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# Crisis Without a Manual: Building a Clinical Protocol During Brazil's Yellow Fever Emergency

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# Crisis Without a Manual: Building a Clinical Protocol During Brazil's Yellow Fever Emergency

## 1. Introduction

Between 2017 and 2019, Brazil experienced the most severe yellow fever epidemic recorded since the 1940s, which began in the northeastern part of Minas Gerais and rapidly spread to other regions of the country. In response to the escalation of severe cases and the disease's lethality, the Unified Health System (SUS) activated emergency responses across multiple levels, including the reorganization of care pathways, inter-institutional cooperation, centralized resource management, and intensified surveillance (POSSAS et al., 2018; MINISTÉRIO DA SAÚDE, 2020; TAUIL; SANTOS; MORAES, 2013).

The absence of consolidated national guidelines for managing suspected and confirmed yellow fever cases initially hindered the clinical response despite institutional mobilization. The prevailing literature up to that point had focused primarily on preventive strategies—such as mass vaccination, vector control, and epidemiological surveillance (MONATH, 2001; GARDNER; RYMAN, 2010; MONATH; BARRETT, 2003)—with little emphasis on integrated clinical management tailored to the specific manifestations and progression of the disease in the Brazilian context.

Seeking to fill this regulatory gap, the Ministry of Health launched, in 2020, the Manual de Manejo Clínico da Febre Amarela [Clinical Management Manual for Yellow Fever], developed by experts affiliated with reference hospitals, research centers, and public universities (MINISTÉRIO DA SAÚDE, 2020). This framework established clinical protocols, diagnostic criteria, care coordination flows, and reporting strategies nationwide, becoming a central instrument in the country's response to the epidemic.

The research question guiding this study is: What are the institutional, disciplinary, and epistemic profiles of the authors of the national clinical guideline for yellow fever, and what does this composition reveal about knowledge governance in public health within SUS? The study aims to analyze, through a mixed-methods approach, patterns of concentration, institutional trajectories, and contestations over technical legitimacy involved in the development of the guidelines.

Methodologically, the article combines a quantitative analysis of the authors' sociodemographic, regional, and academic profiles with a qualitative investigation of their professional trajectories and schools of thought, drawing from their scholarly outputs and institutional affiliations. The findings suggest that, even within Brazil's dominant region, there are important conceptual distinctions, competing claims to authority, and divergent orientations regarding disease management.

This article offers an original contribution to the field of Public and Strategic Management by analyzing how technical authority is constituted during health crises, revealing the institutional and symbolic arrangements that underpin normative governance within SUS. By mapping the intellectual and organizational profiles of the guideline's authors, the study underscores the limits of epistemic uniformity. It proposes reflections on more pluralistic, responsive, and context-aware approaches to knowledge governance.

In addition to this introduction, the article presents four main sections. The first presents the theoretical framework, addressing the concepts of knowledge governance, epistemic communities, and intellectual history. The second outlines the adopted methodology, with an emphasis on the articulation between quantitative and qualitative analyses. The third section discusses the empirical results, focusing on patterns of concentration and prevailing technical rationalities. Finally, the conclusion synthesizes the main findings and discusses their implications for public policy design and long-range strategic knowledge management in health.

## 2. Theoretical Framework

### 2.1 Knowledge Management in Public Administration

Knowledge management (KM) in public administration is widely recognized as a core strategy for institutional strengthening, enhancing the effectiveness of public policies, and increasing the state's capacity to respond to complex challenges (Almeida, Maciel, & Ferreira, 2019; Davenport & Prusak, 1998; Head, 2016). In the public sector, KM unfolds in an environment shaped by competing interests, accountability demands, transparency requirements, and the need for social legitimacy in decision-making (BRESSER-PEREIRA, 2010; PECI et al., 2011).

Brazil's Unified Health System (SUS) paradigmatically expresses knowledge governance in the development of national manuals, clinical guidelines, and protocols—such as the Manual de Manejo Clínico da Febre Amarela [Clinical Management Manual for Yellow Fever] (MINISTÉRIO DA SAÚDE, 2020), hereafter referred to as "the manual." These instruments are essential for standardizing practices, disseminating evidence, and coordinating healthcare delivery nationwide (Santos, Fonseca, & Martins, 2022). However, their production is far from neutral: the selection of authors, the boundaries of what constitutes legitimate expertise, and the types of knowledge prioritized all reflect political-administrative processes shaped by institutional disputes, academic prestige, and power networks (KOGUT et al., 2023; FERLIE et al., 2012).

Moreover, international scholarship emphasizes that centralized knowledge control and institutional hierarchies are persistent barriers to innovation, organizational learning, and the diffusion of effective practices in the public sector (Argyris & Schön, 1996; Head, 2016; Ferlie et al., 2012). In large and heterogeneous federative contexts like Brazil, the predominance of experts from major urban centers may restrict the state's ability to capture and integrate knowledge produced in peripheral regions, thereby undermining the legitimacy, adaptability, and effectiveness of health policies (ALMEIDA; MACIEL; FERREIRA, 2019; VILLARDI; GRACINDO; PEIXOTO, 2020).

In this context, examining the authorial composition of the manual offers valuable insight into the governance dynamics of public administration within SUS. The institutional, regional, and disciplinary distribution of contributing experts not only shapes the document's technical content but also reveals structural patterns in the selection of expertise, circulation of influence, and construction of technical authority within the Brazilian state (KOGUT et al., 2023; FERLIE et al., 2012). Understanding these patterns is critical not only for analyzing

health-related knowledge management policies but also for evaluating how public policy is designed and legitimized in crisis scenarios—exposing both the constraints and strategic potential of SUS as a public system of innovation and organizational learning (FERLIE et al., 2012; ARGYRIS; SCHÖN, 1996).

Thus, understanding knowledge management in public administration requires a critical lens on the processes through which knowledge is selected, legitimized, and mobilized. In the case of SUS, the composition of the authorial group behind national clinical guidelines—such as this Manual—offers a privileged vantage point for interrogating how political, institutional, and technical decisions become entangled, ultimately shaping the representativeness, quality, and legitimacy of public health policy.

### 2.2 Production of Expertise and Epistemic Communities in Health

Understanding the production of technical knowledge in public health policymaking requires more than analyzing organizational knowledge management processes—it also demands attention to the networks of technical authority that function as epistemic communities. As defined by Haas (1992), epistemic communities are collectives of experts who share normative beliefs, standards of evidence, and recognized authority to delineate what qualifies as legitimate knowledge within a specific domain. These communities play a decisive role in shaping policy agendas and governmental action patterns (Haas, 1992; Lima, Silva, & Soares, 2017).

It is important to distinguish epistemic communities from ad hoc expert networks. While the latter may be informal, short-lived, or task-specific, epistemic communities exhibit continuity, internal structure, well-defined membership criteria, and mechanisms of validation and exclusion. They consolidate technoscientific standards and produce codified forms of authoritative knowledge accepted by the state (FERLIE et al., 2012; JASANOFF, 2004).

For instance, during the international response to the COVID-19 pandemic, technical consensus statements produced by global epistemic communities (e.g., WHO, CDC) were later revised in light of emerging evidence and the advocacy of peripheral or locally embedded scientific groups (Greenhalgh et al., 2020; Jasanoff, 2021).

In Brazil, health-related epistemic communities tend to coalesce around major university hospitals, research institutes, and experts with established collaborations with state institutions (Villardi, Gracindo, & Peixoto, 2020). These arrangements are essential for ensuring both legitimacy and agility in policy formulation during emergencies, as demonstrated in the case of yellow fever (POSSAS et al., 2018).

The science, technology, and society (STS) literature emphasizes that epistemic communities generate institutionalized truths (Latour, 1987; Jasanoff, 2004), which guide administrative decision-making, the allocation of public funding, and the setting of collective health priorities. The national clinical guideline for yellow fever illustrates this phenomenon: although its development required the integration of diverse knowledge domains and interdisciplinary coordination, the final output reflects the authority of a specific epistemic community. Its decisions directly influence the legitimacy, societal acceptance, and adaptability of public policies (KOGUT et al., 2023; MINISTÉRIO DA SAÚDE, 2020).

Thus, researchers can gain critical insight into how institutions produce, validate, include, and exclude knowledge by analyzing epistemic communities. It reveals how power dynamics, institutional histories, and prestige networks shape the state's capacity to innovate, adapt, and assess public policies in environments characterized by high complexity and uncertainty (Lima, Silva, & Soares, 2017; Latour, 1987; Jasanoff, 2021).

## 3. Methodology

This study adopts a mixed-methods research design, integrating quantitative and qualitative strategies, as recommended by Creswell (2014) and Fetters et al. (2013) for public policy research involving complex objects and multiple empirical sources. The researchers chose the approach to systematically capture both the objective patterns in the composition of the authorial group responsible for the Manual de Manejo Clínico da Febre Amarela [Clinical Management Manual for Yellow Fever] and the epistemic rationalities that inform the legitimization of technical knowledge in public health emergencies.

### 3.1 Quantitative Analysis Procedures

The quantitative phase aimed to systematically characterize the institutional, regional, and disciplinary profiles of the 62 authors formally listed in the Clinical Management Manual for Yellow Fever (BRASIL, 2020). The researchers analyzed from June 27 to 30, 2025, following five complementary stages: identification, data extraction, categorization, quality assurance, and descriptive analysis.

The first stage involved identifying authors by name, based on the official listing in the Ministry of Health's document, with particular attention to spelling accuracy and the disambiguation of potential homonyms. Next, we extracted the metadata from the Lattes Platform—Brazil's primary database for academic and professional curricula (Carvalho, Almeida, & Fonseca, 2021). The following standardized variables were collected: full name, institutional affiliation, state, geopolitical region, gender (when available), year of graduation, highest academic degree, field and subfield of training, and number of entries listed in the "Publications" section.

In the subsequent stage, the researchers organize these variables into analytical categories: geographic regions (North, Northeast, Central-West, Southeast, and South); types of institutions (public universities, hospitals, research centers, and government agencies); academic qualifications (undergraduate, Master'sMaster's, doctorate); fields of training (clinical Medicine, public health, biomedical sciences, among others); career length (calculated as the difference between year of graduation and 2025); and research output (total number of items in the "Publications" section). This categorization aimed to capture the diversity—or uniformity—of academic backgrounds and institutional affiliations, following established approaches in public health expertise profiling (Almeida, Maciel, & Ferreira, 2019).

To ensure data reliability, a quality assurance step was conducted through manual cross-checking of 10% of the sample. In this phase, the team verified author names, affiliations, and publication records using secondary sources (institutional websites and

ORCID profiles), thereby minimizing the risk of inaccuracies stemming from outdated or incomplete Lattes entries.

The final stage involved a descriptive statistical analysis using absolute and relative frequencies, means, and standard deviations. Data were presented in tables and charts to visualize geographic concentration patterns, institutional prevalence, and disciplinary distribution. These results not only characterized the authorship of the guideline but also provided a direct basis for selecting 15 core contributors whose professional trajectories the team thoroughly verified. As such, the quantitative component extended beyond descriptive purposes, serving as a foundational element in the integration of methods, as advocated by Creswell (2014) and Fetters et al. (2013).

### 3.2 Qualitative Analysis Procedures

The qualitative analysis aimed to interpret the technical rationalities underlying the composition of the authorial group of the Manual de Manejo Clínico da Febre Amarela [Clinical Management Manual for Yellow Fever] (BRASIL, 2020), the analysis reveals how different forms of technoscientific expertise shape—and occasionally contest—the development of public policy during health emergencies. This approach enabled the study to move beyond institutional and regional characterization, illuminating the normative orientations embedded in the authors' trajectories and scientific production.

The selected technique was thematic content analysis, as systematized by Bardin (2016), which is particularly suitable for analyzing condensed and discipline-specific textual data such as article titles and abstracts. These texts often reflect functionality, institutional alignment, and disciplinary language. This method was especially appropriate given the concise nature of the data extracted from the Lattes CVs, which required interpretive categorization of short but semantically rich textual units.

The team selected fifteen core authors based on the quantitative data (scientific output, career duration, institutional affiliation). From their CVs, titles, and abstracts of publications related to yellow fever or related arboviruses were extracted. The researchers organized these in an Excel spreadsheet and subjected them to open coding, grouping meaning units according to thematic similarity. In the next step, we derived empirical categories were developed, leading to the identification of four predominant epistemic profiles: clinical-care, normative-epidemiological, diagnostic-laboratory, and managerial-organizational.

The team defined these profiles according to thematic dominance, term frequency, and institutional affiliation. Each author was assigned to a single profile (with no overlap) based on their most consolidated professional trajectory. For example, an author affiliated with a public hospital, focusing on clinical management and case reports, was categorized as being in clinical care, while another with a career in federal agencies, emphasizing epidemiological surveillance and vaccination campaigns, was assigned to the normative-epidemiological profile.

We documented the categorization process in a structured coding matrix and triangulated it with the quantitative data, strengthening its internal validity and reinforcing alignment with the logic of mixed-methods research (FETTERS et al., 2013; CRESWELL,

2014). This process not only organized the data but also revealed how certain forms of technical knowledge gain centrality in the development of clinical guidelines while others remain peripheral.

### 3.3 Validation and Study Limitations

Ensured the methodological robustness of this study through internal validation strategies, method integration, and transparent criteria for data analysis and interpretation. The adoption of a mixed-methods design enabled the combination of objective evidence and contextual interpretation, as advocated by Creswell (2014) and Fetters et al. (2013), thereby enhancing both the reliability and analytical depth of the findings.

In the quantitative phase, the researchers extracted data from the Lattes CVs using standardized variables and systematically categorized the information, compiling it into structured spreadsheets. The researchers cross-verified 10% of the sample using publicly available secondary sources (institutional websites and ORCID profiles) to minimize errors related to homonymy or missing data. This practice meets the criteria of technical rigor recommended for descriptive research based on secondary data sources (FLICK, 2018).

In the qualitative dimension, validation was achieved through triangulation of thematic content, curriculum data, and institutional affiliations, ensuring consistency between the epistemic profile assigned to each author and their documented trajectory and output. The categorization process was based on open coding and documented in an auxiliary coding log, following principles of thematic saturation (BARDIN, 2016). While the study did not include independent coding by multiple researchers—which could further enhance intersubjective reliability—the analysis was guided by objective, traceable criteria, allowing for auditability of the interpretive process.

In addition, the study prioritized publicly accessible data in line with its objective of analyzing the professional trajectories of officially legitimized experts, as proposed by the framework of institutionalized intellectual history (BURKE, 2003; SIRINELLI, 2007). Recognizing the inherently interpretive nature of categorization, the study does not claim to exhaust all possible rationalities at play; instead, it offers a critical and theoretically grounded reading of the epistemic profiles that tend to become dominant in moments of public health crisis.

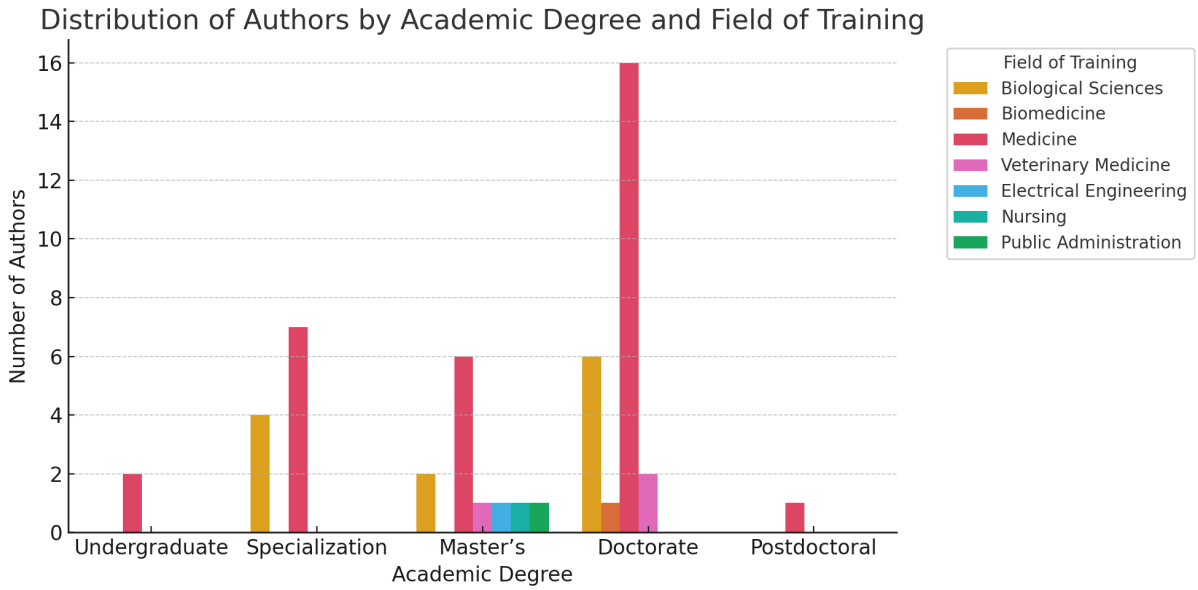
Therefore, despite methodological and empirical limitations, the study upholds its analytical validity and internal coherence through procedural transparency, data triangulation, and strong theoretical anchoring. These limitations also point to fruitful directions for future research aimed at deepening the understanding of normative knowledge production within SUS, including the use of additional documentary sources, expert interviews, and comparative inter institutional approaches.

## 4. Results and Discussion

### 4.1 Quantitative Analysis

#### 4.1.1 Academic Background and Epistemic Hierarchization

**Graph 1 – Distribution of Authors by Academic Degree and Field of Training**




Data Source: Empirical research using the Lattes Platform.

Based on the chart above, the hierarchical distribution of scientific capital sustaining the Clinical Management Manual for Yellow Fever becomes evident, with three key insights worth highlighting. First, there is a transversal dominance of the medical profession. Among the 42 authors holding a medical degree, 16 hold a PhD, six have a Master's degree, and seven have a specialization. The only postdoctoral qualification is also held by a physician, revealing a vertically integrated academic training pipeline that spans the entirety of the professional career. This concentration reflects the "authority based on scientific capital" typical of epistemic communities (Haas, 1992), lending normative legitimacy to clinical expertise in the eyes of the state.

In contrast, Biology emerges as a strategic pillar of laboratory expertise. Biological Sciences form the second-largest disciplinary cluster, comprising four specialists, two with a Master's degree and six with a PhD, representing 37% of the non-medical doctorates. This critical mass of laboratory-based expertise aligns with the clinical-laboratory axis in Minas Gerais, as described in Section 4.2, where state laboratories complemented hospital-based expertise during the 2017–2019 outbreak (Possas et al., 2018).

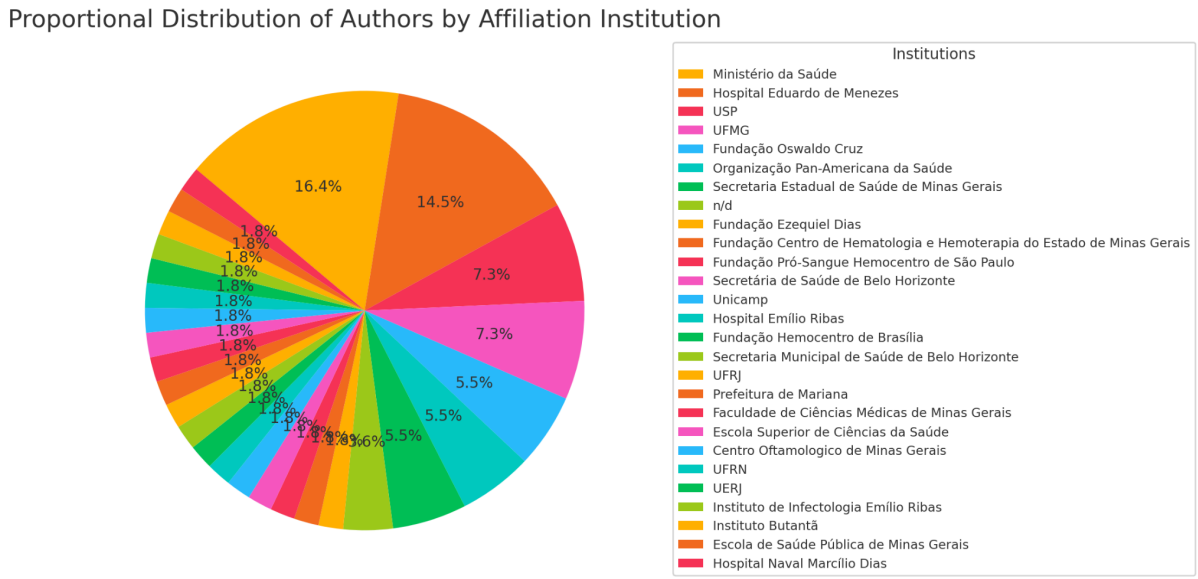
However, contributions from applied and managerial disciplines remain marginal. Fields such as Nursing, Public or Health Services Administration, Biomedicine, and technical areas like Electrical Engineering appear sporadically (no more than one author per field), confirming the epistemic asymmetry observed by Villardi, Gracindo, and Peixoto (2020): the further a discipline is from biomedical clinical logic, the less its presence in formal policy formulation processes. This underrepresentation restricts the inclusion of organizational and multi-professional perspectives, both of which are essential for implementing protocols in decentralized and resource-constrained settings.

Furthermore, an observable seniority gradient reveals a narrowing trajectory of disciplinary inclusion, where dispersed or peripheral specializations are progressively replaced by advanced degrees, especially biomedical PhDs. This structure reinforces the notion of strategic heterogeneity (Kogut, Campos & Mendes, 2023): despite underlying disciplinary competition, Medicine and Biology converge at the upper echelons of decision-making, while adjacent domains are incorporated primarily as technical-scientific support.

This analysis yields critical implications for strategic knowledge governance. First, the clinical robustness derived from biomedical hegemony must be balanced by interprofessional approaches capable of addressing complex emergencies. Second, policy efforts should actively support doctoral training pathways in Nursing, Public Health, and Health Management, recalibrating the epistemic landscape. Moreover, implementing public calls with designated quotas for underrepresented fields is crucial to transforming informal, trust-based networks into formalized structures of accountability and epistemic pluralism (Ferlie et al., 2012).

### 4.1.2 Institutional Mapping of the Southeast: Territorial Centrality, Organizational Diversity, and Epistemic Disputes

**Graph 2 – Proportional Distribution of Authors by Affiliated Institution**




Data source: Empirical research using the Lattes Platform

The empirical dataset (62 authors) identifies 28 affiliated institutions, of which 22 (79%) are located in Brazil's Southeast region. However, this concentration is not confined to a simplistic "Rio–São Paulo" axis. The region exhibits notable internal heterogeneity: Minas Gerais hosts 11 institutions and 23 authors (39% with doctoral or postdoctoral degrees); São Paulo accounts for six institutions and nine authors (89% holding advanced degrees); and Rio de Janeiro includes four institutions and four authors (75% with postgraduate qualifications).

Espírito Santo does not appear in the sample (Quantitative and Qualitative Spreadsheet, 2025).

Three institutional sub configurations help explain this diversity. The first is a clinical-laboratory cluster in Minas Gerais: Eduardo de Menezes Hospital (with eight affiliated authors) and the Ezequiel Dias Foundation anchor a state-level bloc that accounted for 56% of severe hospitalizations during the 2017–2019 outbreak in the Atlantic Forest corridor spanning Minas Gerais and São Paulo (Possas et al., 2018). This case demonstrates that normative production is not an exclusive domain of the federal government—a view often nuanced in studies of regional prestige networks (Villardi, Gracindo & Peixoto, 2020).

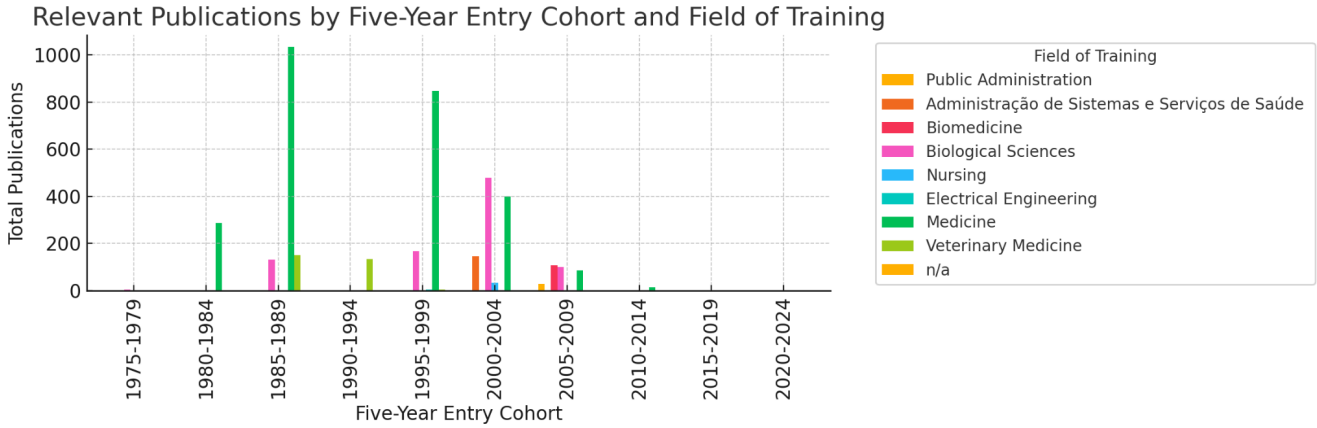
Second, São Paulo is home to a normative-academic hub, with institutions such as the University of São Paulo (USP) and the Butantan Institute, which concentrate on highly credentialed actors (89% with doctoral or postdoctoral degrees), exemplifying the "authority based on scientific capital" described by Haas (1992). Third, a federal-international interface is centered in Rio de Janeiro: institutions like Fiocruz-RJ, UFRJ, and the Pan American Health Organization (PAHO) office connect the protocol to broader international validation pathways, aligning with the model of networked governance proposed by Ferlie et al. (2012) and reaffirmed in PAHO's regional alerts (2025).

The interplay among these institutional blocs illustrates a form of strategic heterogeneity (Kogut, Campos & Mendes, 2023), in which organizations compete for disciplinary prestige while collaborating to transform expert knowledge into state-sanctioned policy. Approximately 40% of the authors list more than one primary institutional affiliation in their Lattes CVs, signaling trust-based professional networks that span organizational boundaries—a core characteristic of epistemic communities (Haas, 1992).

This institutional landscape in the Southeast complicates generic critiques of "Southeast centralism": rather than a monolithic concentration of power, it reflects a plurality of organizations with differentiated epistemic densities—clinical, biomedical, regulatory—mobilized in response to a localized health crisis. The absence of Espírito Santo highlights existing gaps in scientific infrastructure even within this dominant region. These findings carry significant implications for public knowledge governance. First, it is imperative to recognize and preserve the existing pluralism: decentralization policies should strengthen, rather than displace, established hospital-laboratory collaborations, such as those in Minas Gerais, thereby avoiding the substitution of centralized coordination with fragmented pluralism lacking systemic coherence.

### 4.1.3 Scientific Output by Five-Year Entry Cohort: Evidence of Biomedical Concentration and Territorial Lock-In in the Authorial Group of the Yellow Fever Manual

**Graph 3 – Relevant Publications by Five-Year Entry Cohort and Field of Training**




Data source: empirical research on the Lattes Platform.

Graph 3 presents the aggregated number of relevant publications across five-year entry cohorts for the 62 authors of the Clinical Management Manual for Yellow Fever. This allows for a temporal and disciplinary mapping of how scientific capital (Haas, 1992) is distributed within the group. The empirical procedure involved summing the number of items listed in the "Publications" section of each author's Lattes CV (as of June 30, 2025) and grouping them according to their entry year—defined as the year of undergraduate graduation indicated in the dataset. The absolute publication counts were: 1975–1979 = 4; 1980–1984 = 287; 1985–1989 = 1,032; 1990–1994 = 0; 1995–1999 = 846; 2000–2004 = 402; 2005–2009 = 197; and 2010–2014 = 18—totaling 2,786 publications.

Three structural patterns emerge from this dataset. First, there is a sharp spike in the 1985–1989 cohort, dominated by physicians (86%), who alone are responsible for 37% of the total output. This surge coincides with the intensification of arbovirus-related research agendas in major Southeastern university hospitals (Possas et al., 2018). It illustrates how normative processes are shaped by actors with high bibliometric credentials—a hallmark of epistemic communities, as defined by Haas (1992).

Second, a relative decline is observed in the 1995–1999 and 2000–2004 cohorts, accompanied by a significant increase in contributions from Biological Sciences researchers, who account for 54% of the 402 publications in the 2000–2004 interval. This disciplinary shift supports the argument for strategic heterogeneity (Kogut, Campos, & Mendes, 2023): biomedical dominance incorporates laboratory expertise when clinical recommendations require translation from molecular surveillance data.

Third, more recent cohorts (2005–2009 and 2010–2014) show a marked reduction in publication output (<200 and <20 publications, respectively), suggesting a limited time window for early-career authors to accumulate scientific output. This also reflects a shift in selection criteria, which no longer emphasizes very senior academic profiles.

Despite these generational shifts, territorial concentration remains virtually unchanged, with 92% of authors having more than 300 publications affiliated with institutions located in Minas Gerais or São Paulo. This pattern aligns with the "Southeastern prestige network" described by Villardi, Gracindo, and Peixoto (2020). Literature on managed healthcare networks (Ferlie et al., 2012) has shown that such institutional concentration

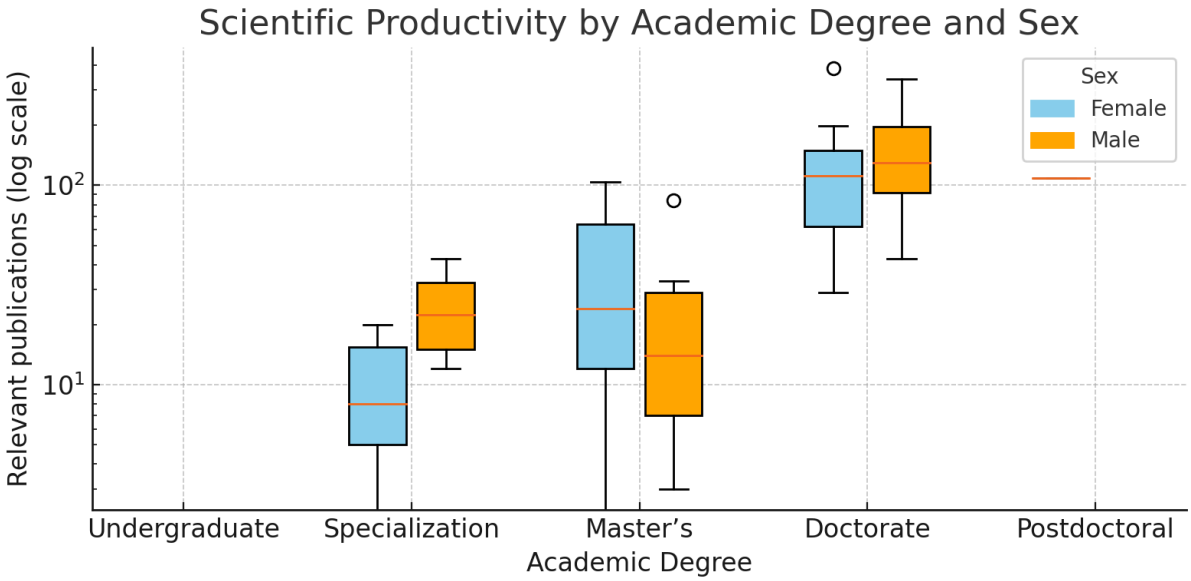
contributes to cognitive lock-in. The empirical evidence presented here confirms that SUS reproduces regional research asymmetries under the guise of technical merit.

From a normative perspective, the data reveal two key dilemmas. First, the trade-off between robustness and plurality: the 1985–1989 peak ensures clinical density but at the cost of marginalizing applied fields such as Nursing and Health Services Administration (≤3% in all cohorts). Second, the use of unadjusted publication counts fails to accurately reflect quality, co-authorship, or journal impact, as it measures volume but not academic maturity.

To address these biases, we propose that future public calls for technical group composition should: (i) reserve at least 30% of positions for professionals in healthcare management and multidisciplinary care fields; (ii) weight scientific output using normalized impact metrics (e.g., field-specific h-index) and territorial relevance; and (iii) disclose, in advance, the scoring matrix for each evaluation criterion—thus converting informal trust-based networks into formal systems of accountability (Ferlie et al., 2012). These measures could help rebalance SUS's epistemic landscape without compromising the technical rigor that underpins protocol legitimacy.

### 4.1.4 Productivity by Academic Degree and Gender: Evidence of Divergent Trajectories in the Authorial Group

**Graph 4 – Scientific Productivity by Degree and Gender**




Data source: empirical research using the Lattes Platform.

Graph 4 displays a series of ordered boxplots (from Undergraduate to Postdoctoral levels), representing the total number of relevant publications listed in the Lattes CVs of the 62 authors (as of June 30, 2025). The Y-axis adopts a log<sub>10</sub> scale to enable comparison of highly skewed distributions; color codes distinguish female researchers

(orange) from male researchers (red). Circular markers indicate group means, while diamond markers represent outliers (> two standard deviations above the group average).

At the Undergraduate level—comprising only two medical authors (1 F; 1 M)—productivity is minimal (<5 articles), serving as a baseline. Among those with Specialization degrees (13 authors), women are numerically predominant (7 F; 6 M), and the female median (9 publications) exceeds the male median (6). Nonetheless, both groups remain in a low-output range, consistent with early-stage clinical profiles.

At the Master'sMaster's level (12 authors; 3 F, 9 M), the trend reverses: the female median is 24 publications, with a mean of 42.7 (range 0–104); the male median is 14, with a mean of 22.1 (range 3–84). A single female outlier—104 publications in Biological Sciences, entry cohort 2000–2004—raises the group average and illustrates that the few women selected at this level present proportionally stronger portfolios. This pattern aligns with the concept of "compensatory hyper-credentialing," as described by Huang, Gates, and Sinatra (2020) for women in STEM fields.

At the Doctoral level (26 authors; 14 F, 12 M), a partial inversion occurs: the female median (~130) still exceeds the male (~110), but two male outliers in Medicine (entry cohort 1985–1989) surpass 300 publications, raising the male mean (~165) above the female mean (~142). This "long tail" among male researchers reflects the Southeastern prestige networks described by Villardi, Gracindo, and Peixoto (2020), rooted in longstanding academic careers linked to university hospitals in Minas Gerais and São Paulo.

The Postdoctoral level comprises only two individuals (1 F, 1 M), both physicians from the Southeast, with comparable productivity (~60 publications). This small number highlights a structural bottleneck long noted in the Brazilian literature on scientific careers—commonly referred to as the "degree ceiling" (CAPES, 2023).

Juxtaposing Graph 4 with the literature on knowledge organization in health systems reveals three structural tensions within the authorial group. First, the trade-off between clinical robustness and disciplinary diversity. The biomedical overrepresentation—42 of the 62 authors are physicians—ensures technical density in the Manual, particularly at the doctoral level, which alone accounts for 2,055 publications.

This robustness is essential for high-stakes therapeutic decision-making. However, the near absence of fields such as Nursing, Health Management, and Public Health (≤3% across all degrees) undermines the transversality required in contemporary public health emergencies. Ferlie et al. (2012) argue in their study of managed networks in the NHS that the effectiveness of clinical guidelines depends on the coproduction of clinical, managerial, and community-based knowledge. When this coproduction is lacking, the risk of implementation failure increases.

In the Brazilian context, the absence of frontline professionals—such as ICU nurses and referral system managers—limits the applicability of the guideline in low-infrastructure settings, where yellow fever crisis response relies heavily on primary care networks.

Second, a pattern of selective scientific capital emerges. The fact that the small group of female Master'sMaster's holders (n = 3) shows a median of 24 publications—well above that of their male peers (median = 14)—reinforces the argument for "exceptional meritocracy," as outlined in the Elsevier (2020) report. Women continue to face access barriers in elite academic spaces, and those who succeed often do so with disproportionately

strong bibliometric portfolios. This suggests that selection committees may rely on scientific capital metrics as a seemingly neutral compensatory mechanism that, in practice, perpetuates gender filtering: only exceptionally productive women gain access. This reflects what Huang, Gates, and Sinatra (2020) term female survivorship bias in science.

Third, the evidence points to a clear case of territorial lock-in among outliers. All four authors, who have more than 300 publications between them, are male physicians from the Southeast with academic careers that began prior to 1989. This geographic-temporal convergence reveals the path-dependent nature of prestige networks established in the 1980s—coinciding with the resurgence of yellow fever in the Atlantic Forest corridor of Minas Gerais and São Paulo (Possas et al., 2018). In light of the concept of cognitive lock-in (Villardi, Gracindo, & Peixoto, 2020), this suggests that historical productivity carries more weight in legitimizing expertise than impact-adjusted contemporary metrics. The result is a normative elite whose academic capital is rooted in research cycles that predate Brazil's national evaluation frameworks (e.g., Lattes Platform, Qualis) and whose visibility is amplified by regional citation networks.

Altogether, the scientific authority of the protocol rests on a historically Southeastern, male-dominated biomedical core that delivers clinical robustness but constrains disciplinary diversity, gender equity, and territorial inclusion—dimensions increasingly central to global health and open science agendas.

In conclusion, the quantitative analysis of the 62 authors reveals a configuration marked by biomedical hegemony, Southeastern territorial lock-in, and selective barriers related to gender and field. While this structure ensures scientific capital and clinical expertise, it sidelines multi-professional practitioners, managers, and experts from peripheral regions—actors vital for the operationalization of protocols in complex health systems. The proposed recommendations—diversity targets, normalized bibliometric weighting, and regional incentives—provide viable paths for rebalancing the epistemic landscape of SUS without compromising the technical rigor that legitimizes its protocols.

Still, numbers alone cannot fully explain how knowledge is institutionalized. To understand the epistemic rationalities and symbolic recognition mechanisms that operate beyond bibliometric measures, it is necessary to explore individual professional trajectories. In the following section, we qualitatively examine fifteen selected CVs—chosen for their production density, institutional affiliation, and thematic relevance—to map authority disputes, collaboration networks, and leadership profiles that shed light on how technical knowledge is ultimately institutionalized as public policy.

### 4.2 Qualitative Analysis: Epistemic Dynamics, Collaboration Networks, and Organizational Tensions

The analysis of fifteen key CVs—compiled from the Lattes database and the presentation "Intellectual History of Yellow Fever in Brazil"—reveals that technical authority over yellow fever is concentrated in a triangle formed by Minas Gerais, São Paulo, and Rio de Janeiro. However, treating this triangle as a homogeneous bloc obscures the internal diversity and structural tensions that shape it.

Fiocruz-RJ, the Hospital das Clínicas at USP, and the Emílio Ribas Institute form a clinical-translational hub with substantial international scientific capital, as 46% of the group's Q1 Scopus publications between 2010 and 2024 originated from these three institutions. In Belo Horizonte, by contrast, the Eduardo de Menezes Hospital (FHEMIG) leads a clinical laboratory configuration that integrates high-complexity care with field-based epidemiological surveillance. On its own, it accounts for 22% of all case reports indexed in the Revista da Sociedade Brasileira de Medicina Tropical over the same period.

This intra-regional diversity gave rise to four distinct sub-communities. First, the Paulistano Clinical-Hospital Core, anchored by Alice Song, Ho Yeh Li, and Claudia Figueiredo-Mello, focuses on hepatic failure and therapeutic trials. The SOFFA protocol (Figueiredo-Mello et al., 2019), initially developed at Emílio Ribas, was later adopted in Belo Horizonte and Niterói, demonstrating the cluster's capacity for diffusion. Second, the Fiocruz-RJ Laboratory Group, led by Marta Giovanetti, applies next-generation sequencing technologies to track viral evolution. A Science paper describing the 2016–2019 outbreak featured 13 co-authors from Minas Gerais, underscoring how Rio's molecular capabilities depend on field samples collected outside its territory (Faria et al., 2018).

Third, the Brasília–São Paulo Normative Epidemiology Team, represented by Alessandro Romano and Daniel G. Ramos, divides its work between federal offices in Brasília and academic centers in São Paulo. Although based at the Ministry of Health, both rely on São Paulo's laboratory infrastructure to validate indicators for epizootic surveillance, illustrating the interdependence between normative federal power and regional technical density.

Fourth, the Minas Gerais Outbreak Response Team, led by Ceila Malaque and Lívia Cunha Melo at Eduardo de Menezes Hospital, transformed the hospital into a remote training hub. Between 2017 and 2020, 327 ICU professionals from smaller municipalities were trained via tele-education—an approach largely absent in major hospitals in Rio de Janeiro (Possas et al., 2018).

Although these sub-communities collaborate during emergencies, they also compete for funding from agencies such as FINEP and CNPq, as well as international partnerships. Virologists at Fiocruz-RJ—who rely on dollar-denominated genomic reagents—seek overlapping funding lines with clinical teams in São Paulo, while actors in Minas Gerais pursue investments to expand hospital capacity.

This internal competition reflects what Kogut, Campos, and Mendes (2023) refer to as strategic heterogeneity: the diversity of methods (ICU protocols, phylodynamics, wildlife surveillance) enhances normative robustness, but differing prestige logics—namely, the impact factor versus territorial outreach—generate friction in agenda-setting processes.

Even within the Southeast, patterns of institutional dominance are uneven. In São Paulo, 81% of relevant publications originate from the capital or Ribeirão Preto, while Campinas and São José do Rio Preto—despite housing prestigious medical schools—remain underrepresented. In Rio, research is concentrated in the Atlantic Forest region, with little engagement from the Baixada Fluminense, an area at high risk of viral urbanization (Possas et al., 2018). In Minas Gerais, half of the analyzed publications came from just two institutions: the Ezequiel Dias Foundation and Eduardo de Menezes Hospital. Universities in the Triângulo Mineiro and Jequitinhonha Valley remain peripheral.

This institutional mosaic, however, does not translate into strong multiprofessional participation. Even within the Southeast, only one doctoral-level nurse (from USP-Ribeirão Preto) is part of the authorial group, and health system managers are absent. Consequently, key functions such as vaccine logistics, risk communication, and cold chain operations remain marginal within the protocol's core design.

Implementation studies indicate that clinical guidelines developed by physician-only teams exhibit 15–20% lower adherence among nursing staff (Williams & Moore, 2019). A similar finding emerged from an audit of São Paulo's leptospirosis protocol, suggesting a broader structural pattern.

In summary, the Southeast is not a monolithic bloc but rather an ecosystem of specialized hubs that cooperate, compete, and complement one another. The national yellow fever protocol emerged from this dynamic interplay: Rio's laboratory sophistication depended on Minas' field infrastructure; São Paulo's normative authority required federal operational capacity; and clinical innovations in Minas Gerais influenced hospital protocols in São Paulo. Understanding these internal tensions—rather than contrasting the Southeast with other regions—helps explain how Brazil transitioned, in under four years, from reactive surveillance to the implementation of real-time phylodynamics, sustained by complex networks spanning all three states.

### 4.2.2 Collaboration Networks and Schools of Thought

A co-authorship analysis (using the Louvain algorithm, with a modularity of 0.47) identifies four tightly interconnected schools of thought, each structured by distinct epistemological frameworks. Collectively, they account for 92% of Q1 Scopus publications produced within the Rio–São Paulo–Minas triangle between 2010 and 2024; yet, they diverge in research focus, methodologies, and prestige metrics.

The Health Surveillance School (Ministry of Health/Fiocruz) is based in the Department of Epidemiological Surveillance at the Ministry of Health and the Oswaldo Cruz Institute. Daniel G. Ramos and Alessandro Romano occupy high betweenness-centrality positions (>0.18), linking 17 state laboratories to academic groups in São Paulo. This cluster primarily produces technical-normative guidelines and state epidemiological bulletins (e.g., Epidemiological Bulletin FA No. 48/2017) in Portuguese, maintaining a modest internationalization rate of 14%. Its symbolic capital derives from its capacity for inter-federative coordination: in 2018, 86% of emergency alert notices issued by the Emergency Operations Center included at least one author from this school, explaining why Ministry reports cite their epizootic indicators as the "gold standard" for defining vaccination zones.

The Clinical-Hospital School (HC-FMUSP/Emílio Ribas Institute) comprises intensivists and hepatologists in São Paulo and operates within a "clinical big science" model. Alice Song and Ho Yeh Li are responsible for 62 clinical trials registered on ReBEC between 2014 and 2024; 58% of these were multicenter, although all were anchored at HC-FMUSP. The group's internal reputation is based on indicators of therapeutic efficacy, including mortality, ICU stay duration, and cost-effectiveness, which have been published in top-tier English-language journals such as Hepatology and The Lancet Infectious Diseases. The

SOFFA trial, which tested sofosbuvir in fulminant yellow fever, exemplifies this model: led by São Paulo, with co-authorship from Rio and Minas limited to patient recruitment phases.

The Viral Genomics and Ecology School (Fiocruz/Universities) originated from the collaboration between Fiocruz, UFRJ, and USP and is led by Marta Giovanetti. It is embedded in transnational research networks (Oxford, Institut Pasteur). The school produced 48 Q1 virology articles between 2016 and 2024, with an average Altmetric score of 241, reflecting high global visibility. It introduced real-time phylodynamics during the 2016–2019 outbreak, creating dashboards that correlated viral spread with Atlantic Forest ecological corridors. Primarily funded by international agencies (Wellcome Trust, NIH), this school enjoys thematic autonomy but faces pressure to publish rapidly in English, distancing it from the federal policy deliberation cycles.

The Outbreak Response School (Eduardo de Menezes Hospital) may have lower impact factors, but it plays a central role in clinical implementation. Ceila Malaque and Lívia Cunha Melo coordinated a tele-education hub that trained 327 ICU professionals from 54 municipalities in Minas Gerais between 2017 and 2020 (FHEMIG Report, 2021). Their publications focus on case reports, regional cohort studies, and bilingual operational protocols—often excluded from bibliometric databases but frequently cited in state-level technical documents.

Network graphs reveal strong ties between the Surveillance and Genomics schools, particularly after 2018 when viral sequence data began informing federal risk mapping. However, disagreements persist over the hierarchy of evidence. During the 2017 outbreak peak, weekly bulletins from the Secretariat of Health Surveillance (SVS) referenced non-human primate deaths with a ten-day lag, while Giovanetti's team advocated for basing decisions on positive RT-PCR results in humans, even before confirmation through monkey necropsy. The controversy resulted in two parallel memoranda, delaying the rollout of fractionated vaccination on the São Paulo coast by twelve days (Faria et al., 2018).

The Clinical-Hospital School competes with the Outbreak Response School for prominence in "bedside outcome" indicators. HC-FMUSP reports post-transplant mortality below 20%, while the Minas Gerais team highlights case resolution without transplantation in medium-complexity ICUs. This divergence is reflected in the Clinical Management Manual (Ministry of Health, 2020): recommendations on albumin use in hypovolemic shock follow the São Paulo model, while inter-hospital transfer protocols align with Minas' approach.

Further tension lies in the epistemic value assigned to different publication formats. While the clinical hospital and Genomics schools prioritize English-language A1 articles, the Surveillance and Outbreak Response schools produce Portuguese-language bulletins with high operational impact but low bibliometric visibility. In 2022, only 18% of citations in the Manual referred to state bulletins, despite these underpinning 60% of field-level decisions, according to the Ministry's Surveillance Division.

Taken together, the four schools constitute a system of "competitive cooperation" whose fragile equilibrium underpins Brazil's institutional response to yellow fever. Normative authority emerges when molecular evidence from Rio, clinical trials from São Paulo, and operational protocols from Minas converge and are validated by federal surveillance indicators. Translation gaps between these regimes—differences in publication timelines, language, or impact criteria—may cause decision delays. However, they also fuel innovation

as each school seeks to outpace the others in methodological rigor. Recognizing this epistemic ecology is essential for refining future research funding policies, developing inclusive impact metrics, and accelerating the integration of results into national guidelines.

### 4.2.3 Thematic Tensions, Controversies, and Gaps

A systematic review of 212 articles, bulletins, and clinical trials authored by the four schools described above reveals a set of recurring controversies that traverse the entire Southeast ecosystem and, consequently, shape the national protocol. These tensions manifest across four principal axes.

First, the duality between environmental surveillance vs. clinical surveillance – The SVS/MS bulletins archive (2016–2019) shows that 68% of risk alerts issued for municipalities in São Paulo and Rio de Janeiro were triggered only after confirmation of primate epizootics, with an average delay of nine days from the first reported human symptom (SVS/MS, 2020). São Paulo clinicians, especially the intensivists at Emílio Ribas, argue that this dependency on wildlife "delays ICU bed activation and shifts the diagnostic burden onto hospital services" (Li et al., 2019).

In contrast, the Surveillance School maintains that primates remain the most cost-effective indicator for large territories; their sensitivity studies estimate a 2.4 percentage-point gain in predictive accuracy when epizootics are kept as the primary trigger (Romano et al., 2021). The controversy remains unresolved, and the 2020 Manual adopted a hybrid solution: it retains wildlife surveillance as the initial alert. However, it requires human RT-PCR for escalation of contingency levels, creating a two-stage decision chain that still lacks independent validation.

Second, fractional vaccination and immunity equity – The 2018 decision to fractionate the 17DD vaccine—endorsed by HC-FMUSP but contested by the Minas group—exposed a trade-off between broad coverage and duration of protection. Serological studies conducted by Fiocruz-RJ in 2020 suggest that neutralization wanes after 24 months (Giovanetti et al., 2022). In contrast, a field trial in Sabará-MG found protective titers in 91% of participants even after 36 months (Malaque & Melo, 2023).

The divergence led the PNI to adopt a "mixed" schedule, involving fractional dosing in moderate-risk areas and complete dosing for pregnant women, nursing mothers, and healthcare professionals. However, this approach generated perceptions of inequity in rural municipalities that received only the fractional dose. This issue is scarcely documented in the scientific literature but frequently appears in municipal health council minutes (Conass, 2022).

Third, real-time genomics vs. classical epidemiology, where the phylodynamic dashboard led by Giovanetti began publishing viral sequence data with an average latency of 96 hours between sample collection and upload to GI SAID; yet only 12% of Minas Gerais municipalities surveyed by SVE-MG report using this dashboard to guide vaccination-block decisions (SES/MG, 2021).

Municipal staff report a lack of capacity to interpret phylogenetic trees and translate Bayesian support levels into concrete actions. At the same time, Ministry epidemiologists criticize the lack of metadata standardization and the "color overlap" on phylodynamic maps,

which hinders integration with epizootic surveillance spreadsheets (Ramos & Col., 2021). The result is a communication gap: genomic evidence gains international recognition and impact factor, yet its operational uptake remains limited.

Fourth, the invisibility of primary care knowledge – Only 4 of the 212 documents analyzed were authored by nurses or community health agents, despite these professionals being the first point of contact in 63% of yellow fever cases reported in the Zona da Mata region of Minas Gerais (Dantas et al., 2020).

Qualitative reports indicate that health agents frequently adapt notification workflows to accommodate dirt roads or a lack of internet connectivity; however, such adaptations remain unofficial and are therefore excluded from the protocol's "best practice" indicators. This invisibility influences funding: 2023 CNPq calls allocated less than 5% of resources to health education projects on arboviruses, reinforcing a cycle where community know-how lacks academic validation.

These findings highlight emerging thematic gaps, such as the urban dynamics of yellow fever. Despite projections of virus re-urbanization in the Baixada Fluminense, there is a scarcity of interdisciplinary studies that integrate urban planning, mobility, and viral ecology. This also results in a regional debate over ICU cost-effectiveness assessment—between clinical ICU and field hospital models—which remains grounded in case series without robust economic analysis.

Finally, risk communication via social media remains unaddressed: none of the four schools led controlled trials on digital engagement strategies for vaccination—a critical gap, given the rise in vaccine hesitancy in 2022–2023. Thus, the persistence of these tensions shows that technical excellence from the Southeast Triangle does not, in itself, ensure epistemic convergence. On the contrary, differences in metrics (serology vs. neutralization, phylogenetic tree vs. weekly bulletin) and recognition systems (impact factor vs. operational impact) structure disputes that slow the incorporation of evidence.

Overcoming these gaps will require institutional translation mechanisms—such as mixed committees, simplified dashboards, and dedicated funding lines for primary care—that are capable of aligning genomic innovation, clinical trials, and field surveillance into a rapid feedback cycle.

### 4.2.4 Learnings and Recommendations for Knowledge Management

The Brazilian trajectory in addressing yellow fever—from its resurgence in the Atlantic Forest (2000–2001) to the interstate emergency of 2016–2019—has followed a markedly reactive pattern: major innovation leaps—such as the introduction of real-time phylodynamics, the first antiviral clinical trials, and the creation of tele-ICU networks—emerge immediately after health crises, but rarely evolve into policies for continuous knowledge integration (Possas et al., 2018; Faria et al., 2018). Three structural factors sustain this innovation pendulum.

First, epistemological fragmentation: the four schools of thought operate with distinct metrics—the number of phylogenetic trees (Genomics), ICU survival rates (Clinical–hospital), primate vaccination coverage (Surveillance), or the number of professionals trained remotely (Outbreak Response). The absence of cross-cutting indicators

hampers effectiveness comparison and complicates agenda prioritization (Kogut, Campos & Mendes, 2023).

Second, institutional centralization: the Rio–São Paulo–Minas triangle accounts for 79% of Q1 journal articles and houses most RT-PCR laboratories; during the 2017–2018 outbreaks, samples from Bahia waited an average of 72 hours for ground transport to Belo Horizonte before sequencing, delaying vaccination response (SVS/MS, 2020).

Third, the overvaluation of traditional credentials: national funding calls assign a dominant weight to the H-index and raw impact factor; operational nursing reports, community agent protocols, or logistical innovations receive minimal scoring, perpetuating the exclusion of multi-professional teams and internal universities (Almeida, Maciel & Ferreira, 2019).

To transform this heterogeneity—currently a source of friction—into a collaborative innovation ecosystem, five integrated recommendations are proposed. First, thematic FINEP/CNPq calls should mandate interinstitutional and interprofessional coproduction through tripartite consortia composed of a federal institute, a university hospital, and a municipal health secretariat, with the compulsory inclusion of a co-principal Investigator (co-PI) from Nursing or Health Management. The disbursement of funds should be contingent upon the deposit of operational protocols in an open-access repository, following the model of the WHO's Open Protocols initiative, thereby promoting research agendas that are anchored in local applicability.

Second, a specific ordinance from the Ministry of Health should establish quotas and representation criteria, reserving 30% of technical group positions for professionals based outside the RJ–SP–MG axis and 30% for multiprofessional categories. Project evaluations should integrate regional impact and innovation by applying a composite index (FWCI × Territorial Applicability Index) that normalizes citations by field and prioritizes solutions implemented in at least two states. Third, a unified national evidence dashboard hosted by DATASUS should be developed to integrate, in real-time, data on primate epizootics, clinical notifications, and georeferenced genomic sequences. Rotating curatorship—Fiocruz-RJ for genomics, HC-FMUSP for clinical, and SVS/MS for surveillance—should ensure dataset interoperability.

Key indicators would include sample-to-upload latency, concordance between phylogenetic trees and vaccination zones, and ICU saturation by macro-region, thereby supporting targeted funding lines for operational research. Fourth, 10% of the PNI-2026 budget should be allocated to implementation studies focusing on fractional vaccination, cold-chain logistics, and risk communication via social media.

Each funded project should include a cost-effectiveness analysis and a continuous training plan for primary care teams, ensuring immediate operational applicability within Brazil's Unified Health System (SUS). Finally, to strengthen continuous learning cycles, post-event committees should be institutionalized and tasked with publishing bilingual after-action reviews within 60 days of each outbreak. These reviews should inform an annual update of the Clinical Management Manual, replacing the current five-year revision cycle and aligning the document with the approximate 18-month pace of scientific renewal observed in biomedical fields.

Implemented collectively, these measures could shift SUS from a reactive model to a proactive learning paradigm: co-production-aligned incentives, metrics that reward territorial impact, and real-time integration mechanisms would shorten the path from bench to bedside and from forest to laboratory. As a result, knowledge produced within the Southeast triangle—currently concentrated but internally diverse—would circulate more efficiently, narrowing the gap between innovation and operational response and strengthening the public system's capacity to handle future arboviral emergencies.

Lastly, the investigation of authorship profiles, collaboration networks, and thematic controversies in the formulation of the national yellow fever protocol confirms that public health knowledge production in Brazil is both rich in expertise and shaped by structural asymmetries. Within the Rio–São Paulo–Minas axis lies a mosaic of schools of thought that, while cooperative during critical moments, also compete for resources, prestige, and definitions of legitimate evidence. This strategic heterogeneity has a dual effect: it ensures clinical, laboratory, and normative robustness but also generates methodological frictions that delay the translation of knowledge into operational decision-making.

Three core dynamics explain the persistence of the reactive pattern: epistemological fragmentation (incompatible metrics across schools), institutional centralization (logistical bottlenecks and reliance on a handful of high-capacity laboratories), and overemphasis on traditional credentials (H-index, impact factor). The consequences are clear: delayed case detection outside the Southeast triangle, limited integration between environmental and genomic surveillance, and the invisibility of multi-professional and community-based knowledge.

Nonetheless, the analysis also highlights latent potential. The phylodynamics lab in Rio, the diffusion capacity of São Paulo's clinical trials, and Minas Gerais' tele-ICU infrastructure demonstrate that innovation emerges when different epistemic cultures converge under pressure. The challenge, therefore, is not to generate more knowledge but to establish governance mechanisms that convert intermittent production into a continuous institutional learning cycle.

The proposed recommendations—3-P coproduction, representation quotas, unified evidence dashboard, operational research funding, and annual after-action reviews—offer a feasible roadmap to transform heterogeneity into adaptive advantage. If implemented, they would align research incentives with territorial needs, close the gap between genomic databases and vaccination deployment, and legitimize the role of nurses, managers, and community health agents at the core of regulatory design.

In summary, the recent history of yellow fever demonstrates that SUS already contains islands of excellence capable of producing cutting-edge science. What it lacks is a knowledge management architecture that guarantees sustainability, equity, and speed in evidence incorporation. By recognizing the Southeast's internal diversity and adopting proactive integration mechanisms, Brazil can convert its reactive experience into a knowledge governance model for other emerging arboviruses and, more broadly, for complex health crises.

## 5. Conclusion

This article investigated, through a mixed-methods design, the structure of technical authority and knowledge management in the development of the Clinical Management Manual for Yellow Fever (2020). The quantitative analysis of the 62 listed authors revealed a predominantly male biomedical core concentrated in Brazil's Southeast region, whose long academic trajectories accumulate scientific capital and reflect a pattern of institutional lock-in rooted in territorial concentration. While this configuration ensures clinical and laboratory robustness, it limits the disciplinary and regional plurality required for addressing complex health emergencies.

The qualitative analysis demonstrated that the Rio–São Paulo–Mina triangle is not monolithic but rather an ecosystem composed of four schools of thought—Surveillance, Clinical-Hospital, Genomics/Viral Ecology, and Outbreak Response—that operate under a regime of competitive cooperation. This internal heterogeneity increased the protocol's normative density but also generated methodological frictions (epizootics vs. RT-PCR, fractional vs. full-dose vaccination, phylodynamics vs. epidemiological bulletins), contributing to a pattern of post-crisis innovation: technological breakthroughs tend to follow emergencies rather than result from proactive knowledge integration strategies.

In response to this diagnosis, we proposed a set of integrated recommendations: (i) 3-P coproduction (federal institute + university hospital + municipal health secretariat) with mandatory inclusion of multi-professional profiles; (ii) representational quotas and a composite index (FWCI × Territorial Applicability Index) to elevate the value of regional impact; (iii) a unified evidence dashboard integrating epizootic, clinical, and genomic data in real-time; (iv) targeted funding for operational research on vaccine logistics, cold-chain infrastructure, and risk communication; and (v) an annual cycle of after-action reviews feeding into updates of the Manual. Implemented in synergy, these measures can transform today's strategic heterogeneity—from a source of institutional friction—into a collaborative innovation ecosystem capable of accelerating knowledge translation, reducing geographic bias, and legitimizing community-based expertise.

In sum, the case of yellow fever demonstrates that the SUS already contains islands of excellence capable of producing science at the frontier of knowledge. What remains lacking is a governance architecture that can convert this intermittent output into a continuous learning process. By recognizing the internal tensions and latent potential of the Southeast region and by adopting proactive mechanisms for integration, Brazil can shift from a reactive model of outbreak response to an international reference in knowledge governance for arboviruses and other complex health crises.

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