

## Regional inequalities and low physician retention in Brazil: Evidence from 15 years of cohort analysis

*Desigualdades regionais e baixa retenção de médicos no Brasil: evidências de 15 anos de análise por coorte*

Daniel do Prado Pagotto<sup>1</sup>, Wanderson Marques<sup>2</sup>, Érika Carvalho de Aquino<sup>3</sup>, Rafael Alves Guimarães<sup>4</sup>, Cândido Vieira Borges Júnior<sup>1</sup>, Antônio Isidro da Silva Filho<sup>1</sup>

DOI: 10.1590/2358-28982025E197971

**ABSTRACT** This study aimed to describe the application of an innovative methodology to measure physician retention rates in Brazil's health regions from 2009 to 2024. Using microdata from the National Registry of Health Establishments – Professionals (CNES-PF), annual cohorts were constructed and analyzed through churn, survival, and cohort analysis techniques, based on unique encrypted identifiers. Retention was measured by the continuity of physicians working in the same health regions over time. Results showed a national median retention rate of 51%, with higher values in the South and Southeast regions and lower rates in the North and Northeast. The Federal District had the highest retention (80.4%), while Maranhão had the lowest (36.5%). Intra- and interstate inequalities were identified, with state capitals showing higher retention levels. A strong positive correlation between retention and the physician-to-population ratio ( $r = 0.748$ ;  $p < 0.01$ ) suggests a direct impact on healthcare coverage. This study addresses a gap in the literature by offering a replicable method for nationwide analysis of medical workforce retention, contributing to strategic healthcare planning within the Unified Health System (SUS) and informing public policies aimed at strengthening professional retention in vulnerable areas.

**KEYWORDS** Health workforce. Employee turnover. Health planning.

**RESUMO** Este estudo objetivou descrever a aplicação de uma metodologia inovadora para mensuração da taxa de retenção de médicos nas regiões de saúde do Brasil entre 2009 e 2024. A partir dos microdados do Cadastro Nacional de Estabelecimentos de Saúde – Profissionais, foram construídas coortes anuais e empregadas técnicas de análise de churn, sobrevivência e coorte, com base em identificadores únicos criptografados. A retenção foi calculada pela permanência dos profissionais nas mesmas regiões ao longo do tempo. Os resultados revelaram uma taxa mediana nacional de retenção de 51%, com maiores valores nas regiões Sul e Sudeste e menores nas regiões Norte e Nordeste. O Distrito Federal apresentou a maior taxa (80,4%) enquanto o Maranhão teve a menor (36,5%). Foram identificadas desigualdades intra e interestaduais, com capitais estaduais apresentando maior retenção. A correlação positiva entre a retenção e a densidade médica por 1.000 habitantes ( $r = 0,748$ ;  $p < 0,01$ ) sugere impacto direto na cobertura assistencial. Este estudo preenche uma lacuna na literatura ao oferecer um método replicável para análise nacional da retenção médica, contribuindo para o planejamento estratégico da força de trabalho em saúde no Sistema Único de Saúde e subsidiando políticas públicas voltadas à fixação de profissionais em áreas vulneráveis.

**PALAVRAS-CHAVE** Mão de obra em saúde. Rotatividade de pessoal. Planejamento em saúde.

<sup>1</sup>Universidade Federal de Goiás (UFG), Centro de Inovação em Gestão da Educação e do Trabalho em Saúde (Cigets) – Goiânia (GO), Brasil.

<sup>2</sup>Secretaria de Estado da Saúde de Goiás (SES-GO) – Goiânia (GO), Brasil.

<sup>3</sup>Universidade Federal de Goiás (UFG), Instituto de Patologia Tropical e Saúde Pública da (IPTSP) – Goiânia (GO), Brasil. ecaquino@hotmail.com

<sup>4</sup>Universidade Federal de Goiás (UFG), Faculdade de Enfermagem e Nutrição (FEN) – Goiânia (GO), Brasil.



## Introduction

Brazil is a country of continental scale, marked by demographic, socioeconomic, and epidemiological disparities that influence the coverage of health services<sup>1</sup>. A skilled workforce is essential for any health system<sup>2</sup>, yet its spatial distribution is uneven. The South and Southeast regions, along with major urban centers, have the highest densities of health professionals per capita compared to other regions of the country<sup>3-6</sup>.

Various strategies have been implemented to address shortages in regions with lower densities of health professionals. However, research indicates that simply increasing the number of professionals may have a limited impact on establishing a robust Healthcare Workforce (HWF) in more remote and vulnerable areas. Initiatives such as establishing higher education programs within these territories, providing financial incentives, and implementing return of service requirements can temporarily expand the supply of professionals<sup>7,8</sup>. Nevertheless, building a sustainable HWF depends on addressing a critical, often overlooked factor: the retention of physicians<sup>9</sup>.

Retention of the healthcare workforce is defined as the continued presence of specific groups of professionals in the same locality over time<sup>10</sup>. It is essential to acknowledge that absolute retention of health professionals is unrealistic, as their exit from the workforce can occur through various pathways, including migration, career changes, disability, death, or retirement<sup>9</sup>. However, concern arises when turnover in a given territory is high. This situation contributes to the persistence or expansion of geographic areas with low retention and low densities of professionals per capita.

To measure retention, the concept of churn can be employed, which corresponds to terms such as turnover, discontinuity, or disengagement within a given service. In healthcare, studies have examined the

impact of churn on the treatment of patients living with HIV<sup>11</sup>. In the field of human resources, churn is used to quantify staff turnover within organizations<sup>12</sup>. Accordingly, regions with high churn exhibit low retention, and vice versa.

Studies on physician retention in Brazil have aimed to investigate the factors associated with this phenomenon. However, most of these studies focus on theoretical discussions or qualitative data<sup>13,14</sup>. To date, no comprehensive quantitative analysis has been conducted to assess the retention of health professionals in Brazil, although some initiatives have sought to measure retention and related phenomena, such as the circularity of the medical workforce<sup>15</sup>. Yet, these initiatives are limited to a small number of municipalities or regions, which inhibit a full assessment and the development of public policies to enhance health professional retention, particularly in more vulnerable areas<sup>9</sup>.

Although it is recognized that Brazil has substantial areas with physician shortages and that retention is a key factor in HWF planning, gaps remain due to the lack of studies providing a comprehensive national assessment of retention capacity across different geographic areas. The absence of such a diagnostic assessment is one of the factors hindering the development of sustainable healthcare with strategic, long-term guidance<sup>16</sup>, limiting the implementation of human resource strategies aimed at expanding universal health coverage in various regions of the country. Thus, the research question of this study was: 'What is the outlook of physician retention in Brazil?'. To address this question, the study aimed to describe the application of a methodology for measuring physician retention rates across Brazil's health regions. The study's methodology is innovative in terms of data processing, analysis, and interpretation, and it can be applied to other professional categories and localities in future research.

## Material and methods

A descriptive study of physician retention rates across Brazil's health regions from 2009 to 2024.

The study followed a retrospective longitudinal design, using secondary data from the administrative records of the National Registry of Health Establishment – Professionals (CNES-PF), which allowed for the tracking of annual cohorts of physicians throughout the country. For the analysis, only professionals with an encrypted Individual Taxpayer Registry (CPF) listed in the public database and actively employed in January of each year were included, a criterion that enables longitudinal follow-up of individuals over time.

Cases with missing or inconsistent identifiers were excluded, as were short-term employment links (less than 12 months), since these prevent accurate measurement of retention. Modeling and calculations were performed using automated algorithms developed in Python, with Structured Query Language (SQL) employed for data manipulation, ensuring transparency and replication. It should be noted, however, that the analysis depends on the accuracy and timeliness of CNES-PF records and is limited by the non-inclusion of employment links exclusively in the private sector.

### Healthcare professional data

Retention was measured using microdata from CNES-PF<sup>7</sup>. The microdata were obtained from the public access servers of the Information Technology Department of the Unified Health System (DataSUS) and imported into a relational database. Data on all physicians across Brazil's 5,570 municipalities were accessed over 15 years (2009–2024), with January of each year serving as the reference month. The unit of aggregation for this study was Brazil's health regions (n = 450), resulting in 6,750 units of analysis.

The following CNES-PF variables were extracted: (i) month/year of record; (ii) municipality code of the physician's employment link; (iii) Brazilian occupation code; and (iv) encrypted key of the physician's Individual Taxpayer Registry (CPF), available in the public DataSUS database, which enabled tracking of professional employment links throughout the cohort. The use of this last variable is consistent with recommendations in the literature, which emphasize the need for an approach in which each professional has a unique ID, allowing for monitoring of mobility and changes in employment status<sup>9</sup>.

### Calculation of the healthcare retention rate

The calculation of retention rates drew on established analytical approaches, including churn analysis<sup>12</sup>, survival analysis<sup>18</sup>, and cohort analysis<sup>19</sup>. At the core of the method was the construction of a triangular matrix (*graph 1*), where each row refers to a cohort—representing the year in which the professional first began working in health facilities within a given health region—and the columns capture the passage of time in 12-month intervals. Based on this structure, we developed an algorithm that proceeds through the following steps:

- i. Assign each health professional to the year in which they began working in that health region. This step associates the professional with a specific cohort (year). The literature recommends using cohort-based approaches to evaluate workforce retention<sup>9</sup>. As an illustration, *graph 1A* presents the health region of Médio Paraíba, Rio de Janeiro, which recorded 280 physicians entering the 2009 cohort.
- ii. Track the presence of the professional in subsequent years: continuing the previous example in *graph 1A*, the

280 physicians in the 2009 cohort were followed over time. After 12 months, 233 physicians (83.2%) remained in the region. After 24 months, 202 physicians (72.1%) from the 2009 cohort were still in the health region. By the end of 180 months, 137 physicians (48.9%) were still working in the same health region.

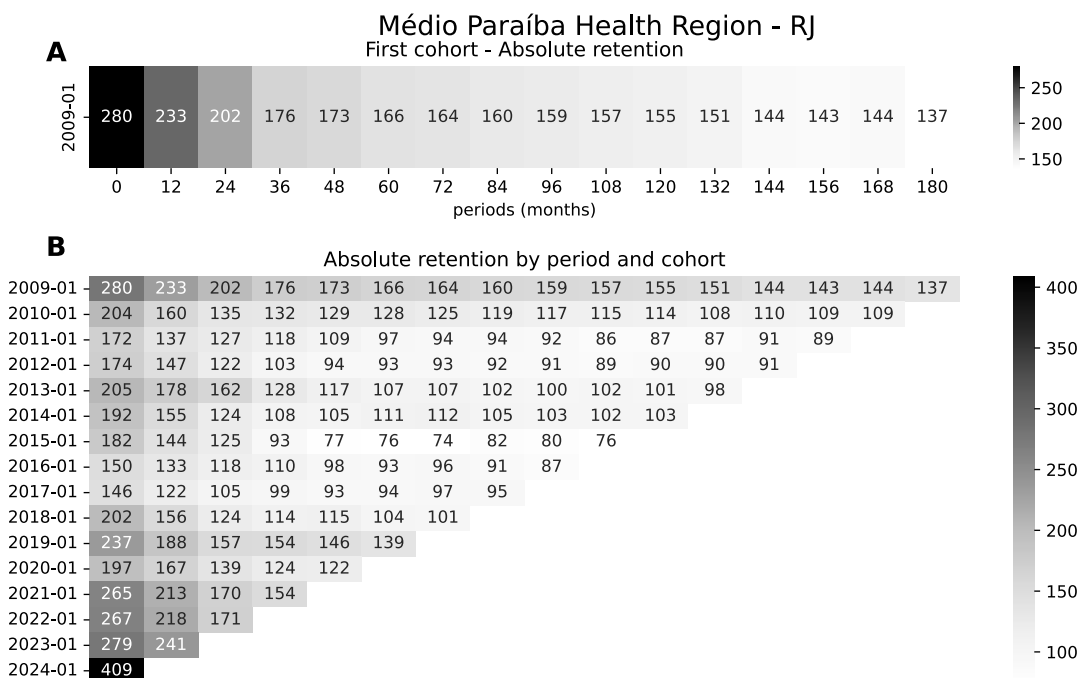
iii. Analyze the remaining cohorts: the third step involved repeating the procedure for all cohorts within the health region, as shown in Figure 1B. For example, in the 2010 cohort, 204 physicians were registered at the health region. After 12

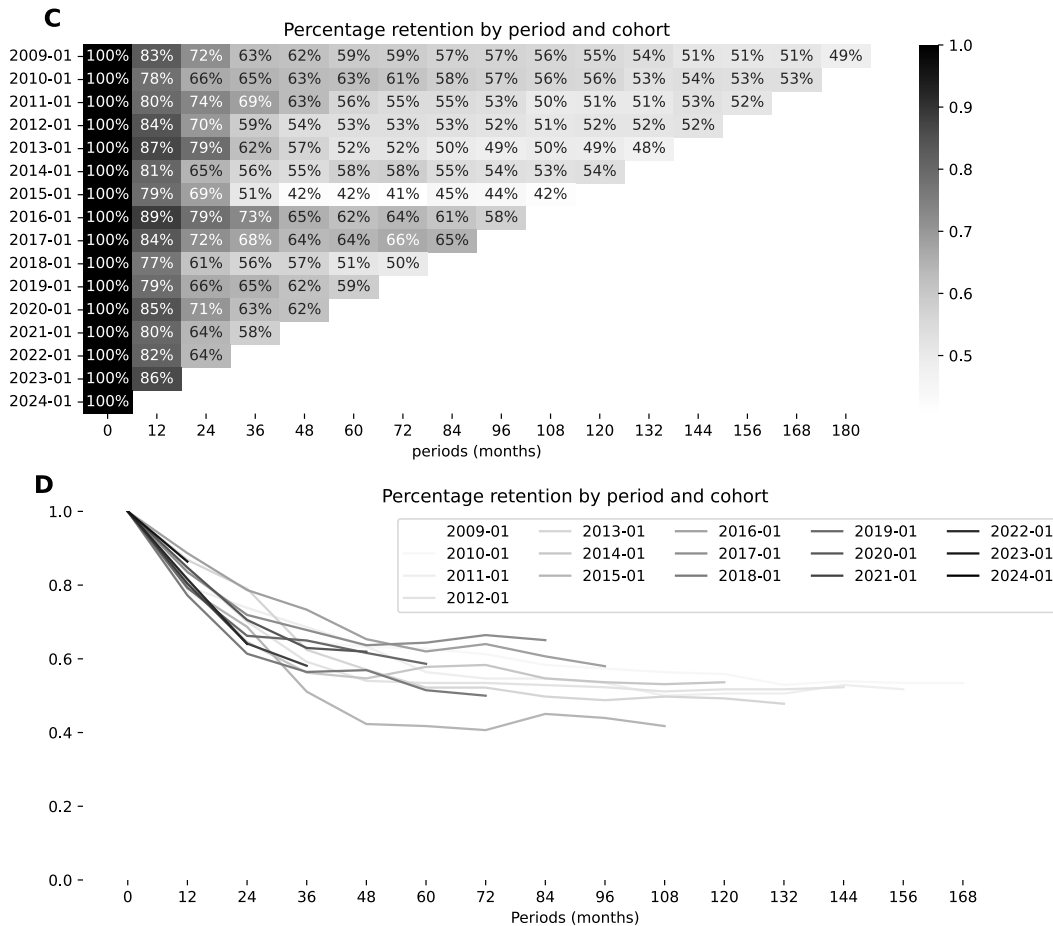
months, 160 physicians (78.4%) remained there, and after 168 months, 109 (53.4%) were still present. Graph 1C shows the same results in relative terms.

iv. Graph 1D presents the results in relative terms as a line graph. It shows that, on average, cohort retention drops to around 60% after 24 months and then remains relatively stable over time.

v. By applying iterative structures, steps i-iv can be automated for all health regions in Brazil.

Graph 1. Evolution of physician retention by entry cohort in the Médio Paraíba health region (RJ), 2009-2024





Source: Owm elaboration.

The retention rate for each cohort was calculated based on the number of professionals who remained in the respective health region relative to the number of entrants/professionals in the cohort's baseline year, multiplied by 100. An average retention rate was then calculated for each health region. This was estimated as the arithmetic mean of the triangular matrix representing the individual retention rates of all cohorts, as illustrated in *graph 1*.

## Data analysis

Data analysis was conducted using multiple technologies. Public CNES microdata were

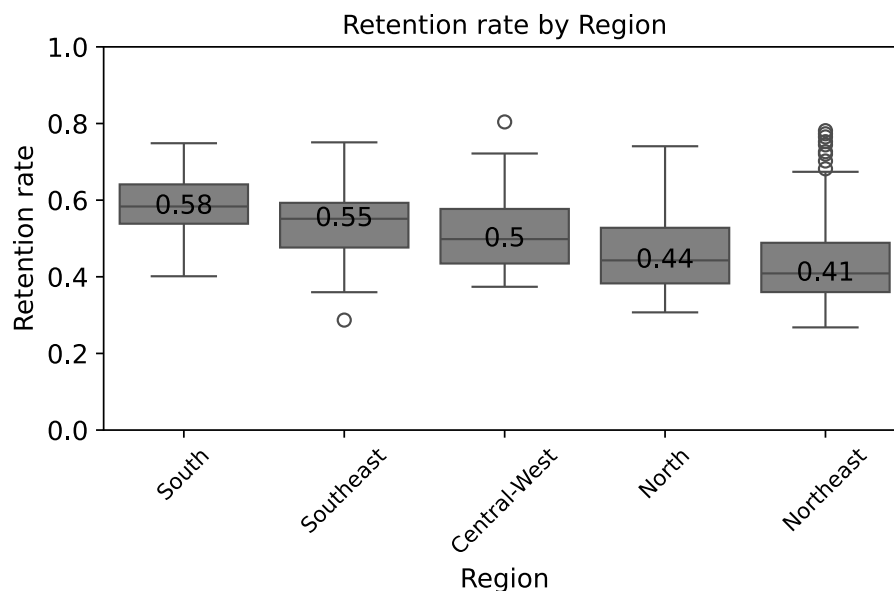
accessed directly from DataSUS and imported into a data infrastructure. Data load was performed using SQL, and the algorithm implementing the calculations described in the previous subsection was developed in Python. Python was also used to generate graphics, while the map was created using ArcGIS. In addition, a Pearson<sup>20</sup> correlation coefficient analysis was conducted to examine the relationship between the average retention rate and the number of physicians per 1,000 inhabitants, using the Federal Units as the unit of analysis. Data on the physician-to-population ratio were obtained from the 2023 Medical Demographics database<sup>6</sup>.

## Results

The median physician retention rate across Brazil's health regions between 2009 and 2024 was 51%. The results revealed disparities in retention rates among regions. The South,

Southeast, and Central-West regions had the highest median retention rates (58.3%, 55.1%, and 49.8%, respectively), while the Northeast and North regions showed the lowest rates (40.8% and 44.2%, respectively) (*graph 2*).

Graph 2. Distribution of physician retention rates by region

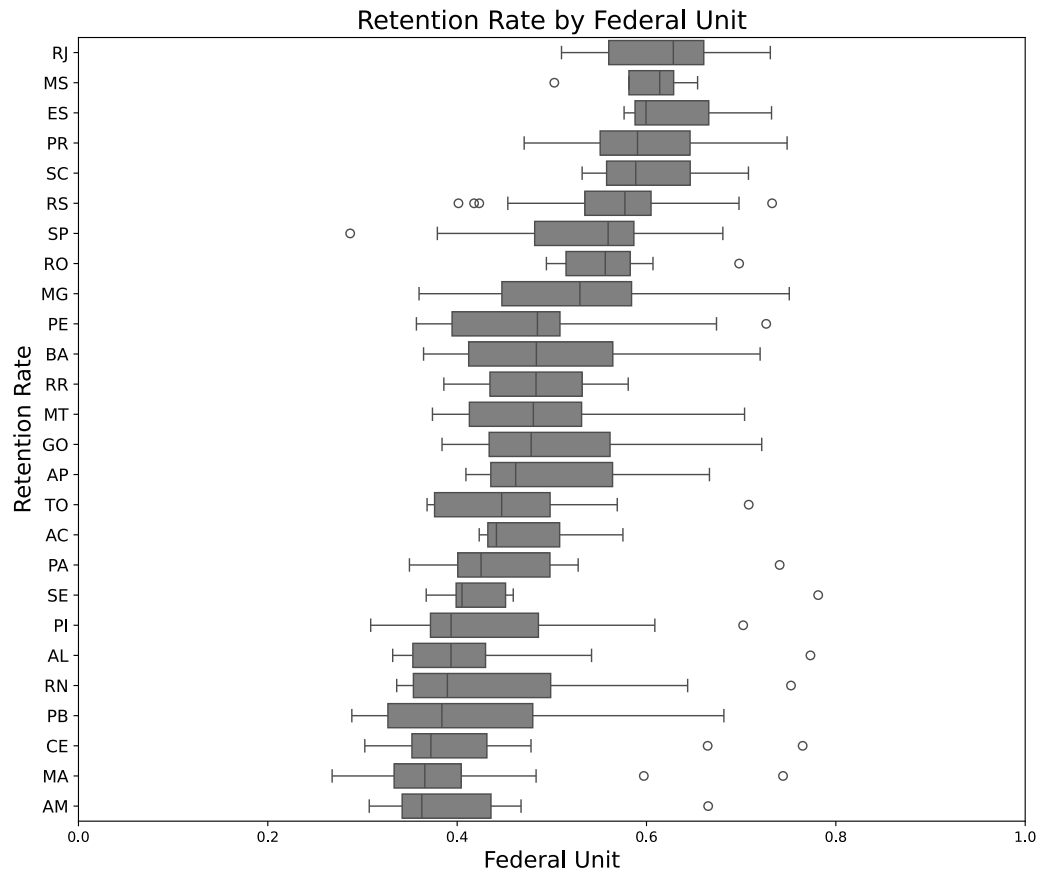


Source: Own elaboration.

Differences in average retention rates were observed across the federal units. All states in the South and Southeast regions had retention rates above the national median, while all units in the Northeast fell below it. Even in units with high overall retention, such as São Paulo and Rio Grande do Sul, there were outlier health regions with notably low retention rates, including Alto Capivari-SP (28.7%), Bons Ventos-RS (40.1%), and Belas Praias-RS (41.7%). In the North, only Rondônia exceeded the national median, while in the Central-West, this was the case for the Federal District and Mato Grosso do Sul. The highest retention rate

was observed in the Federal District (80.4%) in the Central-West region, and the lowest in Maranhão (36.5%) in the Northeast (*graph 3*). It is worth mentioning, however, that the Federal District is somewhat atypical due to its political-administrative structure—with administrative regions (*idades satélites*) that are generally not associated with an IBGE municipality code, preventing a fully regionalized analysis—as well as its small geographic size with nearby localities. Excluding the Federal District, the highest retention rate was observed in Rio de Janeiro (62.8%).

Graph 3. Distribution of physician retention rates in Brazil's health regions by Federal Unit



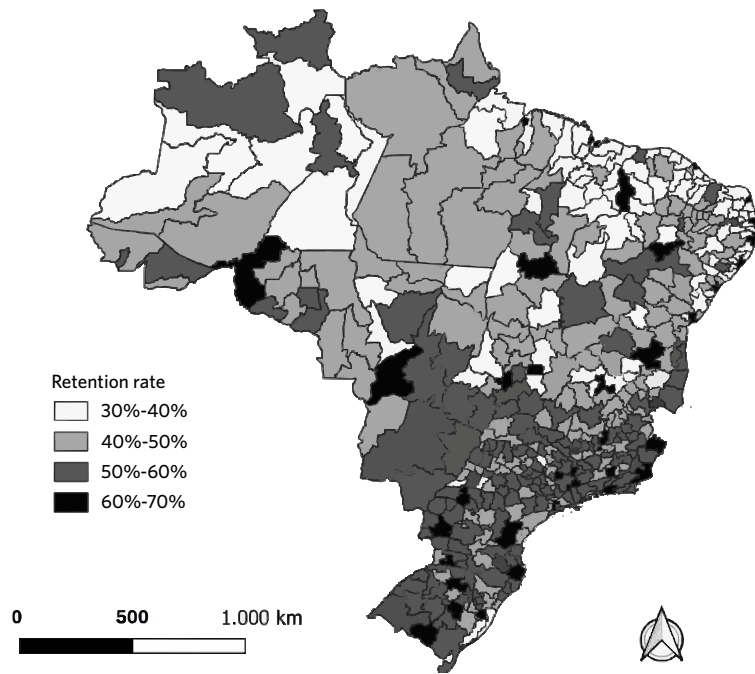
Source: Own elaboration

Retention rates across health regions vary considerably, with some exceptions, such as the states of Mato Grosso do Sul and Sergipe. The distribution of retention rates by health region shows that the lowest rates are concentrated in the North and Northeast, while the highest rates are found in the South and Southeast. A notable feature in *graph 3* is the presence of outliers in the North and Northeast, which

generally correspond to health regions that include state capitals, as illustrated in *graph 4*.

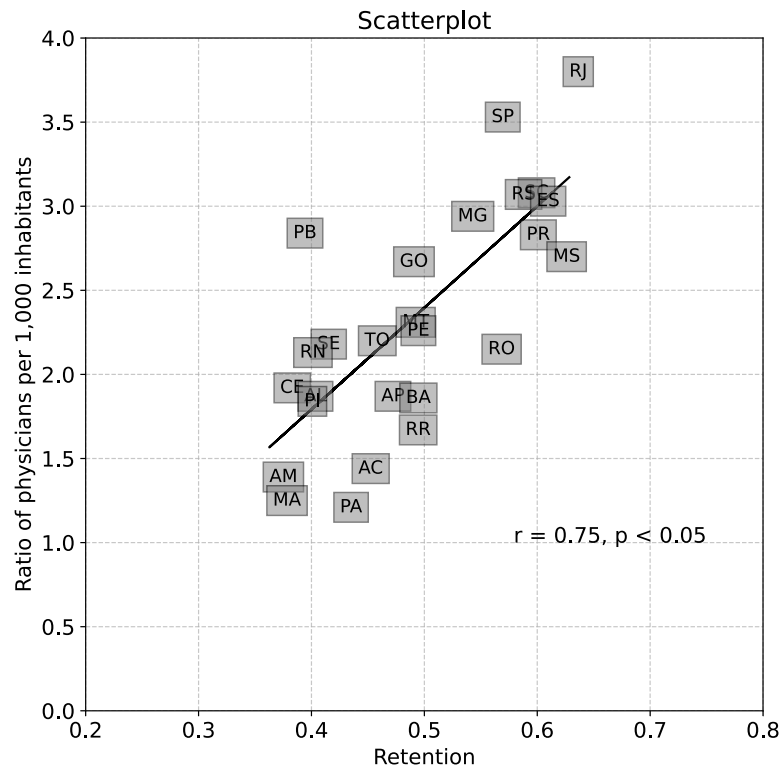
*Graph 5* shows the relationship between retention rates by federal unit and the number of physicians per 1,000 inhabitants. A positive and significant correlation was observed between these two variables ( $r = 0.748$ ;  $p < 0.01$ ).

Graph 4. Average physician retention rate by health region, 2009-2024



Source: Own elaboration.

Graph 5. Correlation between the ratio of physicians per 1,000 inhabitants and retention rate



Source: Own elaboration.

## Discussion

This study found that physician retention rates across Brazil's health regions was, in average, just above 50%, indicating that more than half of physicians remain in the same locations over the long term. Marked regional disparities were identified: the more developed South and Southeast regions showed the highest median retention rates, while the North and Northeast regions recorded the lowest. Differences were also observed both between and within states, with higher values found in health regions that include state capitals.

Federal Units with lower retention rates also exhibited the lowest ratios of physicians per 1,000 inhabitants. According to the 2023 Medical Demographics, the Federal District had the highest physician-to-population ratio (5.53 physicians per 1,000 inhabitants). In contrast, the states of Pará (1.18), Maranhão (1.22), and Amazonas (1.36) recorded the lowest ratios<sup>6</sup>. These three states also showed the lowest retention rates in their respective regions, highlighting the impact of limited retention on the availability of physicians.

The retention rate proposed in this study emerges as a strategic indicator for monitoring the effectiveness of public policies aimed at recruiting and retaining physicians, such as the Programa Mais Médicos (More Doctors Program, PMM) and Programa de Valorização do Profissional da Atenção Básica (Program to Value Primary Healthcare Professionals, PROVAB). Both initiatives sought to expand healthcare coverage in vulnerable areas but faced challenges in ensuring the long-term presence of physicians in their assigned locations. Recent studies have shown that instability in the medical workforce undermines continuity of care and the resilience of health services, with negative effects on sensitive health indicators such as infant mortality and vaccination coverage<sup>21</sup>.

The methodology adopted was grounded in cohort analysis and the concept of churn, which enables the assessment of not only

physician entry into the workforce but, more importantly, their longitudinal retention. This approach provides a more accurate view of the tangible effects of healthcare policies across territories. It aligns with the need for more robust tools to support decision-making in workforce management, particularly in light of the persistent regional disparities observed in the distribution and productivity of physicians<sup>22</sup>. Therefore, by estimating retention as a continuous and geographically based measure, this study offers valuable evidence to strengthen national governance of healthcare.

Workforce retention poses a challenge for many countries, especially in rural and remote areas, and is a complex issue influenced by numerous factors beyond just financial incentives<sup>25</sup>. Inequitable distribution of physicians in Brazil stems largely from their preference to settle in state capitals and metropolitan areas, which are economically more developed. In addition to offering better professional and educational opportunities, these locations provide other important advantages, such as leisure options and services for physicians and their families. As a result, less advantaged and/or remote areas tend to face greater challenges in attracting and retaining physicians<sup>26,27</sup>.

This study aimed to describe physician retention across Brazil, without intending to test association models. Nevertheless, based on the findings of this research and previous studies on workforce retention and distribution, it is possible to formulate hypotheses that help interpret the results of this investigation. The findings suggest that these phenomena may be influenced by factors operating at multiple levels, including characteristics of the local context (e.g., socioeconomic conditions, violence), system-level conditions (such as health and education), organizational environments, and individual motivations—areas that merit further investigation in future studies<sup>23,27-29</sup>.

Previous studies have shown that the distribution of physicians in Brazil is positively associated with the Human Development Index (HDI) and Gross Domestic Product (GDP)<sup>30</sup>.

The findings of this study are consistent with such a conclusion. The highest retention rates were observed in states with the highest HDI values in the country: the Federal District (0.814), São Paulo (0.806), and Santa Catarina (0.792). Conversely, states with the lowest average retention rates also have the lowest HDI values, including Maranhão (0.676), Alagoas (0.684), and Amapá (0.688)<sup>31</sup>. When examining other local context characteristics, such as violence (measured by the rate of intentional violent deaths)<sup>32</sup> and economic factors (measured by GDP per capita)<sup>33</sup>, correlations with retention can also be observed.

Working conditions may also contribute to retention in a given location. These include issues related to remuneration, type of employment contract, workload<sup>27,34,35</sup>, as well as the infrastructure of health services, and the availability of diagnostic tests, medications, and equipment<sup>27,36</sup>.

A previous study examined the spatial distribution of mammography equipment in Brazil and identified significant imbalances. Approximately 21% of municipalities lack full coverage for mammography services, even when considering locations within a 60 km radius. These municipalities are primarily located in the states of Maranhão, Bahia, and Piauí. In addition, in Mato Grosso, municipalities with these coverage gaps account for roughly 74% of the state<sup>37</sup>.

Education is also an important predictor of physician retention<sup>36,37</sup> and can take various forms. Expanding the selection of students from socioeconomically disadvantaged backgrounds has been identified as an effective retention strategy, as individuals from these contexts are more likely to work<sup>41</sup> and remain in remote locations<sup>27,29,31-43</sup>. There is also evidence that completing part of one's training in rural or remote regions—whether during undergraduate studies or residency—can influence physician retention<sup>30,42,44</sup>. Finally, opportunities for continuing education are a key factor in supporting the ongoing professional development and retention of practicing physicians<sup>36</sup>.

According to the 2023 Medical Demographics, Brazil has experienced a considerable increase in medical school seats and programs, particularly driven by the expansion of private institutions in the interior regions of the states. The Southeast region continues to hold a substantial share of these seats (43.8%), followed by the Northeast (25%). Approximately 70% of medical residency programs are concentrated in the Southeast and South regions. Moreover, 69.2% of resident physicians are located in state capitals or metropolitan areas. In a primary survey, just over half of the residents reported an interest in remaining in the location where they are completing their residency<sup>9</sup>. Following the logic outlined above, the concentration of undergraduate and residency programs in the South, Southeast, and capital regions may help explain the historical inequalities in physician distribution<sup>30</sup> and the low retention observed in the North, Northeast, and Central-West regions. Of particular concern is the Northeast: despite having a relatively high number of medical school seats, retention remains low, highlighting the need for further studies on graduates from this region.

There are also numerous other factors, at both the individual and organizational levels, that influence professional retention. These include management styles, incentives, career structure, salary scales, recruitment practices, employment flexibility, opportunities for professional growth, workload, opportunities for spouses and children, and type of employment contract, among others<sup>23,25,27,29,34,36,45,46</sup>.

The findings of this study indicate that the highest retention rates are concentrated in health regions that include state capitals and large urban centers, where the availability of medium- and high-complexity services is greater. This pattern suggests adherence to a hospital-centered model of healthcare, in which medical practice tends toward specialization and concentration at secondary and tertiary levels of health care<sup>47</sup>. The predominance of employment in hospital and

specialized outpatient facilities reinforces this interpretation. Primary care, especially in the most vulnerable regions, continues to exhibit lower retention rates, reflecting historical challenges in workforce placement at this level of health care<sup>47</sup>, despite efforts through programs such as PROVAB and PMM. Incorporating variables that capture the type of practice setting and level of care could enrich future analyses, supporting more integrated and effective healthcare planning<sup>38,39</sup>.

This scenario also highlights that the unequal distribution of higher-complexity health equipment serves as an important determinant of physician retention, attracting professionals who seek appropriate conditions for practicing clinical and surgical specialties. However, this influence varies across regions. The study showed that the South and Southeast regions exhibit the highest retention rates, largely associated with the greater presence of training centers, referral hospitals, and well-structured healthcare networks. By contrast, the North and Northeast—where primary care plays a more central role in service delivery—experience lower retention rates, indicating that professionals in primary care specialties face greater turnover, especially in locations far from major urban centers.

Additionally, the analysis by health region revealed pronounced disparities even within states, with higher retention observed in metropolitan areas and state capitals, while inland regions—particularly those in the Legal Amazon and the semi-arid Northeast—continue to face critical challenges in retaining physicians. This reinforces the need to better understand the dynamics specific to each medical specialty and how they relate to the regional organization of healthcare services, providing valuable insights for the design of more tailored workforce allocation policies<sup>48-50</sup>.

Between 2009 and 2024, several public policies were implemented with this goal, most notably the PROVAB and the PMM, both focused on strengthening primary care and

assigning physicians to underserved areas. These initiatives combined financial, educational, and regulatory strategies, including the expansion of undergraduate and residency training opportunities in priority regions<sup>48</sup>. The relaunch of the PMM in 2023 further reinforced this agenda by introducing new criteria for selection and retention<sup>49</sup>.

Even so, the findings of this study indicate that the regions with the highest retention rates remain those with greater hospital infrastructure density and more developed care networks. This suggests that, while physician supply policies have had meaningful impacts, they have not yet been sufficient to structurally change the underlying pattern of workforce concentration. The proposed methodology enables the longitudinal monitoring of such effects and can support the redesign of more integrated strategies.

This approach becomes even more relevant when viewed in light of the physician supply policies implemented during the study period, such as the Programa Mais Médicos (PMM), launched in 2013, and Médicos pelo Brasil (Doctors for Brazil), introduced in 2019. Both initiatives sought to address the shortage of physicians in underserved regions; however, they have lacked systematic and objective mechanisms to monitor whether professionals remain in their assigned locations over time. The methodology proposed in this study helps fill this gap by providing a robust and replicable metric that allows for an evidence-based assessment of physicians' long-term retention after their initial placement.

This study offers several key contributions. First, it enables the identification of regions with the highest and lowest physician retention rates, thereby supporting targeted public policy interventions in areas with lower retention. The findings also highlight a persistent issue: the unequal distribution of physicians in Brazil remains a chronic challenge. Regions with the lowest physician density are also those with the lowest retention rates. Consequently, policies focused solely on

increasing workforce supply may have limited effectiveness if these regions are unable to retain professionals over time. From a methodological perspective, this research contributes by proposing a systematic approach to measuring physician retention—a critical phenomenon for planning, sizing, and managing healthcare. The method was implemented using data science techniques applied to open microdata. Although the analyses presented here focus on physicians, the codes and datasets are publicly available through DataSUS servers, enabling other researchers to replicate or adapt the approach for different professional categories and levels of disaggregation.

This study has certain limitations. Although the proposed method allows for analyses covering the entire Brazilian territory, it depends on the quality and completeness of the available data. Delays in the inclusion or removal of professionals in the CNES-PF database may lead to under- or overestimation of retention rates. Moreover, CNES-PF does not provide comprehensive records of professionals working exclusively in the supplemental health care sector, which represents another limitation. Nevertheless, CNES-PF remains a widely used and reliable source among researchers, and the results presented here are consistent with the workforce imbalances identified in previous studies.

## Final considerations

Physician retention across Brazil's health regions is a multifaceted phenomenon shaped by contextual, institutional, and individual determinants. This study applied an innovative and replicable methodology—grounded in cohort analysis and data science techniques—to measure the longitudinal retention of physicians across different regions of the country over a 15-year period. The findings revealed marked regional disparities and structural patterns of workforce concentration in areas with greater infrastructure density and higher levels of service complexity.

The analysis presented in this study directly engages with the design and evaluation of public programs and policies implemented since 2013—such as Programa Mais Médicos (PMM), Programa de Valorização do Profissional da Atenção Básica (PROVAB), and, more recently, Médicos pelo Brasil—all aimed at reducing turnover and strengthening physician retention in underserved areas. The proposed methodological approach offers an objective, longitudinal tool to monitor the effects of such policies, addressing the limitations of evaluations based solely on initial workforce allocation indicators.

Although the scope of this study was descriptive, the findings suggest that the impact of workforce allocation policies has been limited in shifting the pattern of physician retention in historically underserved regions. This highlights the need for more integrated policies that go beyond allocation to address working conditions, continuing education, stable employment arrangements, and adequate care service infrastructure. Future analyses incorporating variables related to the level of care (primary, hospital, or specialized) and employment arrangements could provide a deeper understanding of the mechanisms driving physician retention.

Moreover, the approach adopted in this study provides valuable insights to inform medium- and long-term strategies for both researchers and policymakers, highlighting promising directions for strengthening healthcare governance in Brazil. Applying this methodology in synergy with existing national policy frameworks and mechanisms may enhance the effectiveness of ongoing initiatives and foster greater equity in the distribution of health professionals across the country.

## Collaborators

Pagotto DP (0000-0001-6791-9511)\*, Marques W (0000-0003-2965-5759)\*, Aquino ÉC

(0000-0002-5659-0308)\*, Guimarães RA (0000-0001-5171-7958)\*, Borges Júnior CV (0000-0003-3362-4074)\*, and Silva Filho AI

(0000-0003-1174-8586)\* contributed equally to the preparation of the manuscript. ■

## References

1. Viacava F, Porto SM, Carvalho CC, et al. Health inequalities by region and social group based on data from household surveys (Brazil, 1998-2013). *Ciência saúde coletiva*. 2019;24(7):2745-60. DOI: <https://doi.org/10.1590/1413-81232018247.15812017>
2. World Health Organization. Global strategy on human resources for health: Workforce 2030 [Internet]. Geneva: WHO; 2016 [acesso em 2024 jul 15]. 61 p. Disponível em: <https://iris.who.int/bitstream/handle/10665/250368/?sequence=1>
3. Bleicher L, Cangussu MCT. The evolution of inequalities in the distribution of dentists in Brazil. *Ciência saúde coletiva*. 2024;29(1):e15942022. DOI: <https://doi.org/10.1590/1413-81232024291.15942022>
4. Machado MH, Ximenes Neto FRG. The management of work and education in Brazil's unified health system: Thirty years of progress and challenges. *Ciência saúde coletiva*. 2018;23(6):1971-80. DOI: <https://doi.org/10.1590/1413-81232018236.06682018>
5. Mendes M, Martins MS, Acordi I, et al. Força de trabalho de enfermagem: cenário e tendências. *Rev Enferm UFSM*. 2022;12:e11. DOI: <https://doi.org/10.5902/2179769267928>
6. Scheffer M, Guilloux AGA, Miotto BA, et al. Demografia Médica no Brasil 2023 [Internet]. São Paulo, SP: FMUSP, AMB; 2023 [acesso em 2024 jul 15]. 120 p. Disponível em: <https://amb.org.br/>
7. Freer J. Sustainable development goals and the human resources crisis. *Int Health*. 2017;9(1):1-2. DOI: <https://doi.org/10.1093/inthealth/ihw042>
8. Russell D, Mathew S, Fitts M, et al. Interventions for health workforce retention in rural and remote areas: a systematic review. *Hum Resour Health*. 2021;19(1):103. DOI: <https://doi.org/10.1186/s12960-021-00643-7>
9. Castro-Lopes S, Guerra-Arias M, Buchan J, et al. A rapid review of the rate of attrition from the health workforce. *Hum Resour Health*. 2017;15(1):21. DOI: <https://doi.org/10.1186/s12960-017-0195-2>
10. Brown P, Fraser K, Wong CA, et al. Factors influencing intentions to stay and retention of nurse managers: a systematic review. *J Nurs Manag*. 2013;21(3):459-72. DOI: <https://doi.org/10.1111/j.1365-2834.2012.01352.x>
11. Nosyk B, Lourenço L, Min JE, et al. Characterizing retention in HAART as a recurrent event process: Insights into 'cascade churn.' *AIDS*. 2015;29(13):1681-9. DOI: <https://doi.org/10.1097/qad.0000000000000746>
12. Buchan J. Reviewing The Benefits of Health Workforce Stability. *Hum Resour Health*. 2010;8:29. DOI: <https://doi.org/10.1186/1478-4491-8-29>
13. Scalco SV, Lacerda JT, Calvo MCM. Modelo para avaliação da gestão de recursos humanos em saúde. *Cad Saúde Pública*. 2010;26(3):603-14. DOI: <https://doi.org/10.1590/S0102-311X2010000300017>

\*Orcid (Open Researcher and Contributor ID).

14. Girardi SN. Estudo de atração e retenção de profissionais de saúde em áreas remotas e desassistidas por meio de experimento de preferência declarada. Belo Horizonte, Rio de Janeiro: EPSM; 2013.
15. Seixas PHDÂ, Ibañez N, Silva JA, et al. Physicians' commuting in five health regions in São Paulo, Brazil: Patterns and intervening factors. 2019;35(Supl 2):e00135018. DOI: <https://doi.org/10.1590/0102-311x00135018>
16. Rees GH, James R, Samadashvili L, et al. Are Sustainable Health Workforces Possible? Issues and a Possible Remedy. Sustainability. 2023;15(4):3596. DOI: <https://doi.org/10.3390/su15043596>
17. Ministério da Saúde (BR). Cadastro Nacional de Estabelecimentos de Saúde [Internet]. [Brasília, DF]: Ministério da Saúde; 2024 [acesso em 2024 jul 15]. Disponível em: <https://cnes.datasus.gov.br/>
18. Russell DJ, Humphreys JS, Mcgrail MR, et al. The value of survival analyses for evidence-based rural medical workforce planning. Hum Resour Health. 2013;11:65. DOI: <https://doi.org/10.1186/1478-4491-11-65>
19. Narayanan CS. A novel cohort analysis approach to determining the case fatality rate of COVID-19 and other infectious diseases. PLoS One. 2020;15(6):e0233146. DOI: <https://doi.org/10.1371/journal.pone.0233146>
20. Pearson K. Mathematical contributions to the theory of evolution. III. Regression, heredity and panmixia. Philos Trans R Soc Lond. 1986;187:253-318. DOI: <https://doi.org/10.1098/rsta.1896.0007>
21. Nunes PC, Jatobá A, Palmieri P, et al. Efeitos da volatilidade da força de trabalho, determinantes de óbitos infantis e resiliência na Atenção Primária do SUS. Ciênc saúde coletiva. 2025;30(6):e03572025. DOI: <https://doi.org/10.1590/1413-81232025306.03572025>
22. Barros RD, Andrade JASV, Melo HC, et al. Distribuição geográfica e fatores associados com a produtividade de médicos e enfermeiros na atenção primária brasileira. Ciênc saúde coletiva. 2025;30(7):e11452024. DOI: <https://doi.org/10.1590/1413-81232025307.11452024>
23. Dussault G. A ligação em falta no caminho para a Cobertura Universal de Saúde: a gestão. Ciênc saúde coletiva. 2015;20(10):2930. DOI: <https://doi.org/10.1590/1413-812320152010.15822015>
24. Ferreira N, McKenna O, Lamb IR, et al. Approaches to locum physician recruitment and retention: a systematic review. Hum Resour Health. 2024;22(1):24. DOI: <https://doi.org/10.1186/s12960-024-00906-z>
25. Morris ME, Brusco NK, McAleer R, et al. Professional care workforce: a rapid review of evidence supporting methods of recruitment, retention, safety, and education. Hum Resour Health. 2023;21(1). DOI: <https://doi.org/10.1186/s12960-023-00879-5>
26. Campos FE, Machado MH, Girardi SN. A fixação de profissionais de saúde em regiões de necessidades. Div Saúde debate. 2009;(44):13-24.
27. Van Stralen ACS, Massote AW, Carvalho CL, et al. Percepção de médicos sobre fatores: De atração e fixação em áreas remotas e desassistidas: rotas da escassez. Physis. 2017;27(1):147-72. DOI: <https://doi.org/10.1590/S0103-73312017000100008>
28. Asadi H, Ahmadi B, Nejat S, et al. Factors influencing the migration of Iranian healthcare professionals: A qualitative study. PLoS One. 2018;13(6):e0199613. DOI: <https://doi.org/10.1371/journal.pone.0199613>
29. Dussault G, Franceschini MC. Not enough there, too many here: Understanding geographical imbalances in the distribution of the health workforce. Hum Resour Health. 2006;4:12. DOI: <https://doi.org/10.1186/1478-4491-4-12>
30. Póvoa L, Andrade MA. Distribuição geográfica dos médicos no Brasil: uma análise a partir de um modelo de escolha locacional. Cad Saúde Pública. 2006;22(8):1555-64. DOI: <https://doi.org/10.1590/S0102-311X2006000800004>
31. Instituto Brasileiro de Geografia e Estatística. Índice de Desenvolvimento Humano - Ranking [Internet]. [Rio de Janeiro]: IBGE; 2021 [acesso em 2024 jul 15]. Disponível em: <https://cidades.ibge.gov.br/brasil/ac/pesquisa/37/30255?tipo=ranking29>

32. Fórum Brasileiro de Segurança Pública. Anuário Brasileiro de Segurança Pública [Internet]. São Paulo: FBSP, 2023 [acesso em 2024 jul 15]. 357 p. Disponível em: <https://forumseguranca.org.br/wp-content/uploads/2023/07/anuario-2023.pdf>
33. Instituto Brasileiro de Geografia e Estatística. Sistema de Contas Regionais: Brasil 2021 [Internet]. [Rio de Janeiro]: IBGE; 2023 [acesso em 2024 jul 15]. Disponível em: <https://www.ibge.gov.br/estatisticas/economicas/contas-nacionais/9054-contas-regionais-do-brasil.html>
34. Soares C. Análise dos fatores de Atração e retenção de profissionais médicos da estratégia da saúde da família na região oeste de Minas Gerais. APS. 2022;4(1):12-8. DOI: <https://doi.org/10.14295/aps.v4i1.233>
35. Soares JP, Oliveira NHS, Mendes TMC, et al. Fatores associados ao burnout em profissionais de saúde durante a pandemia de Covid-19: revisão integrativa. Saúde debate. 2022;46(Esp 1):385-98. DOI: <https://doi.org/10.1590/0103-11042022E126>
36. Willis-Shattuck M, Bidwell P, Thomas S, et al. Motivation and retention of health workers in developing countries: A systematic review. BMC Health Serv Res. 2008;8:247. DOI: <https://doi.org/10.1186/1472-6963-8-247>
37. Koike S, Okazaki K, Tokinobu A, et al. Factors associated with regional retention of physicians: a cross-sectional online survey of medical students and graduates in Japan. Hum Resour Health. 2023;21(1):85. DOI: <https://doi.org/10.1186/s12960-023-00871-z>
38. Amaral P, Luz L, Cardoso F, et al. Distribuição espacial de equipamentos de mamografia no Brasil. Rev Bras Estud Urbanos Reg. 2017;19(2):326-41. DOI: <https://doi.org/10.22296/2317-1529.2017v19n2p326>
39. Barbosa SP, Coelho KA, Carvalho LM, et al. Aspectos que compõem o perfil dos profissionais médicos da Estratégia Saúde da Família: o caso de um município polo de Minas Gerais. Rev Bras Educ Med. 2019;43(1):395-403. DOI: <https://doi.org/10.1590/1981-5271v43suplemento1-20180177>
40. Feuerwerker LCM. A formação de médicos especialistas e a residência médica no Brasil. Saúde debate. 2001;25(57):39-54.
41. Puddey IB, Playford DE, Mercer A. Impact of medical student origins on the likelihood of ultimately practicing in areas of low vs high socio-economic status. BMC Med Educ. 2017;17(1):1. DOI: <https://doi.org/10.1186/s12909-016-0842-7>
42. Holst J. Increasing rural recruitment and retention through rural exposure during undergraduate training: An integrative review. Int J Environ Res Public Health. 2020;17(17):6423. DOI: <https://doi.org/10.3390/ijerph17176423>
43. Pessoa VM, Almeida MM, Carneiro FF. Como garantir o direito à saúde para as populações do campo, da floresta e das águas no Brasil? Saúde debate. 2018;42(Esp 1):302-14. DOI: <https://doi.org/10.1590/0103-11042018S120>
44. Playford D, Ngo H, Atkinson D, et al. Graduate doctors' rural work increases over time. Med Teach. 2019;41(9):1073-80. DOI: <https://doi.org/10.1080/0142159x.2019.1621278>
45. Tenório MEC, Sampaio J, Soares GB. Recrutamento e retenção de médicos para a Atenção Básica: permanentes desafios para o Brasil. Rev APS. 2020;23(4):901-22. DOI: <https://doi.org/10.34019/1809-8363.2020.v23.31241>
46. Gonçalves E, Oliveira Júnior AJ, Mialhe FL. Análise da distribuição de médicos especialistas em microrregiões de saúde na área de consórcios intermunicipais de saúde no Sul de Minas Gerais. REAS. 2021;13(4):1-10. DOI: <https://doi.org/10.25248/REAS.e7005.2021>
47. Carnut L. Cuidado, integralidade e atenção primária: articulação essencial para refletir sobre o setor saúde no Brasil. Saúde debate. 2017;41(115):1177-86. DOI: <https://doi.org/10.1590/0103-1104201711515>
48. Cavalli LO, Rizzotto MLE, Guimarães ATB. O médico no processo de avaliação externa do Programa Nacional de Melhoria do Acesso e da Qualidade da Atenção

Básica, ciclos I e II. *Saúde debate*. 2016;40(111):87-100.  
DOI: <https://doi.org/10.1590/0103-1104201611107>

49. Santana AF, Silva KCS, Guimarães MCS, et al. Do PROVAB ao Programa Mais Médicos: caminhos percorridos no estado da Bahia. *RBSP*. 2022;46(1):247-57, 2022. DOI: <https://doi.org/10.22278/2318-2660.2022.v46.n1.a3579>
50. Oliveira JPA, Pacheco C, Taves FAQ, et al. Efeitos do Programa Mais Médicos na Atenção Primária e seus impactos na saúde: uma revisão sistemática. *Trab*

*Educ Saúde*. 2024;22:e02635249. DOI: <https://doi.org/10.1590/1981-7746-ojs2635>

---

Received on 09/10/2024

Accepted on 05/15/2025

Conflict of interest: Non-existent

Data availability: Research data are included within the manuscript and in a public data repository (<https://github.com/danielppagotto/retencao>, <https://doi.org/10.48331/SCIELODATA.XBROON>)

Financial support: Cooperation agreement between the Federal University of Goiás and the Department of Labor and Education Management in Health/Ministry of Health - TED 179/2019.

Process: 25000206114201919/FNS

**Editor in charge:** Paulo Victor Rodrigues de Carvalho