

Preparedness, Surveillance, and Response to Public Health Emergencies in the City of Rio de Janeiro, Brazil, from 2021 to 2024

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THEMATIC ARTICLE

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Abstract *This article describes the trajectory of the city of Rio de Janeiro in facing public health emergencies between 2021 and 2024, based on three axes of action proposed by the World Health Organization (WHO): preparedness, surveillance, and response. Innovation in timely data analysis from non-conventional information sources has enabled an early detection of events, promoting reorientation in health surveillance practices. The construction of a strong institutional identity, as well as the coordination of response actions in Emergency Operations Centers, contributed to the consolidation of a culture of rapid response and networking. The integration of primary health care (PHC) and surveillance networks guaranteed a continuity of care and coordinated risk management, highlighting the importance of a decentralized health system that seeks intersectorality in responding to emergencies. The advances observed in combating the COVID-19 and dengue epidemics during this period in the city were driven by adequate investments in structure and human resources, emphasizing the importance of continuous financing and strategic planning aimed at this model of care.*

Key words Public Health Surveillance, Primary Health Care, Pandemics, Emergencies, Epidemiological Monitoring

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Introduction

According to International Health Regulations (IHR), a public health emergency of international concern is defined as “an extraordinary event [...] posing a risk to public health for other nations due to the international spread of disease, potentially requiring a coordinated international response”¹. In Brazil, the term public health emergencies of national concern is used to characterize “situations that require the urgent use of measures to prevent, control, and contain risks, damages, and harm to public health”. These events can be classified as epidemiological, which include outbreaks or epidemics, disasters, and the lack of care provided to the population².

Public health emergencies declared by the World Health Organization (WHO) have included the influenza A H1N1 pandemic (2009), polio (2013), Ebola in West Africa (2014), congenital syndrome associated with Zika virus infection (2016), Ebola in the Democratic Republic of the Congo (2019), COVID-19 (2020), and mpox (2022 and 2024). Brazil has experienced declared emergencies of congenital Zika syndrome (2015), COVID-19 (2020), and the lack of health care provided to the Yanomami indigenous population (2023), as well as major epidemics of urban arboviruses. In addition, the impacts on the municipalities of Brumadinho and Mariana, following the disasters caused by the collapse of dams, involve both environmental and abrupt changes in the social organization and ways of life in these regions. The recent COVID-19 pandemic has brought new challenges to health systems, highlighting the vulnerability of countries in dealing with potentially epidemic infectious diseases³⁻⁵.

To deal with such events, the WHO recommends the adoption of three axes of action: preparedness, surveillance, and response, which favor the implementation of coordinated measures aimed at anticipating risks and an early detection of threats, based on an integrated work process that strengthens the capacity of health systems to act in the face of public health emergencies. Preparedness involves the operationalization of strategies and resources that ensure a rapid and adequate response; surveillance ensures the continuous monitoring of health threats; and response mobilizes health systems to mitigate impacts and limit the spread of emergencies⁶⁻⁹.

In this sense, health authorities should consider certain priorities: knowledge of the magni-

tude and characteristics of risks, strengthening institutional arrangements, and investing in the creation of resilient systems, including from the point of view of governance and regulation of the health sector¹⁰.

The Municipality of Rio de Janeiro (MRJ) is marked by challenges related to potential public health emergencies, both in terms of morbidity and mortality, as well as in terms of the overload of the healthcare network, which reinforces the need for municipal policies that strengthen the organizational capacities of the health system to mitigate the impacts of these events. In this light, this article aims to systematize the preparedness, surveillance, and response initiatives for public health emergencies that occurred in MRJ between 2021 and 2024.

Preparedness

The process of preparing for public health emergencies includes such activities as planning, risk mapping, identifying the sources of information needed to analyze data, evaluating and organizing available resources, developing contingency plans and procedures, and conducting training and simulations⁹.

After the transition of municipal management in 2021 in MRJ, the Special Committee for Confronting COVID-19 (*Comitê Especial de Enfrentamento da Covid-19* – CEEC) was established on the first day of administration. It is made up of specialists with expertise in different areas of the Unified Health System (*Sistema Único de Saúde* – SUS). It holds regular meetings to assess actions to combat the situation and recommendations for municipal management regarding COVID-19 in the city. In 2022, with the improvement of the epidemiological scenario of COVID-19, the CEEC became the Committee for Confronting Public Health Emergencies (*Comitê de Enfrentamento às Emergências em Saúde Pública* – CEE), contributing to the ongoing improvement of the performance of SUS in managing public health emergencies in the city.

Furthermore, the restructuring of the primary health care (PHC) network and the organization of the health surveillance network were strategic priorities to prepare the city to face public health emergencies. From then on, PHC has been restructured in such a way as to resume the 70% population coverage of the Family Health Strategy, which had been reduced between 2017 and 2020. Starting in 2021, it once again counted on full family health strategy teams and organized work, positioning it-

self as the coordinator of care and organizer of the healthcare network, integrating surveillance and care actions, ensuring that potentially risky events were timely identified and appropriately addressed within the healthcare system¹¹.

Investments were also made in preparedness, bed regulation flows, and access to specialized care, which were strengthened to serve as support or backup in emergency situations.

In health surveillance, based on the strengthening of the Strategic Information Coordination in Health Surveillance (*Coordenação de Informação Estratégica em Vigilância em Saúde* – CIEVS-Rio), ten rapid response teams were implemented and strategically distributed throughout the city. Each team, called a Rapid Response Unit, is made up of two professionals with a degree in the field of health (nurse, biomedical scientist, nutritionist, psychologist, among others), postgraduate degrees in the area of Public Health, and those with expertise in health surveillance and public health emergencies. These professionals work in a decentralized manner in the ten programmatic areas to expand the capacity to detect and investigate outbreaks and other public health events as well as to coordinate with the region in response to these events. In addition, 26 hospital epidemiological surveillance centers were set up in the National Hospital Epidemiological Surveillance Network, thus expanding the capacity to detect, monitor, and propose prevention and control measures for in-hospital public health events^{12,13}.

The sentinel surveillance strategy, responsible for ensuring biological samples and monitoring the circulation of pathogens in the city to timely detect possible changes in the circulation pattern of viruses and other pathogens, was expanded from five to ten units, with the hiring of nursing professionals to work exclusively on this surveillance. In addition to the number of units, its scope was also increased to include samples of influenza-like syndrome, arboviruses, acute diarrheal diseases, and conjunctivitis. Furthermore, genomic surveillance of SARS-CoV-2 was implemented in partnership with reference laboratories, seeking an early identification of relevant genetic mutations in the COVID-19 virus. This partnership also favors genomic surveillance of other respiratory viruses, such as respiratory syncytial virus and influenza¹⁴.

The Rapid Response and Sentinel Units play complementary roles in strategies for the timely detection of public health emergencies, each with its own distinct competencies. Sentinel

Unit professionals generally work from a health unit, monitoring the clinical care provided at the unit, analyzing the epidemiological scenario of that specific region, and collecting biological samples systematically, according to the recommendations in their scope of action and established criteria, aiming to identify and monitor pathogens of epidemiological relevance. Rapid Response Units have a broader scope of action, carrying out actions of preparedness, surveillance, warning, and response to public health events and emergencies in the programmatic (regional) area in which they are located, whether from occurrences, notifications, or laboratory results reported by dozens or even hundreds of health units (public and private), which includes information obtained from sentinel surveillance, or through Event-Based Surveillance, detecting rumors or events of epidemiological interest in a timely manner, allowing for coordinated, rapid, and effective prevention and control measures.

The experience of distributing COVID-19 vaccines during the pandemic in a metropolis with 239 vaccination rooms and more than 3,000 vaccination points outside the city walls led to the decentralization and strengthening of the cold chain in MRJ, through the implementation of Regional Cold Chain Centers in the different regions, in as well as in the municipal center, which ensured that immunobiological agents and other supplies could be stored and distributed safely, effectively, and quickly, especially in crisis situations¹⁵.

In parallel with the structuring of the healthcare and surveillance network, with regard to the preparedness stage itself, specific contingency plans for each event, with their respective protocols and standard operating procedures, were created by professionals from different areas of Municipal Health Secretariat of Rio and specialists, in order to guide and equip the network on how to activate the response at its different levels. These documents, which are essential to ensuring a rapid, organized, and coordinated response to emergencies, were structured along strategic lines that included the mobilization of resources, the definition of responsibilities, and the organization of response actions in the city¹⁶⁻¹⁸.

In this sense, simulations and workshops were carried out to test and improve emergency contingency plans, such as workshops with Pan American Health Organization (PAHO) for the COVID-19 contingency plan in 2021 and the Arbovirus Plan in 2024, together with sim-

ulations in partnership with the Civil Defense, especially for the natural disaster contingency plan.

The continuous training of teams was an essential component in preparing to tackle public health emergencies. In MRJ, in addition to specific and routine training, the management invested in the Field Epidemiology Training Program at the frontline level, with a strategic goal of training 300 frontline field epidemiologists in MRJ, providing professionals qualified to detect, investigate, analyze, and respond to public health emergencies at all levels of care and management, with theoretical and field activities¹⁹.

Preparedness in the city of Rio de Janeiro during this period was based on a series of integrated measures that included professional qualifications; the creation of contingency plans; and the organization of efficient, integrated, and robust healthcare and surveillance networks.

Surveillance and Early Detection

Surveillance, in the context of public health emergencies, is an early warning system used to detect and monitor events that may become public health emergencies. This process involves collecting, analyzing, and interpreting data from different sources, seeking to identify early signs before they become more widespread. Robust surveillance capabilities can contribute to the prevention of future epidemics and pandemics^{20,21}.

In MRJ, given its size, heterogeneity, and complexity, from 2021 onwards, the management strategy was to develop and incorporate “mosaic surveillance”, following WHO guidelines, which indicate that, to face current challenges, it is essential to expand surveillance approaches, diversifying data sources for decision-making during inter-epidemic periods and ensuring that surveillance is timely and scalable in emergency situations^{22,23}.

The experience of dealing with the COVID-19 pandemic left as a legacy the need to integrate different data sources in order to build robust analyses that could detect changes in the population's pattern of illness and death²⁴.

In this sense, in MRJ, this stage is marked by a robust approach based on the integration of various systems and data sources to produce strategic information, using both traditional health surveillance data (such as cases and deaths) and non-conventional data (such as care in the healthcare network) in order to improve the capacity for surveillance and the early detection of

risks. Thus, in addition to traditional and universal surveillance, data from the expansion of sentinel and genomic surveillance; event-based surveillance; surveillance of urgent, emergency, and primary care data; surveillance based on a syndromic approach; laboratory surveillance; data on regulation and bed occupancy; environmental, entomological; and climate surveillance; consumption of strategic inputs; among others, were integrated in order to expand the capacity to monitor and detect early warnings of risks.

The concept of epidemiological intelligence was first used in a structured manner in the service of public health in Brazil, with the implementation of the Epidemiological Intelligence Center (EIC) in MRJ in March 2022. This center is based on the need for transparency and efficiency in the use of public data, investment in technological infrastructure, and the operationalization of intelligence to predict epidemics^{24,25}.

The use of assistance records by the EIC is an innovative activity in the health surveillance work process to explore patterns of occurrence of signs/symptoms in care provided in health units in the municipality, thus favoring the early detection of outbreaks and epidemics, the dissemination of warnings to the health network, and more timely responses to possible public health emergencies²⁴.

The collaboration of the EIC in the preparation of strategic health information for decision-making and the early detection of changes in the morbidity and mortality pattern includes the integration of different sources of information, the use of statistical and modeling techniques in data analysis, in addition to monitoring through panels, dashboards and automated epidemiological bulletins, as well as the expansion of the publication and transparency of health information for civil society²⁶.

Such models used for early detection, such as nowcasting and forecasting, signal significant changes in trends, which can be viewed and monitored through the time series of daily care data. The warnings generated from these models mobilize the health surveillance network in established flows to verify the identified signals²⁷.

Sentinel surveillance is one of the strategies for the early detection of public health events and the monitoring of circulating pathogens in Rio de Janeiro. Based on systematic collections in units with different levels of care and distinct clinical profiles, sensitive and robust sentinel surveillance is maintained, through which it is possible to regularly detect and monitor arboviruses and circulating serotypes of the dengue

virus, as well as the influenza virus and its subtypes and lineages, SARS-CoV-2 and its genomic variants, and any change in the identification scenario of these and other pathogens of interest, regardless of their seasonality periods, thus enabling a timely and specific implementation of prevention and control measures.

In addition to the aforementioned surveillance models, the event-based surveillance strategy, active in MRJ to monitor health events at international, national, and local levels, also stands out. This strategy monitors warnings and information from major official portals, such as that of the WHO, the PAHO, the Centers for Disease Control and Prevention, and the Ministry of Health on a daily basis. In addition, unofficial sources are used to detect events in their early stages, facilitating a timely investigation of rumors and possible prevention and control measures. In MRJ, several tools are also used for event-based surveillance, including Epidemic Intelligence from Open Sources, Google Trends, HealthMap, and other devices for monitoring local media and social networks. After detecting these rumors, health surveillance teams follow the steps of screening, verification, risk assessment, and communication for action and response⁶.

Response

The response to public health emergencies is provided by a set of coordinated actions that aim to reduce risks and mitigate their impacts. This response must be proportional and adaptable to the magnitude and type of the event, focusing on the speed of actions, resilience of the health system and governance capacity of the actors involved, ensuring the mobilization of resources and effective communication between the different sectors²⁸.

In this sense, the integration between health surveillance and PHC is a determining factor in organizing the response. In MRJ, 239 PHC units, which work in the coordination of care, guarantee the majority of care to the population during public health emergencies in such a way as to maintain the balance between the provision of services and the maintenance of continued care for their assigned population. However, as the demand for care increases, the installation of service, testing, and/or vaccination centers is a commonly need in the city in order to increase the installed capacity to produce the proper response, thus ensuring that suspected cases are quickly identified, diagnosed and treated^{29,30}.

It is important to note that this response is coordinated, ensuring that fixed and temporary care equipment, as well as laboratory infrastructure, supplies, and regulation, are connected to each other in a network, organized by PHC and guided by the same flows and protocols.

The projections and risk analyses constructed by health surveillance, based on the preparation of epidemiological bulletins, contribute to decision-making concerning the appropriate times to activate (or deactivate) this temporary care equipment, as well as to reverse dedicated beds, purchase supplies, and mobilize professionals. The role of health surveillance divisions, rapid response units, environmental surveillance teams, and other surveillance structures in the decentralized response in coordination with the health units in the territories is also of utmost importance.

This integration between PHC, health surveillance and other points of the care network, such as regulation, urgency and emergency, also takes place in the Emergency Operations Center (EOC), a key strategy for responding to public health emergencies. The EOC is organized as a centralized command structure, responsible for planning, monitoring, and coordinating the actions necessary to deal with the emergency. The city of Rio de Janeiro activated EOCs during the COVID-19 epidemic in 2021 and the dengue epidemic in 2024, in order to unite, in a single space, different sectors responsible for dealing with the situation, thereby ensuring communication, coordination, and synergy of actions between the actors and structures of the health system involved in strategic decision-making^{31,32}.

In addition to the health-related decisions shared in the EOC, this is also the space where intersectoral and interinstitutional issues are discussed with agencies involved in the response, such as the secretariat of education, the secretariat of the environment, civil defense, research institutions, or partner laboratories.

Another government initiative that also contributed, not only to the preparedness, but also to the response to public health emergencies in MRJ, was the implementation of the Emergency Response Committee, a strategic support advisory committee comprised of nationally relevant experts who provide technical support for decision-making³³.

Furthermore, communication plays a key role in the response to public health emergencies. Risk communication strategies in the context of public health emergencies must be linked

to strong and accessible health systems, and be transparent, timely, and easy to understand, reaching affected populations through multiple platforms, methods, and channels so as to build trust, increase the likelihood that guidelines will be followed, and reduce infodemics^{34,35}.

In this sense, the experience of Rio de Janeiro reinforces the strategy of risk communication between high management and the population. Through the coordination of the Communications Office of the Municipal Health Secretariat, press conferences were held and broadcast in the main media outlets. The dissemination of guidelines on protective measures, vaccination campaigns and health alerts was also coordinated. The communication plan for emergencies was essential to ensure that accurate and timely information reached the population, also strengthening transparency and trust in the actions adopted by the secretariat³⁶.

The robustness of the healthcare network, the adoption of standardized clinical and surveillance protocols, intersectoral cooperation, as well as intra and intersectoral integration and communication are essential elements for a rapid, coordinated, and efficient response to public health emergencies in MRJ.

Discussion

The response to public health emergencies in MRJ between 2021 and 2024 was marked by three fundamental pillars: epidemiological intelligence, institutional identity, and integration between surveillance and PHC.

With regard to epidemiological intelligence, the implementation of a center characterized by innovation in data analysis and the development of tools aimed at the early detection of important events in public health marks one of the interfaces for improving the cycle of preparedness, surveillance, and response in the city²⁴.

Based on the incorporation of various sources of information in the analysis of morbidity and mortality patterns, the implementation of mosaic surveillance sought to promote a paradigm shift in the conduct of the work process by reorienting the predominant logic of universal and passive surveillance, which is mainly based on receiving reports from health units²².

The construction of an institutional identity to respond to public health emergencies also proved to be relevant within the priority governance model. Over the years, MRJ has consolidated a culture of rapid response, an un-

derstanding of networking, and the recognition that emergency response requires coordination among the stakeholders involved. Organizing the response into EOCs has provided the city of Rio de Janeiro with coordinated management with clearly defined roles³³. This process was strengthened by the creation of visual and discursive elements that increased the sense of belonging of the surveillance and care teams during times of crisis.

The integration of PHC and surveillance networks was essential for the effectiveness of emergency response actions in the city. Strong PHC, as a coordinator of care and the organizer of the care network, ensured the continuity of care, while surveillance served to provide timely information for the activation of specific actions and equipment, forming a risk management axis based on an articulated, permanent work process in accordance with the local reality^{37,38}.

The resilient health system framework emphasizes that it is essential to invest in PHC services and ensure that there is reserve capacity, adequately provided through health professionals, financing, medicines, and technologies, to allow for the rapid expansion of public health services during serious, prolonged, and/or rapidly evolving events¹⁰.

This framework is in line with the model proposed in Rio de Janeiro, which emphasizes the importance of a decentralized surveillance system, which is close to the people and the regions and is complete with care at all levels. It also reinforces that family health strategy teams should have the support of health professionals in nearby centers to monitor people's health; identify social, environmental, collective, and individual risks; and provide local planning with community participation, thus improving health actions in the region and generating timely information³⁸.

In addition to PHC, the integration between the components of the health care network in MRJ promotes faster and more efficient responses, as it is consolidated through standardized protocols, well-defined flows, coordinated actions, and a robust care network. It is important to highlight the intersectoral approach proposed through the involvement of several institutions in dealing with emergencies, from laboratories for genomic surveillance to the departments of the environment and education, enabling the response to consider more comprehensive approaches. Risk communication also played a key role, ensuring that accurate information was disseminated to society.

Driven by global efforts to prepare for climate change, the issue of public health emergencies has gained prominence on current agendas, highlighting the need for coordinated work between the various sectors involved in reducing potential risks.

The strategies reported in this study enabled not only more effective monitoring of events, but also the proposal of measures that helped mitigate risks, anticipate team actions, and, ultimately, reduce morbidity and mortality from diseases and injuries, as observed in the fight against the COVID-19 and dengue epidemics. During the dengue epidemic that occurred in 2024, MRJ had the lowest incidence and lethality rate caused by the disease, when compared to other epidemics over the past 20 years. Throughout the COVID-19 pandemic, the reduction in the lethality of the disease observed from 2021 onwards can be attributed to several factors. The organization of the coping strategies in 2021, compared to those of 2020, may have played a relevant role in this context. It is also important to recognize that the large-scale vaccination strategy for the entire population was one of the core elements for this improvement. However, it is also important to recognize that operationalizing vaccination during a major health crisis and successfully reducing mortality rates is the result of coordinated action to address public health emergencies.

It is important to highlight that these advances were possible thanks to adequate investments in infrastructure and human resources. The expansion of PHC coverage, the strengthening of the health surveillance network, and the training

of field epidemiologists were decisive for the perceived impact. This reinforces the importance of continuous funding and strategic planning that considers the training of health teams and the organization of the network to deal with future emergencies.

Despite the significant progress, there are limitations to be considered, such as the overload upon the health system during periods of high demand and the lack of resources in the most vulnerable areas of the city. In this sense, the need for continuous investments is of utmost importance to ensure the capacity to respond in a homogeneous manner, taking into account the vulnerabilities arising from each region in order to pursue the SUS principle of equity.

Final considerations

Strong governance, political leadership, collaboration, and accountability are essential to managing risks that affect health systems³⁹. Lessons learned from recent emergencies reinforce the need for continuous improvement of health care and health surveillance networks, so that the city is progressively more prepared to face future crises.

It is hoped that the issues presented in this article can contribute to the collective construction of a theoretical framework on the subject, in addition to serving as support for other cities in strengthening their work processes, in an attempt to provide more effective responses to public health emergencies.

Collaborations

GMO Aguilar contributed to the project conception, writing, and review; and approved the final version. LF Carvalho contributed to the project conception, writing, and review; and approved the final version. CLP Ribeiro contributed to the project conception, writing, and review; and approved the final version. JR Cavalcante contributed to the project conception, writing, and review; and approved the final version. R Proença contributed to the project conception, writing, and review; and approved the final version. GO Penna contributed to the project conception and review; and approved the final version. MHO Garcia contributed to the project conception and review; and approved the final version. D Soranz contributed to the project conception and review; and approved the final version.

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