EXPENDITURES ON SCIENCE AND TECHNOLOGY (S&T) AND RESEARCH AND DEVELOPMENT (R&D) APPLIED TO THE MINISTRY OF HEALTH: CORRELATION WITH HUMAN RESOURCES TRAINING AND PUBLIC POLICIES FOR THE PERIOD 2014 – 2023

DISPÊNDIOS EM CIÊNCIA E TECNOLOGIA (C&T) E PESQUISA E DESENVOLVIMENTO (P&D) APLICADOS AO MINISTÉRIO DA SAÚDE (MS): CORRELAÇÕES COM A FORMAÇÃO DE RECURSOS HUMANOS E POLÍTICAS PÚBLICAS DO PERÍODO 2014-2023

GASTOS EN CIENCIA Y TECNOLOGÍA (C&T) E INVESTIGACIÓN Y DESARROLLO (I+D) APLICADOS AL MINISTERIO DE SALUD: CORRELACIONES CON LA FORMACIÓN DE RECURSOS HUMANOS Y LAS POLÍTICAS PÚBLICAS PARA EL PERÍODO 2014-2023

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Roberto Augusto Caracas Neto[1], Marcelo Luiz Soares Pereira[2], Maira Uchôa Moura[3], Thalita Duque Martins Paes[4], Cristiana Maria do Valle Freitas[5], Eduardo Winter[6], Evanildo Vieira dos Santos[7]

ABSTRACT

This study analyzes public expenditures on Science and Technology (S&T) and Research and Development (R&D) within the Ministry of Health (MS), correlating them with human resources training provided by the Ministry of Education (MEC/CAPES) between 2014 and 2023. The timeframe covers the period from the 2015 fiscal crisis to the 2023 budgetary restoration, including the critical impact of the COVID-19 pandemic. The research investigates how structural investment in the scientific base and personnel qualification within

[1] Doctoral student. Programa de Pós-Graduação em Propriedade Intelectual e Inovação (PPGPI). E-mail: robertocaracas2000@gmail.com Orcid: https://orcid.org/0000-0001-8484-411X Lattes: https://lattes.cnpq.br/4553279121829196
[2] Doctoral student. Programa de Pós-Graduação em Propriedade Intelectual e Inovação (PPGPI). E-mail: marceloluiz2016@gmail.com Doctoral student: https://orcid.org/0009-0009-1917-3554 Lattes: https://lattes.cnpq.br/7433237430544504
[3] Master's student in Intellectual Property and Technology Transfer for Innovation. Universidade Federal de Pernambuco (UFPE). E-mail: maira.uchoa@ufpe.br Doctoral student: https://orcid.org/0009-0007-1948-4147 Lattes: https://lattes.cnpq.br/9179958502552393
[4] Doctoral student in Intellectual Property and Innovation. Instituto Nacional da Propriedade Industrial (INPI). E-mail: thalita@duquepaes.com.br Doctoral student: https://orcid.org/0000-0002-5546-7375 Lattes: https://lattes.cnpq.br/1501220349253023
[5] Master's student in Intellectual Property and Innovation. Instituto Nacional da Propriedade Industrial (INPI). E-mail: cristianavf@gmail.com Doctoral student: https://orcid.org/0009-0000-0538-999X Lattes: https://lattes.cnpq.br/1012752946972157
[6] Dr. in Science. Universidade Estadual de Campinas. E-mail: winterinpi@gmail.com ORCID: https://orcid.org/0000-0002-0896-9276 Lattes: http://lattes.cnpq.br/5404510836890906
[7] Dr. in Intellectual Property and Innovation. Instituto Nacional da Propriedade Industrial (INPI). E-mail: evanildo@inpi.gov.br Doctoral student: https://orcid.org/0000-0002-5546-7375 Lattes: http://lattes.cnpq.br/0291501734843678

the National Graduate System support the Health Economic-Industrial Complex (CEIS). Adopting a transversal approach, it examines the role of regulatory frameworks, such as the New Legal Framework for S,T&I, in reducing external dependence and promoting health sovereignty. The results indicate that the resilience of health policies depends on the integration between the MS technological induction and the academic capacity fostered by the MEC.

Keywords: Innovation Financing. Health Sovereignty. National Graduate System.

RESUMO
Este estudo analisa os dispêndios públicos em Ciência e Tecnologia (C&T) e Pesquisa e Desenvolvimento (P&D) no Ministério da Saúde (MS), correlacionando-os à formação de recursos humanos via Ministério da Educação (MEC/CAPES) entre 2014 e 2023. O recorte temporal abrange desde a crise fiscal de 2015 até a recomposição orçamentária de 2023, incluindo o impacto crítico da pandemia de COVID-19. A pesquisa investiga como o investimento estrutural na base científica e a qualificação de pessoal no Sistema Nacional de Pós-Graduação sustentam o Complexo Econômico-Industrial da Saúde (CEIS). Utilizando uma abordagem transversal, examina-se o papel de marcos regulatórios, como o Novo Marco Legal de C,T&I, na redução da dependência externa e na promoção da soberania sanitária. Os resultados indicam que a resiliência das políticas de saúde depende da integração entre a indução tecnológica do MS e a capacidade acadêmica fomentada pelo MEC.

Palavras-chave: Financiamento da Inovação. Soberania Sanitária. Sistema Nacional de Pós-Graduação.

RESUMEN
Este estudio analiza el gasto público en Ciencia y Tecnología (C&T) e Investigación y Desarrollo (I+D) del Ministerio de Salud (MS), correlacionándolo con el desarrollo de recursos humanos a través del Ministerio de Educación (MEC/CAPES) entre 2014 y 2023. El período abarca desde la crisis fiscal de 2015 hasta la recuperación presupuestaria de 2023, incluyendo el impacto crítico de la pandemia de COVID-19. La investigación analiza cómo la inversión estructural en la base científica y la cualificación del personal del Sistema Nacional de Posgrado apoya el Complejo Económico-Industrial de la Salud (CEIS). Mediante un enfoque transversal, examina el papel de los marcos regulatorios, como el Nuevo Marco Legal para C&T e I+D, en la reducción de la dependencia externa y la promoción de la soberanía sanitaria. Los resultados indican que la resiliencia de las políticas de salud depende de la integración entre la inducción tecnológica del MS y la capacidad académica impulsada por el MEC.

Palabras clave: Financiamiento de la Innovación. Soberanía Sanitaria. Sistema Nacional de Posgrado.

1 INTRODUCTION

The national sovereignty of a country, in the twenty-first century, is intrinsically linked to its capacity for technological response in the face of global health crises and to the robustness of its National Innovation System (SNI). In Brazil, this dynamic is supported by a strategic institutional binomial: on the one hand, the Ministry of Health (MoH), which acts as a demand inducer and funder of applied Research and Development (R&D); on the other, the Ministry of Education (MEC), which, through the Coordination for the Improvement of Higher Education Personnel (CAPES) (BRASIL, 2023), provides the human and academic infrastructure necessary for the production of knowledge.

The time frame between 2014 and 2023 is particularly emblematic for analyzing this integration. This decade was crossed by a contradictory institutional duality. If, on the one hand, regulatory frameworks such as the New Legal Framework for S, T&I (Law No. 13,243/2016) sought to reduce bureaucracy in innovation and foster the triple helix, on the other hand, the imposition of Constitutional Amendment No. 95/2016 ("Spending Ceiling") subjected public investments to a scenario of financial asphyxiation, deepening the chronic underfunding of the Unified Health System (SUS) and impacting the sustainability of long-term policies (Souza *et al.*, 2020; FIOCRUZ, 2023).

In this context, health is not seen only as a social service, but as a thriving economic sector, synthesized in the concept of the Health Economic-Industrial Complex (CEIS) (BRASIL, 2023). According to the perspective of Mariana Mazzucato's (2014; 2022) "Entrepreneurial Public Administration", the State must act not only by correcting market failures, but as an inducing agent of strategic "missions". In Brazil, however, the operationalization of this theory faces the challenge of budget fragmentation and a temporal misalignment between the training of masters and doctors and the capacity of absorption of these talents by the market and the public sector according to the Organization for Economic Co-operation and Development (OECD, 2023).

The COVID-19 pandemic in 2020 acted as a catalyst for this system, exposing both the resilience of Brazilian research institutions and their external vulnerability in basic inputs (APIs) and cutting-edge technologies. While the Ministry of Health presented emergency peaks in expenditures to respond to the crisis, the Ministry of Education faced the challenge of maintaining the stability of the National Graduate System (SNPG) in the face of budget cuts and the discontinuation of internationalization programs, such as Science without Borders, which generated direct impacts on the global circulation of knowledge and the phenomenon of "brain drain" (CGEE, 2022).

In view of the above, the present study seeks to analyze the correlation between the expenditures in Science and Technology (S&T) and R&D carried out by the Ministry of Health and the Ministry of Education and the Ministry of Education (MEC/CAPES) in the mentioned period. We investigate the hypothesis that the volatility of the Ministry of Health's investments, in contrast to the relative formative inertia of the Ministry of Education, creates a mismatch that threatens national health sovereignty. The objective is to understand how the fluctuation of these *input* indicators affected the scientific base in the health area and how the alignment, or lack thereof, with current public policies shaped the country's innovation capacity.

2 METHODOLOGY

This study is based on the analysis of official secondary data released by the Ministry of Science, Technology and Innovation (MCTI) (BRASIL, 2025), referring to federal expenditures in Science and Technology (S&T) and Research and Development (R&D) carried out by the Ministries of Health (MS) and Education (MEC) in the period from 2014 to 2023. The collection of indicators is under the scope of the hypothetical-deductive method (Marconi; Lakatos, 2024). The objective was to examine the evolution of these expenditures over time, focusing on the area of Health and the training of human resources.

Marconi and Lakatos (2024) divide this process into rigorous steps that guarantee the validity of the subsequent analysis:

a. **Planning**: define exactly what to measure (the indicators).
b. **Instrumentalization**: create the collection forms or matrices.
c. **Data Collection**: the field phase or secondary data collection.
d. **Tabulation**: organization of the data so that they can "speak".
e. **Analysis and Interpretation**: where the data are confronted with the initial theory.

Financial data were extracted from the MCTI's *publication National Indicators of Science, Technology, and Innovation 2025* (BRASIL, 2025), specifically from Tables 1.2.2 (*Federal government expenditures on S&T, by agency, 2000–2023*) and 1.2.3 (*Federal government expenditures on R&D, by agency, 2000–2023*). Based on this information, comparative Figures were prepared for expenditures in S&T and R&D directed to the Ministry of Health and the Ministry of Education.

In addition, indicators related to the training of human resources and scientific capacity in Health Sciences were analyzed, also obtained from the same MCTI report (BRASIL, 2025), in the specific areas of the area. Data from the CNPq Directory of Research Groups (2023) (Table 2.4.2 – *Researchers registered by major area, 2000–2023*), CAPES on graduate scholarships awarded in the country (Table 3.7 – *Scholarships by large area, 2000–2024*), as

well as information on academic background, were used, based on Tables 2.2.1 (*Undergraduate graduates*), 2.3.2 (*Doctoral students*), and 2.3.3 (*Master's degree students*), all referring to the period from 2000 to 2024.

The analysis focused on input indicators, organized into two axes: (i) financial indicators, including federal expenditures on S&T and R&D, disaggregated by ministry and analyzed in annual historical series at current values; and (ii) indicators of scientific capacity and training of human resources, covering the number of undergraduate and graduate students, national and foreign graduate scholarships, and the number of researchers registered in the area of Health Sciences.

The methodological procedures involved descriptive analysis of the time series and interinstitutional comparison between the Ministry of Health and the Ministry of Education, with the organization of the data in Figures to allow the visualization of the patterns of funding and scientific training over the period analyzed.

3 RESULTS AND DISCUSSION

3.1 THE EVALUATION OF THE EVOLUTION OF INPUT INDICATORS IN SCIENCE, TECHNOLOGY AND INNOVATION IN THE AREA OF HEALTH

The analysis of the evolution of *input* indicators in Science, Technology, and Innovation (S&T) and Research and Development (R&D) in the area of Health, in the period from 2014 to 2023, shows distinct patterns of funding and formation of scientific capacities among the main federal actors, notably the Ministry of Health (MS) and the Ministry of Education (MEC). These indicators allow us to understand both the budgetary dynamics and the support of the human resource base and research groups responsible for national scientific production.

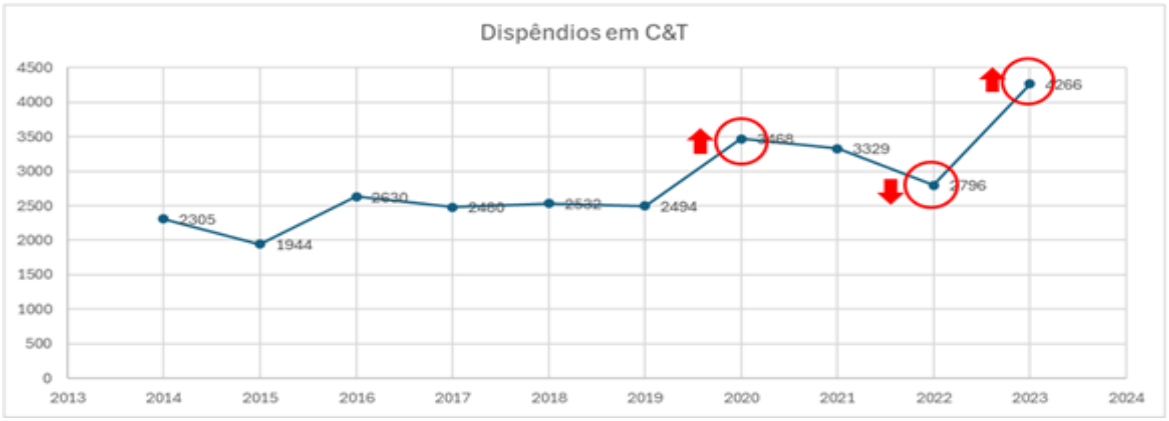
Figures 1 to 4 were generated with data from 10 years (2014-2023) from tables 1.2.2 and 1.2.3 of the *MCTI's National Indicators of Science, Technology and Innovation 2025* (BRASIL, 2025, p. 33 and 35).

Figures 1 and 2 show the amounts of expenditures indicated in the aforementioned tables made to the Ministry of Health. These Figures show significant oscillations in investments to the Ministry of Health, highlighting points of more significant increases or decreases in investments in the analyzed series. In S&T, there was a decrease between 2014 and 2015, followed by a recovery in 2016 and relative stability between 2017 and 2019. In 2020, there is a strong expansion in expenditures, followed by a retreat in 2021 and a further reduction in 2022. In 2023, investments reached the highest level in the time series (R$ 4.266 million), signaling a significant resumption of financing. The trajectory of R&D spending is

similar, with a decline in 2015, a recovery in 2016, stability until 2018, and growth in 2019. In 2020, there was a new peak, followed by retractions in 2021 and 2022. In 2023, R&D expenditures grew significantly again, reaching the highest level of the decade (R$3.883 million).

Figure 1

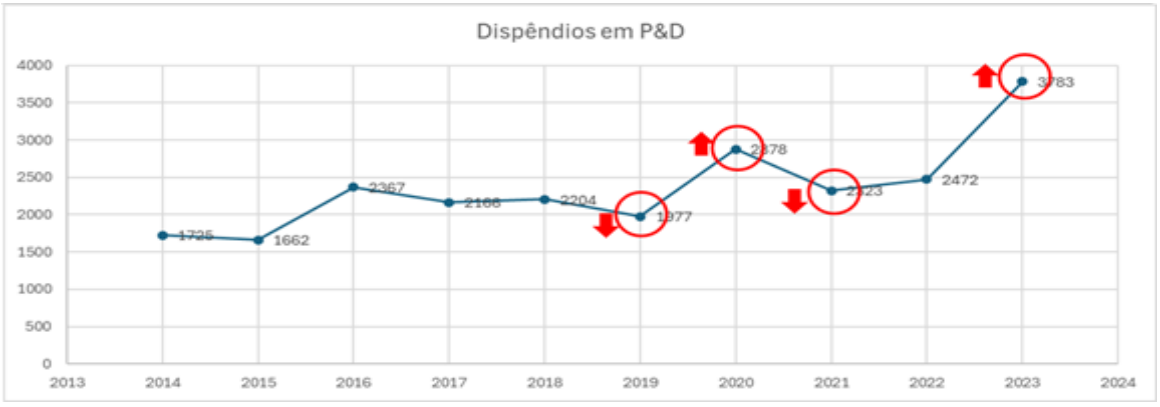
S&T expenditures to the Ministry of Health between 2014 and 2023



Source: BRAZIL (2025).

Figure 2

R&D expenditures to the Ministry of Health between 2014 and 2023

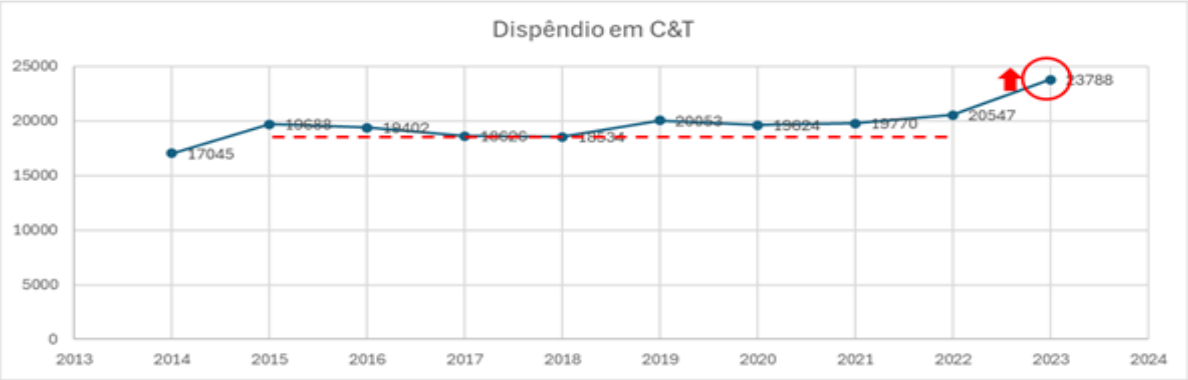


Source: BRAZIL (2025).

Figures 3 and 4 show the amounts of expenditures indicated in the aforementioned tables made to the Ministry of Education. In contrast to the Ministry of Health's outline, the Ministry of Education's expenditures on S&T and R&D show a significantly more stable trajectory over the period analyzed. Between 2015 and 2021, the values remain relatively constant, with small oscillations around a stable average. From 2022 onwards, there is more consistent growth, culminating in 2023 at the highest level in the series in both S&T (R$21.788 billion) and R&D (R$21.934 billion).

Figure 3

S&T expenditures to the Ministry of Education between 2014 and 2023.



Source: BRAZIL (2025).

Figure 4

R&D expenditures to the Ministry of Education between 2014 and 2023.

Source: BRAZIL (2025).

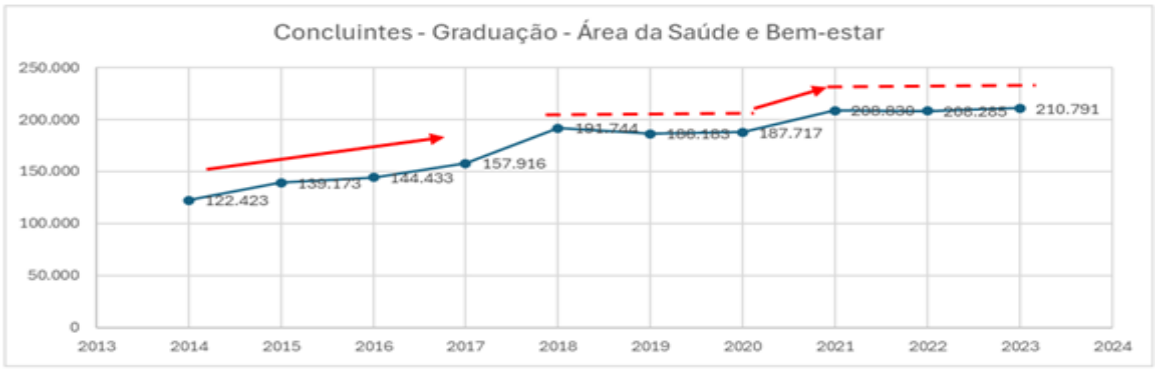
The comparison between the expenditures of the Ministry of Health and the Ministry of Education in S&T (Figures 1 and 3) and R&D (Figures 2 and 4) shows that there is no direct or synchronized link between the two budgets. While the MEC shows regular and predictable behavior, the MS exhibits greater volatility, responding to specific policies and health events. This dissociation suggests that these spheres of federal investment operate according to different logics: a structural one, aimed at maintaining the scientific base (MEC), and a conjunctural one, oriented to the application and response in public health (MH).

Figures 5, 6 and 7 were prepared with 10-year data from tables 2.2.1, 2.3.2 and 2.3.3 of the *MCTI National Indicators of Science, Technology and Innovation 2025* (BRASIL, 2025, p. 70, 76 and 79) and show that the training of human resources in the area of Health and Social Welfare showed gradual, but timid growth throughout the decade, both at the undergraduate and graduate levels. In undergraduate studies, there was a more upward trajectory between 2014 and 2017, followed by a decrease in pace between 2018 and 2020, forming a plateau, with a subsequent resumption in 2021 and a new stabilization until 2023.

A similar pattern is identified in graduate studies, with continuous growth in the number of master's and doctoral degrees until 2019, a sharp drop in 2020, and a gradual recovery in subsequent years. These movements indicate that, despite the expansion of the training base in Health Sciences, growth occurs in a contained way.

Figure 5

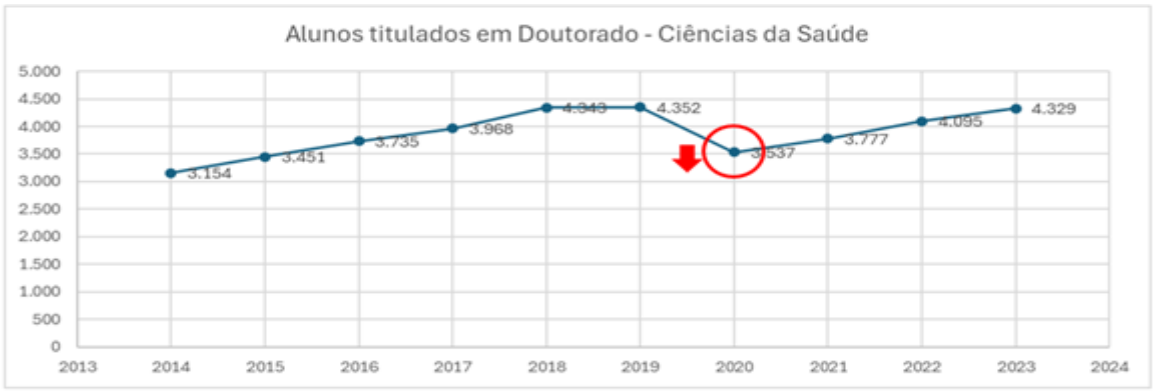
Number of graduating undergraduate students in the area of health and well-being between 2014-2023



Source: BRAZIL (2025).

Figure 6

Number of PhD students in the area of health sciences between 2014-2023



Source: BRAZIL (2025).

Figure 7

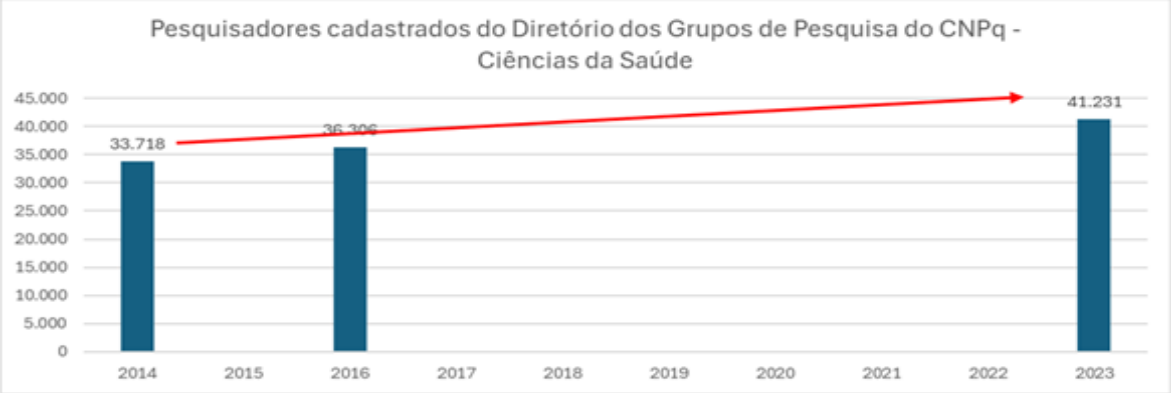
Number of students with master's degrees in the area of health sciences between 2014-2023

Source: BRAZIL (2025).

Figures 8, 9 and 10 were generated from tables 2.4.2 and 3.7 of the *MCTI National Indicators of Science, Technology and Innovation 2025* (BRASIL, 2025, p. 85 and 104). There is a continuous growth in the number of researchers registered in the CNPq Directory of Research Groups (2023) between 2014 and 2023, with an approximate expansion of 22%, indicating a strengthening of the scientific capacity installed in the country. However, this growth has not been proportionately matched by funding for advanced training. National graduate scholarships remained relatively stable between 2014 and 2018, with a slight retraction in 2019 and only timid growth until 2023. In contrast, graduate scholarships awarded abroad showed a strong retraction throughout the decade, with a sharp drop from 2015 onwards, reflecting the reduction in the internationalization of health research and the limitation of the global insertion of Brazilian researchers.

Figure 8

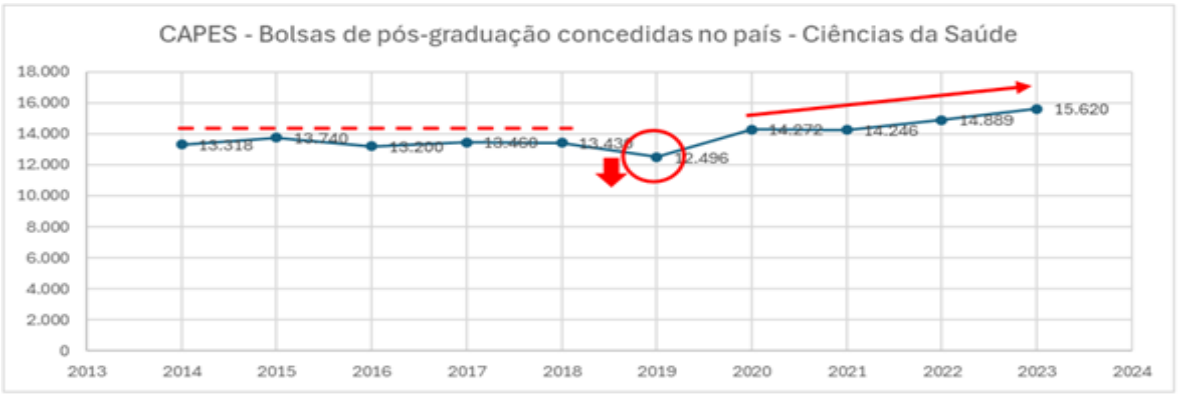
Number of Researchers Registered with CNPq – Health Sciences area, between 2014-2023



Source: BRAZIL (2025).

Figure 9

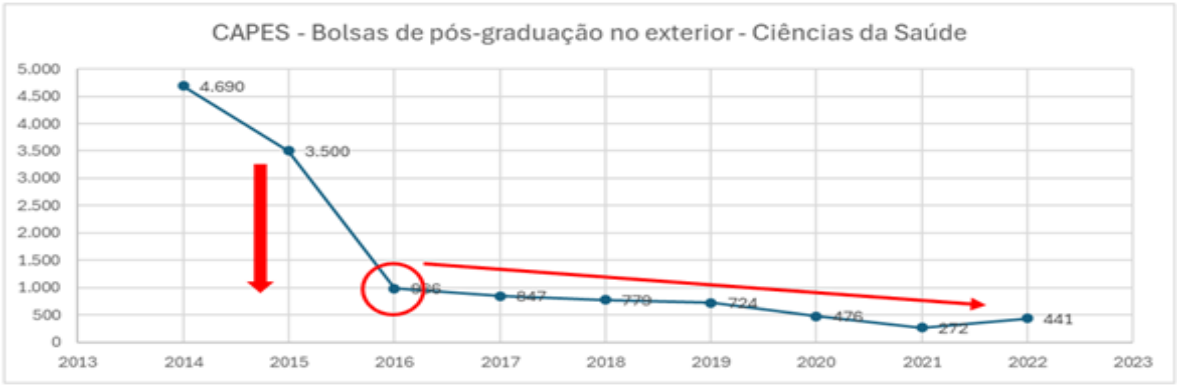
Number of CAPES Graduate Scholarships – Health Sciences area, awarded nationally between 2014-2023



Source: BRAZIL (2025).

Figure 10

Number of CAPES Postgraduate Scholarships – Health Sciences area, awarded abroad between 2014-2023



Source: BRAZIL (2025).

3.2 ALIGNMENT WITH GOVERNMENT PUBLIC POLICIES (2014-2023)

The alignment between public expenditures in Science, Technology and Innovation (S, T&I) and Research, Development and Innovation (R&D&I) in the areas of Health and Education with federal public policies from 2014 to 2023 reveals a trajectory marked by institutional advances, fiscal tensions and strategic redefinitions in the role of the State as an inducer of innovation. This alignment can be understood in three interdependent planes: political-normative, budgetary and strategic-programmatic.

Table 1

Federal Policies – Milestones and Alignments

Policy/Framework	***Alignment and Impact on S,T&I and R,D&I***
National Policy for Science, Technology and Innovation in Health (PNCTIS) – Ministry of Health (MS)	*The PNCTIS has consolidated itself as the structuring axis of the health innovation policy, prioritizing the strengthening of research applied to the Unified Health System (SUS), mainly through the Research for the SUS (PPSUS) program. The MoH's expenditures on S&T (see Table 1.2.3 of the MCTI's 2025 S&T Indicators) (BRASIL, 2025) reflect this orientation, with resources channeled to clinical and epidemiological studies and the development of assistive technologies and strategic medicines. The Department of Science and Technology (DECIT/SCTIE) played a central role in the operationalization of these resources, although budget execution was impacted by fiscal limitation and the slowness of transfers.*
Legal Framework for Science, Technology and Innovation (Law No. 13,243/2016)	*Established to make the management of public research more flexible and to encourage partnerships between universities (MEC), research institutes and the productive sector, the Legal Framework sought to reduce bureaucratic barriers and increase efficiency in the use of R&D resources. In the area of Health, the device expanded the possibilities of interaction between universities and public and private pharmaceutical laboratories, especially in biotechnology projects and vaccine production. In Education, it allowed greater integration between universities and companies, contributing to curricular and technological innovation in strategic areas.*
National Graduate Plan (PNPG 2011–2020) – MEC/CAPES	*The PNPG established guidelines for the expansion and qualification of the National Graduate System (SNPG), providing for strong integration with the S&T and Innovation agendas. The increase in the number of masters and doctors in the area of Health and Science Education shows the effect of public investments and the development policies of CAPES and CNPq. The PNPG also strengthened the training of qualified human resources to work in research and innovation networks, an essential element for the consolidation of R&D&I ecosystems. The new PNPG (2021–2030) reinforces this priority, highlighting health as a strategic area for innovation missions.*
Constitutional Amendment No. 95/2016 (Spending Ceiling)	*It represented a negative inflection point in public financing of S&T and R&D. By limiting the real growth of primary expenditure for 20 years, EC 95 reduced the investment capacity of the Ministries of Health (MS) and Education (MEC). Although the areas have minimal constitutional obligations, the cap imposed severe restrictions on discretionary spending, precisely those that finance grants, laboratories, and scientific infrastructure. This restriction generated structural misalignment between the rhetoric of innovation and budgetary practice, directly affecting the execution of development programs.*

Source: authors.

3.3 GOVERNMENT STRATEGIES AND PLANS (2019–2023)

Federal expenditures on S&T and R&D in the area of Health maintained coherence with the most recent government policies and plans, demonstrating that, even under fiscal constraints, there was an attempt to maintain coherence with the State's strategic missions:

a. Multi-year Plan (PPA 2020–2023): consolidated the guideline for strengthening the Health Economic-Industrial Complex (CEIS) (BRASIL, 2023), encouraging the national production of pharmaceutical inputs, vaccines, and medical equipment. This policy was reflected in the Ministry of Health's expenditures aimed at technological autonomy and innovation in public health, especially during and after the COVID-19 pandemic (BRASIL, 2020).
b. ST&I Plan for Sustainable Development (BRASIL, 2020): promoted the integration of the areas of health, biotechnology, and social innovation, seeking to combine technological innovation with the reduction of regional inequalities. Public investments in biotechnology and pharmaceuticals have aligned with this guideline, boosting R&D projects at universities and public institutes.
c. "New Industry Brazil" Strategy (BRASIL, 2024): still in the implementation phase, it anticipates developments from the previous cycle. NIB's "Health Mission" positions the sector as a vector of technological reindustrialization, prioritizing biotechnology, immunobiologicals and innovation in medical devices. Although outside the time frame (until 2023), its formulation derives from the institutional learning of the previous period, reinforcing the continuity of public policies for innovation in health.

3.4 THE DIMENSION OF EDUCATION AND SCIENTIFIC TRAINING

In Education, investments in S&T and R&D were strongly articulated with policies for the formation of human capital and educational innovation:

a. The MEC, through CAPES, CNPq and Federal Institutes, was responsible for boosting the development of scientific and technological skills at the national level.
b. The expansion of graduate studies and the creation of interdisciplinary programs aimed at pedagogical and technological innovation have strengthened the country's scientific base and sustained the training of researchers focused on priority areas (Health, Education and Technology).
c. Programs to foster educational and scientific innovation — such as PIBIC, the Professional Master's Program in Teaching, and the Interinstitutional Research Networks — were aligned with the guidelines of the PNPG and the goals of the National Education Plan (PNE).

3.5 STATES AND MUNICIPALITIES

The federated entities act mainly through:

a. Research Support Foundations (FAPs): State FAPs, such as those in São Paulo (FAPESP) and Minas Gerais (FAPEMIG), are crucial for R&D funding.
b. PPSUS: The Research Program for SUS (PPSUS) is a decentralized program (MS/CNPq/FAPs) that aligns research with state and municipal priorities, evidencing the federative coordination effort in S&T in Health.
c. Investment in Infrastructure (MEC): States and municipalities are responsible for maintaining part of elementary and secondary education. The contribution to S&T and R&D occurs more indirectly, through support for state universities or the use of resources linked to the Fund for the Maintenance and Development of Basic Education and the Valorization of Education Professionals (Fundeb).

3.6 ANALYTICAL SYNTHESIS

Between 2014 and 2023, it is observed that federal expenditures on S&T and R&D in Health and Education were strongly correlated with federal public policies (BRASIL, 2023; FIOCRUZ, 2023), with emphasis on:

a. The centrality of Health as a vector of national innovation, via PNCTIS, PPSUS and CEIS;
b. Scientific qualification as a State policy, via PNPG and CAPES;
c. The tension between inductive innovation guidelines and fiscal restrictions, especially after EC 95/2016;
d. The strategic reorientation of the role of the State, which, in the light of the Entrepreneurial Public Administration (MAZZUCATO, 2014; 2022), began to assume a more active role in inducing national development and innovation missions.

Thus, the period 2014–2023 configured a decade of institutional consolidation and financial challenges for the Brazilian S&T system, with Health and Education remaining as priority and complementary areas in the effort to transform knowledge into sustainable socioeconomic development.

3.7 HYPOTHESES FOR THE BEHAVIOR OF INDICATORS IN THE HEALTH AREA (MS + MEC)

The Figures indicate that the Ministry of Health's expenditures on Science and Technology and Research and Development do not present a linear or stable trajectory over time, but rather a cyclical behavior, strongly sensitive to conjunctural events. There was a significant increase in investments in 2020, which can be directly associated with the COVID-19 pandemic, a period in which there was an urgent demand for research aimed at the

development of vaccines, treatments, epidemiological studies, and strengthening the scientific capacity of the health system.

In 2023, there is a new peak in investments, which suggests a resumption or even a strategic prioritization of the area, possibly influenced by the lessons learned during the pandemic and the need to strengthen the research infrastructure and the response capacity of the health sector.

On the other hand, the decreases observed in 2015 and in the years 2021 and 2022 may be related to periods of fiscal adjustment or to the reduction of the budget priority allocated to the area, reflecting both changes in government guidelines and the economic context faced by the country at these times.

3.8 HYPOTHESES FOR THE MINISTRY OF EDUCATION'S INDICATORS

In contrast to the behavior observed in the Ministry of Health, the Ministry of Education's expenditures on Science and Technology and Research and Development show a more stable pattern over time. Between 2015 and 2021, investments remained relatively constant, which can be explained by the structural nature of these expenditures, mainly aimed at financing scholarships, maintaining graduate studies, and the functioning of higher education, which require continuous and predictable resources.

As of 2022, there is a growth trend, with emphasis on the values recorded in 2023, which may indicate the adoption of a policy to strengthen the educational and research system as a whole, reinforcing the role of higher education and graduate studies in national scientific production.

3.9 CORRELATION BETWEEN HEALTH AND EDUCATION INDICATORS

The analysis of the indicators reveals that there is no direct correlation between the budgets of the Ministry of Health and the Ministry of Education, since each portfolio has its own financing dynamics and different patterns of behavior over time. Even so, the joint observation of these data allows us to identify some relevant relationships. Although the investments of the Ministry of Education in Science and Technology and in Research and Development remain more consistent, the training of human resources in the area of health, both in undergraduate and graduate courses, showed a gradual expansion over the period analyzed, but with signs of stabilization. This behavior suggests the existence of a plateau, indicating that investments directed to health education were relatively modest and did not keep up with a faster pace of growth.

There is also a contradiction in the promotion of research in the area of Health Sciences. Despite the approximate growth of 22% in the number of researchers between 2014 and 2023, the funding mechanisms, especially graduate scholarships abroad, did not evolve at the same rate. On the contrary, there was a significant retraction in the number of scholarships awarded outside the country, evidencing limitations in the process of internationalization of Brazilian health research. National scholarships, in turn, remained relatively stable over the period, showing only timid growth until 2023, insufficient to compensate for the reduction in international training opportunities.

This scenario is directly related to the closure of the Science without Borders program, which had a significant impact on the promotion of graduate scholarships abroad, especially in the area of Health Sciences. The data show a sharp drop in the number of international scholarships, which went from 4,690 in 2014 to only 686 in 2023. This reduction coincides with the period after the end of the undergraduate program, in April 2017. Although Science Without Borders was later reformulated with a greater focus on graduate studies, this change was not enough to contain the significant decrease in the number of scholarships abroad. Thus, the end of the program is pointed out as one of the main factors responsible for the retraction of the internationalization of research and the limitation of the global insertion of Brazilian science.

As a consequence, the discontinuation of Science without Borders directly contributed to the reduction of the flow of Brazilian researchers abroad, negatively impacting the training of highly qualified human resources and international scientific cooperation, both in the area of health and in other fields of knowledge. In summary, the data indicate that funding in Science and Technology and Research and Development in the area of health tends to be reactive to specific events and specific policies, as occurred during the 2020 pandemic, in contrast to the more structural and continuous nature of investments in education. Despite the numerical growth of the system for training health researchers, funding has not kept pace with this evolution, especially with regard to internationalization, which may represent an obstacle to the development and competitiveness of Brazilian research in this area.

4 FINAL CONSIDERATIONS

The analysis of the period between 2014 and 2023 shows that the Brazilian S, T & I system in the health sector was marked by relevant institutional changes and recurrent fiscal instabilities. This interval ranges from the fiscal crisis of 2015–2016 to the attempts to recompose the budget in 2023, revealing the centrality of the State in responding to health emergencies, especially during the COVID-19 pandemic.

The results show that the MoH's spending on S&T and R&D presents a cyclical and predominantly reactive behavior, sensitive to external shocks, in contrast to the greater stability observed in the MEC's investments aimed at sustaining the scientific base. The investment peaks recorded in 2020, followed by retractions to pre-pandemic levels, show a structural fragility in the funding of applied health research, marked by the dependence on exceptional contributions to the detriment of permanent and predictable mechanisms.

In the axis of human resources training, there was an expansion of the base of researchers until 2020, followed by stagnation associated with budget retraction. Although the number of researchers has grown over the period, the reduction in per capita funding has compromised the continuity of long-term projects and the ability to retain talent. The discontinuity of internationalization policies, reflected in the significant drop in scholarships abroad after 2017, reinforced structural limitations to the international insertion of Brazilian science.

EC No. 95/2016 emerges, in this context, as one of the main factors of systemic restriction to the financing of S, T&I, deepening the misalignment between strategic innovation objectives and the fiscal reality (FIOCRUZ, 2023). Although normative frameworks such as the Legal Framework for S, T & I and the PNCTIS have created instruments favorable to cooperation between academia and the productive sector, their effects have remained conditioned to an environment of chronic underfunding, particularly sensitive within the scope of the SUS and the CEIS (BRASIL, 2023).

5 FUTURE PERSPECTIVES

In light of the findings of this study, the future prospects of S, T & I in health in Brazil depend on overcoming structural inconsistencies identified both in the literature and in institutional practice. One of the main gaps observed lies in the mismatch between the existence of legal frameworks favorable to innovation and the absence of stable financial mechanisms that guarantee its effective operationalization over time.

In this sense, future research can contribute to the development of financing models that articulate budget predictability and institutional flexibility, reducing dependence on emergency cycles associated with health crises. The literature still lacks comparative empirical analyses that assess the impact of different continuous funding arrangements on the sustainability of applied health research (BRASIL, 2023), especially in countries with universal systems similar to the SUS.

Another relevant inconsistency concerns the fragmentation of inter-institutional governance. The results indicate the need to deepen studies on coordination mechanisms

between MS, MCTI, MEC, CAPES, and CNPq (BRASIL, 2023), capable of aligning the training of human resources, scientific research, and technological innovation with the strategic priorities of the health system. Future investigations can explore integrated governance models that minimize overlaps, expand synergies, and optimize the use of public resources.

In addition, the retraction of internationalization policies reveals an important gap in the understanding of the long-term effects of the discontinuity of academic mobility programs on the quality, competitiveness, and global insertion of national science. Future studies may evaluate alternative strategies for international cooperation that reconcile fiscal constraints with the maintenance of strategic scientific networks.

Finally, the adoption of mission-oriented approaches, inspired by the Entrepreneurial Public Administration model, presents itself as a promising field of applied research. Future analyses can examine how this model can be adapted to the Brazilian institutional context, in order to articulate the existing scientific base with innovation guided by concrete challenges of the SUS, contributing to the strengthening of the CEIS (BRASIL, 2023) and to the expansion of technological sovereignty in health.

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