saúde EM DEBATE

ARTIGO ORIGINAL

Efficiency of health expenditures in the SUS: An inter-federative analysis based on outcome indicators (2019-2024)

Eficiência dos gastos em saúde no SUS: uma análise interfederativa com base em indicadores de resultado (2019-2024)

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ABSTRACT This study assesses the efficiency of public health expenditures across Brazilian federative units between 2019 and 2024, using publicly available secondary data. Financing indicators, Unified Health System (SUS) infrastructure, and health outcomes were analyzed, with particular emphasis on the rate of hospitalizations due to primary care-sensitive conditions (HPCSC). Monetary values were adjusted to 2024 BRL and per capita indicators were derived. Relative efficiency was estimated through the residuals of linear models of HPCSC rates as a function of selected inputs (per capita expenditure, hospital beds, and health professionals per inhabitant). Due to possible underreporting of HPCSC in 2019, inferential analyses focused on the 2020–2024 period. Results reveal structural disparities across states and real growth in expenditure, with heterogeneous performance in outcome indicators. Minas Gerais and the Federal District showed better adjusted performance, while states in the North region demonstrated lower relative efficiency. It is concluded that adjusted efficiency assessment is a useful tool for guiding equitable resource allocation and supporting evidence-informed decisions within the SUS.

KEYWORDS Health financing. Unified Health System. Efficiency. Health indicators. Policy evaluation.

RESUMO *Este estudo avalia a eficiência dos gastos públicos em saúde nas unidades federativas brasileiras entre 2019 e 2024, com base em dados secundários públicos e abertos. Foram analisados indicadores de financiamento, estrutura do Sistema Único de Saúde (SUS) e resultados em saúde, com destaque para a taxa de Internações por Condições Sensíveis à Atenção Primária (Icsap). Os dados monetários foram deflacionados para reais de 2024 e calculados indicadores derivados por habitante. A eficiência relativa foi estimada pelo resíduo de modelos lineares da taxa de Icsap em função de insumos selecionados (gasto per capita, leitos e profissionais por habitante). Devido ao possível sub-registro das Icsap em 2019, as análises inferenciais concentraram-se no período de 2020 a 2024. Os resultados revelam desigualdades estruturais entre estados e crescimento real do gasto, com desempenho heterogêneo nos indicadores de resultado. Minas Gerais e Distrito Federal apresentaram melhor desempenho ajustado, enquanto estados da região Norte demonstraram menor eficiência relativa. Conclui-se que a avaliação da eficiência ajustada é um instrumento útil para orientar a alocação equitativa de recursos e subsidiar decisões informadas no âmbito do SUS.*

PALAVRAS-CHAVE *Financiamento da saúde. Sistema Único de Saúde. Eficiência. Indicadores de saúde. Avaliação de políticas.*

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Introduction

The Unified Health System (SUS) was established by the 1988 Federal Constitution[1] and regulated by Law Nº 8.080/1990[2], establishing health as a right of all and a duty of the State, guaranteed through social and economic policies aimed at reducing the risk of disease and ensuring universal and equitable access to health actions and services.

Despite representing a milestone in the consolidation of social rights in Brazil, the SUS faces chronic underfunding, which has been aggravated by fiscal restrictions imposed by instruments such as Constitutional Amendment Nº 95/2016[3], which established a maximum cap for public spending. This limitation directly affects the expansion and improvement of health services, compromising the system's capacity to respond to the population's growing demands[4,5].

In this context, assessing the efficiency of public health spending becomes essential. Efficiency is understood as the capacity to produce the best possible outcomes with the available resources, optimizing allocation and ensuring quality and equity in care. Reports by the Institute for Applied Economic Research[6], the Pan American Health Organization[7], and the Federal Court of Accounts[8] emphasize that improving efficiency can have significant effects on system coverage and resolvability, even under budgetary constraints.

Recent academic studies using methods such as Data Envelopment Analysis (DEA) and cluster-based analyses have identified heterogeneity across Brazilian states in the efficiency with which SUS resources are applied, linking better performance to a balanced combination of infrastructure, qualified workforce, and evidence-based management[9,10].

In the SUS context, analyses of public-spending efficiency should not be understood as instruments for reducing investment, but rather as tools to support auditing, monitoring, and the qualification of interfederative management. Comparative indicators enable the identification of relevant heterogeneities, accountability processes, and regional planning needs, especially in decentralized systems. They also provide technical input for SUS internal auditing in assessing performance and the use of public resources.

Based on this framework, this study's central hypothesis is that differences in public-spending efficiency across states are not explained solely by the volume of resources applied, but also by structural inequalities, variations in management, and interfederative characteristics, with Hospitalizations due to Primary Care-Sensitive Conditions (HPCSC) serving as an indicator capable of preliminarily reflecting these differences in primary care performance. This formulation guides the analysis of the results, enabling the interpretation of rankings and observed patterns in light of management and regional context.

This study seeks to evaluate the efficiency of health spending in the SUS across Brazilian states, using national and regional open data. To this end, three main dimensions were analyzed: SUS spending and financing; demographic and health outcome indicators; and physical infrastructure and resources available in the system. This approach made it possible to relate invested resources and structural availability to health outcomes, providing evidence to support decisions that promote greater equity, quality, and effectiveness in public management.

Material and methods

This ecological, exploratory study is based on public and open secondary data, covering the 27 Brazilian Federative Units (UFs). The analysis period comprised 2019 to 2024, corresponding to the interval with complete, consolidated, and comparable data in the main databases used. Although preliminary records for 2025 are available in some systems, they were not incorporated into the inferential analyses or the main comparisons because

of consolidation lags and heterogeneous coverage. This study analyzed the relative efficiency of health spending within the SUS, the relationship between resources applied and outcomes achieved in selected indicators, and the contribution of this approach to the debate on quality, equity, and efficient resource use in public health policies.

Data sources

The database was organized into three groups according to the nature of the variables analyzed:

Group 1. Financing and socioeconomic indicators: included total health spending, federal transfers, population, mean income, Gini index, and mean schooling.

Sources:

- Public Health Budget Information System (SIOPS)[11];
- Federal government Transparency Portal[12];
- Brazilian Institute of Geography and Statistics (IBGE)/IBGE Automatic Recovery System (SIDRA)[13];
- Atlas Brasil[14].

Group 2. Health outcome indicators: included infant mortality, HPCSC, life expectancy at birth, and vaccination coverage.

Sources:

- Department of Information and Informatics of the SUS (DATASUS)/Health Tabulations (TabNet)[15];
- SUS Hospital Information System (SIH/SUS)[16];
- Ministry of Health monitoring panels[17];
- IBGE – Life table and vital statistics[13].

Group 3. SUS structure and resources: considered the number of health facilities, SUS beds, health professionals, and main equipment.

Sources:

- National Registry of Health Establishments (CNES)[18];
- Ministry of Health panels and historical series[17].

Data processing

The data were standardized by UF and year, using the following procedures:

- Inconsistent zero values were treated as missing data (NA);
- HPCSC counts were converted into rates per 10,000 inhabitants based on IBGE population estimates[13];
- Monetary values were deflated to 2024 Brazilian reais, using the official annual cumulative Extended National Consumer Price Index (IPCA) released by IBGE[19];
- Derived per capita indicators were constructed: beds per 10,000 inhabitants, health professionals per 1,000 inhabitants, and facilities per 100,000 inhabitants;
- A possible break in the series for the HPCSC indicator in 2019 was identified. It was retained in the main database with quality flagging and was subsequently explored in sensitivity analyses.

Analytical strategy

The empirical analysis involved three complementary stages:

1. Descriptive analysis, with the calculation of medians and interquartile ranges by year

and UF. The median was chosen for time-series analyses because it is more robust to extreme values, whereas the mean was used in aggregate comparisons across UFs to summarize the mean behavior over the analyzed period.

2. Graphical analysis, including visualizations of temporal trends, scatterplots, and comparisons across UFs, focusing on the relationship between financial and structural inputs and health outcome indicators.

3. Exploratory modeling, through the annual fitting of a linear model in which the HPCSC rate was specified as a function of per capita health spending, availability of SUS beds, and the number of health professionals: $HPCSC_it = \beta0 + \beta1 \times Spending_pc_it + \beta2 \times SUS_beds_it + \beta3 \times Professionals_it + \varepsilon_it$

The regression residual was used as an exploratory *proxy* for relative efficiency, such that more negative values indicate performance better than expected, given the level of observed inputs. It should be noted that this is not a normative measure of technical efficiency, such as those derived from frontier models, including DEA or Stochastic Frontier Analysis (SFA). This approach was adopted as a descriptive and exploratory strategy to identify relative patterns across UFs, without the intention of estimating optimal frontiers of health production.

Sensitivity analysis

Sensitivity analyses were conducted to assess the robustness of the main findings. The associations between health spending and HPCSC were estimated again, excluding 2019, because of possible underreporting and a break in the series, while the sign and magnitude of the estimated coefficients were maintained. In addition, the time series were evaluated using alternative statistics, including a 5% trimmed mean, with no substantive changes in the observed trends. All analyses were performed in Python, using its statistical and visualization libraries[20].

Ethical considerations

The study used exclusively secondary, public, and anonymized data available from official federal government and SUS portals. Therefore, it does not qualify as human research under Resolution Nº 510/2016 of the National Health Council[21], and review by a Research Ethics Committee was not required.

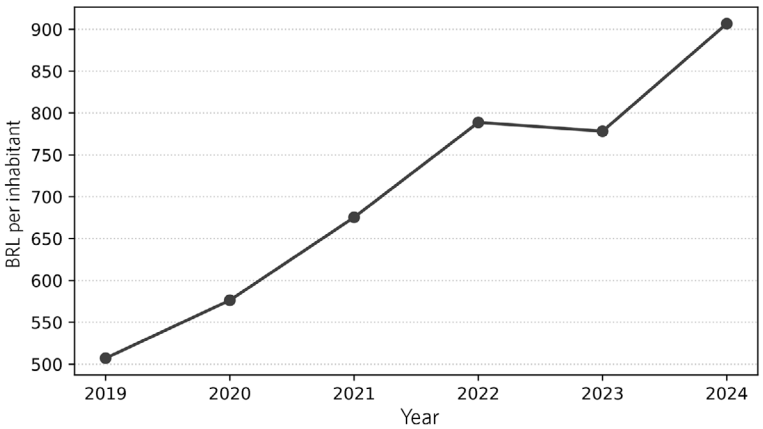
Results

The integrated database included the 27 Brazilian UFs, with coverage of the main variables between 2019 and 2024. After the standardization of identifiers, treatment of zero values as missing, calculation of derived indicators, and deflation of monetary values to 2024 BRL, a heterogeneous panorama was observed across UFs and over time. The results are presented below in three axes: financing, SUS structure, and health outcomes.

Funding

Per capita health spending (in 2024 BRL) showed an upward trend in 2019-2024, with the national median increasing from BRL 677 to BRL 815.8. We also observed an increase in dispersion across states, with greater expansion in the upper values. The states of Amapá (AP), Paraíba (PB), and Sergipe (SE) showed the largest cumulative percentage increases in per capita spending, exceeding 80% over the period (*graph 1*).

Graph 1. Median per capita health expenditure (BRL 2024) among the Brazilian states, 2019-2024



Source: Prepared by the authors based on data from SIOPS[11], IBGE[13], and the Ministry of Health[17].

Note: Median per capita health expenditure (BRL 2024) among the Brazilian states, 2019-2024.

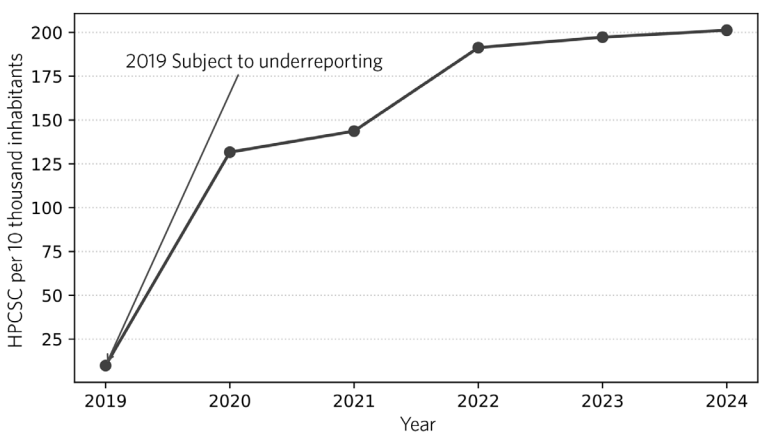
SUS structure

From 2019 to 2024, the number of health professionals per 1,000 inhabitants increased moderately, with the national median rising from 5.2 to 6.8. The indicator of SUS beds per 10,000 inhabitants remained relatively stable (2023 median: 16.5), with regional variation. States in the North showed values persistently below the national median for both indicators.

Health outcomes

HPCSC, converted into rates per 10,000 inhabitants, indicated possible underreporting in 2019 (median: 9.9), shifting to more consistent levels from 2020 onward. From 2020 to 2024, the median rate increased from 131.7 to 197.3, with substantial interstate variation (*graph 2*).

Graph 2. Median HPCSC rate (per 10,000 inhabitants) among the Brazilian states, 2019-2024

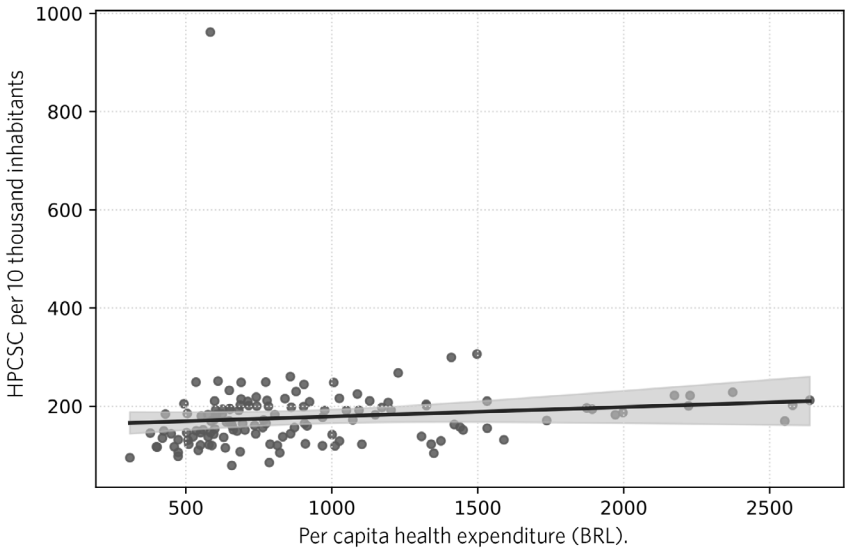


Source: Prepared by the authors based on data from SIH/SUS[16], IBGE[13], and the Ministry of Health.

Note: Median HPCSC rate (per 10,000 inhabitants) among the Brazilian states, 2019-2024

The dispersion between per capita spending and HPCSC showed a weak negative association, with broad heterogeneity across UFs (*graph 3*).

Graph 3. Dispersion between per capita expenditure (BRL 2024) and HPCSC rate by state-year (2020-2024)

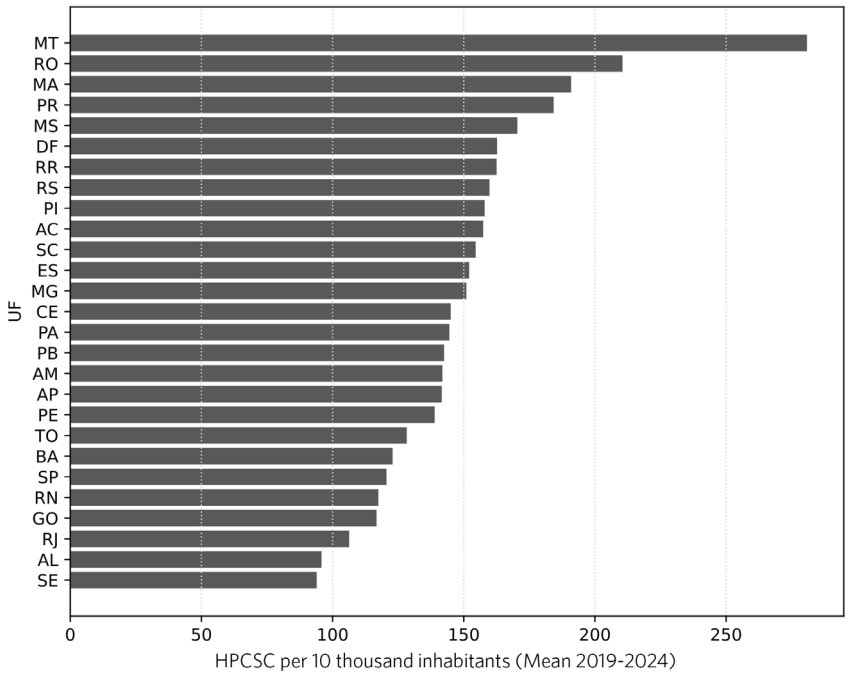


Source: Prepared by the authors based on data from SIH/SUS[16], SIOPS[11], and IBGE[13].

Note: Dispersion between per capita expenditure (BRL 2024) and HPCSC rate by state-year (2020-2024), with regression and 95% CI.

Graph 4 shows the mean HPCSC rate by UF for the 2019-2024 period, highlighting regional heterogeneity.

Graph 4. Mean HPCSC rate (per 10,000 inhabitants), 2019-2024, by State



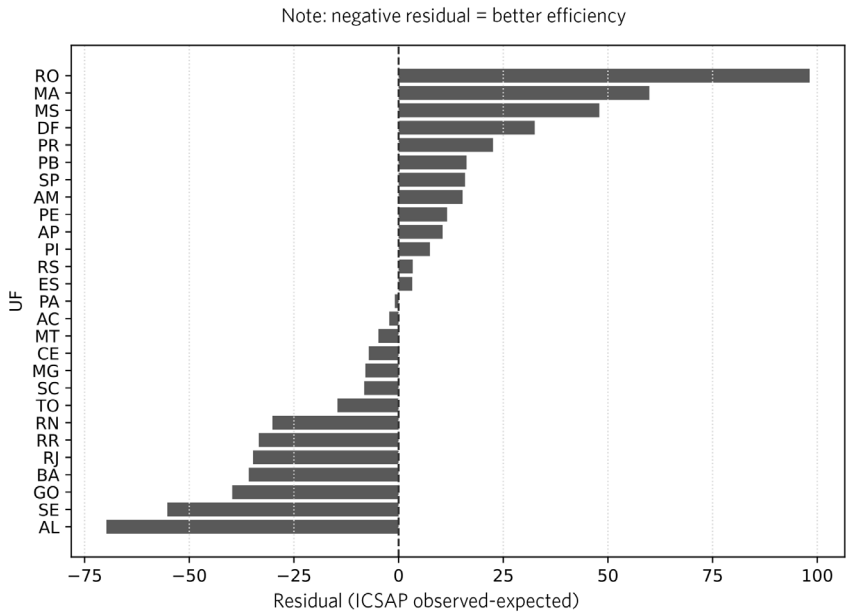
Source: Prepared by the authors based on data from SIH/SUS[16] and IBGE[13].

Note: Mean HPCSC rate (per 10,000 inhabitants), 2019-2024, by State.

Relative efficiency

Based on 2024 data, the HPCSC rate was analyzed using a linear model that considered per capita spending, availability of SUS beds, and the number of health professionals. This model's residuals identify variations in the relative efficiency of UFs, although it should be noted that these results do not establish a direct causal link between spending volume and observed performance. From this perspective, the residual acts as an input-adjusted performance indicator: Minas Gerais (MG), São Paulo (SP), and the Federal District (DF) stood out positively, with the lowest residuals in the sample. By contrast, Roraima (RR), Amazonas (AM), and Acre (AC) had the largest positive deviations, indicating higher hospitalization rates than those predicted by the available resource structure (*graph 5*).

Graph 5. Relative efficiency ranking (residual of the HPCSC model ~ inputs), 2024



Source: Prepared by the authors with data from SIH/SUS[16], SIOPS[11], and IBGE[13].

Note: Relative efficiency ranking (residual of the HPCSC model ~ inputs), 2024.

Discussion

The results reveal persistent regional heterogeneity in resource allocation, SUS structure, and performance in health indicators. Although per capita spending increased in real terms between 2019 and 2024, this growth did not translate uniformly into better outcomes, highlighting the importance of evaluating not only the volume of investment, but also its effectiveness and efficient management[22].

The HPCSC rate used in this study as a proxy for PHC effectiveness increased progressively from 2020 onward, possibly reflecting system overload, changes in demand patterns, and difficulties in timely access to care, especially in regions with lower structural capacity[23]. However, HPCSC has recognized limitations and is sensitive to hospital supply, the regional epidemiological profile, and possible inconsistencies in recording systems, particularly in the initial years of the historical series. Therefore, the results should be interpreted with caution, as analytical approximations of system performance rather than as direct or exhaustive measures of primary care effectiveness[24].

The residual-based relative efficiency analysis indicated that states such as Minas Gerais and the Federal District, despite average spending levels, showed better input-adjusted performance, suggesting greater effectiveness in management. By contrast, UFs such as Amazonas and Roraima, despite relatively higher per capita investments, did not show better performance, corroborating studies that point to the relevance of factors such as local organization, care coordination, and epidemiological profile[25,26].

In this sense, the findings should be interpreted as exploratory inputs for auditing, monitoring, and planning processes within the SUS, aligned with the Collective Health literature, which emphasizes the importance of contextualized evaluative approaches

oriented toward improving public management and defending the universal nature of the health system[27]. Comparative indicators of adjusted performance can support internal oversight bodies, government auditing, and regional planning in identifying heterogeneities and structural weaknesses across UFs, contributing to transparency and accountability among federative levels[28,29]. Nevertheless, these indicators require methodological caution and institutional contextualization to avoid normative or punitive interpretations that may reinforce preexisting inequalities in the system.

Conclusions

The integrated analysis of financing, structure, and health outcomes in the SUS from 2019 to 2024 revealed significant regional disparities and challenges in the efficient allocation of public resources. Although real growth was observed in per capita spending in most UFs, outcome indicators, especially the HPCSC rate, did not follow this increase proportionally or homogeneously. This finding suggests that organizational, contextual, and management-related factors play a relevant role in producing the observed results.

The assessment of input-adjusted relative efficiency through linear models and residuals made it possible to identify UFs with performance better than expected, such as Minas Gerais and the Federal District, even with intermediate spending levels. This finding reinforces the premise that efficiency does not depend exclusively on the volume of investment, but also on service organization, care coordination, and institutional capacity for health management.

Moreover, the states with the poorest performance in terms of relative efficiency largely coincide with those facing greater structural challenges, such as a lower density of professionals and limited infrastructure, which highlights persistent historical inequities in the system.

The methodology adopted, based on public and open secondary data, shows its potential to be linked to SUS internal auditing activities by providing comparative evidence on the relative performance of UFs adjusted for structural inputs. The exploratory indicators adopted here should not be interpreted as normative or punitive instruments, but as auxiliary tools for analytical screening, in order to guide more in-depth qualitative investigations. By employing public, standardized, and replicable data, the study favors integration between academic evaluation and institutional control practices, contributing to internal auditing that is more preventive, strategic, and oriented toward the continuous improvement of management, equity, and service quality within the SUS.

The results reinforce that higher levels of health spending do not automatically translate into better outcomes, highlighting the importance of analyses that consider the relative efficiency of resource use. This approach identifies persistent heterogeneities and patterns of deviation between available resources and observed results, supporting the prioritization of audit targets through a risk-based approach, especially in contexts marked by structural inequalities or atypical performance in outcome indicators. These findings should be interpreted as exploratory support for SUS management and improvement, offering an empirical basis for reflections on interfederative coordination within the SUS, as well as for identifying regional patterns and asymmetries that can be further explored in technical cooperation processes, regional planning, and the exchange of experiences among federative entities with different relative performances.

Authorship contributions

Pallaoro YLR (0000-0002-3733-5707)* contributed to the conception and idealization of the study, definition of the methodological design, analytical planning, organization and

distribution of tasks among the authors, data collection, processing and statistical analysis, interpretation of results, drafting of the initial version of the manuscript, critical review of the intellectual content and final approval of the submitted version. Gasparetto CE (0009-0007-9055-593X)* contributed to data collection and systematization, interpretation of results and preparation of the conclusion. Mass Júnior VD (0009-0005-8262-5956)* contributed to data collection and systematization, interpretation of results and preparation of the conclusion. Azevedo PF (0009-0002-3989-8869)* contributed to data collection and systematization, interpretation of results and preparation of the discussion. Campos TR (0000-0002-3814-1947)* contributed to the organization, structuring, and consolidation of the database and critical review of the manuscript. Zell R (0009-0008-6748-0957)* contributed to the collection and systematization of data, interpretation of results, and preparation of the introduction. Rossi LR (0009-0000-7701-4580)* contributed to the methodology, data sources, and discussion. ■

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