PATHFINDER INFODENGUE

DATA-DRIVEN PROCESS MAPPING FOR THE DEVELOPMENT OF RESEARCH SOLUTIONS AND CAPABILITIES

INFO DENGUE · THE GLOBAL HEALTH NETWORK LATIN AMERICA AND THE CARIBBEAN · FIOCRUZ · MINISTÉRIO DA SAÚDE · GOVERNO DO BRASIL DO LADO DO POVO BRASILEIRO

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Funding and use of tools

This project was supported by the Wellcome Trust (Grant 226688/Z/22/Z). The preparation of this report also benefited from the support of Artificial Intelligence tools, including Claude (Pro version) and ChatGPT (version 5), which assisted with text revision.

Accessibility

Images in this document are accompanied by alternative text.

Cite as

OLIVEIRA, Sara Souza, et al. *Pathfinder InfoDengue*: data-driven process mapping for the development of research solutions and capabilities. Rio de Janeiro: Fiocruz/TGHN LAC. 2025. DOI

EXECUTIVE SUMMARY

In Brazil, recurring dengue and chikungunya outbreaks require ongoing attention from researchers and managers to mitigate impacts and inform prevention and control strategies.

InfoDengue, launched in 2014, has become a Brazilian epidemiological surveillance system that integrates climatic and epidemiological data and produces early warning reports to support decision-making by managers at the federal, state, and municipal levels. Originally developed using available data from a limited number of municipalities, it expanded sequentially and, since 2021, has monitored all Brazilian municipalities in coordination with the Ministry of Health, and has been recognized as a strategic support tool in the National Contingency Plan for Arboviruses 2025.

Throughout this growth process, several solutions were developed in routine operations, sometimes without systematic documentation, which made reproducibility in new contexts and the proposal of new practices more difficult. To address this challenge, this report presents obstacles, adopted solutions, and lessons learned in the development and operation of InfoDengue, mapped using the Pathfinder methodology.

Pathfinder is a collaborative approach aimed at mapping health research processes, enabling the documentation of stages, tools, and stakeholders involved. This systematization values consolidated practices, encourages the proposal of new solutions, and generates shareable learnings, strengthening teams, scientific production, and responses to health threats through surveillance.

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INFODENGUE:

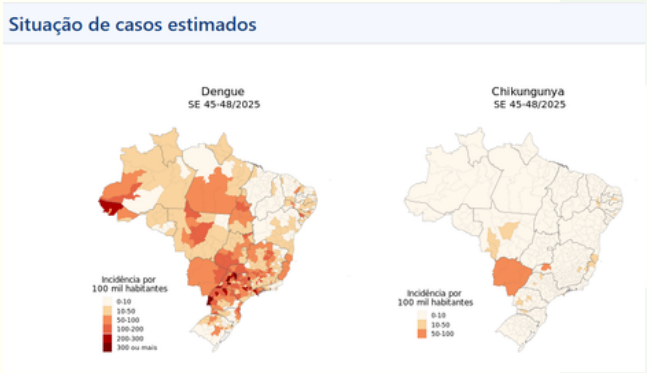
IDENTIFYING RISK AND GENERATING ALERTS FOR ARBOVIRAL DISEASES

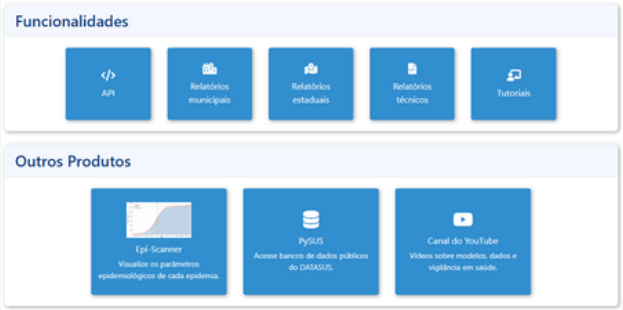
InfoDengue is an early warning system developed to meet the needs of health departments for monitoring arboviral diseases in Brazil. Controlling incidence and preparing to respond to dengue epidemics depend on effective monitoring of signals that indicate increases in cases and potential outbreaks.

To this end, the system operates through the integrated and timely analysis of climatic and epidemiological data and, via a pipeline (a standardized set of steps) for data collection, harmonization, and semi-automated analysis, perform correction for reporting delays, analyses of climatic receptivity, calculation of epidemic thresholds, and short-term forecasts for dengue and chikungunya. Based on these processes, weekly reports analyzing the risk situation of arboviral diseases are generated for all municipalities and districts in Brazil.

InfoDengue began in 2014 with the team of the Scientific Computing Program (PROCC) of the Oswaldo Cruz Foundation (Fiocruz), in partnership with the School of Applied Mathematics of the Getulio Vargas Foundation (FGV), with support from a call for proposals by the National Health Foundation aimed at developing methodologies to improve the Unified Health System (SUS).

The motivation was to develop indicators for a feasible early warning system that Brazilian municipalities and states could use to inform control actions, using routinely collected data and an open and freely accessible interface.



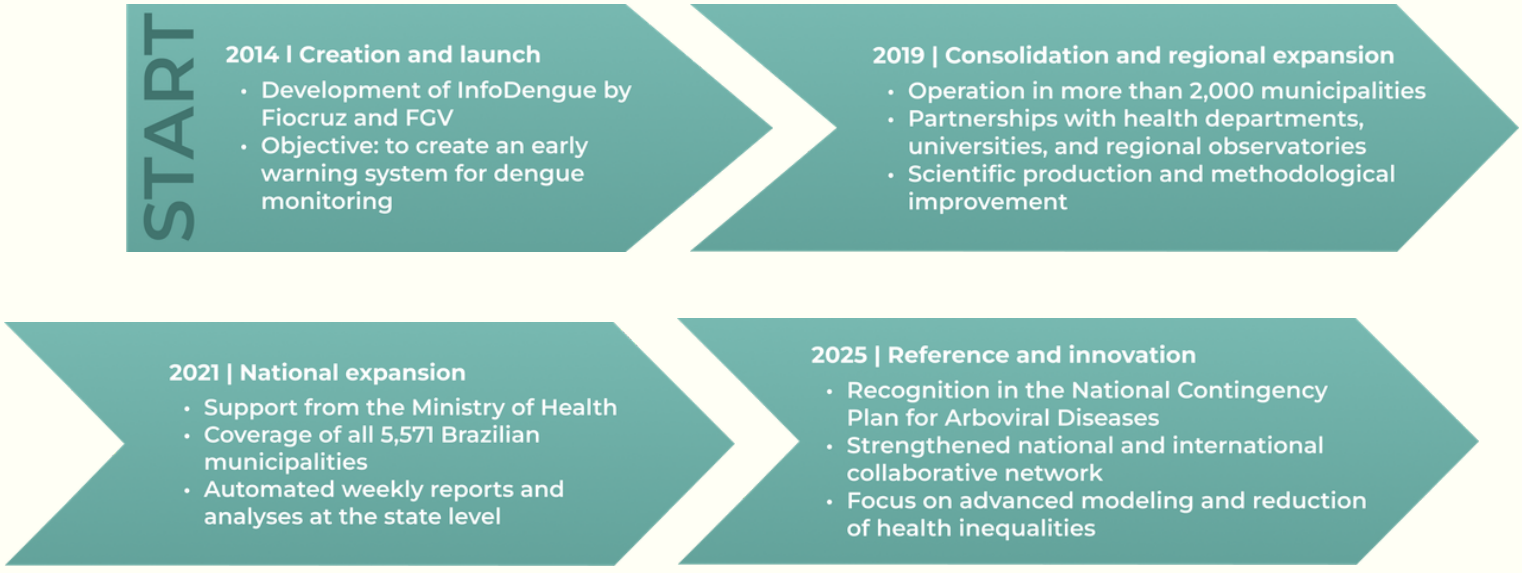


Figures showing the epidemiological situation, functionalities, and products of the InfoDengue website (Dec/2025).

In its initial phase, InfoDengue operated in several partner municipalities and states, with the collaboration of the Municipal Health Department of Rio de Janeiro, the Dengue Observatory of the Federal University of Minas Gerais, and researchers from the Federal University of Paraná and the Western Paraná State University, reaching 2,122 municipalities in its first six years.

From 2021 onward, when it became a strategic project of the Brazilian Ministry of Health (MoH) for combating arboviral diseases, it began monitoring all 5,571 Brazilian municipalities/districts, incorporating scope and operational demands at the national level. In 2025, the system was recognized as a support strategy for the General Coordination for Arboviral Disease Surveillance (CGARB/DEDT/SVSA) in the development of modeling and reports for the National Contingency Plan for dengue, chikungunya, and Zika (Brazil, 2025).

ACCESSIBILITY
Horizontal infographic in a timeline format, with four blocks in shades of green connected by arrows pointing sequentially from left to right.



As a project that began by conducting analyses for a limited number of municipalities and expanded sequentially to reach the national scale, InfoDengue faced structural challenges in accommodating this growth. The processes of adapting to increasing challenges highlighted the need to document the activities carried out, with two key purposes: ensuring the project's continuity and enabling its reproducibility in new contexts.

PATHFINDER METHODOLOGY

In 2023, InfoDengue and **The Global Health Network América Latina e Caribe (TGHN LAC)** established a partnership. TGHN LAC is one of the regional hubs of The Global Health Network (TGHN), a global community of practice with more than one million members dedicated to strengthening health research.

This partnership represented an opportunity to document and map the stages, processes, methodological tools, and stakeholders involved in InfoDengue, contributing significantly to internal organization, facilitating the identification of bottlenecks and opportunities for improvement, and sharing lessons learned, thereby strengthening other initiatives through the Pathfinder methodology.

In view of global inequalities regarding where health research takes place, who conducts it, and which populations benefit from its results, the Pathfinder methodology was developed to document good practices in data-driven research, strengthen quality standards, and accelerate scientific production in contexts most in need of evidence.

ACCESSIBILITY
On this page and the following, on the right-hand side, there is a sequential scheme with vertically organized stages connected by a light blue line.

Global Inequality in Health Research

Structural and capacity limitations. Challenges present in research settings.

Mapping of Research Stages – Pathfinder

Recording of metrics, resources, methods, and results. Identification of challenges and solutions.

Use of Support Resources

Application of tools and references to guide mapping and results.

To this end, Pathfinder offers a set of tools aimed at process mapping, enabling teams to describe the main stages of their workflows so as to ensure data consistency and enable new studies.

This methodology can be applied prospectively, accompanying ongoing research and providing organization at each stage, or retrospectively, in projects that have already been completed, documenting lessons learned, challenges, and solutions, as well as encouraging data reuse (Uppal et al., 2025).

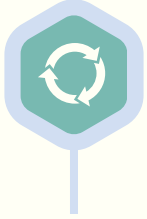
During the mapping process, teams record critical stages and indicators, such as time and resources used, enabling a comprehensive view of the research process. This systematization supports the identification of bottlenecks, the proposal of solutions aligned with best practices, and the documentation of tools, methods, technologies, and governance strategies used. The process also strengthens the capacities of research teams and broadens the circulation of lessons learned, favoring their application in different contexts (Uppal et al., 2025).

Sharing of Processes and Practices

Development of solutions and capacities. Circulation of lessons learned among teams.

Enhancement of Health Research and Team

Quality and elevated standards. Expanded collaboration.



Data Reuse

New research questions and use of evidence.

PATHFINDER INFODENGUE:

STRUCTURING THE MAPPING PROCESS

Pathfinder InfoDengue, developed from July 2024 to December 2025, aimed to trace the steps and processes of InfoDengue to identify the main challenges, achievements, and lessons learned in generating evidence to support health surveillance.

Through this mapping, tools, methods, approaches, and systems applied to **data management and access**, **results and impact**, and **stakeholder engagement** were systematized.

In addition, the process sought to identify new solutions to improve the project's scientific and operational practices. In doing so, it is intended to contribute to helping other studies overcome similar challenges, strengthening research on collective health across different contexts.

The mapping process began with the development of the **InfoDengue Pathfinder Protocol**, in which the objectives, methodology, expected outputs, and timeline were defined.

This protocol served as a guide for the mapping, aligned with the needs and interests of the InfoDengue research group and the potential contributions of the partnership with TGHN LAC.

To support its development, the **Pathfinder Planning Matrix** tool was used, which enabled the proposal to be built collaboratively and through dialogue, based on participation in two **workshops**: one with researchers from TGHN LAC member centers (Argentina, Colombia, Honduras, Peru, and the Dominican Republic; August 2024) and another with InfoGripe researchers (September 2024).

Subsequently, the **Pathfinder Tracker** was completed, a central methodological tool aimed at recording and monitoring the mapped stages.

Different qualitative research techniques were employed, including **documentary analysis** of project records (including protocols, bulletins, articles, meeting minutes, photographs, videos, and asynchronous messaging conversations), **participant observation, and semi-structured interviews** (Araujo et al., 2023).

The triangulation of these methods enabled the collection of diverse perceptions and experiences from the actors involved, resulting in a more robust mapping of processes.

This qualitative approach to mapping was fundamental in the context of Pathfinder studies, as it enabled an understanding of the meanings, contexts, and experiences associated with project development.

This qualitative perspective made it possible to identify barriers and solutions at each stage, revealing aspects that would hardly be captured solely through quantitative indicators. The combination of different techniques strengthens the validity and reliability of the results, offering a broad and detailed view of the stages, processes, and challenges encountered (Minayo; Assis; Souza, 2005).

During the mapping process, regular sessions to discuss and exchange information among various stakeholders involved in the methodology and the Pathfinder studies.

These sessions took place between the InfoDengue team, the InfoGripe team (Brazil's Severe Acute Respiratory Infection surveillance system, also mapped using the Pathfinder approach), and the TGHN LAC Fiocruz team to monitor, evaluate and provide feedback on the mapped results.

Meetings were also held with research centers in Latin America and the Caribbean (Argentina, Colombia, Honduras, Peru, and the Dominican Republic), as well as with the Global Health Data Science Hub of TGHN, composed of partners from TGHN Africa, Asia, and the University of Oxford.

These spaces for exchange fostered continuous evaluation and adaptation of the process, the proposal of solutions to the challenges identified during mapping, and increased visibility of the project, creating opportunities for future collaborations.

FROM MAPPING TO LESSONS:

THE INFODENGUE EXPERIENCE

DATA MANAGEMENT AND ACCESS

Like all vector-borne diseases, arboviral diseases are strongly influenced by climate. For this reason, early warning systems such as InfoDengue need to monitor both climatic conditions and case notifications.

Arboviral diseases have a prominent social and political burden in Brazilian society; therefore, notification data related to these conditions are handled with particular care by the InfoDengue team. Since its inception, the project has adhered to the standards set by the Fiocruz Research Ethics Committee, which include terms of responsibility for data access and use.

The use of arboviral disease case records without individual identification is an essential condition for conducting research within the scope of the project. Mapping data management and access is directly linked to the types of information processed and how they are managed within the project.

InfoDengue uses non-identified records of reported dengue and chikungunya cases from the Information System for Notifiable Diseases (SINAN) to generate analyses and risk alerts. Until 2020, partner states and municipalities sent their databases of case records weekly by e-mail. From 2021 onward, the project began collaborating directly with the Ministry of Health (MoH). Data started to be sent by the MoH, and InfoDengue began monitoring dengue and chikungunya risk in all Brazilian municipalities, generating reports for the 27 federative units, interactive bulletins on the project website for all municipalities in the country, and producing a national weekly report.

In the databases sent weekly by the MoH, the minimum variables required by InfoDengue includes:

- dates (notification, onset of symptoms, and data entry),
- epidemiological week and year of notification,
- municipality of residence and of notification,
- date of birth and
- sex of each case.

Variables related to case outcomes, both laboratory and **epidemiological**, are also collected when available, including final classification (dengue, dengue with warning signs) and confirmation criteria (laboratory or clinical-epidemiological).

Until 2022, the **meteorological data** used by InfoDengue consisted of daily temperature and humidity data (minimum, mean, and maximum) obtained from meteorological stations of the National Institute of Meteorology (INMET). Since 2023, satellite data from the European Copernicus program have been used, providing broader coverage and reducing gaps resulting from the distance between stations. **Demographic data** obtained from the Brazilian Institute of Geography and Statistics (IBGE) are also important for constructing incidence indicators.

All climatic, epidemiological, and demographic data used in the project undergo processes of collection, curation, cleaning, and preparation. These steps are essential to ensure the integrity and quality of the information that underpins the project's analyses. After processing, the data are stored on a server to facilitate findability, accessibility, interoperability, and reusability of the information.

ACCESSIBILITY
Vertical diagram of the phases of InfoDengue data processing. There are seven stages represented by circles in different colors.

Challenges and solutions

Since the creation of InfoDengue, there has been a concern with data management. In the early stages, state and municipal health departments formally established cooperation agreements and provided updated data on a weekly basis, while the project committed to using the data strictly as agreed.

From 2021 onward, with the partnership with the Ministry of Health (MoH), access became centralized, using SINAN data made available weekly by the General Coordination for Arboviral Disease Surveillance (CGARB/MoH). Accommodating this new routine posed a challenge, as it required changes in how data were received and analyzed, as well as in the production of bulletins. It was necessary to rewrite code, reorganize tables and folders, and adapt the data intake platform to handle the increased data volume and the production of bulletins and website updates.

The challenge of data security and privacy became particularly evident due to the format and size of the databases handled from 2021 onward.

The transition to an institutional cloud (ownCloud) provided by Fiocruz represented a significant advancement.

During the 2024 dengue epidemic, due to the large volume of data, further adjustments to the data intake platform were required. The backend team implemented substantial improvements, making the platform more intuitive, speeding up data uploads, and enabling near-immediate error identification.

To improve the collection of climatic data, the backend team implemented a routine to capture satellite data, an advancement that significantly enhanced information quality. In parallel, considerable programming effort was required to generate codes capable of transforming the captured data into a format usable by the project, with these codes properly stored in the project's GitHub repository.

Additionally, the project faced issues related to data updates on the website and the query API, including occasional failures to update weekly and isolated bugs; however, the necessary changes were promptly identified and converted into issues (tasks with deadlines) in the project's GitHub repository to be addressed by the frontend team.

Until 2021, social media data, such as Twitter, were used as an additional layer of information for the system. Mentions of dengue symptoms on social media are a well-known indicator for early warning systems.

Twitter was used because it provided access to a significant sample of messages in a free and open manner. With the closure of this service in 2023, InfoDengue discontinued the use of social media data in its models.

As a data-driven project, InfoDengue considered other data sources at different points in its history, such as entomological data from mosquito trap monitoring. The main challenge in incorporating these databases into alert production is the lack of standardization and nationwide coverage.

Backend team

Responsible for maintaining the system's internal layer, service integration, APIs, and ensuring server security and process stability.

Frontend team

Responsible for maintaining the system's internal layer, service integration, APIs, and ensuring server security and process stability.

Lessons learned

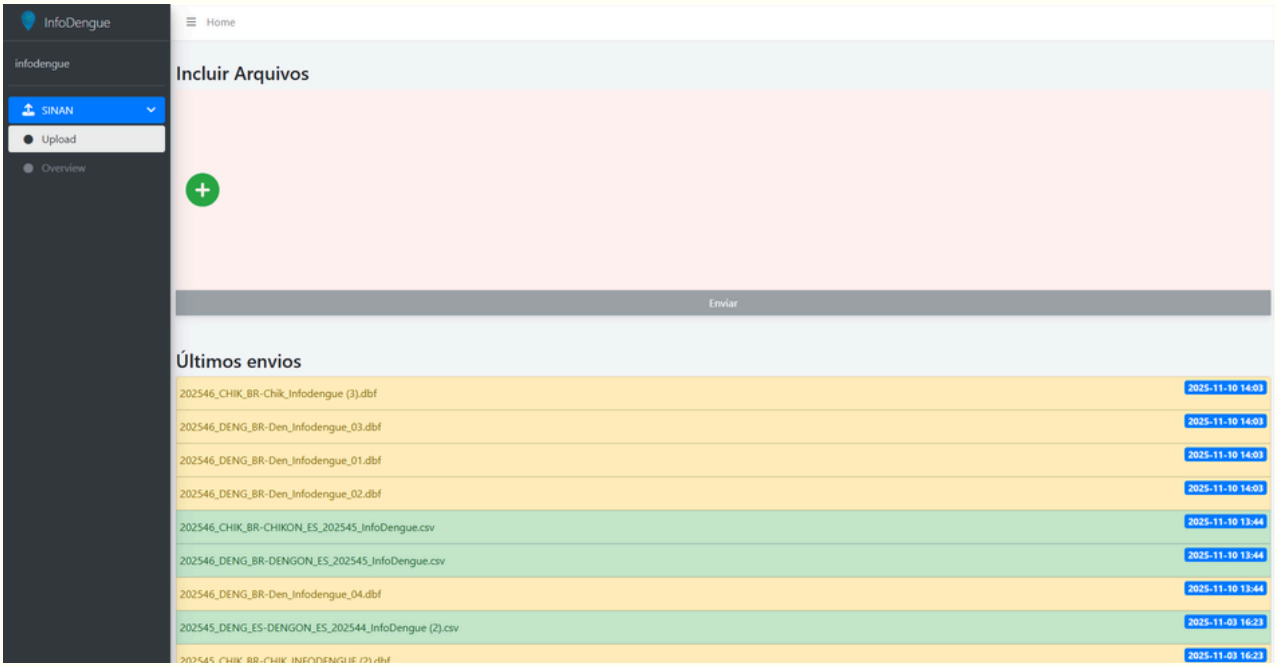
The challenges faced in data management and access within InfoDengue generated important lessons learned. Opportunities for improvement were identified in several areas:

Management of epidemiological data at the national level and data transaction: the restructuring of the system to handle massive data volumes enabled joint analyses at the national and regional levels. When dealing with large volumes of files and transitioning from e-mail to cloud-based systems, the importance of using more secure data transaction platforms and establishing detailed prior agreements on data submission formats became evident.

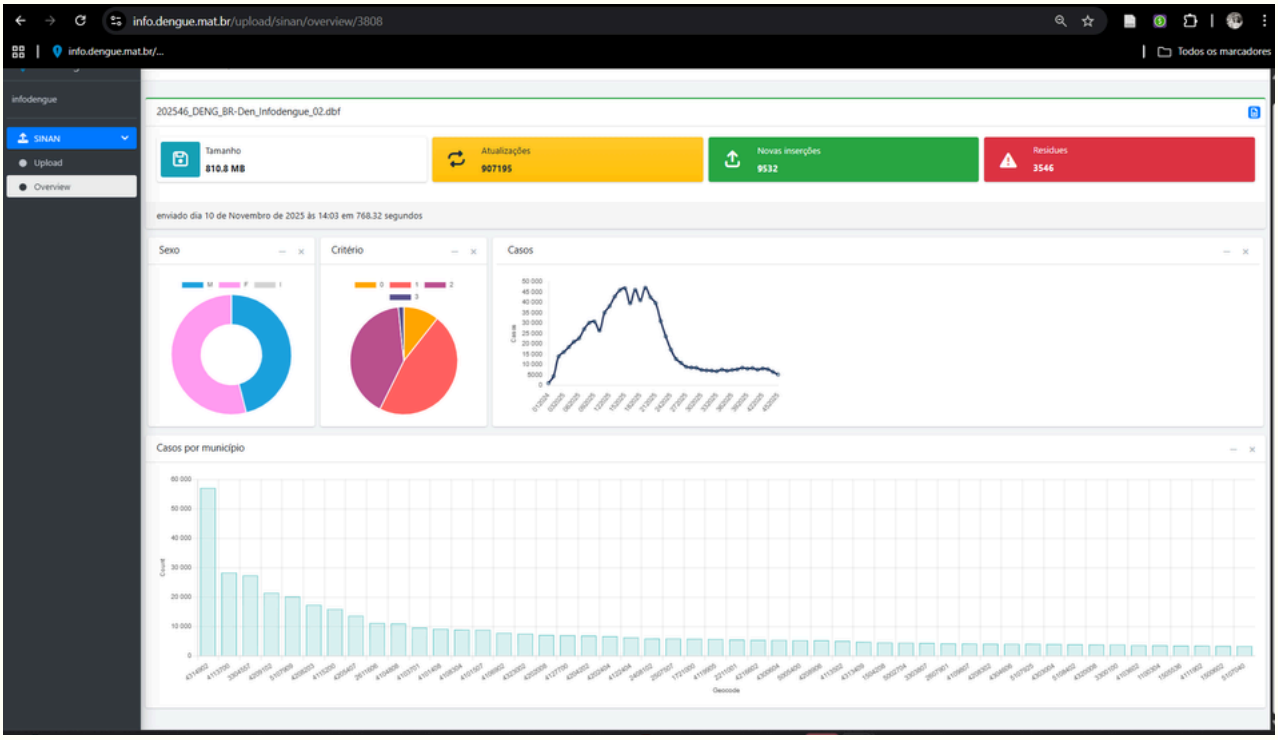
Based on this experience, in the second half of 2025 the project worked on migrating to direct access via query APIs to ensure greater efficiency and security. To prevent interruptions caused by certificate expirations, creating a clear protocol for renewing system passwords and certificates may be useful.

Improvement in data management: investment in paid servers was essential to address overcrowding and ensure compliance with the FAIR principles (Findable, Accessible, Interoperable, Reusable), facilitating not only access to information but also interoperability and reuse.

Improvements to the data intake platform resolved previous issues related to data formatting and transmission, offering basic exploratory analysis at the point of entry.



InfoDengue data upload platform.



Basic exploratory analysis upon entering the database on the InfoDengue platform.

Creation of a workflow for climatic data: implementing a satellite data capture routine was a significant challenge, as it was developed from scratch and required the creation of a specific workflow for capture and municipal-level aggregation.

In addition, the complexity of aligning satellite grids with municipal territorial divisions was overcome through dedicated software and open-source code registration, ensuring reproducibility.

Standardization: the team recognized the need to verify and standardize data updates to ensure the accuracy of incidence calculations.

It also learned to transform problems in the data collection, storage, and analysis pipeline into executable tasks with defined deadlines, ensuring a proactive and structured approach to continuous improvement and preventing potential failures in weekly platform updates.

Flexibility: as it is based on secondary data from open-access sources, InfoDengue depends on the data access policies of the sources used. As these policies change, it becomes necessary to renegotiate agreements or seek new data sources.

The following is a summary of the main challenges, solutions, and respective lessons learned mapped in the process of managing and accessing InfoDengue data.

ACCESSIBILITY
On the following two pages, there are vertical gradient panels in shades of green containing a synthesis of the challenges, solutions, and lessons learned described above. The panels are organized into blocks with the component title, followed by the challenge, solution, and lesson learned, and their descriptions.

Synthesis

DATA MANAGEMENT AND ACCESS

Management and Transition of Epidemiological Data

Challenge

Transitioning from an individualized data collection model (by state health departments) to a centralized and large-scale system with the Ministry of Health using data from the Information System for Notifiable Diseases (SINAN).

Adapting to potential changes in data access policies.

Solution

Restructuring code, tables, and storage folders to handle large data volumes and centralized access.

Investment in servers.

Adaptations implemented in response to changes in data access policies.

Lesson learned

Restructuring was essential to manage large volumes of data.

The use of APIs and the establishment of clear protocols improve security and efficiency.

The ability to adapt to changes in data access policies is a fundamental aspect of project continuity.

Improvements to the Platform and Workflow

Challenge

During the 2024 dengue epidemic, the data platform became overloaded, and the website/ API experienced failures.

Solution

The backend team mapped all failures and generated tasks on GitHub with defined deadlines for correction, implementing improvements to the platform.

Lesson learned

Standardizing processes and transforming problems into tasks with deadlines on GitHub ensure continuous improvement and prevent recurring failures.

DATA MANAGEMENT AND ACCESS

Collection and Analysis of Climatic Data

Challenge

Obtaining accurate climatic data for risk indicators, given data gaps resulting from the distance between meteorological stations.

Solution

The team implemented a routine to capture satellite data from Copernicus and developed code to convert and align these data with municipal divisions.

Lesson learned

The use of satellite data fills gaps caused by the distance between stations.

Registering code as open access on GitHub ensures reproducibility and process transparency, aligning the project with FAIR principles.

Data Security and Privacy

Challenge

Ensuring the security and privacy of non-identified data, especially after the increase in data volume.

Solution

The project followed the standards of the Fiocruz Research Ethics Committee, used terms of responsibility for data access, and migrated to an institutional cloud (*owncloud*).

Lesson learned

Managing sensitive data requires strict care and compliance with ethical standards.

Using secure platforms and formalizing data use are essential steps to ensure security.

OUTPUTS AND IMPACT

InfoDengue establishes a continuous cycle of generating, analyzing, and disseminating crucial information, thereby supporting an agile response to emerging health challenges related to arboviral diseases. On a weekly basis, 27 state bulletins and 1 national bulletin are produced in .pdf format; interactive bulletins for more than 5,000 Brazilian municipalities and for the states are updated and made available on the InfoDengue website.

The most recent dengue and chikungunya data are analyzed in detail in weekly meetings by the group, where next steps and strategies for communicating findings are defined. This dynamic enables the systematic production of weekly and biweekly reports (state and national), offering an up-to-date overview of the epidemiological situation.

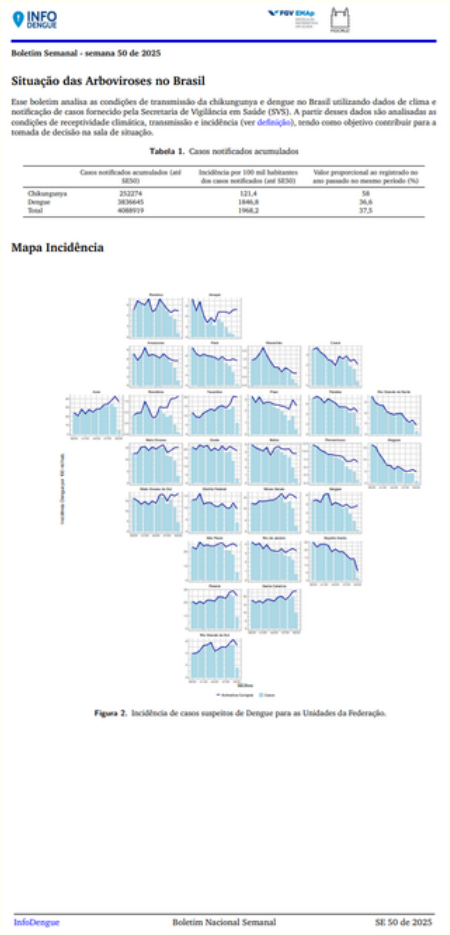
The continuous availability of these reports and the weekly updating of municipal data on the website are essential, as they provide direct input for authorities and partners (managers, municipal and state health departments, and the Ministry of Health) to make faster, evidence-based decisions, optimizing health action planning and resource allocation during critical periods.

Situation rooms, weekly meetings, are the starting point for the conception and development of scientific publications, such as articles and technical notes. Rigor in production is complemented by transparency: scripts, tool packages, and publication content are stored in an organized manner on GitHub, ensuring the reproducibility of analyses and serving as a valuable repository for future investigations and innovations.

In addition to enhancing response capacity to public health events of interest, as mentioned above, the project also stands out for the recognition of its system as a strategic support for the Ministry of Health, as provided for in the National Contingency Plan for Arboviruses 2025 (Brazil, 2025).

At the same time, it strengthens a broad collaboration network: regular meetings and exchanges with researchers and technicians from different institutions enrich internal discussions, generate strategic partnerships, and expand the reach of monitoring.

This collaborative environment also promotes the team's continuous training, developing highly qualified professionals in data analysis, epidemiology, and scientific communication, thereby contributing to increased institutional resilience in the face of new health challenges.



Illustrative figures of the outputs, collaboration within the National Plan, and weekly bulletins produced by the InfoDengue team.

Challenges and solutions

Despite the positive outputs, execution and maximization of the impact of deliverables face challenges inherent to the complexity of monitoring and the dynamics of collaborative projects.

In the stage of **developing publications and dissemination plans**, one of the main challenges lies in defining a concise, objective agenda that is achievable. Discussions must be efficient so that they result in well-defined tasks and the fulfillment of agreed actions. Solutions identified include prioritizing publications and assigning leaders to these productions.

Regarding the **preparation of outputs**, challenges in pipeline execution affected the timeliness of their use for action. Because tasks are sequential, any delay in one step generates an overall delay in the delivery of essential information to partners.

Therefore, those responsible need to be notified as soon as the preceding step is completed.

In 2024, during the dengue epidemic, one solution adopted was for the Ministry of Health to send data in advance on Sundays, allowing the InfoDengue group to make analyses available in time for managers' meetings on Tuesdays.

Regarding the **academic publication** process, which involves preparation, submission, and review, the main obstacle is the team's workload, which requires continuous effort to reconcile internal project demands, the weekly issuance of bulletins (national, state, district, and municipal), and scientific production.

The designation of a project manager was an important step toward organizing and monitoring activities, transforming ideas into concrete outputs within defined timelines, costs, and scope.

Lessons learned

Working groups, deadlines, and continuity: in developing publication and dissemination plans, the team learned the importance of structuring specific working groups, establishing clear deadlines, and maintaining regular meetings. This approach ensures not only continuity and workflow but also strengthens connection and engagement among researchers. For drafting technical pieces and scientific documents, the use of collaborative text production tools has been fundamental.

Project management: the growth of InfoDengue introduced new levels of complexity into daily workflows and highlighted the need for systematic organization of processes and protocols. The role of a project manager became essential for optimizing schedules, ensuring continuity, and securing task completion within the planned scope.

Communication tools: when dealing with output preparation, where issues in sequential task execution can cause delays, learning is continuous. While improving and resolving these issues is an ongoing process, the use of group and asynchronous communication tools such as “Discord” has been very helpful in keeping the team informed about the completion of each stage. The tool allows the creation of servers, events, and separate working groups to divide tasks and topics. In the future, the definitive solution may be to automate as many tasks as possible that do not depend on human analysis, thereby optimizing workflows and ensuring the agile delivery of essential information to partners, guaranteeing that all information is available on the project website.

Commitment: an important lesson from more than a decade of the project is the value of team engagement. All members demonstrate a strong sense of commitment to the activities carried out and feel satisfied seeing the real impact on the country’s health landscape.

The following is a summary of the findings in the mapping of outputs and impact.

Synthesis

OUTPUTS AND IMPACT

ACCESSIBILITY
On this page, there are two vertical panels with a green gradient containing a synthesis of the challenges, solutions, and lessons learned described above. The panels are organized into blocks with the title of the component and, respectively, challenge, solution, and lesson learned, followed by the description.

Internal Management and Organization

Challenge

Overcoming the team's workload to reconcile the analysis and weekly production of bulletins, academic production, and communication activities, while meeting the deadlines required for agile work.

Solution

Designation of a project manager.

Use of management and communication tools, such as GitHub and Discord.

Lesson learned

Task management and the use of tools optimize workflow, minimize noise, strengthen team collaboration, and foster an environment conducive to innovation.

Optimization of Data Flow and Deliverables

Challenge

Delays in data updates that impact the timeliness of deliverables.

Solution

Improvement in time organization and workflow management, with specific working groups, clear deadlines, and regular meetings, in addition to the use of collaborative writing tools.

Lesson learned

A well-defined workflow is essential to ensure the timely delivery of information.

Real-time communication is crucial to avoid delays.

Future automation of tasks can further optimize the process.

STAKEHOLDERS ENGAGEMENT

In the context of InfoDengue, stakeholders include the project team, as well as managers and focal points from state and municipal health departments, the Ministry of Health, international health agencies, other projects with similar fields of work and interests, researchers, students, communication professionals, and civil society.

Each stakeholder engages in a distinct way. Within the internal team, engagement occurs through the strengthening of working relationships and support for capacity development. With external partners, interaction takes place through the dissemination and use of the project's tools, responses to data and analysis requests, interviews and media coverage, scientific communication and dissemination, as well as other actions that strengthen the broader field of data science applied to disease monitoring.

Scientific communication and dissemination occur both through events promoted by the project and through team participation, by invitation, to present models and analytical results at meetings in Brazil and abroad, for different audiences.

The partnership with the MoH and health departments has been one of the main driving forces of the project. One outcome of this collaboration is submunicipal InfoDengue, developed for municipalities prioritized for dengue control, with analyses conducted at the intramunicipal scale.

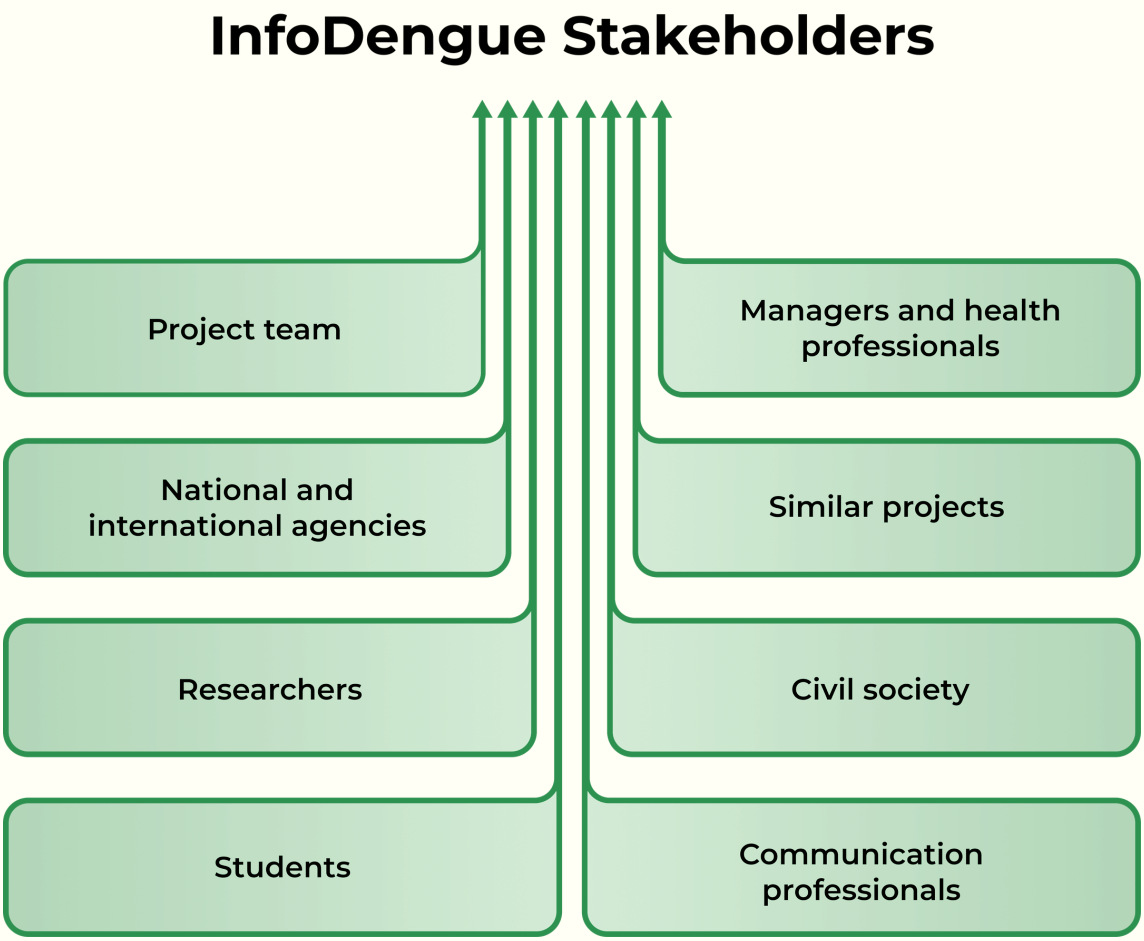
Stakeholders

Stakeholders are all parties that are affected by or can influence a project. The term comes from the English words "stake" (interest) and "holder" (one who holds), with the literal meaning of "holder of interest".

InfoDengue maintains strategic collaborations and acts as a stakeholder in other programs, promoting exchanges and partnerships. These include:

- Harmonize
- IDExtremes
- InfoGripe
- Mosqlimate
- TGHN LAC

Thus, stakeholder engagement in InfoDengue combines internal and external actions to integrate managers, researchers, students, communicators, and civil society. This set of fronts ensures active participation and reinforces the project's credibility as a reliable source of information on arboviral disease risk.



Challenges and solutions

Despite the efforts, there are challenges in stakeholder management. In **relationships with partners**, aligning demands with expectations within the project's production and staffing capacities is a challenge that requires planning and recognition of what is feasible.

The solution lies in transparent and respectful communication and in presenting alternatives when it is not possible to meet a request in the originally proposed manner.

For example, a Research Club was created on the TGHN LAC Platform to record and disseminate the work developed in InfoDengue situation rooms, which have been held weekly since 2021 and aim to bring discussions on the arboviral disease situation in the country, promote the exchange of ideas on topics related to the project, present the work carried out by members and invited guests, address solutions to specific problems, and outline tasks.

InfoDengue Research Club.

In order to also ensure **understanding and use of the system by professionals** working in health departments, the course "InfoDengue and InfoGripe: epidemiological surveillance of transmissible diseases", was created and made available on the Fiocruz Virtual Campus.

InfoDengue and InfoGripe course on Campus Virtual Fiocruz.

This course provides the development of skills in methodologies for analyzing the transmission situation of arboviral diseases and severe acute respiratory syndromes used in the InfoDengue and InfoGripe systems.

For **scientific communication and dissemination**, the work involved often requires knowledge beyond that generated by InfoDengue.

The involvement of other projects in the organization, dissemination, and participation in events promoted by InfoDengue has contributed to improving the quality and versatility of access to the information presented.

InfoDengue has been presented at several international and national events, such as the Dengue Modelling Meeting 2024, organized by the World Health Organization (WHO), the National Meetings for Preparation for the High Transmission Period of Arboviral Diseases, organized by the Health Surveillance Secretariat (SVSA) of the Ministry of Health in 2023, 2024, and 2025, among other conferences. It has also promoted webinars in partnership with the Fiocruz Hub of TGHN and TGHN LAC to disseminate pre-season predictive models for arboviral diseases for the 2024-2025 and 2025-2026 seasons.

Another solution adopted since 2023 has been intensive work on dengue case prediction models in preparation for upcoming seasons. The ensemble model is built through collaboration among researchers from several countries, through the **Desafio InfoDengue–Mosqlimate**. The 2025 challenge brought together 52 researchers from South Africa, Germany, Saudi Arabia, Brazil, Spain, the United States, Italy, and the United Kingdom, with the submission of 19 dengue projection models for Brazil.

For the **media and civil society**, the challenge is to produce didactic and objective responses, without conveying personal opinions, to support understanding of the epidemiological scenario of dengue and chikungunya, so that monitoring can inform the adoption of collective and individual preventive measures.

A communication professional involved in the project, in partnership with researchers, developed the e-book “Facing Dengue in favelas and peripheries” to engage in an accessible manner with populations living in peripheral areas.

E-book "Addressing dengue in favelas and peripheral areas".

As part of the mapping process, a thematic glossary was also developed, listing the technical terms most commonly used in the system, facilitating the understanding and use of information for health action planning.

Trilingual InfoDengue glossary.

As a strategy to strengthen the field of data science applied to the monitoring of transmissible diseases, the InfoDengue team created the E-Surveillance Congress.

E-Surveillance Congress.

The event began as a small meeting with update seminars on the topic and, over time, became a biennial congress held since 2021.

Each edition brings together more than 150 participants, including researchers and students, to discuss technologies for health surveillance and share innovative initiatives, whether already consolidated or with potential for incorporation into public management, specifically in the monitoring and control of transmissible diseases. Examples include the use of drones for health surveillance and dengue control through the release of mosquitoes with the Wolbachia bacterium, among others.

Lessons learned

Relationship with partners: partnerships with governmental entities, other projects, and the scientific community have been a fundamental pillar of the project's development. Exchanges of experiences have fostered work and idea development, perpetuating the building of bridges between partners and the project. In interactions with state and municipal health departments, the team learned the importance of establishing direct communication focal points, overcoming the initial barrier to understanding how to use the bulletins.

Scientific communication and dissemination: participating in and promoting events that fostered interaction and the dissemination of the project's work generated important exchanges with other stakeholders and the scientific community. Partnerships with other entities and projects, such as TGHN and other extensive studies, strengthened dissemination efforts and facilitated the organization of events promoted by InfoDengue.

Relations with the media and the community: in interactions with the media and the public, the central lesson learned was the need for specific skills to communicate technical information in a didactic and impartial manner. The team invested in media training and developed educational materials to disseminate and clarify project-related topics.

The following is a summary of the main challenges, solutions, and respective lessons learned mapped in the process of engaging InfoDengue stakeholders.

ACCESSIBILITY
On the following two pages, there are vertical panels with a green gradient containing a synthesis of the challenges, solutions, and lessons learned described above. The panels are organized into blocks with the title of the component and, respectively, challenge, solution, and lesson learned, followed by the description.

Synthesis

STAKEHOLDERS ENGAGEMENT

Relationship with Partners

Challenge

Aligning external partner requests with the project's production and staffing capacities.

Solution

Maintaining transparent and respectful communication and presenting alternatives whenever requests cannot be met directly or immediately.

Lesson learned

Partnerships with other entities and the scientific community are fundamental pillars.

Establishing direct communication focal points with partners, such as health departments, proved crucial to overcoming barriers to understanding analyses and strengthening collaboration.

Scientific Communication and Dissemination

Challenge

Promoting and participating in events for different audiences to disseminate the system requires knowledge and resources beyond the project's core scope.

Solution

Involving other projects and institutions to organize and support events increases the quality and versatility of dissemination.

Lesson learned

Collaboration with other institutions and projects strengthens dissemination, facilitates event organization, and promotes valuable exchanges with other stakeholders and the scientific community.

STAKEHOLDERS ENGAGEMENT

Communication with the Media and the General Public

Challenge

Producing didactic and objective information, without including personal opinions, so that the project's analyses support media work and encourage the adoption of preventive measures by civil society.

Solution

Investing in media training for the team and developing educational materials to clarify project topics.

Lesson learned

Communicating technical information to a general audience requires specific skills and the development of accessible and impartial materials.

CONCLUSIONS

Pathfinder InfoDengue mapped processes related to data management and access, outputs and impact, and stakeholder engagement to identify challenges, solutions, and lessons learned in generating evidence for health surveillance.

The outputs showed that the centralization of data access with the Ministry of Health, the adoption of satellite-based routines for climatic data collection, and the standardization of workflows were decisive in strengthening the project. Among the main challenges identified were the large volume of data, data security, team workload, and engagement of multiple stakeholders.

The solutions involved the restructuring of code and servers, the use of an institutional cloud, collaborative tools, and the support of a project manager.

The lessons learned highlighted the importance of clear protocols, standardization, direct communication, and systematic organization, consolidating InfoDengue as a reliable reference and offering replicable lessons for other initiatives.

The Pathfinder methodology operates in a dynamic and non-linear manner. This means that the process is not limited to information collection and analysis; rather, it acts as a catalyst for transformations within the project itself.

Throughout the mapping, the in-depth understanding of pathways, challenges, and opportunities led to continuous adjustments and modifications. This adaptive movement refined strategies, expanded the scope of action, and resulted in products aimed at both the academic community and public management.

These outcomes include workflow optimization, the development of tools to support partner understanding of results, the organization of dissemination events, and the use of educational approaches related to InfoDengue topics.

The mapping also revealed that InfoDengue's strength goes beyond its capacity to monitor and generate alerts on dengue and chikungunya risk in Brazil.

Its distinctive feature lies in its commitment to preparing professionals, managers, students, and researchers to understand, interpret, and apply this information in their local contexts. By articulating surveillance, communication, and education, the project has built fertile ground for competency development, expanded the reach of analyses, and continuously strengthened epidemiological surveillance for the benefit of collective health in Brazil.

Follow below all the resources produced and activities organized as part of the partnership between the Fiocruz TGHN LAC team and the InfoDengue team through the Pathfinder mapping.

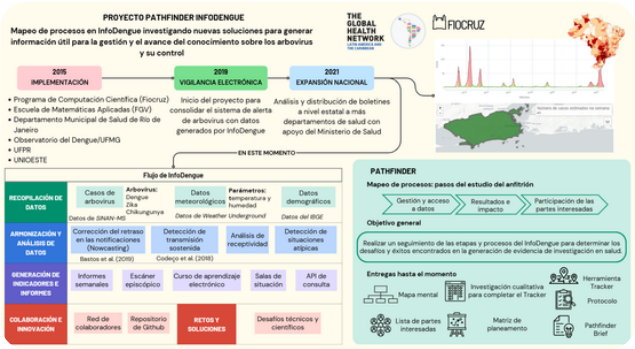
PART I
Planning

InfoDengue Pathfinder Protocol

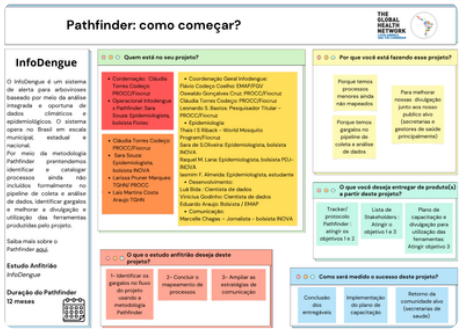
Portuguese, Spanish, and English

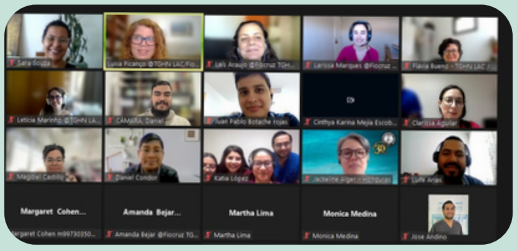
Mind Map

Summary infographic on
InfoDengue and Pathfinder



Pathfinder Planning Matrix





Pathfinder Workshop: how to begin?
participation
(August/2024)

Pathfinder Workshop: building the protocol pathfinder with the host studies InfoDengue and InfoGripe
(September/2024)

Supported Learning Session Qualitative Methodology for Pathfinder - Tracker
participation

(November/2024)

Supported Learning Session of the Tracker: exploring its use at TGHN LAC
participation
(May/2025)

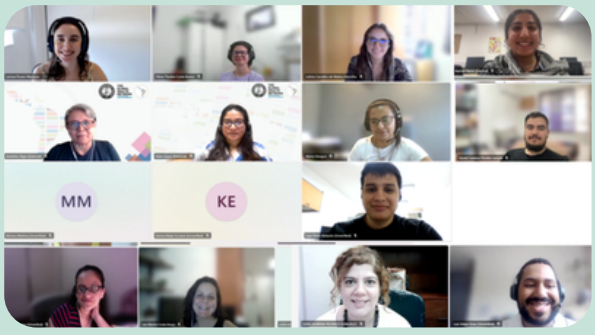
PART II
Mapping

List of agents and stakeholders in InfoDengue

Identification of strategic actors for mapping.

Tracker
Pathfinder tool with mapping data from InfoDengue in the categories "Data Access and Management", "Outputs and Impact", and "Stakeholder Engagement", based on qualitative data sources

- Documentary analysis: protocols, bulletins, articles, meeting minutes, photographs, videos, and conversations via asynchronous messaging tools.
- Conversations with key individuals, guided by a semi-structured script with open-ended. responses, conducted in person and online
- Participant observation.



TGHN LAC Pathfinder Data Clinics

Monthly participation in meetings aimed at improving the use of the Pathfinder methodology and exchanging challenges and solutions in research with researchers from Latin America and the Caribbean.

PART III

Productions

methodological and scientific

Trilingual webinar [Preparing for the 2025 dengue season: insights from predictive models]

(October/2024)
Presentation of the dengue forecasting methodology for Brazil in 2025, with more than 3,100 views.

Trilingual webinar [Preparing for the 2026 dengue season: insights from predictive models]

(October/2025)
Presentation of the final model for dengue case projections for 2026 and dialogue with dengue surveillance in Brazil, with more than 2,200 views.

Webinar [2nd InfoDengue–Mosqlimate Challenge (IMDC) – Results and forecasts for 2026]

(October/2025)
Presentation of the initiative, teams involved, and the methodology of the final dengue case projection model for 2026, with more than 500 views.

Symposium [E-Vigilância]

(November/2025)
Theme “Data science in epidemiological surveillance: for what and for whom?”, with more than 300 participants and 120 submitted papers.

PART IV

Productions

technological and decision-support

Trilingual Thematic glossary

Created with terms and concepts used in the monitoring and alert system, to facilitate understanding and use of information in health action planning.

PART V

Productions

network and capacity development

InfoDengue Research Club

Created on the TGHN LAC Platform to record and disseminate the work developed in situation rooms.

Global Health Data Science Hub of TGHN

Dissemination, presentations, and discussions on InfoDengue at TGHN Hub meetings.

TGHN LAC

Participation of InfoDengue researchers in different exchange spaces with researchers from TGHN LAC member centers.

PART VI

Productions

communication and dissemination

XVIII Latin American Congress of Social Medicine and Collective Health (Rio de Janeiro, August/2025)

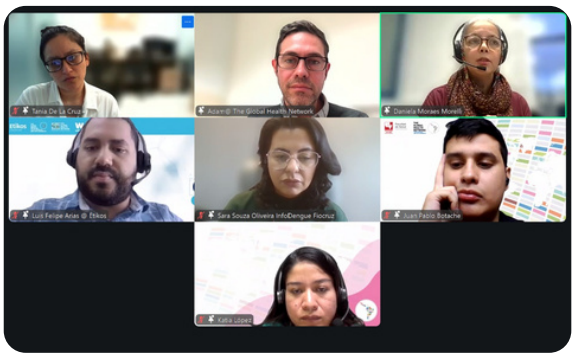
- Roundtable Discussion "Scientific communication as a strategy for equity in health research in Latin America and the Caribbean".
- Workshop "Pathfinder in Health Research: mapping challenges and finding solutions to innovate".

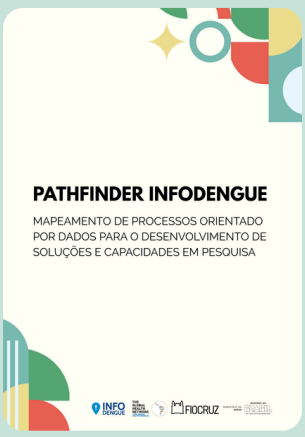
Presentation of Experience Report:

- "A practical approach to overcoming health research challenges through collaboration and innovation: Pathfinder studies in Brazil".
- "Strengthening preparedness and response to public health emergencies: the experience of Pathfinder studies in Latin America and the Caribbean".
- "Innovation and equity in health research: the experience of The Global Health Network Latin America and the Caribbean".

Trilingual webinar [Building Capacity and Collaboration in Health Research: Lessons from Pathfinder Studies in Latin America and the Caribbean]

(December 2025)
Presentation of the InfoDengue mapping results in the TGHN LAC webinar.





Pathfinder InfoDengue Report
Portuguese, Spanish, and English

Access more outputs of the mapping on the Pathfinder InfoDengue webpage.

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