

ORIGINAL RESEARCH ARTICLE

International scientific cooperation in public health: A performance measurement framework based on the “Syphilis No!” Project in Brazil

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Abstract

In this article, we aim to propose indicators to evaluate the performance of international scientific cooperation in public health, based on the operation experience in Brazil’s “Syphilis No!” Project. This is an action research project, based upon Kaplan and Norton’s Balanced Scorecard Method, developed in five stages: (i) Reorganization of the indicators, (ii) validation of the new indicators, (iii) construction of the dimensions of the indicators, (iv) data collection for the indicators, (v) development of the framework for the “Syphilis No!” Project. The metrics and 34 indicators are presented and grouped into four dimensions: technical-scientific, investment, products, and impact. The cooperation that emerged from the project has built an international research network that has the potential to transcend syphilis research. The framework demonstrated that international scientific cooperations, focused on research and product development, have contributed to the promotion of public health policies and have enabled the exchange of knowledge, techniques, experiences, and technologies, fundamental to the international scientific cooperation of Brazilian universities. This contribution will have implications for studies in the field of international relations in health and education.

Keywords: International scientific cooperation; Syphilis; Health policy; Performance evaluation; Global health

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1. Introduction

International scientific cooperation in public health – understood here, according to Marrara (2007) quoted by (Loyola *et al.*, 2010, p. 2008), as the process of becoming international by means of scientific internationalization policies, that is, through “strategies at the service of the training of teachers, researchers, and students [...] carried out both by student activities (involving master’s and doctoral students) and teaching activities, such as research internships abroad, participation in international courses, and congresses and publications in international journals.” – is widely practiced around the world and is strategic for achieving global health goals. If well executed, it has the potential to improve countries’ institutional capacity and strengthen national health systems. Monitoring and evaluating the performance of international scientific cooperation in health therefore enable governments to implement actions in line with objectives, efficient resource allocation, and expected results.

Scientific research on performance evaluation of international scientific cooperation in public health remains scarce. According to Loyola *et al.* (2010):

The limitations imposed by the nature of the most of the data on international cooperation in Public Health, which served as the basis for this study, do not allow us to advance conclusive ideas about this cooperation, except for the need to expand and deepen studies in this area. Although its importance for the formation of Brazilian postgraduate programs as a whole is undeniable, little can yet be said about its effective contribution to the development of postgraduate programs in the area, as well as its real trends, past and future,^(p.2019)

Studies in this field often attempt to capture the financial resources invested, which is insufficient to fathom the social impact and role of international health cooperation in implementing public health policy (Andrade & De Carvalho, 2015; Freitas *et al.*, 2019; Lima, 2011). The system for evaluating the performance of cooperative activities plays an essential role in the conduct, adaptation, and implementation of public policies in health, as it makes analytical categories more flexible than financial

ones (Bititci *et al.*, 2000; Kaplan & Norton, 1997). This performance evaluation represents a critical dimension of short- and long-term strategic management, based on the careful formulation of indicators that provide an objective representation of reality. For Kaplan & Norton (1997), these indicators play a fundamental role in the management process and in managerial decision-making.

Performance evaluation is an important tool for public health policy because it allows us to (i) quantify results and, thus, improve evidence-based decision-making; (ii) quantify the efficacy, efficiency, and effectiveness of the practices adopted; and (iii) identify interventions that can improve health policy performance (Santos, 2013). In this sense, an evaluation framework should include technical factors inherent to international health cooperation and political factors related to the established institutional partnerships (Broniatowski *et al.*, 2008; Pereira *et al.*, 2021).

Against this background, this study aims to propose indicators to evaluate the performance of scientific cooperation in public health, through “Syphilis No!” Project of Brazil, by clarifying two research questions: (i) “What could define a performance evaluation system for international health cooperation agreements between government institutions in public health projects?” and (ii) “What are potential indicators to measure the performance of international scientific cooperation in public health projects, considering the 2030 Agenda?”. Of note, the 2030 Agenda (United Nations & Department of Economic and Social Affairs, 2015) fully supports cooperation with foreign higher education and research institutions and other international organizations and institutions aimed at partnerships for human, scientific, and technological development.

For Freitas (2021), both questions are guiding principles for building the perspectives of the performance evaluation system to align and balance the qualitative and quantitative measures related to international cooperation, especially regarding the global agenda. Therefore, the “Syphilis No!” Project of Brazil served as a reference for deriving related performance indicators. Through this work, we aim to contribute to facilitating more effective international scientific cooperation in public health interventions and policy-making processes between institutions and their stakeholders.

1.1. The Brazilian syphilis epidemic

Syphilis, an infection caused by *Treponema pallidum* subspecies *pallidum*, can be transmitted sexually and congenitally and lead to fetal and neonatal death (Luo *et al.*, 2021; WHO, 2021). The WHO's Global Health Sector Strategy on sexually transmitted infections (STIs) highlights the syphilis response as a global health priority, essential to achieving Sustainable Development Goal (SDG) 3, "Ensure healthy lives and promote well-being for all at all ages." (WHO, 2016).

Although it is an old public health problem, syphilis is reemerging worldwide, affecting countries regardless of their level of human development index (HDI) (Luo *et al.*, 2021; Moseley *et al.*, 2024; Spiteri *et al.*, 2019). Worldwide, there are an estimated one million cases of syphilis in pregnancy (SIP) per year.

In 2016, Brazilian federal control authorities requested the Brazilian Ministry of Health (MoH) to present a strategic plan to control the epidemic after incidence rates of syphilis escalated over the years. In January 2017, the Annual Budget Law No. 13,414 approved the allocation of 200,000,000 Brazilian Reais (BRL) for rapid interventions to combat syphilis to be implemented by the MoH (Mareco *et al.*, 2023; Pinto *et al.*, 2022). The national strategy to combat the syphilis epidemic, known as the "Syphilis No!" Project, has been implemented for a period of at least 4 years, starting in 2018.

1.2. The "Syphilis No!" Project

We explored international scientific cooperation in public health interventions under the "Syphilis No!" Project. Since 2018, the project has been implemented by the Brazilian National Health System (SUS). The Laboratory for Technological Innovation in Health (LAIS) at the Federal University of Rio Grande do Norte (UFRN) has implemented the project nationwide in partnership with the MoH (Mareco *et al.*, 2023; Pinto *et al.*, 2022). The project includes national and international technical cooperation actions to achieve its main objective of reducing the incidence of syphilis in Brazil.

The "Syphilis No!" Project was structured around five interrelated axes (Figure 1): (i) Education, (ii) surveillance, (iii) management and governance, (iv) comprehensive care, and (v) communication. Its driving forces are research activities and national and international cooperation activities, which cover all five axes of the project.

Projects under this cooperative model allow for the implementation of research activities designed to ensure the flow and creation of knowledge. This is done through specialized consulting, knowledge, and capacity building.

The infrastructure of the executing institution where the initiative is to be developed is also supplemented, including the provision of equipment, bibliographic materials, and laboratory instruments. This enables capacity building through the input of knowledge – technology transfer, experiences, practices, *etc.* (Caitano *et al.*, 2022).

Since 2018, at the beginning of the project, LAIS/UFRN, in collaboration with Brazil's MoH MoH and international institutions, has developed partnerships and international scientific cooperation. The agendas have focused on: (i) contributing to the fulfillment of the project's objectives; (ii) comparing the actions developed in Brazil with those of other recognized countries; and (iii) allowing the dissemination and exchange of the Brazilian experience and the actions that Brazil has developed in the areas studied, thus becoming more relevant in the global and international health scenario.

2. Data and methods

2.1. Study design

This is an action research study, as defined by Thiollent (2022) and Tripp (2005), which consists of researchers' effective action in solving problems, monitoring, and evaluating the cooperation actions of the "Syphilis No!" Project. In this regard, our research design was as follows: (i) reorganization of indicators, (ii) validation of new indicators, (iii) construction of dimensions for the indicators, (iv) data collection for the indicators, and (v) development of a framework applicable to the project.

2.2. Rearrangement of indicators

This phase began in 2021. It has followed the development of the project's international actions under the initiative of the new leadership of LAIS/UFRN's Institutional Relations Office. This underpins the action research approach as a method for monitoring and evaluating such cooperations (Thiollent, 2022; Tripp, 2005).

Our study draws on Freitas's (2021) research, which presented an initial proposal of indicators to measure the performance of cooperation efforts that could be applied to the "Syphilis No!" Project. The panel of indicators was drawn from the six perspectives of Kaplan and Norton's Balanced Scorecard (BSC) (Kaplan & Norton, 1997): Sustainability, Learning, Results, Processes, Stakeholders, and Resources.

Freitas's (2021) panel of indicators was used to select indicators suitable for measurement. In selecting the indicators, we were guided by the purpose and objectives of the project, as well as the institutional objectives of the UFRN's Institutional Development Plan (PDI) 2020 – 2029, in terms of its international positioning.



Figure 1. Dynamics behind the execution of the “Syphilis No!” Project. Image created with Adobe Illustrator.

Four of UFRN’s PDI’s many initiatives should be highlighted. First, promoting international cooperation between researchers and undergraduate and graduate students. Second, enhancing internationalization agents through partnerships with international institutions. Third, building international collaboration in developing research of global interest and partnerships that encourage UFRN researchers to cooperate with international research. Finally, participating in national or international cooperation networks, whose goals and proposed actions strengthen the institution’s research areas (Universidade Federal do Rio Grande do Norte, 2021).

2.3. Validation of new indicators

In this phase, key project participants, including public health managers, project leaders, and experts in syphilis and other STIs, were interviewed. All interviewees had national and international experience. In addition, we took into account the premise of action research, which provides for the need to monitor decision-making (Thiollent, 2022; Tripp, 2005).

The interviews were critical for validating and identifying other indicators for international health cooperation. They also supported the validation of the panel of performance indicators for international cooperation in the project implementation. The guiding questions during the interviews were:

- (i) What do you think of the dimensions/perspectives of the performance management system?
- (ii) What indicators do you think should be added to this system to better evaluate performance?

2.4. Building dimensions for indicators

In implementing action research as a model for the panel Freitas (2021) proposed, dimensions were created to group the new indicators and advance the perspectives of

the performance evaluation system of the international cooperation project.

These dimensions, grouped here as technical-scientific, investment, impact, and products, each include a set of indicators that were validated in the interviews. The dimensions identified are consistent action research and balanced scorecard (BSC) (Kaplan & Norton, 1997) in that they allow for interventions and corresponding adjustments to monitor and evaluate cooperation activities. Such interactions allow restructuring according to priorities and solutions based on the reality under study. This phase prompted the development of the project’s framework.

2.5. Data collection for indicators

In a further step, we collected data from project management documents, cooperation activities, and international cooperation agreements signed by the UFRN as part of the “Syphilis No!” Project. Documents included work plans, reports, technical notes, and other records of cooperation activities, such as data from the Virtual Learning Environment of the Brazilian Health System (AVASUS).

Once the sources were organized, they were coded according to the typology of international cooperation activities between January 2018 and July 2023, e.g., technical notes and cooperation agreements. At this stage, we realized that we needed an automated system to monitor the indicators, which we then developed as a tool to evaluate the performance of cooperation activities.

2.6. Development of framework applied to the “Syphilis No!” Project

Figure 2 shows the model of a performance measurement system, which is the main result of this research. It is based on the BSC method adapted by Freitas (2021) and applied to the project’s international cooperation

activities. This framework relies on the following: (i) An orbit of six perspectives to measure the performance of the project cooperations and (ii) four analytical categories, namely dimensions, to evaluate the performance of the cooperations. The orbit of perspectives that permeate all dimensions includes the elements of Sustainability, Resources, Processes, Learning, Stakeholders, and Results.

The performance evaluation perspectives promote and determine a set of activities that facilitate the dimensions of cooperation and the corresponding indicators. This relationship occurs in a cascade effect, where the positive outcome of one dimension directly impacts the other and serves as the basis for the development of the indicators provided (Kaplan & Norton, 1997). In this proposal, the perspectives and their respective concepts are understood as follows:

- (i) Sustainability: Combines the impacts, benefits, and products resulting from the contribution of the cooperation relationships established under the “Syphilis No!” Project. The indicators can be used to verify the extent to which the benefits generated will persist despite the termination of the established cooperation relationship.
- (ii) Results: Refers to the effectiveness of the cooperation, i.e., it is closely related to the quality of the implementation of processes related to the cooperation agreements and their respective work plans, as well as their impact on the project’s target groups. This perspective clearly unfolds in the technical-scientific dimension of the cooperation.
- (iii) Stakeholders: Includes indicators that measure the strengthening of relationships with individuals, groups, or organizations that may interfere with or be affected by cooperation activities. This dimension

- takes into account the need for parties in agreements and work plans to be aligned with the overarching goal of cooperation.
- (iv) Processes: Refers to the identification of the means by which the expected results of the cooperative action will be achieved. The categories and indicators of processes for performance evaluation refer to aspects considered most efficient to achieve optimal results in the cooperation.
- (v) Learning: Refers to capacity-building, growth, and improvement in the internal management of cooperation processes, which must be done using resources, information technologies, and improvements in management practices. The learning processes are not only applicable to the team but also related to structures such as the workplace and the means of obtaining information to facilitate the effectiveness of cooperation activities.
- (vi) Investments: The means by which work plans can be operationalized. It is worth noting that, in this model, the performance measurement indicators are not profit-oriented, although this perspective is directly related to the financial investment dimension.

3. Performance evaluation system for international scientific cooperation in public health: A framework applied to the “Syphilis No!” Project

This performance evaluation system includes the categories or dimensions that emerged from the empirical phase of this research, as well as the set of duly validated indicators. The indicators and their respective equations are given in the Appendix.

The relevance of the individual indicators for answering the research questions is analyzed in the following sections. Our discussion was conducted from the perspective of the SDGs of the United Nations’ 2030 Agenda (United Nations & Department of Economic and Social Affairs, 2015).

3.1. Technical-scientific dimension

In the performance evaluation system, this dimension is closely linked to the results and learning perspective of international cooperation. Its indicators make it possible to measure the scope and diversity of the project regarding International Public Health Cooperation. Figure 3 illustrates the uniqueness of the project, which spans almost all continents, from the West to the East, and includes 18 countries with different characteristics.

Such diversification also demonstrates flexibility, transdisciplinarity, interculturality (or transculturality), and the ability of researchers to adapt to each agenda and

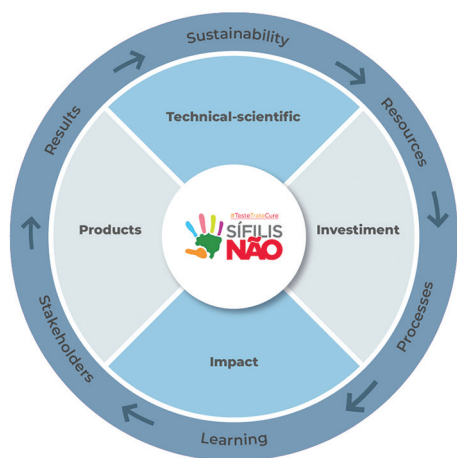


Figure 2. Framework for performance evaluation. Image created with Adobe Illustrator.

its unique contexts and characteristics. The documents analyzed showed that each research group carries out different activities depending on the cooperating institution, but they are always aligned with the objectives of the “Syphilis No!” Project and create synergies. The indicators reflect the project’s capacity for articulation, responsiveness, and resilience. This was important to consolidate all the objectives with international scope and deliver good technical-scientific and sustainable results to the main stakeholder, *i.e.*, the Brazil’s MoH.

As part of institutional alignment and improvement, LAIS/UFRN developed the Institutional Relations System (SIRI) as part of the “Syphilis No!” Project (see <https://siri.lais.ufrn.br/>). Such a move directly underpins the learning perspective of the performance evaluation system developed.

SIRI is a management platform developed to support the management of international cooperation activities. This tool enables us to track cooperation missions from start to finish, to produce management reports on cooperation activities, and to monitor the products and artifacts created during the development of such activities.

The profiles available in SIRI refer to the set of authorizations assigned to each user to access and use the many functions of the system. These are:

- (i) Mission Researcher: responsible for registering the technical note proposals, viewing the technical notes in which they participate, and sending individual mission reports.
- (ii) System Administrator: responsible for managing system parameters, including types of missions,



Figure 3. World map of international scientific and technical cooperation activities. Image created with Adobe Illustrator. Notes: Number of missions = 94; Number of participating institutions = 36. The total number of institutions refers to the sum of all the international institutions participating in the project. Image created with Google Sheets.

locations, institutions, users, access profiles, and approval of link requests.

- (iii) Institutional Relations Supervisor: responsible for approving access requests, managing technical notes (creation, editing, changes, approval, delegation management, backlogs, and export), managing work plans (creation, approval, and update), and individual mission reports (approval, product management, and backlogs). General Mission Coordinator: full and complete oversight of the management of all technical notes, work plans, and individual mission reports. They are the only users authorized to cancel an approved technical note.
- (iv) Institutional Relations Operator: responsible for monitoring the individual mission reports in relation to the project management reports and for the registration and authorization of applications and other administrative activities related to the mission.
- (v) Mission Leader: responsible for monitoring the work plan of the research mission, for which he/she is responsible.
- (vi) Mission Staff: researchers from partner institutions who are members of the delegation, with the same rights as the mission researcher, except for the registration of proposals for technical notes.

In SIRI, the process of an international cooperation activity begins with the registration of a cooperation mission. As soon as this process is completed, a “Technical Note” is created. This document serves as a reference for the cooperation mission, its staff, and the institutions of cooperation partners. The technical note contains strategic information to guide and account for the management indicators, such as the objective, the location of the mission, the researchers involved, the type of mission, related projects, the context, and a justification for the mission.

At the end of the technical-scientific cooperation mission, SIRI allows collaborators to register mission completion reports which are accessible to each collaborator and correspond to the hierarchical profile to which they are assigned in SIRI and the corresponding mission. The final reports list the results of the mission, as defined in the technical note, as well as the products and artifacts produced during the duration of the mission.

With the flow developed by SIRI, it is possible to create a database on cooperations, objectives, and results of activities carried out jointly with foreign institutions. This promotes the exchange of knowledge, experience, and the production of scientific material and feeds into the indicators of the project’s international cooperation panel.

The international technical-scientific cooperation measures carried out as part of the “Syphilis No!” Project are characterized by three types of activities within

the scope of the respective cooperation. These are (i) exploratory missions, (ii) missions with signed cooperation agreements or work plans, and (iii) missions that include any international cooperation activity related to the project.

Exploratory missions aim to prospect possible international cooperation activities to be developed within the project. Such missions are aimed at the future development of new research, joint actions, or the signing of new cooperation agreements and work plans. This is an essential activity to consolidate institutionalization, internationalization, and cooperation between the institutions and researchers involved.

Missions with signed cooperation agreements or work plans are activities to carry out planned activities to achieve the objectives, and products agreed with the partner institutions.

The missions which include other types of cooperation activity comprise various cooperation efforts. They are characterized by occasional international activities, such as laboratory visits and the development of specific studies related to the project’s objectives, participation in scientific events, conferences, and the presentation of papers, among other technical-scientific activities.

Figure 4 shows the number of participating institutions and the number of missions carried out during this period. It can be seen that the number of institutions and missions carried out between 2018 and 2019 reflect the needs that led to the effective launch of the “Syphilis No!” Project. Not only was scientific research carried out but also fundamental negotiations for international cooperation were also conducted, leading to master’s, doctoral, and postdoctoral studies.

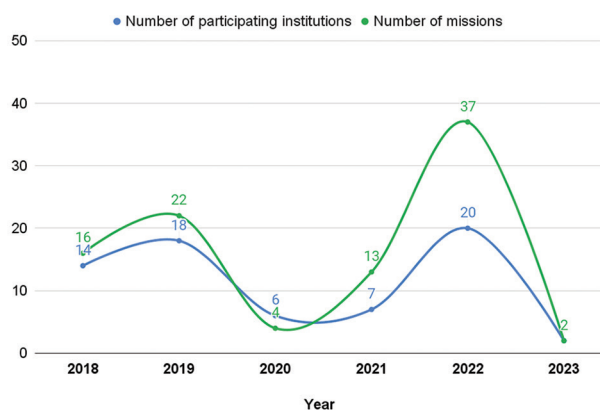


Figure 4. Indicators and quantities generated in the technical-scientific dimension. Notes: Number of missions = 94; Number of participating institutions = 36. The total number of institutions refers to the sum of all the international institutions participating in the project. Image created with Google Sheets.

Figure 4 illustrates the efforts made to implement international cooperation activities based on the needs of the “Syphilis No!” Project’s objectives. Activities with foreign institutions increased between 2018 and 2019. This increase in intensity, *i.e.*, effort, was due to the requirements of the project, which had to be institutionalized at international level in the 1st year (2018 – 2019). This was necessary to ensure the implementation of research and other activities to be operationalized between 2019 and 2023. The decrease in the number of activities carried out in 2020 is due to the reduced international traffic due to the coronavirus disease 2019 (COVID-19) pandemic, which was declared by the World Health Organization (WHO) on March 11, 2020.

Some of the cooperation activities could be maintained remotely during the pandemic, allowing the project to continue in part. The resumption of scientific research activities after the COVID-19 immunization and the suspension of stricter measures enabled an expansion of international cooperation activities between 2021 and 2022. This expansion stood for the sustainability of the project activities and ensured that the first results were published as scientific articles in high-ranking international journals.

During the same period, new and consolidated partnerships were extended until the first half of 2023 through the signing of cooperation agreements and work plans. Even though the project was concluded, the renewal of the work plans demonstrates the sustainability of the project’s international relations, and the trust placed in the partnerships it has initiated.

The technical-scientific dimension comprises seven indicators that are used to quantify and monitor the level of performance and the impact of the measures implemented as part of the international cooperation missions. Table 1 describes the indicators and their respective quantities generated during the period analyzed.

Table 2 lists the 14 cooperation agreements signed between UFRN and international academic and scientific institutions as part of the “Syphilis No!” Project. For each agreement signed, a work plan had to be drawn up defining specific objectives and products to be developed in collaboration and synergy between the institutions. Table 3 lists the 14 work plans that were jointly developed by the partner institutions.

Both instruments enabled 685 national and foreign researchers to participate in cooperation activities with international partner institutions. They developed research work within the framework of the project.

3.2. Investments dimension

The investment dimension refers to the amount of financial resources made available to realize the goal of international

Table 1. Indicators and quantities generated in the technical-scientific dimension

Item	Indicator	Quantity
1	Cooperation agreements	14
2	Work plans	14
3	Technical-scientific cooperation missions	94
4	International institutions involved in cooperation activities	48
5	Brazilian institutions involved in cooperation activities	27
6	Outreach activities (academic events)	54
7	Cooperation missions with two or more foreign institutions	18

Source: Adapted from the accountability reports for Decentralized Execution Terms (TED) No. 54 and 111/2017.

Table 2. Cooperation agreements signed between UFRN and international academic and scientific institutions under the “Syphilis No!” Project

Institutions	Country	N*
Institute for Healthcare Improvement	United States	1
Instituto Superior Politécnico Católico de Benguela	Angola	1
Universidade Aberta de Portugal	Portugal	2
Universidade Autónoma de Barcelona	Spain	1
Universidad Complutense de Madrid	Spain	2
Athabasca University	Canada	1
University of Coimbra	Portugal	1
Drexel University	United States	1
Université de Lorraine	France	1
Universidade Eduardo Mondlane	Mozambique	1
Universidad Nacional de Colombia	Colombia	1
University of Borås	Sweden	1
Total		14

Notes: *Number of agreements per institution. Current agreements can be accessed on the website of UFRN’s Secretariat for Institutional Relations, available at: https://sri.ufrn.br/acordos.php?a=ac_acordos. Source: Adapted from the accountability reports for Decentralized Execution Terms (TED) No. 54 and 111/2017.

cooperation within the framework of the “Syphilis No!” project. This dimension plays an essential role in the implementation of the international cooperation activities and the proper progress of the joint research between the partner institutions and ensures that the proposed activities and project objectives are achieved.

According to the project documents, the financial investment in international cooperation had a direct impact on all other objectives of the “Syphilis No!” project. This characterizes cooperation activities as a real driving

force behind public policy, an element that combines this dimension with the perspective of sustainability in the performance evaluation system.

The indicators generated in this dimension (Table 4) are based on the total amount of funding allocated to the development of the international cooperation activities (ICA) of the “Syphilis No!” Project, R\$ 23,000,000.00 (twenty-three million *Brazilian Reais*) or US\$ 4,581,673.31.1 The set of indicators was intended to measure the financial investment per capita and per activity carried out within the project, such as missions carried out, agreements and plans signed, and products manufactured.

1 Dollar exchange rate as of September 27, 2023, according to the value provided by the Brazilian Central Bank, available at <https://www.bcb.gov.br/estabilidadefinanceira/fechamentodolar>.

Table 3. Work plans signed with partner institutions under the “Syphilis No!” Project

Institutions	Country	N*
Athabasca University	Canada	1
Johns Hopkins University	United States	1
Institute for Healthcare Improvement	United States	2
Universidade Aberta de Portugal	Portugal	3
Universidade Autónoma de Barcelona	Spain	3
Universidad Complutense de Madrid	Spain	2
University of Coimbra	Portugal	2
Université de Lorraine	France	1
Total		14

Note: *Number of work plans per institution. Source: Adapted from the accountability reports for Decentralized Execution Terms (TED) No. 54 and 111/2017.

Table 4. Indicators for the investment dimension

Item	Indicator	Formula	N	Investment in BRL	Investment in USD*
1	Investment per participant benefited from international cooperation activities	$\frac{ICA}{\sum N}$	60,272	381,62	76.02
2	Investment per number of participating institutions		36	638,888.89	127,268.70
3	Investment per number of technical-scientific cooperation missions		94	244.680.85	48,741.21
4	Investment per cooperation agreements signed		14	1,642,857.14	327,262.38
5	Investment per work plans signed		14	1,642,857.14	327,262.38
6	Investment per participant impacted through the production of courses and open educational resources		45,172	509.16	101.43
7	Investment per participants in international events promoted by the project		14,396	1,597.67	318.26
8	Investment by Brazilian and foreign participants in international missions		685	33,576.64	6,688.57
9	Investment per total of products developed		94	252,747.25	50,348.06

Notes: *Dollar exchange rate as of September 27, 2023. Formula= $ICA/\sum N$, where: ICA=Amount of resources allocated to the project for the development of international cooperation activities; N=Quantity. Source: Prepared by authors. Abbreviations: BRL: Brazilian Real; USD: United States dollar.

3.3. Impact dimension

Table 5 contains details on the impact dimension. This includes the indicators and their respective quantities that relate to the project’s international cooperation activities. These social indicators are important to assess the project’s scope in this dimension, which is often overlooked despite its importance. They also serve as a good indicator of the project’s sustainability and response to real social problems, such as the syphilis epidemic in Brazil.

Table 5 shows that the international cooperation developed through the project has reached more than 60,000 participants. These include students, professors, researchers, health professionals, and people from the community who are interested in the topics covered by the cooperation.

The coverage and reach of the project’s social impact are linked to the countless activities and products that have resulted from the project. In sum, these are course enrollments, events in which researchers and society have participated, research activities carried out, scientific articles published, courses and Open Educational Resources (OER) (Ossiannilsson, 2023; Santos, 2013; UNESCO, 2019), patents applied for, software registrations published, doctoral theses, master’s dissertations, course completion papers, technical reports, and so forth.

Particularly worth mentioning are the courses and OER that has been created on the project’s topics and are offered through the Virtual Learning Environment of the Brazilian Health System, AVASUS. AVASUS is currently one of the largest training platforms for the health-care sector in the world, with more than one million students enrolled (Valentim *et al.*, 2022). More than 45,000 users are enrolled

Table 5. Indicators and quantities for the impact dimension

Item	Indicator	Quantity
1	Participants in international events promoted by the project	14,396
2	Brazilian and foreign participants in international missions	685
3	Participants impacted by the production of courses and open educational resources through international cooperation (enrolled participants)	45,172
4	Professionals who received post-doctoral training	5
5	Professionals trained in doctoral programs	4
6	Professionals trained in Master's Degree courses	8
7	Professionals trained in undergraduate courses	2
Total		60,272

Source: Adapted from the accountability reports for Decentralized Execution Terms (TED) No. 54 and 111/2017.

in the courses offered on AVASUS as part of the cooperation. As these are OER, they are available under a Creative Commons 4.0 license: CC BY-NC-SA, thus achieving an even greater social reach. This is because the content can be completely reused, restructured, and remixed openly and freely for the entire population without needing copyright or license fees (Santos, 2013). This aspect increases the dissemination and visibility of the results of international cooperation, as a much larger number of people can be reached. It also helps to improve the cost-effectiveness of the products developed and the per capita value per participant.

In this sense, we observed that the products of the project's international cooperation have effects that benefit not only the group of researchers in their stricto sensu graduate work. They also benefit society in that other people can utilize the results of the applied research and thus contribute to combating the syphilis epidemic in Brazil.

At the same time, the results of international cooperation have contributed to a significant improvement in the overall cost-efficiency of the project. Especially, when it comes to achieving the cooperation objective, which was clearly beyond its scope, as the original project proposal was limited to four institutions. Of note, a total of 36 institutions have been reached so far. This result is eight times greater than the number of international institutions originally proposed. This is also a positive aspect in terms of the relevant social impact of the "Syphilis No!" Project, which outweighs the efficiency and effectiveness of the project as originally intended.

3.4. Products dimension

Table 6 shows the indicators and the number of products achieved during the study period, *i.e.*, from January 2018

to July 2023. Researchers from Brazilian universities and institutions have collaborated with researchers from institutions and universities abroad on all products generated as part of the international collaboration of the "Syphilis No!" Project. All these foreign universities and nations are also listed in Table 6, grouped by indicator.

Of note, developing a rapid test platform for diagnosing syphilis prompted two patent filings (Barros *et al.*, 2022). The current methods for syphilis testing pose barriers, especially for case management, as the results are insufficient for finalizing the diagnosis, which requires additional tests for positive cases. Brazil currently spends around 50 million dollars annually on the import of rapid tests for syphilis alone (Lara, 2021; Ornelas & Gaspar, 2019). The screening test developed by the "Syphilis No!" Project through international cooperation could reduce these annual costs by up to 75%. This may translate to considerable savings for Brazil, as well as the possibility of exporting to other countries.

The following section discusses the significance of each indicator for answering the research questions. Our discussion is framed from the perspective of the SDGs of the UN's 2030 Agenda (UN, 2015; UN & Department of Economic and Social Affairs, 2015).

4. Discussion

In this study, we found that 36 institutions participated in international scientific cooperation as part of the "Syphilis No!" Project, outstripping the original target of only four participating institutions – a prominent sign of the project's success.

Achieving and exceeding the goal of international cooperation, especially in terms of the number of international cooperation agreements signed, shows that syphilis control is also a problem in the context of global health and international human mobility. The issue is exacerbated by the major social changes of present times. According to Luo *et al.* (2021), syphilis is currently not only a problem limited to low- and middle-income countries but also a serious public health challenge in several countries worldwide. Unfortunately, it continues to be one of the main causes of infant mortality and international human mobility (Ramos *et al.*, 2023). This helps to explain the interest of institutions from other countries in participating in the project.

Therefore, international cooperation has made it possible to share knowledge, expand the expertise developed in Brazil, and connect with the experiences acquired in the countries participating in the cooperation. This was a positive aspect, as it created an opportunity for knowledge transfer while developing skills to master

Table 6. Indicators and quantities for the product dimension

Item	Indicator	Quantity	Institution (Country)
1	Awards	1	Université de Lorraine (France) International Council for Distance and Open Education (Norway)
2	Scientific papers in journals	36	Athabasca University (Canada) Complutense University of Madrid (Spain) Harvard University (United States) International Council for Open and Distance Education (Norway) Johns Hopkins University (United States) Open University of Portugal (Portugal) University of Barcelona (Spain) University of Coimbra (Portugal)
3	Books published	02	Athabasca University (Canada) Autonomous University of Barcelona (Spain) Complutense University of Madrid (Spain) Nursing School of Coimbra (Portugal) Open University of Portugal (Portugal) Université de Lorraine (France) University of Coimbra (Portugal)
4	Book chapters	13	Athabasca University (Canada) Autonomous University of Barcelona (Spain) Complutense University of Madrid (Spain) Nursing School of Coimbra (Portugal) Open University of Portugal (Portugal) Université de Lorraine (France) University of Coimbra (Portugal)
5	Capstone projects	02	Complutense University of Madrid (Spain) University of Massachusetts (United States)
6	Master's dissertations	08	Open University of Portugal (Portugal)
7	Doctoral theses	04	Open University of Portugal (Portugal)
8	Postdoctoral reports	05	Open University of Portugal (Portugal) University of Coimbra (Portugal)
9	Patents filed	02	Johns Hopkins University (United States) University of Coimbra (Portugal) University of Massachusetts (United States)
10	Software registrations	10	Johns Hopkins University (United States) University of Coimbra (Portugal) University of Massachusetts (United States)
11	Courses and Open Educational Resources	12	Athabasca University (Canada) Autonomous University of Barcelona (Spain) Complutense University of Madrid (Spain) International Council for Open and Distance Education (Norway) Johns Hopkins University (United States) Open University of Portugal (Portugal) Université de Lorraine (France) University of Coimbra (Portugal)
	Total number of products	95	Number of countries 06 Number of institutions 12

Source: Adapted from the accountability reports for Decentralized Execution Terms (TED) No. 54 and 111/2017.

the methods used in the field of global health (Ventura *et al.*, 2020).

The project's cooperation actions have demonstrated the capacity of Brazilian researchers to engage in dialog with the international literature, question it, and

contribute to emerging critical schools (Ventura *et al.*, 2020). By placing the methods and processes developed in Brazil to combat syphilis on the global health agenda – while adopting the critical thinking of the international schools from a transdisciplinary, transversal, and

horizontal perspective – the project evidenced robust effectiveness, distribution, and utilization of the available resources. Moreover, the project has also encouraged foreign researchers' mobility to Brazil, stimulating their interest and boosting research results. This is the case for research internships, the organization of joint international events, or requests for new projects between Brazilian and foreign universities.

The “Syphilis No!” Project developed international cooperations that spontaneously and synergistically created an international research network. In the specific case of syphilis, this represents the sustainability of an international cooperation network that invites Brazil to resume its leading role in the global health governance agenda (Ventura *et al.*, 2020). This will formally strengthen a network between institutions and researchers that can be replicated for other global health issues and needs – something extremely valuable in the post-pandemic world and in a global and interdependent world.

Establishing an international cooperation network requires long-term joint activities by the participating institutions. A project such as “Syphilis No!” enabled this level of academic investment and consolidated the architecture of a mechanism that can be applied to other research projects with converging objectives in the fields of innovation and health. Likewise, the forward-looking work of LAIS/UFRN will become an instrument of international engagement not only with syphilis but also with any other epidemic or medical demands that need to be addressed at an academic-scientific level.

Even in the face of a public health crisis such as the COVID-19 pandemic, the project's international cooperation missions were not suspended, indicating the pro-science nature of the movement. It withstood the tensions caused by the prevailing, most anti-science political attitudes at the time, whose tendency would jeopardize the future of the implementation of the 2030 Agenda in Brazil (Fernández-Portillo *et al.*, 2020; Ventura *et al.*, 2020). Moreover, the syphilis epidemic in Brazil has not been halted by the COVID-19 pandemic.

Remarkably, such a complex movement was overcome by the project's high commitment, adaptation, resilience, and responsiveness, which sought to act symbiotically with the public health crisis triggered by COVID-19. Many of the project's actions had to be incorporated into the COVID-19 agenda in an articulated and negotiated way to ensure their consistency with the theme. This was necessary because the pandemic was an agenda of great importance and priority. If these articulations and negotiations had not taken place, all the actions developed in relation to syphilis could have been lost.

An example of the articulation between the COVID-19 pandemic and the syphilis epidemic was the development of the Salus Platform. The platform had to address both diseases, even though it was initially designed for syphilis. Adopting a new technology like Salus during the pandemic would have been almost impossible if it did not aid COVID-19 monitoring – and that was an important lesson (Brito *et al.*, 2023; Fernández-Portillo *et al.*, 2020; Lee *et al.*, 2020).

After the pandemic, the model the project implemented for the cooperations presented a new tendency of growth in actions compared to the pre-pandemic period. In this vein, the sustainability of cooperation activities was described as a pillar of international cooperation in health. For the interviewees, this dimension represents the continuity of the benefits generated by the project after its end, even after the conclusion of a cooperation agreement.

The interviews showed that financial planning was fundamental to achieving good results and implementing the cooperation measures in a way that went far beyond what was originally planned. The allocated funds not only strengthened the sustainability of cooperation but also synergized other sub-projects and helped drive public health policy, demonstrating the effectiveness and efficiency of the project's investments. A close look at the relationship between the amounts invested and the indicators – especially those in Table 4 – clearly demonstrates how solid the results are and their impact on the national and global health agenda.

The OER developed for the AVASUS are case in point. In the context of the syphilis epidemic, changes in the SUS workflows ignited actions under the national policy on syphilis control. Such initiatives were associated with the offer of educational resources on the topic of STIs on AVASUS. The increase in syphilis testing was one of the changes observed (Caitano *et al.*, 2022; J. L. R. S. Valentim *et al.*, 2023).

Process improvement was also observed. During the development of the project, processes were redesigned and improved through research, learning, and the experience gained (Ferreira *et al.*, 2023). These factors have contributed to improved and transparent analysis of activities and have promoted the discussion about the system and interaction in international cooperation in health care. The results show that the technical-scientific cooperation established in the “Syphilis No!” Project can be regarded as an initiative within the framework of cooperation practices.

When also considering cooperation measures with foreign higher education institutions and international organizations, the project's initiatives are valuable in achieving the SDGs of the UN's 2030 Agenda (UN & Department of Economic and Social Affairs, 2015). These

contributions are based on the indicators (Brasil, 2018) for monitoring and evaluating the 17 SDGs and their respective 169 targets developed by the Institute for Applied Economic Research (IPEA). When analyzing the performance of cooperation measures, it becomes noticeable that such contributions mainly focus on SDG 3 (Brasil, 2019) and SDG 17 (Brasil, 2020) and lie in the context of human, scientific, and technological development at a global level.

Regarding SDG 3 (Brasil, 2018; 2019), which aims to ensure healthy lives and promote well-being for all, cooperation activities contribute specifically to targets 3.3, 3.7, and 3.b. These targets address urgent public health issues, including combating STI epidemics, promoting access to sexual health services and supplies, and promoting health technologies and innovations.

While SDG 17 (Brasil, 2018; 2020) focuses on strengthening implementation mechanisms and reinvigorating global partnerships for sustainable development, international cooperation measures play a prominent role, especially in targets 17.16 and 17.17. These are inextricably linked to strengthening partnerships for knowledge sharing and SDG achievement, promoting effective partnerships in the public, public-private, private, and civil society sectors.

5. Conclusion

International scientific cooperation activities require performance measurement systems that deliver results to make partnerships more efficient and effective. In the health sector, it has proved necessary to build specific benchmarking using cause-effect relationships, as used in already consolidated models such as the balanced scorecard method. The reason for this is indeed that international scientific cooperation in public health care has a different purpose and has peculiarities that contrast with the objectives of the cooperative environment in which most performance measurement systems have been developed. Thus, the perspectives and performance indicators should point to the results and products expected from international scientific cooperation in public health.

This action research demonstrated the establishment and strengthening of a broad and diverse network of international scientific cooperation under the umbrella of the “Syphilis No!” Project, reinforcing the crucial role of this type of public health intervention in responding quickly and effectively to epidemics and promoting sustainable development.

International cooperation is an essential and fundamental strategy for strengthening countries’ health systems and addressing health challenges in a

global, intercultural, and interdependent world. In this context, it was noted that the international technical and scientific cooperation activities within the project were wide-ranging, as they covered all the modalities offered by the Brazilian Cooperation Agency of the Ministry of Foreign Affairs. The project has helped to publicize the syphilis agenda in the areas of health, education, science, and technology while also shedding light on the syphilis epidemic in countries that did not have this issue on their public health agendas.

The introduction of a performance measurement system in the form presented in this study allows evaluation and comparison of international scientific cooperation in the field of public health, including other established international partnerships. It also enables the identification of weaknesses and strengths and the proposal of targeted efforts to improve specific areas.

This action research shows that the partnerships created through international scientific cooperation, focused on the development of research and products, contribute to the promotion of public health policy while allowing the exchange of knowledge, techniques, experiences, and technologies that are essential for the international cooperation of Brazilian higher education institutions. This could be investigated in future studies that analyze the architecture of international cooperation developed by LAIS/UFRN, its practice, and its role in the internationalization processes of the Federal University of Rio Grande do Norte. This contribution will have implications for studies in the area of international relations in health and education.

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Conflict of interest

The authors declare that they have no competing interests.

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Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data

Data used in this work are available from the corresponding author upon reasonable request.

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APPENDIX

Appendix A1. Panel of performance indicators

Dimension	Indicator
Technical-scientific	<ol style="list-style-type: none"> 1. Cooperation agreements 2. Work plans 3. Technical-scientific cooperation missions 4. International institutions involved in Cooperation activities 5. Brazilian Institutions involved in Cooperation Activities 6. Outreach Activities (academic events) 7. Cooperation missions with two or more foreign institutions
Investments	<ol style="list-style-type: none"> 1. Investment per participant benefited from international cooperation activities 2. Investment per number of participating institutions 3. Investment per number of technical-scientific cooperation missions 4. Investment per cooperation agreements signed 5. Investment per work plans signed 6. Investment per participant impacted through the production of courses and Open Educational Resources 7. Investment per participants in international events promoted by the project 8. Investment by Brazilian and foreign participants in international missions 9. Investment per total of products developed
Impact	<ol style="list-style-type: none"> 1. Participants in international events promoted by the project 2. Brazilian and foreign participants in international missions 3. Participants impacted by the production of courses and Open Educational Resources through international cooperation (enrolled participants) 4. Professionals who received post-doctoral training 5. Professionals trained in doctoral programs 6. Professionals trained in Master's Degree courses 7. Professionals trained in undergraduate courses
Products	<ol style="list-style-type: none"> 1. Awards 2. Scientific papers in journals 3. Books published 4. Book chapters 5. Capstone projects 6. Master's dissertations 7. Doctoral theses 8. Postdoctoral reports 9. Patents filed 10. Software registrations 11. Courses and Open Educational Resources