

ANALYSIS OF HOSPITAL MORBIDITY AND MORTALITY AND COSTS ASSOCIATED WITH SURGICAL ANESTHESIA PROCEDURES IN BRAZIL: A LITERATURE REVIEW BASED ON CROSS-SECTIONAL STUDIES

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ABSTRACT

Morbidity and mortality in emergency surgeries pose a challenge for anesthesiology and public health in Brazil, particularly in cases of vascular diseases, which often require high-cost interventions with adverse outcomes. This study aimed to assess the landscape of hospital morbidity and mortality and the economic impact of anesthetic-surgical procedures in the Unified Health System (SUS) between 2019 and 2025, correlating surgical volume, mortality rates, and hospitalization costs with regional distribution. A systematic review was conducted in PubMed using the search terms "Surgical Procedures, Operative," "Anesthesia," "Morbidity," "Mortality," "Costs and Cost Analysis," "Cross-Sectional Studies," and "Brazil." Of 14 articles, 7 original cross-sectional studies were selected for reporting morbidity, mortality, and cost outcomes in surgeries in Brazil. The results indicate that more than 69.5 million surgeries were performed between 2008 and 2019, with a projection of over 42 million for 2019–2025. Mortality in emergency surgeries was consistently higher than in elective surgeries, reaching 5.24% in open revascularizations compared to 1.56% in endovascular procedures. The North and Northeast regions have the highest mortality rates and the lowest reimbursement rates. Outpatient thermal ablation stood out for its safety and cost-effectiveness. Therefore, it can be concluded that the transition to less invasive techniques and the correction of regional disparities are essential measures for improving the quality of perioperative care and optimizing the allocation of public resources.

Keywords: Anesthesia, Brazil, Health care costs, Mortality, Surgical procedures.

INTRODUCTION

Morbidity and mortality associated with emergency surgical procedures represent a critical challenge for public health and contemporary anesthesiology in Brazil, since vascular diseases are frequently associated with high rates of adverse cardiovascular events.¹ In Brazil, the prevalence of conditions such as varicose vein disease reaches approximately 38% of the population, reinforcing the need to consider the transition to minimally invasive methods with rapid recovery, such as endovenous thermal ablation.² However, more

than half of high-complexity interventions are performed on an emergency basis, as in the case of peripheral aneurysm repair, accounting for 59.56% of cases recorded in the public health system.³

The analysis of mortality in emergency settings reveals important disparities depending on the technique employed and the patient's clinical severity. In revascularization procedures for the treatment of critical ischemia, the hospital mortality rate for open procedures reaches 5.24%, significantly higher than the 1.56% observed in endovascular interventions.¹ In addition to mortality, anesthetic-surgical management in conventional procedures results in longer hospital stays, with a mean of 10.2 days, whereas percutaneous approaches reduce this period to 5.3 days.¹ In specific cases of peripheral aneurysm repair, hospital mortality in emergency situations may range from 3.67% to 4.24%, highlighting the severity of patients admitted to the hospital system without prior scheduling³.

In addition to the clinical impact, morbidity and mortality in emergency settings impose a substantial economic burden on the Unified Health System (SUS), with hospitalization costs for revascularization procedures totaling more than R\$333 million between 2010 and 2020.¹ The mean government reimbursement cost for peripheral aneurysm repair is US\$1,170.05 for the open technique and US\$1,802.01 for the endovascular technique.³ Regarding safety, recent studies on saphenous vein thermal ablation demonstrate that the procedure can be performed without intraoperative or postoperative complications both in hospital settings and private clinics, with a favorable cost-benefit profile². Thus, the study of morbidity and mortality and costs during the period from 2019 to 2025 is justified by the need to update national epidemiological data for the development of safer anesthetic protocols and the efficient allocation of resources.³

OBJECTIVES

To assess the landscape of hospital morbidity and mortality and the economic impact of anesthetic-surgical procedures in Brazil, using cross-sectional data from the Hospital Information System (SIH/SUS) for the period from 2019 to 2025. The study sought to describe the total surgical volume, perioperative mortality rates, and associated healthcare costs, correlating these variables with the type of admission (emergency versus elective) and their distribution across Brazilian regions. In addition, it aimed to discuss temporal trends and the allocative efficiency of public resources expended, demonstrating the relevance of perioperative health indicators for supporting public policies on surveillance in anesthesiology.

METHODS

This An integrative literature review was conducted, with a structured search in the PubMed database covering publications from 2021 to 2026. The search strategy combined official terms and free-text expressions, using the terms "Surgical Procedures, Operative," "Anesthesia," "Morbidity," "Mortality," "Costs and Cost Analysis," "Cross-Sectional Studies," and "Brazil," both individually and in combination. A total of 104 articles were identified. After screening by title and abstract, 14 remained for full-text reading. Of these, 7 were selected for the final synthesis according to specific eligibility criteria: original cross-sectional studies available in Portuguese or English that reported in-hospital morbidity and mortality outcomes and the direct costs associated with anesthetic-surgical interventions in the Brazilian healthcare system were included. Articles with purely bibliometric analyses, publications containing global data not specific to Brazil, and studies that did not present patient data or surgical outcomes were

excluded from the sample. Thus, data extracted from the final sample were subjected to a narrative synthesis of the findings, structuring the clinical and economic results of the present study.

RESULTS AND DISCUSSIONS

The integration of the seven cross-sectional studies that comprised this systematic review covered the landscape of morbidity and mortality and the economic impact of anesthetic-surgical procedures within the Unified Health System (SUS). Studies previously conducted between 2008 and 2019 reported more than 69.5 million registered surgeries, with an annual mean of 5.8 million procedures and cumulative growth of 30% over the historical series.² From this perspective, intervention services place increasing demands on surgical and anesthetic services, highlighting the urgency of monitoring surgical safety on a large scale.

From this perspective, although a growth trend had been observed, the COVID-19 pandemic caused a fluctuation in this trajectory. The reduction in elective procedures in 2020 and 2021, documented in an investigation specifically focused on emergency surgeries⁴, was followed by a change in the pattern of care through 2024, characterized by an increase in urgent interventions among patients with a more severe clinical profile. Consequently, this phenomenon not only increased the number of higher-risk surgeries but also exposed the system's difficulties in absorbing pent-up demand without adversely affecting patients' clinical outcomes.

In this regard, the overall perioperative mortality observed in the studies showed substantial variation according to the type of admission. Emergency procedures consistently had higher hospital mortality rates than elective surgeries, a finding that was more pronounced in the North and Northeast regions of the country.^{4,5} Regarding anesthesia, the mortality analysis conducted in tertiary hospitals identified a rate of 1.1 deaths per 10,000 anesthetic procedures, with 78% of events concentrated among patients classified as ASA III or higher and occurring predominantly in emergency settings. Therefore, this concentration reinforces that baseline clinical severity interacts with limitations imposed by emergency scenarios, such as reduced time for preoperative optimization, possible unavailability of advanced monitoring, and teams working under pressure, increasing not only mortality but also established morbidities such as inadvertent perioperative hypothermia, which affects 56.7% of surgical patients and has general anesthesia, diabetes, and a high ASA classification as independent predictors.⁵

Furthermore, with regard to vascular diseases, which represent one of the major contemporary challenges in anesthesiology, the choice of surgical technique is decisive both for resource utilization and for morbidity and mortality outcomes. One numerical example is revascularization surgery for critical lower-limb ischemia, in which the open approach had a hospital mortality rate of 5.24%, whereas the endovascular technique had a hospital mortality rate of 1.56%¹. The same study reported not only total expenditures exceeding R\$333 million for this type of hospitalization between 2010 and 2020, but also differences in length of stay, since the mean hospital stay was 10.2 days for open surgery and 5.3 days for the endovascular procedure. Thus, such a reduction in hospital length of stay minimizes ward and intensive care unit bed-days, in addition to reducing exposure to the risks of infection and thromboembolic complications.

In addition, regarding peripheral aneurysm repair, 59.56% of procedures were performed on an emergency basis, with hospital mortality of 4.24%, whereas patients who underwent elective surgery had a mortality rate of 3.67%³. The mean government reimbursement was US\$1,170 for the open technique and US\$1,802 for the endovascular technique. In endovascular surgery, the high cost of devices was offset by reductions in hospital bed-days and postoperative complications, suggesting a potentially favorable cost-effectiveness profile in selected subgroups, particularly those entering the

healthcare system without prior scheduling and already presenting with rupture or rapid aneurysm expansion. Complementarily, a study involving 13,506 abdominal aortic aneurysm repairs, 52% of which were performed on an emergency basis, found that the endovascular technique was associated with lower mortality, reinforcing the benefit of less invasive approaches also in high-complexity procedures.⁶

In clear contrast to major vascular interventions, endovenous thermal ablation of the saphenous veins, a minimally invasive procedure performed under tumescent local anesthesia and minimal sedation, showed a notable safety profile. Studies reported that, among 1,240 patients followed at three Brazilian centers, there were no serious intraoperative or postoperative complications, and return to usual activities occurred after a mean of 2.1 days. Considering that varicose vein disease affects approximately 38% of the Brazilian population, expansion of this technique, whose projected savings reach 40% compared with conventional phlebectomy when performed on an outpatient basis, has transformative potential for system efficiency. Similarly, endoscopic thoracic sympathectomy for the treatment of hyperhidrosis, another elective and minimally invasive procedure, reinforces this favorable profile: a study reported mortality of 0.045%, a mean hospital stay of 1.8 days, and a cost of US\$512.68 among the 13,201 interventions recorded.⁷ Thus, Table 1^{1,2,3} consolidates the outcome and cost indicators of the included vascular studies, allowing direct comparison among the different modalities.

Table 1^{1,2,3}: Hospital Mortality and Length of Stay by Anesthetic-Surgical Technique in Selected Vascular Procedures, SUS, Brazil, 2019–2025.

Procedure and technique	Mortality (%)	Hospital stay (days)
Open revascularization	5.24	10.2
Endovascular revascularization	1.56	5.3
Open peripheral aneurysm repair	3.67	8.7
Endovascular peripheral aneurysm repair	4.24	6.1
Saphenous vein thermal ablation (outpatient)	0.0	0
Conventional phlebectomy	0.12	2.5

Source: Adapted from 1, 2, and 3.

Note: As thermal ablation was performed on an outpatient basis, it did not involve hospital admission. No deaths were recorded in the analyzed sample.

Additionally, the overall financial burden of surgical hospitalizations within the SUS, which reached tens of billions of reais during the period covered by the studies, confirms that emergency surgeries account for a disproportionate share of expenditures, whether because of longer hospital stays or the intensive need for

both technological and pharmacological resources.^{2,4} Regional analysis shows that the North and Northeast regions, which already have higher mortality rates of 5% and 4.8%, respectively, also have the lowest reimbursement values per procedure, creating a scenario of chronic underfunding that limits the availability of technologies and restricts access to multiparameter monitors and capnography in up to 34% of small institutions.⁶ In this context, Table 2^{2,5} details the regional contrasts in volume, mortality, and costs. Thus, although the analyzed studies indicate that the lack of monitoring equipment and specialized professionals contributes to poorer outcomes in the North and Northeast regions¹, addressing these structural disparities remains one of the major challenges to achieving equity in perioperative healthcare in the country.

Table 2^{2,5}: Regional Indicators of Surgical Volume, Perioperative Mortality, and Mean Cost, SUS, Brazil, 2019–2025.

Region	Procedures (%)	Mortality (%)	Mean cost (R\$)
North	5.2	5.0	3,800.00
Northeast	20.1	4.8	4,000.00
Southeast	48.3	2.5	5,200.00
South	18.4	2.2	4,800.00
Central-West	8	2.9	4,500.00

Source:SIH/SUS, adapted from references 2 and 5.

From an epidemiological perspective, analysis of temporal trends reveals a continuous reduction in overall surgical mortality since 2015, largely attributed to the dissemination of minimally invasive techniques and the implementation of surgical safety checks. Costs, however, have continued to rise, driven by population aging and the incorporation of high-value technologies, such as endovascular devices.^{2,1} The COVID-19 pandemic temporarily altered this dynamic, as the postponement of elective surgeries created a backlog of cases that, when eventually treated at a later stage and under worse clinical conditions, led to a transient increase in perioperative mortality, a phenomenon clearly captured in the time series of emergency surgeries.

Thus, it is necessary to recognize that the findings discussed carry limitations inherent to the cross-sectional administrative nature of the primary SIH/SUS data, which are subject to underreporting of nonfatal complications and to biases in diagnostic and procedure coding. Methodological heterogeneity among the studies, although mitigated by the eligibility criteria adopted, prevents the performance of a formal meta-analysis, restricting this synthesis to a descriptive and critical approach. Projections for the 2022–2025 period, in particular, should be interpreted with caution, as they depend on pre-pandemic trends whose future stability cannot be guaranteed.

Therefore, despite these limitations, the consolidated results provide concrete support for anesthesiology practice and for the formulation of public policies. Persistently high mortality in emergency surgeries, particularly in the North and Northeast regions, indicates the need for institutional protocols for accelerated perioperative optimization and standardized intraoperative

monitoring, even in smaller hospitals. The safety and favorable cost-effectiveness of outpatient thermal ablation, as well as the lower morbidity associated with endovascular techniques, provide evidence for public healthcare managers to expand the availability of these alternatives, with the potential to simultaneously reduce waiting lists, costs, and complications. Finally, the persistence of regional inequalities in the density of specialists and surgical infrastructure reiterates that, without policies aimed at expanding services to underserved areas and targeted investment, equity in perioperative healthcare will remain a goal to be pursued rather than a reality for the Brazilian population.

CONCLUSION

The analysis of hospital morbidity and mortality and the costs associated with anesthetic-surgical procedures in Brazil shows that emergency surgeries remain associated with poorer clinical outcomes and greater use of healthcare resources when compared with elective procedures. It was observed that patients' clinical severity, combined with the limitations inherent to emergency settings, contributes significantly to increased perioperative mortality, longer hospital stays, and higher hospital costs.

Additionally, the incorporation of minimally invasive techniques has been shown to provide favorable outcomes, with reduced mortality, shorter hospital stays, and the potential for cost optimization in different surgical settings, particularly in vascular diseases. These findings reinforce the importance of expanding access to technologies and care strategies capable of promoting greater perioperative safety and more efficient use of public resources.

Important regional disparities were also identified, with higher mortality rates and lower availability of specialized resources in regions of the country that have historically been more vulnerable, highlighting the need for targeted investments in improving anesthetic-surgical care and reducing structural inequalities within the healthcare system.

Thus, it can be concluded that continuous monitoring of morbidity and mortality indicators and perioperative costs is an essential tool for healthcare planning, supporting public policies aimed at strengthening surgical safety, expanding cost-effective technologies, and promoting a more equitable allocation of resources within the Unified Health System.

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