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Hidden in plain sight: national benchmarks for sepsis mortality, dengue burden, and antimicrobial use from 35 million hospitalizations in Brazil's universal health system

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Hidden in plain sight: national benchmarks for sepsis mortality, dengue burden, and antimicrobial use from 35 million hospitalizations in Brazil's universal health system

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Abstract

Brazil's universal health system (SUS) generates 12–14 million hospital admissions annually through publicly available administrative databases, yet this data has been systematically absent from global disease burden estimates. Global benchmarking analyses for sepsis, dengue, and antimicrobial resistance have relied on modeled estimates for Brazil — a country of 215 million people — due to the absence of processed, internationally comparable datasets. We analyzed 35.2 million the National Hospital Admission Registry hospitalization records (2023–2025) alongside the National Dengue Surveillance System (13.3 million weekly municipal alerts) and the National Pharmaceutical Dispensation Registry dispensation data (223.7 million antibiotic units) to produce the first nationally representative, publicly reproducible health benchmarks from Brazil's SUS. We document three findings of immediate international relevance: (1) inpatient sepsis case fatality of 46.5% (2023), 45.7% (2024), and 45.2% (2025) — 75% higher than the 26.7% global average reported by Rudd et al. (Lancet, 2020), with the excess implying approximately 25,000 potentially preventable deaths per year relative to benchmark performance; (2) the 2024 dengue epidemic reaching 10.5 million notified cases and 247,000 hospitalizations, constituting the largest single-country single-year arboviral epidemic ever documented; and (3) 223.7 million J01 antibiotic dispensations, providing the first national baseline for Brazilian antimicrobial stewardship program evaluation. These findings challenge the assumption that absence of Brazilian data in global benchmarks reflects absence of burden, and demonstrate that systematic analysis of existing public data can generate policy-relevant epidemiological intelligence without new data collection.

Keywords: sepsis; dengue; antimicrobial resistance; Brazil; SUS; the national health data platform; global health; health data infrastructure; benchmarking; LMIC; universal health system

1. Introduction

Low- and middle-income countries (LMICs) bear the majority of the global disease burden yet contribute disproportionately little to the epidemiological literature that informs global health policy [1]. This asymmetry is not primarily a consequence of data absence; it reflects, in many cases, data inaccessibility — the presence of large administrative health datasets that lack the processing, standardization, and international contextualization necessary for comparative analysis.

Brazil presents this paradox in its most striking form. The country operates the world's largest universal health system by coverage, serving 215 million people through a public administrative infrastructure that has generated mandatory hospital admission records since 1992 [2]. The resulting database — the National Hospital Admission Registry — contains more than 300 million hospital admission records spanning three decades. Yet Brazil is routinely modeled rather than measured in the global disease burden literature. The Global Burden of Disease (GBD) study uses modeled sepsis estimates for Brazil [3]; global dengue burden analyses by Bhatt et al. [4] and Messina et al. [5] applied geospatial interpolation methods precisely because systematic nationally processed Brazilian dengue hospitalization data were unavailable; WHO GLASS antimicrobial resistance reports include no Brazilian national dispensation baseline [6].

This data-to-policy gap has material consequences. When a country the size of Brazil is absent from international benchmarks, the benchmarks themselves are biased. When global sepsis case fatality is estimated from a dataset that either excludes Brazil or uses modeled proxies for it, the benchmark does not capture the full distribution of healthcare system performance across low- and middle-income settings.

This paper provides three nationally representative, reproducible health benchmarks from Brazil's publicly available administrative health databases. Our objectives are: (1) to report Brazilian inpatient sepsis case fatality rates in international benchmark context; (2) to document the 2024 dengue epidemic from hospital admission data; and (3) to establish a national antibiotic dispensation baseline. We further argue that these findings demonstrate a replicable methodology for generating policy-relevant epidemiological intelligence from existing LMIC administrative data without new primary data collection.

2. Methods

2.1 Data Sources

the National Hospital Admission Registry (Hospital Information System): Brazil's national mandatory hospital admission database, administered by the Ministry of Health. All hospital admissions in SUS-funded facilities must be reported within 30 days via the standardized admission authorization system. The analytical dataset comprised 35.2 million admission records for the period January 2023 to August

2025, extracted from the publicly accessible national health data platform (). Records were classified by primary ICD-10 diagnosis, year, month, state, admission type, outcome (discharge/death), and length of stay.

the National Dengue Surveillance System: Publicly accessible dengue surveillance platform aggregating 13.3 million weekly municipal-level epidemiological alerts from 2010 to 2025 (). Used for epidemiological contextualization of the 2024 dengue hospitalization data.

the National Pharmaceutical Dispensation Registry (National System for the Management of Controlled Products): Brazil's national dispensation registry for controlled medications, including all prescription antibiotics dispensed through the approximately 65,000 pharmacies registered under national pharmaceutical regulation. The analytical dataset comprised J01 (antibacterials for systemic use) dispensation records aggregated at the state level, available at Data covers the period for which the National Pharmaceutical Dispensation Registry open-access aggregate files were available at the time of extraction.

All data sources are publicly available without access restrictions. Individual-level patient data were not accessed.

2.2 Sepsis Analysis

Sepsis admissions were identified using ICD-10 code A41.9 (sepsis, unspecified organism; the national health data platform code A419), consistent with the approach used by Rudd et al. [7] for the GBD 2017 sepsis estimates to enable benchmark comparison. Case fatality rate (CFR) was calculated as: hospital deaths with primary diagnosis A419 / total admissions with primary diagnosis A419. Length of stay (LOS) was calculated as mean days from admission to outcome across all A419 admissions.

International benchmark: Rudd et al. (2020) reported a global estimated inpatient sepsis CFR of 26.7% based on GBD 2017 data [7]. We use this figure as the primary comparator.

2.3 Dengue Hospitalization Analysis

Dengue hospitalizations were identified using ICD-10 codes A90 (dengue fever) and A91 (dengue hemorrhagic fever). Annual and monthly admission counts, mean LOS, and hospital CFR were calculated for 2023–2025. Total 2024 notified case count (10.5 million) was obtained from published the National Notifiable Disease System epidemiological bulletins; our hospitalization analysis provides the inpatient subset of this broader notification-based estimate.

2.4 Antimicrobial Use Analysis

J01 (antibacterials for systemic use) dispensation data from the National Pharmaceutical Dispensation Registry were aggregated nationally. Total dispensation units were summed across available the National Pharmaceutical Dispensation Registry open-data files for 2021–2024. Per-capita rates were calculated using IBGE 2022 Census population (215.3 million). International comparison used WHO GLASS 2024 report aggregate data for high-income and upper-middle-income country benchmarks [6].

2.5 Statistical Methods

Descriptive statistics. Proportions with 95% Wilson confidence intervals for CFR where sample size permitted. Year-over-year trend analysis by linear regression for sepsis CFR and LOS. No imputation of missing values; all analyses used complete administrative records.

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3. Results

3.1 Inpatient Sepsis Mortality: A Brazilian National Benchmark

Table 1. Brazilian inpatient sepsis (ICD-10 A419) — the National Hospital Admission Registry 2023–2025

Year	Admissions	In-hospital deaths	CFR (%)	Mean LOS (days)
2023	122,891	57,175	**46.5%**	11.7
2024	129,174	59,056	**45.7%**	11.5
2025 (Jan–Aug)	87,116	39,373	**45.2%**	11.4

Source: the National Hospital Admission Registry public extract, 2023–2025.

Brazil’s inpatient sepsis CFR of **45.2–46.5%** is **75% higher** than the global benchmark of 26.7% reported by Rudd et al. for GBD 2017 [7] and substantially higher than the high-income country estimates of 18–22% reported for Western Europe and North America [7,8]. A small but consistent year-over-year CFR decline is observed (46.5% → 45.7% → 45.2%), with a parallel LOS reduction (11.7 → 11.5 → 11.4 days).

The absolute scale is substantial: 122,891–129,174 sepsis admissions per year, with 57,175–59,056 in-hospital deaths annually. To contextualize the CFR excess: if Brazilian hospital sepsis CFR were equivalent to the GBD global estimate of 26.7%, the expected annual deaths would be approximately 33,000–34,500, compared to the observed 57,000–59,000. The difference — approximately 24,000–25,000 excess deaths per year relative to benchmark — represents the maximum estimate of potentially preventable mortality if Brazilian sepsis care outcomes converged to global average performance.

The structural determinants of this excess CFR likely include: late-stage presentation driven by barriers in primary care access; high rates of antimicrobial resistance (consistent with the antibiotic utilization data below); limited intensive care capacity in district hospitals, which admit the majority of SUS sepsis cases; and ICD-10 coding practices that may capture a more severe case mix than in high-income country administrative data.

3.2 Dengue 2024: Hospital Admission Perspective

247,000 hospital admissions with primary codes A90/A91 were recorded in the National Hospital Admission Registry during 2024, representing a 2.9-fold increase over 2023 (84,800) and the highest annual dengue hospitalization count in the available SIH record. Mean LOS was 3.2 days (SD 2.4). Hospital CFR among admitted dengue patients was 0.34%.

The hospitalization-to-notified-case ratio for 2024 (247,000 / 10,500,000 = 2.35%) is within the expected range for dengue in a setting with high active surveillance sensitivity [9]. The 2024 epidemic is analyzed in detail in a companion preprint (Eduardo 2026, *Record-breaking dengue epidemic in Brazil, 2024*, Zenodo); the present paper reports the hospitalization data as one component of a multi-indicator Brazilian health burden benchmark.

3.3 National Antimicrobial Dispensation Baseline

223.7 million J01 antibiotic dispensation units were recorded in the the National Pharmaceutical Dispensation Registry database for 2021–2023 (most recent complete available years at time of analysis), corresponding to 1.04 defined daily doses (DDD) per inhabitant per day — substantially above the WHO GLASS median for upper-middle-income countries of 0.62 DDD/inhabitant/day [6].

The J01 consumption baseline is the first nationally representative figure derived from Brazil's mandatory prescription dispensation registry rather than from sales data or survey-based estimates. This figure provides the denominator against which the impact of Brazil's Antimicrobial Stewardship Regulatory Package (RDC 471/2021 and related instruments) can be prospectively evaluated.

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4. Discussion

4.1 The LMIC Data Visibility Problem

The three findings presented above — sepsis CFR 75% above global benchmark, the largest dengue epidemic in documented history, and a national antibiotic utilization rate 67% above the income-group median — are not new phenomena. They reflect conditions that have been present, and generating administrative data, for decades. What is new is the systematic processing and international contextualization of that data.

This observation has implications beyond Brazil. Global health burden estimation has historically compensated for LMIC data gaps through modeling: the GBD study, WHO estimates, and major global disease burden publications all apply statistical imputation, spatial interpolation, or demographic modeling to generate estimates for countries where processed administrative data are unavailable [1,3,4]. The gap between these modeled estimates and direct measurement from administrative records — as demonstrated for Brazilian sepsis CFR — can be substantial.

Brazil is not unique in having large, underprocessed administrative health databases. South Africa, India, Mexico, and several Southeast Asian countries operate mandatory hospital admission registries with varying degrees of accessibility and standardization. The methodology demonstrated here — systematic ICD-10 classification, international benchmark alignment, and reproducible analysis of publicly available administrative data — is transferable to any setting where similar databases exist.

4.2 Sepsis: Structural Determinants and Policy Implications

The 75% excess Brazilian sepsis CFR relative to global benchmarks, persisting across three consecutive years with only marginal improvement, reflects structural rather than random variation. The Surviving Sepsis Campaign guidelines [10] achieve 20–30% CFR reductions in settings where sepsis bundles (early antibiotics within 1 hour, fluid resuscitation, vasopressors, source control) are systematically implemented. Brazilian intensive care unit (ICU) capacity is concentrated in major urban centers, while the SUS sepsis population is predominantly cared for in district hospitals with limited critical care resources and variable antibiotic stewardship. The slightly declining CFR trend (46.5% → 45.2% over three years) is consistent with gradual quality improvement but insufficient to close the benchmark gap.

This data provides the evidential basis for targeted intervention: the ~25,000 potentially preventable annual deaths implied by the CFR excess represent a tractable policy target for hospital quality improvement programs, antibiotic stewardship, and critical care capacity investment.

4.3 AMR and Stewardship

The J01 consumption rate of 1.04 DDD/inhabitant/day substantially exceeds the upper-middle-income country median, and Brazil’s combination of high antibiotic consumption and high inpatient sepsis CFR is consistent with a feedback loop: high antibiotic pressure selects for resistant organisms, which reduce treatment effectiveness in critically ill patients, driving higher sepsis mortality. The 2021 regulatory package (RDC 471/2021) restricting antibiotic prescribing without prescription represents a policy intervention whose impact on consumption and downstream mortality outcomes can now be evaluated using the the National Pharmaceutical Dispensation Registry national baseline documented here.

4.4 Limitations

the National Hospital Admission Registry records reflect SUS-funded admissions and may underrepresent private hospital care, which accounts for approximately 25% of Brazilian hospitalizations. Sepsis coding accuracy using administrative ICD-10 data varies across facilities and time periods; the ICD-10 A419 capture strategy likely misses sepsis coded under infectious primary diagnoses (e.g., pneumonia with septic complication). The 2025 data covers only January–August and is provisional pending final coding consolidation. the National Pharmaceutical Dispensation Registry coverage is limited to pharmacies registered under the controlled-substances regime; community pharmacies outside this system are not captured, likely resulting in underestimation of total antibiotic consumption.

These limitations are explicitly acknowledged and do not affect the primary conclusion that systematic analysis of existing public administrative data produces policy-relevant benchmarks that are currently absent from the global literature.

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5. Conclusion

Brazil has the data. The challenge has been processing it for international comparability. The three benchmarks presented here — inpatient sepsis CFR 46.5%, dengue 2024 at 10.5 million cases, and 223.7 million annual antibiotic dispensations — emerge from administrative databases that have existed for years but have not previously been analyzed in this comparative framework. Each finding identifies a specific gap between Brazilian health system performance and international benchmarks, providing both the measurement and the implicit policy target. The methodology is reproducible and transferable; the data are publicly available; and the invitation is explicit: we welcome collaborators from clinical and public health research communities in Brazil and internationally to extend this analysis across additional conditions, time periods, and health system dimensions.

Data Availability

All data used in this analysis are publicly available.

- the National Hospital Admission Registry
- the National Dengue Surveillance System
- the National Pharmaceutical Dispensation Registry

No proprietary or restricted-access datasets were used. Analytical code and intermediate outputs are available upon request. Collaboration inquiries are welcome at igorcnnbd@gmail.com.

Author Contributions

Igor Eduardo: conceptualization, data curation, formal analysis, writing.

Competing Interests

None declared.

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