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Access and effectiveness inpatient care indicators and economic crisis: analysis based on the Brazilian Unified Health System data, Brazil and Southern Brazil states, 2009-2018

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Abstract *In the context of crisis and resource constraints, it is reasonable to assume the deteriorated weaknesses of the Unified Health System (SUS), such as regional inequalities, underfinancing, and care quality issues. This study explored the application of easily comprehensible and calculated access and effectiveness indicators that could reflect the hospital network crisis. Five indicators extracted from the Hospital Information System, related to Brazil and states of the Southeastern region, were analyzed in the 2009-2018 period: hospitalizations resulting in death; surgical hospitalizations resulting in death; elective surgeries in the total of surgical hospitalizations; hip prostheses in the senior population; and angioplasties in the population aged 20 years and over. Statistical control charts were used to compare indicators between states, before and from 2014. In Brazil, overall hospital deaths had a slight increase while surgical deaths declined; elective surgeries and hipprosthesis also decreased. In Southeastern Brazil, Rio de Janeiro was the worst performer, especially the decrease of the elective surgeries. The results illustrate the potential of indicators to monitor crisis effects on hospital care.*

Key words *Indicators, Access, Effectiveness, Statistical control charts, Crisis*

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Introduction

Gross Domestic Product (GDP) had been evolving positively since 2002 in the Brazilian macroeconomic scenario of the 21st century, except for a few quarters of 2009 and 2014 to 2016[1]. The national economy endured a critical period from the second quarter of 2014 to the fourth quarter of 2016 and recorded a significant decrease in GDP, whose peak of stagnation occurred in the fourth quarter of 2015 (-5.52) and the first quarter of 2016 (-5.14)[1]. Up to 2014, favorable economic cycles and social policies were accompanied by social advances, with an impact on child mortality and the use of health services[2-4]. Between 2017 and 2018, however, efforts to reduce inequalities suffered visible setbacks, with deteriorating indicators evidencing a declining social progress in the country[5]. An OXFAM report highlights, for example, stagnation in the Gini index, general retraction of national income and rising unemployment from 6.8% in 2014 to 12.7% in 2017.

This unfavorable economic scenario produced a fiscal and political crisis, and consequently, the emergence of a series of austerity measures[5,6]. Among these, prioritizing the adjustment of public accounts, the Constitutional Amendment (EC) 95/2016 was approved, which limits and freezes public spending for a period of 20 years[6]. The Expenditure Cap PEC has determined that federal expenditures can only increase as per accumulated inflation. Although some distinction has been made for health and education, there is much debate about the undesirable consequences. Estimates indicate that, by 2036, health may lose an amount of 400-700 billion reais, which is a risk to the Unified Health System (SUS)[7] that, besides being historically underfunded, must prospectively face population aging and epidemiological profile that combines chronic, infectious diseases and external causes.

The economic and fiscal crisis has affected everyone within the states. Based on three fiscal indicators - debt, current savings, and liquidity ratios, the National Treasury rates states on their ability to repay when contracting new loans[8]. This composite index assigns concepts as per predetermined criteria, ranging from A to D. Except for Minas Gerais, due to lack of information, in 2018, following this methodology, 13 states obtained A or B payment capacity rating, which is satisfactory. State classification varies, as well as the specific indicators that underpin this index, but the final rating polarizes at the extremes the best performing Espírito Santo (grade A) and the worst performing Rio de Janeiro and Rio Grande do Sul (grade D). The Southeast is the most developed and populous Brazilian geographic region and includes the three states with the highest percentage of national GDP: São Paulo, Rio de Janeiro, and Minas Gerais. However, the only well-ranked state concerning payment capacity was Espírito Santo, whose contribution to national GDP is below the first 10 states. On the one hand, the southeastern states evidence a different picture between each other regarding the crisis scenario; on the other hand, they concentrate a large part of the network of services and consumption of financial resources of the Unified Health System (SUS).

Historically, the SUS has provided Brazilians with essential gains in access to and use of health services[9]. Recognizing the validity of the EC 95 and the many gaps and need for improvement in the SUS, in the context of fiscal crisis, it is reasonable to suppose the deterioration of some known deficiencies, such as regional inequalities, underfunding, and care quality issues. The crisis itself may focus on more significant people illness and higher demand for public health services due to job loss and private health insurance[10,11]. Also, the general environment of economic and social crisis intensifies competition among sectors for financial resources, highlighting projects oriented by the pursuit of equity or increased macro and microeconomic efficiency that postulates, among others, less tax, a more significant role of the private sector and fewer State actions.

In this context, the evaluation of service performance and quality of care is of particular importance. Despite recognized theoretical and conceptual challenges, strategies aimed at monitoring the performance of health services and systems have long been present in the health agenda in several countries[12]. Methodologically robust studies are fundamental to measure the effect of social policies and provide evidence for decision making[2,3]. However, more easily understood and widely disseminated analyses are crucial for policy evaluation, gaining space in the media and on the agenda of managers and society. At present, except frequent media reports, little is known about the impact of the crisis on system and health service performance indicators, particularly on access and effectiveness. It is plausible to suppose that the effect of the crisis, namely, the lack of financial resources, affects the structure of services and, therefore, the availability of technological and human inputs, and con-

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sequently the care process and its results. Thus, this may reflect on the reduced access, effectiveness, and standard of use of services. Therefore, it is urgent to monitor the performance of the SUS, even as a strategy to avoid setbacks in the path taken. Considering this general situation and the importance of monitoring closely to contextual events, this study aimed to explore the application of easily understandable and calculated indicators that could reflect the crisis in the SUS hospital network.

Methods

The study of the development of indicators of access and effectiveness of hospital services provided by the SUS in the face of the Brazilian fiscal crisis assumed that these indicators could vary within a statistical control margin that could be broken with the crisis.

Analyses of non-obstetric hospitalizations of adults (≥ 18 years) were performed – excluding hospitalizations related to a primary diagnosis of Chapter XV, Pregnancy, Childbirth and the Puerperium of the International Classification of Diseases and Related Health Problems (ICD 10) – covered by the SUS in the four states of the Southeast and in Brazil as a whole. Data were obtained from the SUS Hospital Information System (SIH) on the portal of the SUS Department of Informatics (DATASUS), covering the period from January 2009 to December 2018. The observations were grouped by quarters, with the period considered in the study divided into two five-year phases, given the expected capture of effects of the crisis from 2014.

In this work, choices were guided by viability and thrift. The focus on the four states of the Southeast is justified by the relevance of the region from an economic viewpoint, as well as allowing to capture possible change of trend of these indicators between states with different contexts and responses to the crisis. Providing analyses for Brazil as a whole, in turn, provides a more general view of the behavior of indicators in the country and serves as a comparative parameter.

The most general criterion for selecting the indicators was to obtain data from SIH/SUS. The list of indicators monitored by the Health System Performance Assessment Project (PROADESS) [https://www.proadess.icict.fiocruz.br] was also taken into account. More specifically, it was relevant to consider overall in-hospital mortality, defined concerning the proportion of deaths in the set of hospitalizations, as a traditional measure of hospital performance. Also included was the proportion of deaths among surgical hospitalizations, which globally have been responsible for a significant part of adverse events recorded in hospitals[13] and targeted for their reduction. Both indicators are unambiguous measures of care outcome although, as performance indicators, they are susceptible to problems arising from the non-adjustment by the severity of the case and the difficulty in identifying to what extent they are attributable to the quality of care[14]. In the inclusion of access indicators, priority was given to programmed care (non-urgency) and the use of costly inputs (orthoses and prostheses), envisaging that these expenses could be postponed. Thus, we considered the proportion of elective surgeries in the total number of surgical admissions, the rate of hip prostheses in the elderly aged 60 years and over and the angioplasty rate in individuals aged 20 years and over. As explained, we considered that such procedures, due to the characteristics involved, either due to the elective nature or the complexity and costs involved, would be hard to access due to the crisis, varying as per the local scenario. Concerning the proportions, the hospitalizations performed in the states in which they occurred were considered. Regarding hip prosthesis and angioplasty rates, the definition of which took into account PROADESS datasheet [https://www.proadess.icict.fiocruz.br/], we considered hospitalizations in patients' states of residence, referred by 100 thousand inhabitants in the state. The rates obtained are crude, not considering the population covered by health plans in the numerator. The population data, in turn, were sourced from the Brazilian Institute of Geography and Statistics (IBGE) and also obtained from the DATASUS portal.

From the perspective of using a technique that allowed the visualization of the behavior of the indicators over time, and the detection of future changes in this behavior as a reflection of the fiscal crisis, the choice of statistical control charts was applied[15-17].

Statistical control charts were initially applied in the industry and have been widely used more recently to monitor process indicators and endpoints of interventions in health services and systems. They presuppose the idea of statistical control over the trend of indicators over time, which can be broken by either a positive or negative event. They show the indicator trend curve at different points in time, a line indicating the

mean value of the indicator and the statistical control "zone" conventionally bounded by three standard deviations above and below the mean value, similar to the confidence intervals. A temporary change in the current equilibrium pattern can be configured, as well as a change in the level and variability of the indicator, depending on the event/intervention. The advantage of the technique is its simplicity and ability to allow visualization of the trend of indicators, capturing changes resulting from undesirable events or improvement interventions.

The analyses used the "proc shewhart" procedure of the Statistical Analysis System (SAS®) statistical package. Specifically, the 'pchart' command was used for the proportions, accounting for the binomial distribution, and the 'uchart' command for the population-denominated rates, for the Poisson distribution.

Results

The results showed in charts show the behavior of the five indicators in two periods, from 2009 to 2013 and 2014 to 2018, in Brazil and the four states of the Southeast.

Concerning effectiveness indicators (hospital and surgical deaths), there was a slight growth trend in the proportion of hospital deaths in the total of hospitalizations over 18 years, between the periods considered, in Brazil and the states. In Rio de Janeiro, growth was much steeper, from a mean of 8.8% in the first period to 10.5% in the second period (Figure 1).

The proportion of surgical deaths in the total number of surgical hospitalizations recorded a slight decline in Brazil and all states, except in the state of Rio de Janeiro, which grew between the two periods, from a mean of 2.6% to 3.1% (Figure 2).

Regarding the access indicators, considering the proportion of elective surgeries in the total of hospitalizations of people older than 18 years, a slight downward trend was recorded in Brazil, Espírito Santo, and Minas Gerais. In Rio de Janeiro, the decrease was much steeper, with a mean of around 57.4% in the first period and 49.5% in the second period. In contrast, the state of São Paulo shows a small growth in the proportion of elective surgeries, from a mean of 52.6% to 54.4% (Figure 3).

The rate of hip prosthesis in the population aged 60 years and over showed a slight downward trend in Brazil. The mean was 17.6 prostheses per 100,000 inhabitants aged 60 and over in the first period, while it decreased to about 16.9/100,000 in the second. A declining trend was also observed in Minas Gerais, from a mean of 21.6 to 21.3 per 100,000 inhabitants aged 60 and over, and in São Paulo, from about 20.3/100,000 to 17.5/100,000 inhabitants aged 60 years and over. The states of Espírito Santo (mean of 14.4 to 15.6/100,000 inhabitants aged 60 years and over) and Rio de Janeiro (mean of 12.9 to 16.3/100,000 inhabitants aged 60 years and over) recorded and an increased rate between the periods, in contrast to the other results mentioned (Figure 4).

The rate of angioplasty performed in the population aged 20 years and over evidenced a continuous growth in both periods in Brazil and all states. Noteworthy is the trend of the state of Espírito Santo, which evolved from a mean of 16.4 procedures per 100,000 inhabitants aged 20 years and over in the first period to 19.3 procedures per 100,000 inhabitants aged 20 years and over in the second period. The lowest growth between the two periods was recorded in Rio de Janeiro, from a mean of 9.2 to 10.1/100,000 inhabitants aged 20 years and over (Figure 5).

Discussion

This study aimed to explore the application of the selected indicators as possible markers of changes in the performance of the SUS hospital network as a result of the financial crisis in the country, especially from 2014 onwards. The identification of possible competing causes for changes in the trend of indicators was not the purpose of this work.

It is also noteworthy that a single factor does not explain the performance of the hospital network. Multiple causes contribute to changes in the behavior of its indicators. Thus, with its exploratory perspective, this paper does not make cause and effect associations between changes in indicators and the economic crisis that the country has faced and still faces. It only signals the need for further investigation, including the identification of its causes.

Statistical control charts[15-17], commonly used for monitoring changes in processes and endpoints, and in health, more particularly in monitoring the implementation of care quality initiatives, also seem to work to signal changes in the pattern of hospital network performance indicators. In considering the indicators measured concerning population rates, however, the

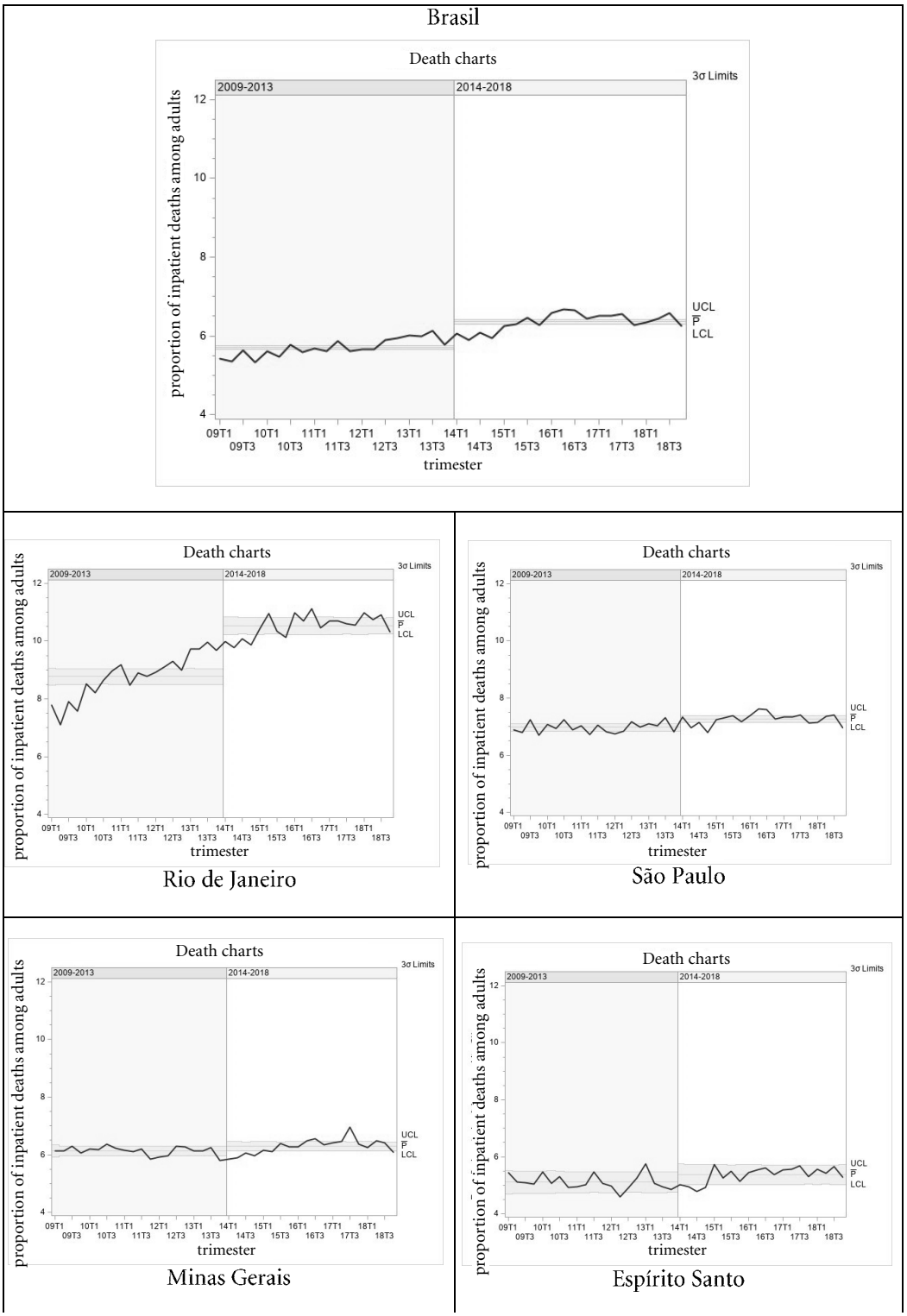

Figure 1. Statistical control charts for inpatient mortality (%) in hospitalizations of adults covered by the SUS per trimester. Brazil and Southeastern States, 2009-2018.

Fonte: Ministério da Saúde - Sistema de Informações Hospitalares do SUS (SIH/SUS).

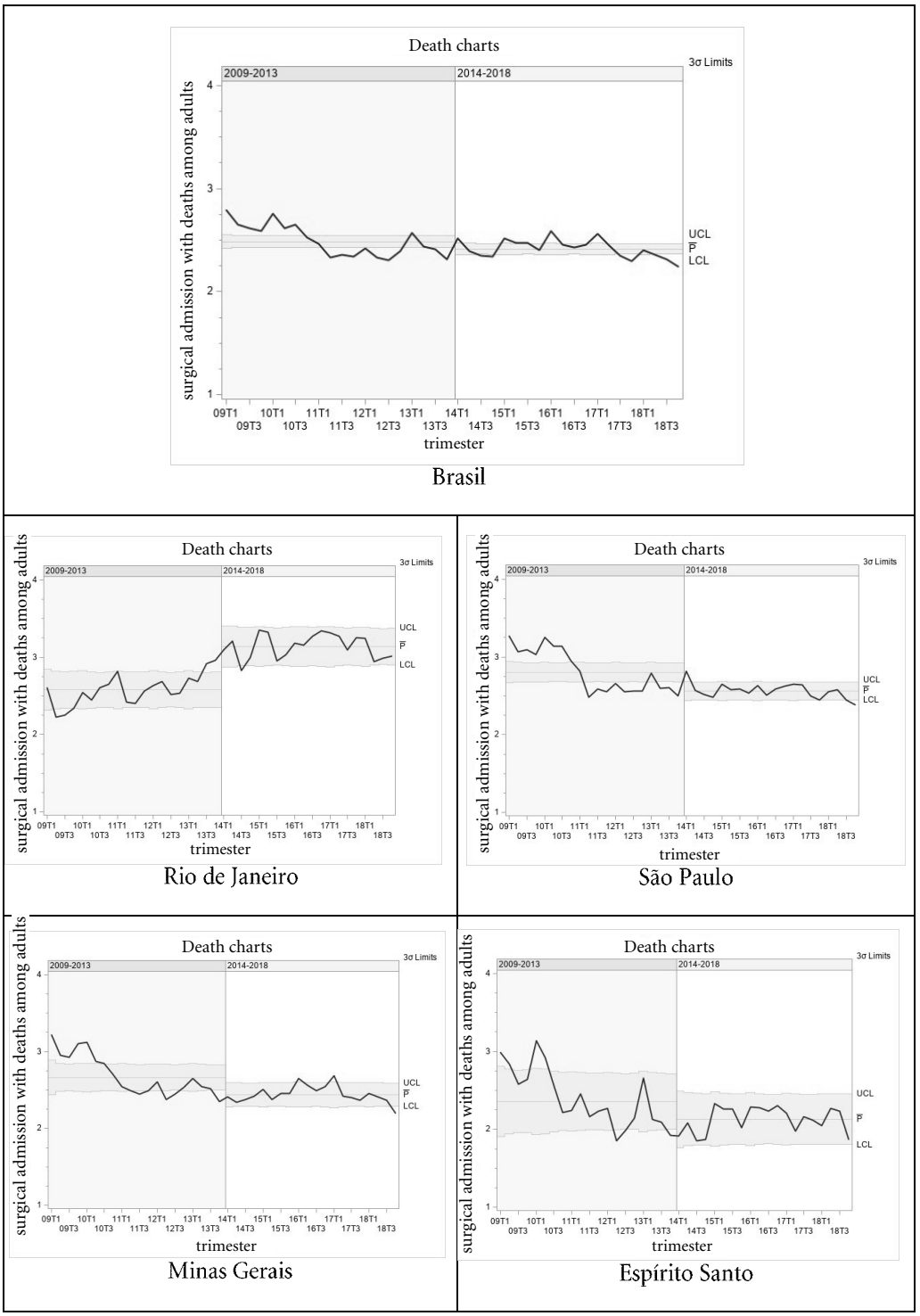

Figure 2. Statistical control charts for inpatient mortality (%) in surgical admissions of adults covered by the SUS per trimester. Brazil and Southeastern States, 2009-2018.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS).

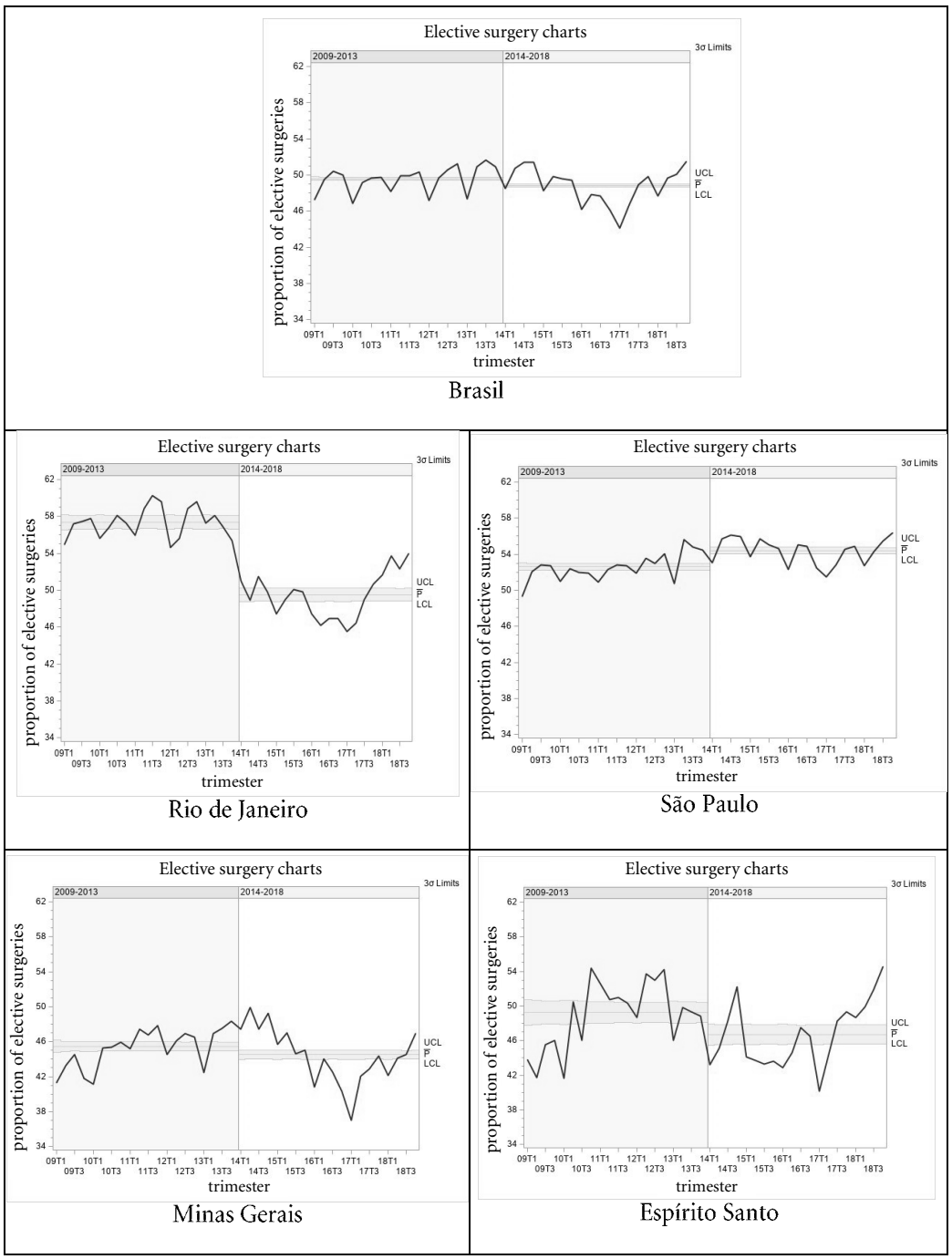

Figure 3. Statistical control charts for elective surgery (%) in surgical admissions of adults covered by the SUS per trimester. Brazil and Southeastern States, 2009-2018.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS).

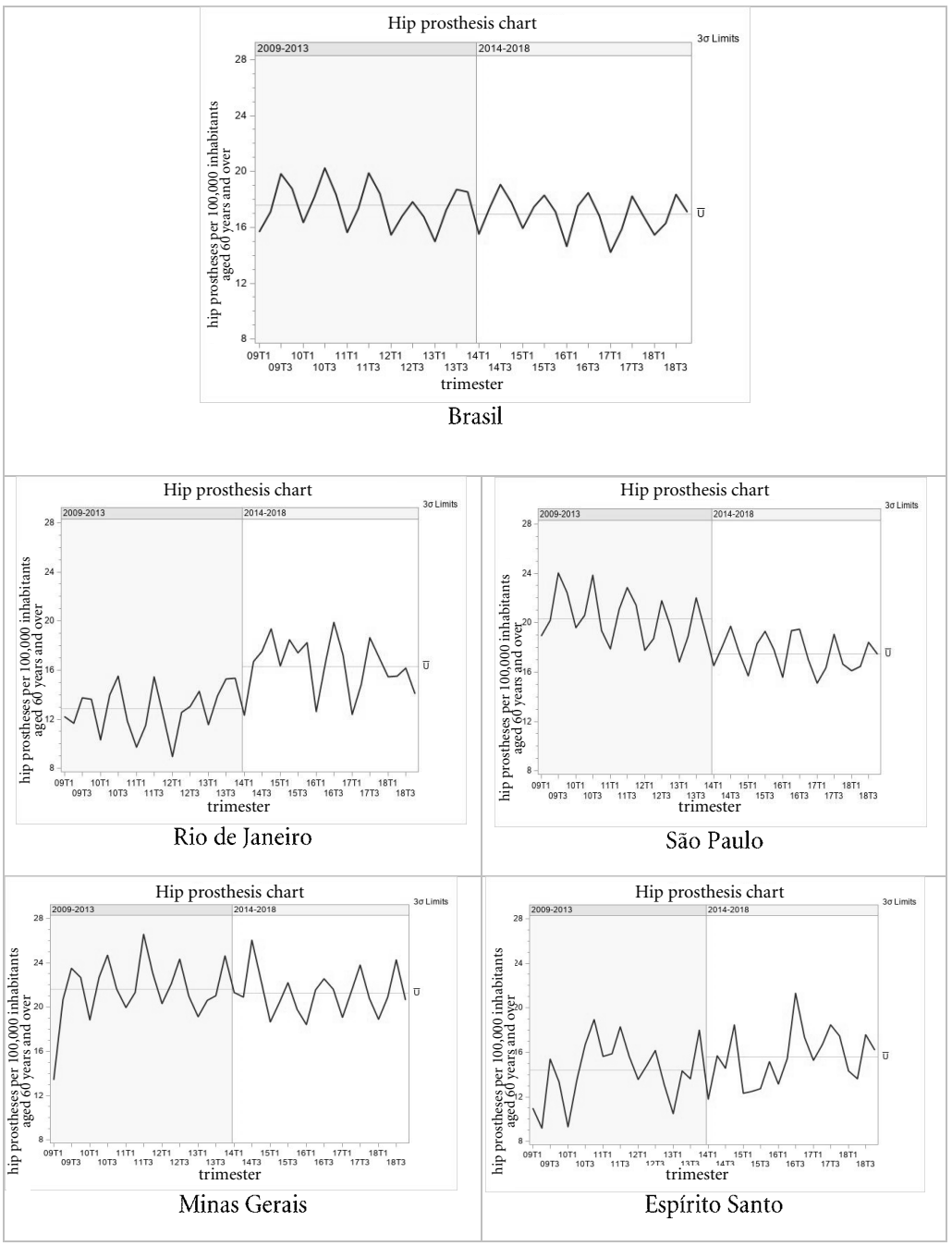

Figure 4. Statistical control charts for SUS-covered hip prosthesis surgery rates per 100,000 inhabitants aged 60 years and over per trimester. Brazil and Southeastern States, 2009-2018.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS).

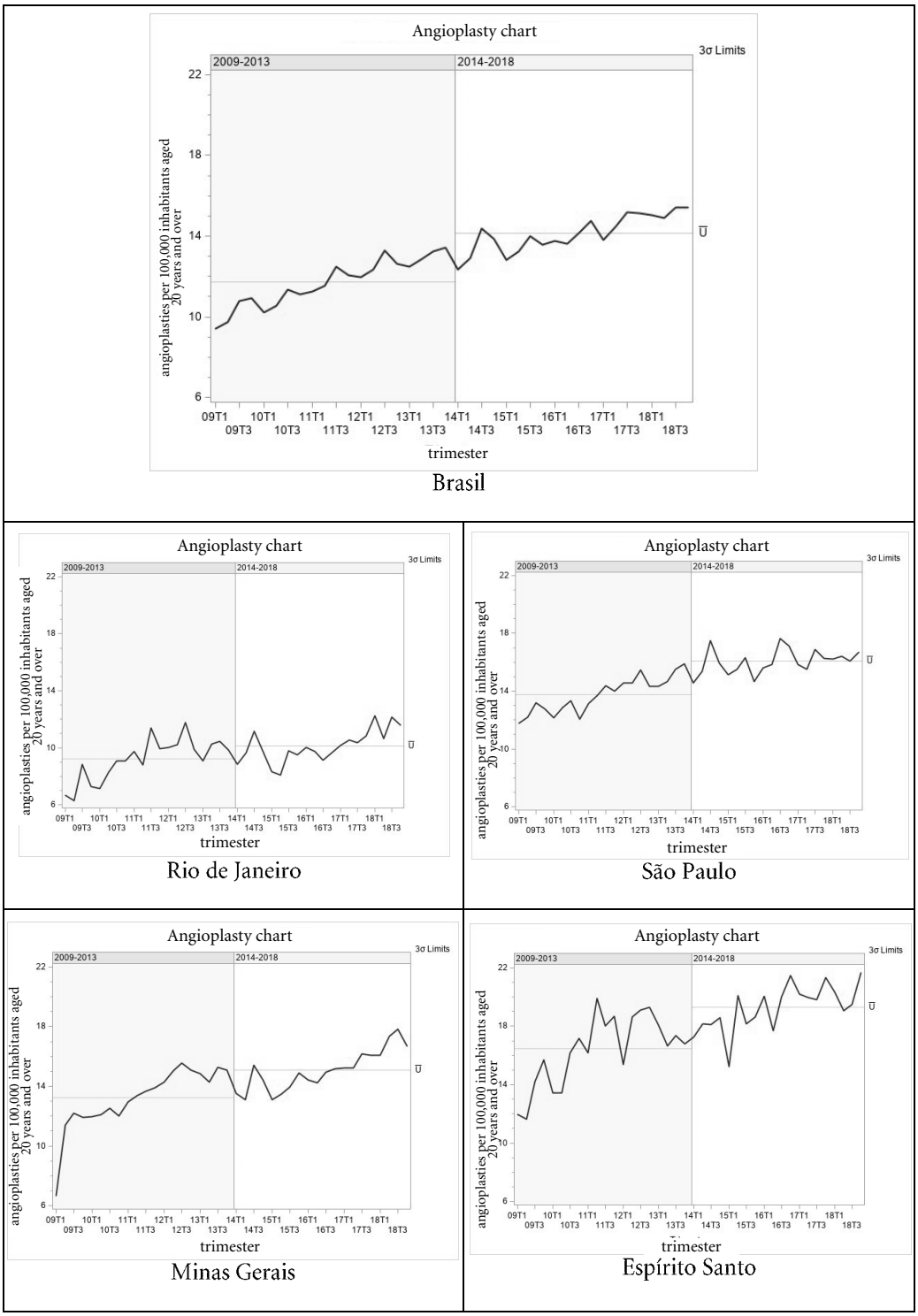

Figure 5. Statistical control charts for the rates of angioplasty covered by the SUS per 100,000 inhabitants aged 20 years and over per trimester. Brazil and Southeastern States, 2009-2018.

Source: Ministry of Health – SUS Hospital Information System (SIH/SUS).

high denominators end up sharply reducing the statistical control zone, leaving out, in practice, the delineation of the mean rate trend over time. This implies a limitation but still allows the description of the indicator's development and visualization of growth or falling trends.

It is noteworthy that only the hospital sector that provides services to the SUS was considered in this analysis. However, it is worth mentioning the use of indicators built from databases of public and unrestricted access, which allows wide dissemination.

In general, the indicators selected to monitor access (angioplasty, hip prosthesis, and elective surgeries) and effectiveness (general and surgical deaths) in the SUS hospital network were analyzed to detect changes in the network performance of the, and the underlying causes would be subjected to further investigation. It was expected that, in a financial crisis with possible resource constraints for the care network, these indicators would show negative variation, especially from 2014, implying a decreased access with falling indicators and deteriorated results, with an increased number of deaths.

Analyzing the variability presented by the indicators, it can be observed that hospital and surgical death proportions remained predominantly within the expected variability ranges, as delimited by the minimum and maximum limits of the statistical control zone obtained for the patients in the two periods studied. However, a significant increase was recorded in the level of hospital and surgical deaths in the state of Rio de Janeiro, between the two periods. The indicator of elective surgery showed more significant variability in Brazil and all states, and the state of Rio de Janeiro showed the most substantial decrease in the mean proportion of elective surgery between the two periods considered. In the case of access indicators, the absence of the statistical control zone compromised the definition of expected variability patterns, but the high variability when performing hip prosthesis surgeries is especially noticeable.

The state of Rio de Janeiro showed the worst indicators, except for hip prosthesis performance rate, which grew between the two periods studied. In summary, contributing elements to this adverse scenario were the angioplasty rate, which had the lowest growth, the proportion of elective surgeries, with the most significant fall, and higher levels of surgical and hospital deaths, and Rio de Janeiro was the only state with an increase in the considered periods. This picture is compatible with the severe fiscal crisis in Rio de Janeiro, compared to other states in the Southeast. It is worth noting that Rio de Janeiro was one of the two states in the federation with the worst payment capacity rating as per the National Treasury classification. Also, late effects may occur over the longer term.

Despite slightly different levels, the variation patterns observed in the five indicators for the states of Espírito Santo, Minas Gerais, and São Paulo are relatively similar. Some difference was observed in the use of hip prosthesis, which showed a slightly growing trend in Espírito Santo, and decline in Minas Gerais and São Paulo.

Of the compared states, only São Paulo recorded a higher proportion of elective surgeries. It is worth pointing out that the downward trend in surgical hospitalizations' mortality in the three states may express the nationwide spread of global campaigns aimed at reducing adverse events associated with surgical procedures[18].

Of the indicators analyzed, two were not sensitive to the crisis in the analyzed period, namely, hip prosthesis and angioplasty rates. The upward trend in the hip prosthesis rate in Rio de Janeiro performed differently from the others of the same state and caused a stir because it is high-cost care. Because it receives different funds, located in Rio de Janeiro and national reference in the specialty, the National Institute of Traumatology and Orthopedics may have implemented actions that have delayed the effect of the expressed crisis measured in this indicator. Given what has been observed, the need for further investigation of the critical elements and the inquiry as to the validity of this indicator remains. Thus, continued monitoring would be necessary for longer-term trend capture.

The growing rate of angioplasty in all states may have been influenced by the technological incorporation of this procedure to replace revascularizations. Angioplasty is a procedure that can be performed electively or in emergencies in hospitals. This may partly explain the increasing trend as well. The assumption that the procedure considered would be sensitive to the effect of the crisis on the SUS was not verified; however, its observation for a longer time would be required for monitoring the observed trend.

The central limit of the approach employed is the restricted number of indicators explored and, thus, other indicators deserve to be tested, aiming at proposing a monitoring panel, besides incorporating other geographical areas. In summary, the indicators of overall hospital mortality and

the proportion of elective surgeries were more sensitive to the expression of the crisis in the SUS. Despite the exploratory nature of the study and its inherent limits, the snapshot on the performance of the SUS hospital network allowed, on the one hand, to measure the usefulness of this type of approach for continuous monitoring. Although specific values of the indicators matter and require contextualized critical readings, the analyses shown here focused on capturing their variation patterns over time. On the other hand, they allowed us to glimpse the perverse effects that the fiscal crisis can bring to access, effectiveness, and equity.

Cost cuts and resource scarcity are expected in the austerity setting of the measures debated. As with the effects observed in European countries in the 2008 crisis, barriers to access and compromised quality of health care, which will consequently increase social inequality, health and the use of health services[10,11,19] are a matter of concern. If the experience of European countries whose measures taken to address the crisis have caused declining social well-being – unemployment, labor market insecurity, impoverished population, and exclusion and social inequalities[10], solutions focused on reducing Brazilian public spending on health may result in even more adverse effects on access to care and health of the population. They can also promote a profound reshaping of the private sector's role in several health activities[20].

Anchored in concerns about equity and access to health, especially in contexts of economic, fiscal, and social crisis, initiatives that allow foreseeing the impact of the crisis on the use of health care are essential. However, no summary measure will provide a good indicator of the country's health system performance[21]. However, decision-making on health policy implementation and outcomes guided by an indicator panel informing about socioeconomic conditions, health determinants, inequalities in resource allocation, access and use of health services can signal the positive or negative direction of changes reflected in performance indicators[22]. In this perspective, the strengthening of monitoring and alert initiatives and systems, such as PROADESS (https://www.proadess.icict.fiocruz.br/), are relevant, but reliant on quality and timely information, as well as sensitive indicators.

Despite the publications in the scientific literature, there are gaps and some controversy regarding the effect of the economic crisis on health outcomes[23]. In the national context, some papers draw our attention to the risks to the SUS, expanded role of the private sector, and manifestations advocating for health entities and collective health[9,20,24-26]. However, there is a lack of studies that prospectively evaluate where, as well as the direction of the possible impacts of financial cuts and fiscal austerity measures within the SUS. This situation calls for action in several directions, as crises remedied by austerity measures affect the poor more and, in the absence of protective social policies, increase inequalities in all walks of life[11], requiring mobilization and in-depth debate regarding the values and interests at stake.

Collaborations

M Martins, SML Lima, CLT Andrade and MC Portela contributed to the concept and design, data analysis and interpretation, drafting the paper and its critical review, and approval of the final version of the manuscript.

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