adult hospitalizations at a tertiary-care center in Manaus, Brazil, from May 2016 to June 2025. Electronic medical record and administrative data included demographics, ICD-10 diagnoses, admission unit, in-hospital mortality, length of stay, 30-day readmissions, and emergency and outpatient volumes. Analyses were descriptive using monthly and annual aggregates. **Results:** A total of 112,520 admissions were recorded. Most patients were women (61.2%), and the mean age was 29.2 years. The most common diagnostic groups were others, pregnancy/childbirth/puerperium, and digestive diseases, with marked rises in respiratory diagnoses from 2020 onward. Crude hospital mortality was 1.4%, peaking at 11.1% in May 2020 and January 2021. Median monthly mean length of stay was 9 days, and the 30-day readmission rate was 4.1%. The hospital managed 1.9 million emergency visits and 3.5 million outpatient consultations, with 5.8 admissions per 100 emergency visits. **Conclusion:** This study offers longitudinal insight into service demand, diagnostic distributions, and outcome patterns, underscoring the importance of sustained, data-driven monitoring to support planning and enhance hospital resilience.

Keywords: Hospitalization; Epidemiology; Health services

1. INTRODUCTION

Hospitals serve as essential components of health systems, reflecting population health needs and functioning as entry points for acute, chronic, and emergency care. Monitoring patterns of hospital utilization is central to understanding healthcare demand, optimizing resource allocation, and supporting data-driven policy development [1].

In low and middle-income countries, where demographic transitions, local disease burdens, and health system constraints intersect, hospital-based epidemiological information is particularly valuable [2]. Brazil presents marked regional heterogeneity in health outcomes and service capacity, with the Northern region facing longstanding challenges [3]. Hospital-level epidemiological data from the Amazon

remain scarce, limiting the ability of regional planners and clinicians to benchmark service needs, anticipate demand, and design context-specific interventions.

Understanding the diagnostic and demographic composition of hospitalized populations is also necessary for anticipating workforce needs and ensuring preparedness for both routine care and periods of increased clinical demand. The Coronavirus disease (COVID-19) pandemic exposed major vulnerabilities in Amazonas, which experienced high mortality rates in the country and substantial strain on hospital networks [4]. Longitudinal hospital-level analyses spanning pre-pandemic and post-pandemic periods remain limited but are critical for understanding how service utilization evolved across this unprecedented event.

To address these gaps, this study provides a 10-year characterization of hospitalizations in a major tertiary-care center in Manaus, Amazonas. By examining demographic patterns, diagnostic profiles based on International Statistical Classification of Diseases and Related Health Problems, 10th Revision (ICD-10) groupings, and key hospital outcomes, this work aims to offer a contextually relevant epidemiological overview that can help inform regional planning, healthcare delivery, and future research across the Western Brazilian Amazon.

2. MATERIALS AND METHODS

2.1. Study Design and Setting

This was a retrospective, observational cohort study conducted at a large private tertiary-care center located in Manaus, Amazonas, Brazil. The hospital provides emergency, intensive care, surgical, and medical services to a predominantly urban population in the Western Brazilian Amazon. The study evaluated all hospitalizations occurring between May 1, 2016, and June 30, 2025.

2.2. Participants and Eligibility Criteria

All inpatient admissions recorded in the institutional electronic medical record (EMR) system during the study period were eligible for inclusion. Eligible admissions consisted of adults hospitalized in any inpatient ward, intensive care unit (ICU) or observation unit, provided they had a complete administrative record and a documented primary diagnosis coded according to the ICD-10. Admissions were excluded if they contained critical missing information that prevented analysis. For patients with multiple admissions, each hospitalization was treated as an independent event, and readmissions occurring within 30 days were identified and analyzed separately.

2.3. Data Sources and Data Collection

Data were extracted from the institution's EMR and administrative databases using structured queries developed by the information technology department. Variables were collected consistently throughout the study period and organized monthly to ensure temporal comparability.

The dataset included demographic variables (sex and age), indicators of hospital outcomes (in-hospital mortality and length of stay), information on the type of admission unit (ICU or ward), the primary diagnosis coded according to ICD-10, the number of readmissions occurring within 30 days, and the monthly totals of emergency department visits and outpatient clinic visits. All data were fully de-identified prior to analysis, and any linkage between patient identifiers and anonymized records was deleted after extraction to ensure compliance with Brazilian data protection regulations.

2.4. Variable Definitions

The primary outcome was the clinical-epidemiological profile of hospitalizations, defined by patient demographics, diagnostic categories based on ICD-10 codes, and hospitalization metrics. Secondary outcomes included overall and unit-specific mortality, length of stay, and 30-day readmissions. ICD-10 codes were grouped into major diagnostic categories such as cardiovascular, infectious, respiratory, endocrine/metabolic, external causes, and neoplastic diseases. Length of stay was reported in the database as monthly mean values.

2.5. Statistical Analysis

All analyses were descriptive and based on monthly and annual aggregated data. Categorical variables were summarized as absolute frequencies and percentages, and continuous variables were presented as means or medians with their respective dispersion measures. Temporal patterns in hospitalizations, diagnostic categories, mortality, length of stay, readmissions, and service-volume indicators were evaluated using monthly and yearly aggregates across the study period.

3. RESULTS

From May 2016 to June 2025, a total of 112,520 hospitalizations were recorded. The median number of admissions was 1,139 per month (interquartile range [IQR], 631–1,270), with a minimum of 481 and a maximum of 1,697 monthly admissions. Most hospitalizations involved female patients: 68,838 admissions (61.2%) occurred in women and 43,691 (38.8%) in men. The mean age of hospitalized patients, estimated from monthly mean ages weighted by the number of admissions, was 29.2 years, and the monthly mean age ranged from 25 to 42 years over the study period. The highest monthly mean ages were observed in April 2020, May 2020, and January 2021, with mean ages of 40, 42, and 38 years, respectively.

Across all admissions, 132,041 diagnostic entries were registered in the ICD-10–based grouping system. The three most frequent diagnostic groups were “Others” ($n = 45,824$; 34.7% of all diagnostic entries), pregnancy, childbirth and the puerperium (O00–O99; $n = 21,688$; 16.4%), and diseases of the digestive system (K00–K93; $n = 17,029$; 12.9%). The remaining diagnostic categories included diseases of the genitourinary system (N00–N99; 13,637 entries; 10.3%), diseases of the respiratory system (J00–J99; 7,111; 5.4%), neoplasms (C00–D49; 7,049; 5.3%), external causes (S00–T98; 5,643; 4.3%), diseases of the circulatory system (I00–I99; 4,837; 3.7%), infectious and parasitic diseases (A00–B99; 4,298; 3.3%), endocrine, nutritional and metabolic diseases (E00–E90; 1,968; 1.5%), diseases of the nervous system (G00–G99; 1,850; 1.4%), mental and behavioral disorders (F00–F99; 811; 0.6%), and trauma and injuries (V01–Y98; 218; 0.2%). Annual counts of respiratory diagnoses showed a marked rise

in 2020, with 1,144 entries compared with 741 in 2019 and values consistently below 500 in all preceding years, accompanied by sustained elevations throughout the months of 2020. From 2020 onward, yearly totals ranged from 644 to 1,208 entries, exceeding all values recorded before 2020. When adjusted for the annual number of hospitalizations, respiratory diagnoses also demonstrated greater proportional representation in 2020, corresponding to 8.28% of all admissions compared with 7.16% in 2019 and proportions consistently below 6.5% between 2016 and 2018. Although proportions decreased in 2021 and 2022 (4.04% and 4.62%, respectively), they increased again in subsequent years, reaching 7.72% in 2024 and 8.27% in the first half of 2025.

Over the 10-year period, there were 1,569 in-hospital deaths, corresponding to a crude hospital mortality of 1.4% among all admissions. Of these, 1,198 deaths (76.4%) occurred in the intensive care unit and 371 (23.6%) in ward units, representing 1.1% and 0.3% of all hospitalizations, respectively. When analyzed by calendar year, crude annual hospital mortality ranged from 0.7% to 3.2%, with the highest values observed in 2020 (3.2%) and 2021 (2.5%). On a monthly basis, the median hospital mortality rate was 1.0% (IQR, 0.64–1.35), with monthly values ranging from 0.16% to 11.1%. The highest monthly mortality rates occurred in May 2020 and January 2021, both reaching 11.1%.

The median of the monthly mean length of stay was 9 days (interquartile range, 5–18), and monthly mean values ranged from 4 to 441 days throughout the study period. A total of 4,482 readmissions within 30 days were recorded, corresponding to 4.0% of all hospitalization episodes. The median monthly 30-day readmission rate was 4.1% (IQR, 3.65–4.38), with monthly values ranging from 3.5% to 4.8%. During the same period, 1,916,992 emergency department visits and 3,486,696 outpatient consultations were documented. The median monthly number of emergency department visits was 16,945 (IQR, 11,243–22,050), with monthly totals ranging from 6,809 to 35,515. Outpatient consultations had a median of 37,077 visits per month (IQR, 13,461–45,777), ranging from 605 to 57,295. When hospitalizations were related to service volume, the median number of hospital admissions was 5.8 per 100 emergency department visits (IQR, 5.3–6.7), 3.0 per 100 outpatient consultations (IQR, 2.7–4.1), and 2.0 per 100 combined encounters (IQR, 1.8–2.5).

4. DISCUSSION

This 10-year analysis characterizes hospital utilization, morbidity patterns, and clinical outcomes in a tertiary-care center in the Western Brazilian Amazon. The findings provide long-term information on service demand and may support regional health planning while addressing an important gap in the literature from Northern Brazil.

In this study, hospitalizations were predominantly among young patients, with a higher proportion of admissions occurring in women. This pattern aligns with previous findings from the Brazilian Amazon, where hospitalization was reported to be twice as frequent in women compared with men [5]. One possible explanation is the well-documented difference in health-seeking behavior: men tend to access healthcare services less frequently, whereas women are generally more health-conscious and engaged in preventive behaviors [6,7]. The substantial burden of obstetric admissions observed in our center is consistent with large administrative datasets showing that obstetric hospitalizations account for millions of admissions in the Brazilian Unified Health System and remain a major driver of hospital service use among women of reproductive age [8]. Additionally, direct obstetric causes remain a leading contributor to maternal morbidity and mortality in Brazil, highlighting the need for vigilant clinical surveillance given the potential for severe complications and fatal outcomes [9].

The high frequency of digestive and genitourinary conditions shows that these diseases remain an important component of hospital demand, even in a relatively young population with a substantial obstetric burden. These findings have practical implications for service planning, particularly for bed allocation, multidisciplinary staffing, and coordination between outpatient, emergency, and inpatient care. They also reinforce the importance of continuity of outpatient care, which has been associated with fewer potentially avoidable hospitalizations [10].

Respiratory diagnoses and mortality showed a temporal shift during the COVID-19 pandemic. Respiratory admissions increased in 2020 and remained elevated in subsequent years, consistent with national reports of increased hospitalizations for severe acute respiratory infections and COVID-19 [11]. Our data showed mortality peaks in May 2020 and January 2021. Monthly mortality rose from a pre-pandemic median of approximately 1% to as high as 11.1%. These peaks likely reflect the increased clinical burden and healthcare pressures associated with the pandemic. Similar patterns were reported in Manaus, where overall mortality more than doubled compared with 2019 and the mean number of daily burials tripled [4]. Other Brazilian hospital systems also reported substantial pandemic-related effects, with in-hospital mortality reaching 22% overall and 59.5% among patients requiring invasive mechanical ventilation [12]. The lower mortality rates may have been influenced, among other factors, by the early adoption of a locally developed non-invasive ventilation strategy designed to reduce aerosol dispersion while allowing non-invasive ventilatory support [13]. However, given the observational nature of the present study and the absence of patient-level comparative analyses, the

independent contribution of this strategy to clinical outcomes cannot be determined.

Several strengths should be highlighted. The study included a large number of admissions over nearly a decade, allowing the assessment of temporal trends before, during, and after the COVID-19 pandemic. The use of standardized ICD-10 coding and consistent data extraction procedures throughout the study period also improved data comparability over time and with other datasets using similar classification systems.

Limitations must also be acknowledged. The single-center design, based on a private tertiary-care hospital in Manaus, may limit generalizability to other healthcare settings, particularly public hospitals and smaller facilities in the Amazon region. In addition, the use of aggregated monthly and annual data prevented patient-level adjustment for comorbidities, socioeconomic factors, and clinical severity, which may influence hospital outcomes.

Future research should incorporate multicenter and population-based datasets to determine whether the hospitalization patterns observed in this tertiary-care center are representative of the wider Brazilian Amazon. Patient-level studies could further evaluate the influence of age, sex, comorbidities, socioeconomic characteristics, clinical severity, and diagnostic categories on mortality, length of stay, and readmission. Comparative analyses between public and private hospitals may also help identify differences in healthcare utilization and outcomes. Continued longitudinal surveillance is warranted to monitor post-pandemic changes in respiratory disease burden, hospital demand, and mortality. Future studies may additionally evaluate predictive models for hospital demand and readmission risk, which could support resource allocation, service planning, and development of context-specific healthcare strategies in the Amazon region.

5. CONCLUSION

This 10-year analysis identified a young patient profile, a high burden of obstetric admissions, and frequent digestive and genitourinary conditions. Respiratory morbidity and mortality also showed important temporal changes during the study period. These findings highlight distinct healthcare demands in the Brazilian Amazon and may support locally tailored health planning. Further patient-level analyses may help refine care pathways and resource allocation in the region.

6. DECLARATIONS

Ethics Approval and Consent to Participate

This study was based on retrospective analysis of de-identified electronic medical record and administrative data. All data were fully de-identified prior to analysis, and the linkage between patient identifiers and anonymized records was deleted after data extraction.

Consent for Publication

Not applicable. This study used retrospective, de-identified data and does not contain individually identifiable patient information.

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no conflicts of interest.

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Authors' Contributions

All authors contributed to the conception and/or design of the study, data interpretation, preparation and critical revision of the manuscript, and approved the final version for publication.

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Use of Artificial Intelligence

The authors declare that no artificial intelligence tools were used to generate, analyze, or interpret the scientific data reported in this manuscript.

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