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Case Report

Scientific Denialism, Climate Change and Public Health: Lessons from the 2024 Dengue Epidemic in Brazil

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ABSTRACT

The 2024 dengue epidemic in Brazil exposed critical weaknesses in the public health system and demonstrated the harmful influence of digital misinformation on vaccine uptake. This study examines the sociopolitical and communication barriers that undermined the effectiveness of the immunization campaign using the Qdenga vaccine, despite its proven safety and efficacy. Vaccine hesitancy was fueled by denialist rhetoric, failures in official communication and the unregulated spread of disinformation through social media. Furthermore, climate change has expanded the geographic range of the Aedes aegypti mosquito, internationalizing the crisis. The findings indicate that effective epidemic response requires integrated actions to combat misinformation, strengthen digital literacy, promote community engagement and rebuild public trust in vaccines as essential tools for public health.

Keywords: Dengue epidemic, Vaccination, Misinformation, Public health, Epidemic control

1. The 2024 Epidemic and the Vulnerability of Brazil's Public Health System

The beginning of 2024 marked a tragedy in Brazil: the worst dengue epidemic recorded in its history, following periods of fluctuating high incidence and some control over the disease's spread[1]. This scenario highlights not only the vulnerability of the Brazilian public health system but also the complexity of tackling arboviruses in a context of rapid urbanization[2], climate change and digital disinformation[3]. Millions of citizens have been affected by the disease, facing dramatic consequences, while hundreds, probably thousands, have lost their lives. This crisis revealed not only the seriousness of the spread of arboviruses but also exposed society's vulnerabilities in the face of misinformation and the anti-vaccine movement[4]. Data from the Ministry of Health indicates that in 2024, Brazil recorded more than 6 million probable cases of dengue, making this the largest epidemic in the country's history[5]. This scenario highlights not only the fragility of health infrastructures but also the urgent need for integrated strategies to face this challenge.

The severity of this epidemic reveals longstanding weaknesses in Brazil's sanitation infrastructure and the control of urban endemic diseases. Accelerated, often unregulated urbanization, combined with socio-spatial inequality and the precariousness of basic services such as waste collection and rainwater drainage, creates a favorable environment for the proliferation of Aedes aegypti, the primary vector of dengue[6]. Medium and large

cities in the Southeast and Central-West regions have reported the highest infection rates, reflecting both socio-environmental vulnerabilities and institutional shortcomings in public health response[7].

In addition to environmental and infrastructural factors, the impact of climate change on the distribution and intensity of the disease has been widely documented. Rising average temperatures, increased rainfall and extreme weather events provide ideal conditions for greater vector density and higher infection rates[8]. Recent studies published in 2024 and 2025 indicate that Brazilian urban areas are experiencing a prolonged period of dengue transmission risk, directly linked to global warming and the tropicalization of urban environments that were previously characterized by milder climates[9,10].

2. Political Denialism, Disinformation and Vaccine Hesitancy

It is also imperative to re-inform the population about the value of vaccines, a public health tool that has been proven over decades[11]. The recent Brazilian context, marked by a government that, between 2019 and 2022, downplayed the seriousness of various health crises and spread disinformation about immunizations, has aggravated the current situation[12]. The Bolsonaro government has contributed to an environment of uncertainty and vaccine hesitancy, while anti-intellectualism and science denialism have gained strength[13,14]. This context was amplified by political speeches that discredited consolidated scientific evidence, promoting mistaken narratives that associated vaccines with unfounded risks. This rhetorical strategy fostered mistrust among the population and perpetuated myths that were detrimental to vaccine adherence[15]. This institutional negligence had devastating consequences, since it facilitated the proliferation of discourses that discouraged adherence to fundamental vaccination campaigns, including against dengue.

Vaccine hesitancy in Brazil must be understood as part of a complex process of delegitimization of science and the weakening of public health institutions. Studies indicate that trust in vaccines is directly related to trust in health systems and governments, a relationship that, in the Brazilian context, has suffered significant erosion in recent Years[16,17]. The COVID-19 pandemic highlighted how political and ideological factors can influence adherence to immunization campaigns, creating a legacy of mistrust that extends to other vaccines, such as the dengue vaccine[18]. A survey carried out by the Ipsos Institute in partnership with Takeda revealed that although 88% of Brazilians trust in the efficacy of the dengue vaccine, 41% of those interviewed reported having received false information about vaccines on social media, which negatively impacted their decision to get vaccinated[1].

Moreover, the spread of false content on social media, often through sophisticated disinformation strategies, has contributed to the consolidation of informational bubbles dominated by denialist discourses and conspiracy theories[19]. This dynamic creates cognitive barriers to the acceptance of scientific evidence, making it more difficult to convince the population of the safety and effectiveness of vaccines, even in the face of severe outbreaks such as the current one. Combating this scenario requires not only informational campaigns, but also structured actions of media and scientific literacy, especially within the school environment[20].

3. The Qdenga Vaccine: Technology and the Failure of Public Uptake

The Brazilian government, although perhaps late in its response and lacking the necessary diversity of initiatives, has attempted to provide the best available vaccine against dengue - an opportunity that few countries currently possess[21]. Qdenga is a vaccine developed by the Japanese pharmaceutical company Takeda, based on an attenuated dengue virus[22]. Thus, before detractors and denialists falsely claim that it is a dangerous vaccine simply because it is new, as widely circulated on social networks and the internet, it is important to emphasize that this vaccine uses one of the oldest and most established technologies for producing immunizations[23]. Despite scientific proof of the efficacy of the Qdenga vaccine, the spread of false information, such as unfounded claims about serious side effects, has contributed to low adherence to vaccination, especially among parents of children and adolescents.

The Japanese vaccine, despite its logistical production limitations, offered valuable hope[24], initially targeted at children aged 10 to 11. The introduction of Qdenga represents a significant milestone in the fight against dengue, utilizing established technology for immunization production and reaffirming confidence in science as an indispensable tool for public health[25]. However, even in the face of the epidemic's severity, adherence to vaccination among this group was disappointing. This lack of interest persisted even after the eligible age range was expanded to include adolescents up to 14 years old, reflecting an alarming level of public disinterest in immunization.

If Brazil had succeeded in implementing a successful mass vaccination campaign against dengue, the country would have achieved an unprecedented global victory in public health. Large-scale immunization against dengue would constitute a historical milestone, not only due to the complexity of logistics but also because of the magnitude of the problem being addressed. The positive impact of this achievement would resonate globally, positioning Brazil as a reference in the fight against arboviruses and the control of epidemics. The success of such a campaign would have saved thousands of lives and represented significant savings in hospital treatment and disease control costs, in addition to contributing to the overall stability of the health system[26].

Although vaccine hesitancy is a central factor contributing to low dengue vaccination rates, other elements have also played a role. The lack of prioritization of health issues, underestimation of the disease's severity and ignorance regarding the lethality of dengue may also affect individuals' decisions to vaccinate[27]. However, it is undeniable that the anti-vaccine movement and the spread of false information on social media play a decisive role in perpetuating this phenomenon, directly impacting public health.

This alarming scenario is further aggravated by the persistence of disinformation, particularly online. The spread of fake scientific news fuels the anti-vaccine movement[28], undermining public trust in vaccines. Therefore, vaccination rates remain low even amid a devastating epidemic and there is a real risk of wasting precious vaccine doses due to lack of demand and expiration.

4. Institutional Communication and the Limits of the Vaccination Campaign

Despite the severity of the epidemic and the urgency of the situation, the current government (Lula administration) failed to implement an effective communication campaign to convince the population of the importance of vaccination, even with the target audience limited to the most vulnerable age groups. This communication failure, compounded by the absence of clear and persuasive messaging from health authorities at both municipal and state levels, has seriously compromised the reach of vaccination campaigns. Even in the context of a health crisis, where the severity of the situation should have motivated greater adherence, the lack of effective dissemination and public awareness strategies was a determining factor behind low vaccination rate. The campaigns should have been conducted more assertively, utilizing all available means of communication, especially those with the greatest reach, such as television, the internet and radio[29].

The weak coordination between the Ministry of Health and mass communication channels compromised not only the population's understanding of the risks associated with dengue but also the recognition of Qdenga as an effective solution. By failing to meaningfully engage community leaders, family health agents and digital influencers, the government neglected to mobilize strategic segments of society that could have extended the campaign's reach and reversed low vaccination uptake[30]. This absence also limited the spread of accurate information about the vaccine, allowing misinformation to prevail among various segments of the population.

Studies in health communication have shown that successful campaigns require clear language, the identification of trusted spokespersons for each target audience and the use of multiple platforms to disseminate scientific information in an accessible manner[31]. In this context, the absence of a robust national communication plan undermined the country's ability to respond effectively to the epidemic and reiterated a longstanding issue in the Brazilian healthcare system: the lack of coordination between federal, state and municipal levels, especially in times of crisis[32].

5. Climate Change, Dengue Expansion and Emerging Risks

Brazil is the only country in the world attempting to immunize its population on a large scale against dengue, a remarkable achievement[24]. This initiative highlights Brazil's pioneering role in tackling arboviruses at a national level, serving as a potential model for other countries facing similar challenges, especially in tropical and subtropical regions. Such immunization efforts are likely desired by other nations, such as Argentina, which recently experienced, at the start of the second decade of the 21st century, a dengue epidemic in the city of Buenos Aires, a region previously free of the disease due to its temperate/cold climate. This outbreak is a direct result of climate change, specifically global warming[33].

In this way, the issue is also related to climate change denialism, providing concrete and didactic evidence of the phenomenon and its consequences[3]. Recent studies show that the increase in average temperatures and changes in rainfall patterns due to climate change have expanded the area of incidence of Aedes aegypti, including previously non-endemic regions such as southern Brazil[34].

Dengue fever is a growing disease around the world, especially in the context of climate change and global warming[35]. Higher temperatures and altered rainfall patterns create ideal conditions for the proliferation of Aedes aegypti, the mosquito vector of dengue, which is finding new habitats and adapting more easily to environmental changes[36]. Global warming not only accelerates the mosquito's life cycle but also enables its spread to regions that previously did not face dengue outbreaks. This includes areas with temperate climates that are now registering dengue cases due to these environmental transformations.

In 2023, countries such as France, Italy and Spain reported 128 cases of this type of dengue, even though they once appeared free of the arbovirus. This data reinforces the urgent need for interdisciplinary approaches to mitigate the effects of climate change on public health, integrating the efforts of scientists, policymakers and educators. The phenomenon further highlights the need for global and coordinated action to address the consequences of climate change on public health[37].

6. Combating Disinformation and Rebuilding Trust in Vaccines

It is crucial to tackle the source of this problem. We live in an environment where social networks are the main source of information for many Brazilians, but they are also vehicles for harmful misinformation[38]. The spread of unfounded theories about vaccine risks, often associated with COVID-19[39], is now affecting other well-established immunization efforts, such as the polio vaccine[40,41], amplifying the risk of an even deeper public health crisis.

The resistance to dengue vaccination during such a severe epidemic reveals the magnitude of the challenge. We can no longer ignore the impact of misinformation on public health[42]. All sectors of society, government, the academic community, civil society organizations and educators - must join forces to combat this threat and its consequences. The "infodemic," characterized by the massive spread of false information, especially through social media, has compromised public trust in vaccines. This scenario demands coordinated action to fight misinformation and promote digital literacy[43].

To restore confidence in science and immunization, we need to rethink our communication strategies[44]. Traditional information channels such as television, newspapers and magazines should be revitalized, alongside proactive promotion of reliable online sources. Additionally, innovative strategies leveraging algorithms to combat misinformation on social media are crucial[45]. Collaboration between digital platforms, academic experts and public health authorities is essential to counter the spread of myths and restore confidence in vaccines. Educating the public about the proven benefits of vaccines and debunking harmful myths circulating on social networks must be a priority.

Traditional media outlets must also be called upon to treat vaccination with the seriousness it deserves[46]. In a context where social media constantly propagates misinformation, traditional media has a responsibility to adopt a more proactive and committed stance in disseminating information based on

scientific evidence[47]. By giving space to unfounded narratives or failing to adequately explore the benefits of immunization, portions of the media inadvertently contribute to vaccine hesitancy. Therefore, journalism must not only be a vehicle for transmitting news but also an active agent in educating the public, reinforcing confidence in vaccines and scientific knowledge.

The current resistance to vaccination is not merely a matter of individual choice; it reflects the consequences of a culture of misinformation that has taken root across various segments of society. Scientific denialism, which is widespread on social media, affects all spheres of knowledge, with public health being among the most severely impacted. Combating this wave of disinformation must be as intense and urgent as our response to the epidemic itself, recognizing that while digital platforms can be allies, they have also served as channels for the proliferation of myths and conspiracy theories[43]. This problem transcends national borders and demands a coordinated response both in Brazil and internationally.

Furthermore, urgent action is required to contain this wave of disinformation. We must invest in comprehensive educational programs that promote both digital literacy[48] and scientific education, from schools to the broader media landscape. Only through such efforts can we reverse the dangerous trajectory that threatens to undermine disease control efforts, not only against dengue but in the broader context of global public health[49].

At this critical moment for Brazil and in fact for the world, we must unite our efforts to protect public health and save lives. We cannot allow misinformation to continue undermining our ability to combat epidemics such as the one Brazil is facing in 2024. The future of Brazilian and global health depends on our collective ability to fight not only dengue but also the epidemic of misinformation that accompanies so many diseases.

7. Conclusion

Finally, combating scientific denialism must be treated as an urgent priority. Overcoming this challenge requires not only institutional efforts but also the active engagement of community and religious leaders, who can extend the reach of messages grounded in scientific evidence. Only through an integrated approach will it be possible to restore public confidence in immunization and protect population health. Brazil's experience during the COVID-19 pandemic has shown that when governments fail to tackle disinformation decisively and immediately, the consequences for public health are devastating. The current lack of vaccination against dengue, even amid an epidemic, clearly reflects this failure, a scenario where doubt and fear, amplified by the internet and social media, override science and reason. Reversing this situation requires not only broader and more effective public awareness campaigns but also the strengthening of public policies aimed at directly combating misinformation and promoting confidence in vaccines.

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