Diretrizes para implementação de um observatório para emergências de saúde pública

Guidelines for implementation of a public health emergency observator

Lineamientos para la implementación de un observatorio de emergencias en salud pública

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Dominic da Veiga Puggi
Bacharel em Ciência e Tecnologia
Instituição: Universidade Federal de Santa Catarina
Endereço: Joinville, Santa Catarina, Brasil
E-mail: nicpuggi@gmail.com

Alex Santos Príncipe
Mestre em Saúde Pública
Instituição: Fundação Osvaldo Cruz (FIOCRUZ)
Endereço: Manguinhos, Rio de Janeiro, Brasil
E-mail: alex.principe@fiocruz.br

Bruna Aparecida Souza Machado
Doutora em Biotecnologia
Instituição: Centro Universitário SENAI CIMATEC
Endereço: Salvador, Bahia, Brasil
E-mail: brunam@fieb.org.br

Ingrid Winkler
Doutora em Administração
Instituição: Centro Universitário SENAI CIMATEC
Endereço: Salvador, Bahia, Brasil
E-mail: ingrid.winkler@doc.senaicimatec.edu.br

Cristiano Vasconcellos Ferreira
Doutor em Engenharia Mecânica
Instituição: Universidade Federal de Santa Catarina
Endereço: Joinville, Santa Catarina, Brasil
E-mail: cristiano.v.ferreira@ufsc.br
RESUMO
Os primeiros anos da década de 2020 ressaltaram a vulnerabilidade das respostas do governo e a confiança do público nas autoridades políticas, científicas e médicas. Tem sido observado que uma infodemia tem acompanhado as epidemias modernas. Para lidar com a apreensão do público, é necessária uma atitude decisiva, multidisciplinar, interdisciplinar e integrada, que requer análises profissionais completas. Neste sentido, uma ferramenta importante para informar planos de ação, intervenções governamentais e tomada de decisões durante futuras emergências de saúde pública são os observatórios de saúde pública. Este artigo tem como objetivo apresentar um conjunto de diretrizes para implementação de observatórios de emergência de saúde pública. Para isto foram estudados observatórios no setor de saúde pública e urbana e tecnologias relevantes para uma referência cruzada. As diretrizes propostas são aderentes aos padrões internacionais de melhores práticas e, ao mesmo tempo, considera os contextos nacionais. Este artigo também pretende tratar do papel essencial da tecnologia e da colaboração no estabelecimento e manutenção de um observatório de saúde. Foram observadas uma falta de dados concretos e atualizados durante a realização da pesquisa analisando observatórios e os efeitos da desinformação na confiança pública.

Palavras-chave: Emergências de Saúde Pública, Observatório, Tomada de Decisão, Tecnologia.

ABSTRACT
The first years of the 2020s highlighted the vulnerability of government responses and the public’s trust in political, scientific and medical authorities. It has been observed that an infodemic has accompanied modern epidemics. To deal with public apprehension, a decisive, multidisciplinary, interdisciplinary and integrated attitude is needed, which requires thorough professional analysis. In this sense, an important tool for informing action plans, government interventions and decision-making during future public health emergencies are public health observatories. This article aims to present a set of guidelines for implementing public health emergency observatories. To this end, observatories in the public and urban health sector for cross-referencing. The proposed guidelines adhere to international standards of best practice while taking into account national contexts. This article also aims to address the essential role of technology and collaboration in establishing a health observatory. A lack of concrete and up-to-date data was observed during the course of the research regarding observatory analysis and the effects of misinformation in public trust.

Keywords: Public Health Emergencies, Observatory, Decision-Making, Technology.
exhaustivo. En este sentido, una herramienta importante para informar los planes de acción, las intervenciones gubernamentales y la toma de decisiones durante futuras emergencias de salud pública son los observatorios de salud pública. Este artículo tiene como objetivo presentar un conjunto de pautas para la implementación de observatorios de emergencias de salud pública. Para ello, se crearán observatorios del sector salud público y urbano para el cruce de referencias. Las directrices propuestas se ajustan a las normas internacionales de mejores prácticas y al mismo tiempo tienen en cuenta los contextos nacionales. Este artículo también pretende abordar el papel esencial de la tecnología y la colaboración en el establecimiento de un observatorio de salud. Durante el curso de la investigación se observó una falta de datos concretos y actualizados sobre el análisis del observatorio y los efectos de la desinformación en la confianza pública.

Palabras clave: Emergencias de Salud Pública, Observatorio, Toma de Decisiones, Tecnología.

1 INTRODUCTION

Public health emergencies are defined just as much by their consequences to health as they are by their causes and precipitating events (NELSON et al., 2007). A public health emergency (PHE) refers to a situation that poses significant risk to the health and well-being of a population, requiring an urgent and coordinated response to protect and mitigate the impact on public health. It is characterized by an extraordinary threat to public health that can be caused by infectious diseases, natural disasters, chemical or radiological accidents, bioterrorism or other hazards. Carmo, Penna, and Oliveira (2008) describe any event that presents: “a risk of spreading or disseminating diseases to more than one Federated Unit (State or Federal District), with priority of immediately notifiable diseases and other public health events (regardless of nature or origin), found, after risk assessment, that may require an immediate national response” (CARMO et al., 2008, p.22).

To deal with PHEs, it is important to note that governments have access to guides and information made available by the World Health Organization, such as the Emergency response framework (2017) and Guide for establishing health observatories (2016), as well as their own guideline documents, made by government sectors responsible for health, such as the Brazilian Ministry of Health's Public Health...
Emergency Response Plan (2014). However, although these documents are detailed, each emergency situation ends up having its own peculiarities. Territory, available resources, cultural barriers, organizational levels and political climate are all challenges present in pandemics and health crises in general, requiring a contextualized approach.

The arrival of the digital age has fundamentally transformed the landscape of health information dissemination, presenting new opportunities and governance challenges. Today, disinformation spreads rapidly through various online platforms, and it is of the utmost importance to have effective mechanisms to guide government responses and distinguish between false information and that guided by scientific evidence. A health observatory, based on knowledge, data and international best practices, emerges as a mechanism to support evidence-based policymaking, combat the spread of misleading or malicious information, and clarify situations during times of crisis and panic.

Public trust in emergency response strategies is the fundamental basis of an effective health system, as it represents society's certainty in the institutes, authorities, health professionals and information responsible for safeguarding and promoting health.

Science-based information is vital for individuals to follow recommendations, guidelines and regulations, and for full strategic communication, in the concept of risk communication, which guides the population regarding diseases, symptoms, and treatment protocols. Community involvement in health initiatives and campaigns is the guarantee that health services and resources are distributed equitably and fairly, regardless of their origin, socio-economic status or other factors.

Despite the importance of trustworthy information, skepticism can arise for various reasons, such as the proliferation of false information that occurred in the Covid-19 pandemic, characterizing an infodemic. Previous cases of unethical behavior, such as medical experimentation without consent or discriminatory practices, have previously undermined trust in health systems, especially among marginalized communities, such as the study of untreated syphilis in black men in Tuskegee, Alabama, in the United States (JONES, 2008), or the forced sterilization of indigenous women in Canada and the United States (PEGORARO, 2015). Conflicts of interest, where financial or political motivations
influence health policies, question the impartiality of scientific recommendations.

In this sense, this article highlights the need to establish a public health observatory model focused on emergencies and crises, using international examples such as the Global Health Observatory (GHO) of the World Health Organization, the Observatoire suisse de la santé (OBSAN) of Switzerland, and the Surveillance Resource Center (SRC) of the CDC of the United States of America. An observatory of this topic will serve as a centralization of health-related data, filtered and peer-reviewed information, and evidence-based reports and investigations to contextualize reality for society, in particular to support decision-making by governments and by analyzing and disseminating accurate and up-to-date health information to guide them in public health plans and policies. By comparing these international examples, we aim to identify key features and good practices to create the guidelines for an effective system for future emergencies.

It should be noted that proposing an observatory model per se is not within the scope of this article, but rather proposing guidelines for proposing a model, which could be a future study. These guidelines can be understood as being orientations and/or instructions to guide the behavior or actions of organizations in implementing an observatory in this area of PHE management.

In addition, this article aims to highlight the essential role of technology and collaboration in establishing a health observatory. Technological advances are essential for handling large amounts of health data and facilitating the rapid dissemination of accurate information to the public. Interdisciplinary collaboration involving health professionals, data analysts, communication experts and policy makers will ensure an appropriate approach, enriching the functionalities and impact of the observatory for the guidance of society. The concepts of observatory, public trust, public health and public health emergencies were also investigated, as well as the technologies that help create and maintain a health observatory: electronic health records (EHR), health information exchange (HIE), wearable health technologies, Big Data analytics, geographic information systems (GIS) and mobile health applications (mHealth).

Proposing guidelines for the design of a public health emergency observatory is
in line with the immense need for evidence-based decisions in the field of public health during times of crisis. To this end, definitions of observatories and public health emergencies are first presented. This is followed by a survey of observatory models and technologies used. And finally, the proposed guidelines.

2 THEORETICAL BACKGROUND

The definition of an observatory is uncertain and has evolved over the years as practice and concepts have developed. Wilkinson and Hemmings (2003) showed that although the practice began in 1974 in Ile de France with the Observatoire Régional de Santé Île-de-France, there was no consensus on what the term meant in this context. The word observatory has a connotation of something purely passive: for example, an organization or system that simply observes the public or data, which, according to the authors, is a myth, as observatories identify themselves as "proactive researchers, providing strong policy messages that inform policy-making" (Wilkinson; Hemmings, 2003, p.324).

This uncertainty of established identity has affected the use of services by users, investors and partners, their attributions and scopes, and collaboration on a national and international scale (Wilkinson; Hemmings, 2003).

The work of both authors is cited in several other works. Castillo-Salgado, Aspinall, and Jacobson (2016) comment that although the model has continued and spread rapidly, the original 2003 question still remained unanswered a decade later. According to them, the number of observatories had already passed 150, and despite several attempts, there was no exact definition. Initial efforts included "providing relevant, high-quality regional health information to the observatories' host areas, synthesizing existing data and defining specific areas for data collection, strong networks for data access, comparative autonomy and setting priorities for their work" (Aspinall et al. 2016, p.1).

According to Gattini (2009), a health observatory is a virtual platform, a national center that conducts comprehensive observations and produces systematic reports on aspects of population health and health systems to support health policies and plans. The
observatory integrates, without replacing, the results or functions of information, monitoring and surveillance systems, allowing for a comprehensive, coherent and solid overview, simultaneously covering the health situation, the determinants influencing health and the functioning of health systems, including information on different sectors while developing as a national and integrated management tool, supporting the work of political and high-level decision-makers in public health and health systems (Gattini, 2009).

Many of the initial public health observatory projects, although they varied depending on the region, tended to cover the same objectives: identifying gaps in health information, increasing accessibility to data, facilitating the use of evidence by working with all levels of government, and supporting evidence-based policies and practices (Hunter et al., 2000).

When national health information is available, it is rarely in a single, easily accessible source. Often, this information is fragmented in different libraries, virtual documentation centers, research centers and monitoring and surveillance systems. This function of synthesizing information ends up being a large part of the identity of a health observatory (Gattini, 2009).

There are various types of observatories within the health field, such as the Belo Horizonte Urban Health Observatory, which deals with socio-environmental issues in the municipality, or the Barcelona Health and Policy Impact Observatory, which focuses on both health and the effects of legislation on it and existing inequalities. However, for this article, the interest lies in the management of public health emergencies.

The level of each emergency can vary, but it is generally characterized by escalating abruptly, requiring rapid mobilization of resources and coordination of efforts, leading to disruptions in daily life, economic crises, social unrest, and by intensified response measures such as disease surveillance, quarantines and isolation, public communications, case identification and contact tracing.

Along these lines, in May 2023, the Independent Advisory and Oversight Committee for the World Health Organization's Health Emergencies Program released its report on PHEs considering the period from May 2022 to April 2023, listing the following
situations that may or may not lead to a public health emergency: "the coronavirus disease (COVID-19) pandemic, multi-country outbreaks of mpox (monkeypox), global cholera outbreaks, floods in Pakistan, Sudan virus disease in Uganda, Marburg virus disease, drought and food insecurity in the Greater Horn of Africa, humanitarian crisis in the Sahel region of Africa, the Ukraine emergency, the earthquake in the Syrian Arab Republic and Türkiye, and other protracted emergencies and humanitarian crises" (Ammar et al., 2023, p.3).

Emergency management is a topic of great interest to the administrative governance sector and the public health sector. Emergencies, such as natural disasters, accidents or pandemics, can be extremely damaging in terms of property and lives, and minimizing casualties and damage is only possible with effective emergency and crisis management.

The state, according to articles 5 and 6 of the Brazilian Constitution, guarantees the safety and health of its citizens (BRASIL, 1988), and emergency management is a fundamental aspect of fulfilling this duty (Khan et al., 2018), both legally and ethically, and it is in the state's best interest to promote stability after an incident. Significant inter-agency coordination is also required between the federal, state, ministerial and military levels, as well as the need for a strategic level of crisis communication to ensure that the public is well informed. A sense of chaos will negatively affect public confidence in the administration, diminishing crisis mitigation efforts.

According to the literature, emergency management includes four phases, described in Table 1: preparedness (PHEP), response, recovery and mitigation.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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<tbody>
<tr>
<td>Preparedness</td>
<td>Occurs before and during an event and focuses on building or maintaining the capacity of a team, systems, and infrastructure, as well as carrying out planning, training, and exercising.</td>
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<tr>
<td>Response</td>
<td>Occurs when recognizing a hazard that threatens to overwhelm day-to-day functions or capabilities.</td>
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<tr>
<td>Recovery</td>
<td>Occurs during and after the response. It covers efforts to return or adapt to &quot;new&quot; normal conditions after an event.</td>
</tr>
<tr>
<td>Mitigation</td>
<td>It is the reduction of losses or risks of danger and the control of expected damage. It can take place before, during and after an event.</td>
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Rose et al. (2017) demonstrate in Figure 1 each phase of the PHE management cycle and cite examples that may or may not happen during each phase, such as testing and training during the Preparedness phase, implementation of procedures during the Response phase, long-term monitoring during the Recovery phase, and health interventions during the Mitigation phase.

According to Mayer et al. (1995), it is during these crisis and risk situations that the need for trust becomes real. Trust is understood as a certain willingness on the part of one party to be vulnerable to the actions of another, based on the expectation that they will carry out a specific action regardless of their ability to monitor or control that other party (Mayer et al., 1995). Public trust, however, is the trust of a group or person in an institution or social system. It is a generalized attitude, partly influenced by experiences with representatives of institutions or systems and partly influenced by the media, whether mainstream or social. Public trust, in turn, influences how people come into contact with health systems, whether public or private. There is also the aspect of interpersonal trust: trust between individuals, which will also affect public trust. (Van Der Schee et al., 2007)
The interest of this article on the topic lies in the negative effect of a lack of public trust in public authorities and policies, especially the lack caused by misinformation, and how the observatory can help combat it.

Briony and David (2019) have two distinct definitions: health misinformation and health disinformation. Health misinformation is knowledge that is contrary to the consensus of the scientific community on a concept or application, as the veracity of facts tends to change frequently due to new evidence, techniques and methods. Health disinformation is the deliberate or coordinated effort to knowingly circulate erroneous information for financial or political gain. Given that healthcare is a domain with enormous financial incentives at stake, it ends up being an attractive location for intentional disinformation (Swire-Thompson; Lazer, 2020).

According to Chou, April, and Klein (2018), this disinformation, which then affects public trust, promotes skepticism towards medical guidelines, having adverse effects on public health. The authors cite as an example not only the Ebola outbreak in 2014, where there was open hostility towards health professionals that made it difficult to control the epidemic, but also the increasingly prevalent anti-vaccine publications on social networks that legitimize the debate on vaccine safety, which may contribute to the reduction in vaccination rates that led to the return of measles in both the United States and Brazil (Chou et al., 2018).

Public trust is the basis of relationships between patients and professionals, enabling open communication and facilitating more accurate diagnosis and effective treatment. Horn and Kersaidou (2020) point out that, in 2013, the UK government implemented a plan to connect health and social care data across the NHS (National Health System) called care.data, with various objectives, such as economic growth and transparency for the general public.

Within a few months, more than a million patients opted out of the new system and, in 2016, it was discontinued, all due to concerns that NHS data would be shared with private commercial companies (Horn; Kersaidou, 2020). Gille et al. (2015) writes that trust is fundamental to the delivery of health services, exemplifying how unproven links between vaccines, intestinal diseases, and autism were publicized by the media in the late...
1990s in the UK, causing low vaccination coverage and disease outbreaks due to a lack of trust (Gille et al., 2015). Blendon et al. (2015) stated that without increasing public trust, many policy decisions affecting patient care will be made by those who would not consider the perspective of the medical profession itself (Blendon et al., 2015).

During the Munich Security Conference in February 2020, WHO Director-General Tedros Adhanom Ghebreyesus was quoted as saying: "We are not just fighting an epidemic; we are fighting an infodemic. Fake news spreads faster and more easily than this virus, and it's just as dangerous" (Ghebreyesus, 2020). Defined by the WHO as an overabundance of information, whether accurate or not, the infodemic is a modern challenge, making it difficult to find reliable sources and safe guidance. The damage of an infodemic is two-sided, harming both the public's health with false prevention measures and false cures, and the public's trust in the health system and in public authorities and policies (Who, 2020).

The success of an observatory is intrinsically linked to the trust that individuals and communities have in the integrity, transparency and ethical practices of the data collection, analysis and storage processes.

3 SURVEY OF AVAILABLE OBSERVATORIES

It is difficult to determine the exact number of health observatories worldwide, as it can vary depending on the definition, scope and whether they have been appropriately named as such. When considering health observatories as entities that systematically collect, analyze and disseminate health-related data and information, there is a wide list of possible bases for a future observatory. In addition, the current state and existence of health observatories can change over time as new initiatives are established or existing ones evolve or dissolve due to loss of public and financial support.

Table 2 shows a search carried out using keywords such as "observatories", "surveillance", "health systems" on Google and Google Scholar, as well as following examples studied in other articles. The search detailed existing scopes and the alignment of their objectives with their description, as well as showing the growing trend to form
new observatories in the health area, organized chronologically.

Table 2 - Existing observatories, description and example of objectives

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<thead>
<tr>
<th>Name, city, country, year established</th>
<th>Description</th>
<th>Example of Objectives</th>
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<tbody>
<tr>
<td>London Health Observatory (LHO), London, England (2001-2013)</td>
<td>A previously integral part of the network of twelve public health observatories in the UK and Ireland. The LHO produced data, information, and intelligence on the health and healthcare of the then 7.8 million people living in London.</td>
<td>It provided information, data and understandable interpretations to be used by policy-makers and the public to influence health and reduce health inequalities. It also provided a health knowledge signposting service and carried out training and capacity building for health professionals.</td>
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<tr>
<td>Swiss Health Observatory (OBSAN), Neuchâtel, Switzerland (2001)</td>
<td>A center of expertise, services and information supported by the Confederation and the cantons. Started as part of the national health policy dialog.</td>
<td>Provides scientific analysis and information on population health, the health system, and population health policy. Provides customized analysis and consulting services to partners and stakeholders.</td>
</tr>
<tr>
<td>Belo Horizonte Urban Health Observatory (OSUBH), Belo Horizonte, Brazil (2002)</td>
<td>A partnership between the Federal University of Minas Gerais (UFMG) and the Municipality of Belo Horizonte. Focused on acquiring in-depth knowledge about urban health through scientific research to understand the social and environmental conditions of urban life, creating an empirical basis for determining urban health interventions.</td>
<td>Produces research related to the urban scenario. It contributes to the training of academics and health professionals. Systematically analyzes health events and their determinants. It produces methods for measuring the attributes of the urban context. It also establishes a data warehouse for the systematic analysis of health data.</td>
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<tr>
<td>Nairobi Urban Health and Demographic Surveillance System (NUHDSS), Nairobi, Kenya (2002)</td>
<td>Pioneering demographic and urban health surveillance system established in two slum communities in Nairobi because they have the worst health and socio-economic outcomes of any group in Kenya.</td>
<td>It provides a platform to investigate the long-term health and socio-economic consequences of living in urban slums. It seeks to be a global center of excellence and a consistent source of scientific evidence for policy and action on population, health and education in Africa.</td>
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<tr>
<td>Bangladesh Urban Health Network (BUHN), Dhaka, Bangladesh (2009)</td>
<td>A civil society network that regularly engages in advocacy, working as a political pressure organization to bring together different actors in the urban health sector to collaborate on health equity issues, running social media campaigns to raise public awareness and organizing conferences with other organizations.</td>
<td>It promotes the generation, exchange and application of high-quality urban health knowledge to achieve health equity in urban environments across the country.</td>
</tr>
<tr>
<td>Surveillance Resource Center (SRC), Atlanta, USA (approx. 2010)</td>
<td>A website that allows the surveillance community to easily access and share useful methods, tools, legal, ethical and regulatory guidance to improve surveillance practice and serve as a web-based management system.</td>
<td>Provides easy access to guidance developed by the CDC and its partners to improve surveillance practice. It allows analysis, usage and collection of data to drive prevention in public health.</td>
</tr>
<tr>
<td>Name, city, country, year established</td>
<td>Description</td>
<td>Example of Objectives</td>
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<td><strong>Global Health Observatory (GHO), Geneva, Switzerland (2010)</strong></td>
<td>Created by the World Health Organization, the GHO contains health-related statistics for more than 1000 indicators from almost 200 Member States. Many of these indicators are used to monitor progress towards the Sustainable Development Goals. It can be searched by theme, category, indicator or country. Includes metadata on most indicators.</td>
<td>Shares data on global health, including statistics by country and information on specific diseases and health measures.</td>
</tr>
<tr>
<td><strong>Australian Urban Observatory, Melbourne, Australia (2013)</strong></td>
<td>Created by the Royal Melbourne Institute of Technology to bring together the link between city design, policy and planning with health and well-being using liveability indicators, developed by a multidisciplinary team of academic researchers.</td>
<td>Collects urban liveability indicators, providing access to multiple data sources in one place. Saves money and time in obtaining and analyzing data - a range of indicators provides users with a clear understanding of the situation in each of Australia's twenty-one largest cities.</td>
</tr>
<tr>
<td><strong>Chilean Public Health Observatory, Santiago, Chile (approx. 2014)</strong></td>
<td>OCHISAP is considered an informational support tool for the community's knowledge of health-related issues, as well as providing relevant evidence for health-related management and actions.</td>
<td>It makes relevant population health information available to the entire community in order to motivate them to actively participate in health issues and guide them in the development of health policies and decisions.</td>
</tr>
<tr>
<td><strong>Asia-Pacific Observatory on Health Systems and Policies (APO), New Delhi, India (approx. 2015)</strong></td>
<td>Based in the WHO regional office for South-East Asia, it is a collaborative partnership of interested governments, international agencies, foundations and researchers that promotes evidence-informed health systems policies regionally and in all countries of the Asia-Pacific region.</td>
<td>It collaboratively identifies priority health system issues in the region. Develops and synthesizes relevant research to support and inform evidence-based policy development in the countries involved. Engages in national dialogue with key stakeholders, be they governments, development partners, civil societies or academia.</td>
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<tr>
<td><strong>Fiocruz Observatory on Science, Technology and Innovation in Health, Rio de Janeiro, Brazil (2016)</strong></td>
<td>Data science initiative of the Oswaldo Cruz Foundation (Fiocruz) to collect, process, analyze and make available, in open access, data and information, supporting the institutional mission and the consolidation of the Brazilian Unified Health System (SUS).</td>
<td>It contributes to research management and the formulation of institutional policies in the area. It supports institutional development, providing strategic information to support decision-making. Promotes the availability of various data and indicators relevant to the health area.</td>
</tr>
<tr>
<td><strong>Observatory of Health and Policy Impact (OBSIP), Barcelona, Spain (2020)</strong></td>
<td>A tool to monitor the state of health in the city and the inequalities between neighborhoods and social groups and the impact on health of certain policies carried out by the City Council. It aims to be a way of promoting transparency and auditing public policies.</td>
<td>It monitors the state of health of people living in Barcelona and the factors that determine it, taking into account any existing inequalities. It assesses the impact of municipal policies on health and its determinants, as well as their impact on social inequalities in health.</td>
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Source: Author (2023).
The identified observatories, which range from monitoring health trends to generating medical research, function as dynamic hubs that transform raw data into actionable insights. The use of technology in healthcare not only increases our understanding of complex problems in this area, but also guides more informed decision-making. As the volume of data continues to increase, these observatories act as good tools to guide policymakers in the health sector.

Finally, it should be noted that there is a lack of observatories specifically focused on general crises and PHEs. The technologies implemented in the observatories are discussed below.

4 TECHNOLOGIES EMPLOYED IN OBSERVATORIES

There are various methods for acquiring and collecting data, which is one of the main functions of an observatory. Among the main methods used in this area are: Big Data Analytics (BDA), Health Information Exchange (HIE), Electronic Health Records (EHR), Geographic Information System (GIS), mobile health (mHealth) and wearables.

All have certain factors and possible disadvantages in common, described below in each section of the article, but advantageous possibilities for the coming years in the area of PHE management, which would be part of the responsibility of a public health emergency observatory. Although they all require financial investments, they vary according to availability and local socio-economic contexts.

Many of the observatories listed rely on information such as data, articles and reports provided by external sources and their own members to prepare dissemination materials. For example, Fiocruz's Brazilian Climate and Health Observatory (OCS), operates based on a model explained by Barcellos et al. (2016).

4.1. BIG DATA

Big Data can be defined as a set of data large enough to make it difficult to interpret. According to Dash et al. (2019 apud LANEY, 2001) "data was growing in three
different dimensions: volume, velocity and variety. Big in Big Data is indicative of its sheer volume. Velocity indicates the rate at which data is collected and made available for further analysis; on the other hand, variety refers to the different types of organized and unorganized data that any company or system can collect, such as transaction-level data, video, audio, text, or log files. These three Vs have become the standard definition of big data" (Dash et al., 2019, p.2-3, apud Laney, 2001).

This evolution of data has required new techniques and effective solutions for processing and analyzing Big Data. These solutions, known as Big Data Analytics (BDA), can play a decisive role in any observatory, providing both specific information and identifying trends, patterns and correlations. This is noteworthy given the scope of observatories that can reach millions of people, as London's LHO did.

Predictive modeling using Big Data could help predict the spread of a disease and estimate the demand for health resources, which are often inadequately distributed in an emergency, such as the allocation of medical professionals, hospital beds, vaccines, ventilators and mechanical respirators and other relevant resources.

BDA enables real-time monitoring of health-related data streams, including trends in hospital admissions, emergency room visits, laboratory results and other data, providing a dynamic understanding of emergency progression and stage. Another invaluable potential is to help with contact tracing by analyzing data from mobile devices and social media to keep the movement of individuals in mind. This online tracking can also help assess public perception, concerns and misinformation. This can be used to adapt communication strategies, address concerns and combat possible malicious actors.

However, there is a serious danger to privacy and security when using BDA in this way. Robust anonymization techniques need to be implemented and adherence to ethical data practices should be mandatory to ensure that individual privacy is maintained while still being able to extract desirable information. Dash et al. (2019) states that more appropriate software and hardware still needs to be developed to support this analysis of this 'endless sea' of information, as well as ensuring easy visualization for users, however, recent advances have been demonstrated in machine learning, deep learning, data mining, and predictive analytics tools and their ability to identify trends, clusters and anomalies.
4.2 HIE AND RES

Dixon (2016) points out that Health Information Exchange (HIE) has two distinct meanings as a verb and a noun. HIE, as illustrated in Figure 4, refers both to the action of physically exchanging data and information with authorized stakeholders, such as hospitals, laboratories, pharmacies, urgent care centers and many others, and to the organizations, private or governmental, that are responsible for handling this exchange due to legal and privacy concerns, since the vast majority of data involves sensitive and confidential information.

Although the data itself can be in various formats, the most logical format would be the Electronic Health Record (EHR). The concept of an EHR, according to Hoerbst and Ammenwerth (2010), is that of a comprehensive, cross-institutional collection of a patient's history, allowing authorized participants to engage not only in current medical treatment, but also in the patient's overall health situation, while allowing them to access and manage health-related data. This, combined with HIE, can help the health sector improve the coordination of patient care, reduce errors and have an enhanced health data management experience while simultaneously enabling continuous sharing between other teams or stakeholders, such as observatories.

To illustrate the use of this technology, citizens, health professionals and managers in Brazil have access to Conecte SUS, the Ministry of Health's initiative to digitally strengthen the principles and guidelines of the SUS, as illustrated in Figure 2.

It's possible to make a comparison between HIE, RES and BDA by connecting the fact that, for the purposes of the observatory, much of the data would be RES sent via HIE in such volume, variety and speed that it could be considered Big Data during emergency situations. The same problem of privacy, security, and ethics still remains, but the Brazilian government has already taken the first steps to address this situation by creating its own system and platform in 2020, the Rede Nacional de Dados em Saúde (RDNS), whose goal of serving as a platform for information systems aligns with health repositories and observatories.
The RDNS, presented in Figure 3, is a network that connects actors and data, establishing a national information platform, connecting health unit and operator management, support for lines of care, alert services, health professionals, population health data, emergency and urgent care services, research and development centers, pharmacies, laboratories, online communities, and health care regulations.


4.3 GIS

The interest in GIS, or Geographic Information System, for the purposes of this article is in using Maguire's (1991) partial definition of a representation of reality as geographic features for decision support systems that emphasize modeling and analysis for authority figures, such as the use of administrative boundaries for census counts.

"When diseases can spread so quickly, information needs to move even faster. This is where map-based dashboards become crucial" (Boulos, Geraghty, 2020, p.2). By combining GIS with web services, users can utilize and visualize an impressive amount of data without the need for a central hosting or processing service, which allows for rapid dissemination of information (Boulos; Geraghty, 2020).

As an example, Figure 4 illustrates a UDESC initiative to geographically visualize the evolution of the COVID-19 pandemic in Santa Catarina, Brazil, using the Boletim do Diário Oficial do Governo do Estado de Santa Catarina. The number of cases per municipality is visually represented by the size of each circle, according to its legend. The GIS proved successful during the Covid-19 pandemic, even at the beginning, with experts writing article after article trying to predict and demonstrate the rates of spread in real time in support of the WHO and local governments.

Figure 4 – Confirmed COVID-19 cases during the pandemic in Santa Catarina, Brazil.

Source: UDESC (2022).
GIS is a tried and tested method that many observatories rely on due to its versatility, reliability and ease of use, both for the experienced and the layman. It serves as an interesting tool for topics such as population analysis or outbreak mapping, while also communicating visually with the public to convey the geographical impact of an emergency, illustrate trends and explain mitigation strategies that would otherwise be potentially overlooked by complex texts that wouldn't have the same reach or dissemination potential.

Certain problems, although mitigable, can arise with the use of GIS, such as the privacy and security concerns mentioned earlier, as with any system that deals with this type of data. However, due to its nature, there are also wider socio-economic and political contexts that can be omitted, forgotten or misunderstood, which can lead to misguided decision-making at all levels. Countries with distinct rural and urban areas may find themselves unable to include both communities at the same level, with the same quality or with the same accuracy, and even at city level you may find the same division between urban and suburban centers and neighborhoods. Users can also misinterpret spatial patterns and draw inappropriate conclusions depending on the quality of the communication sent along with the GIS visualization. On an international scale, there can be issues related to data sovereignty, ethics and the different regulatory frameworks between them (Elwood, 2006).

It is possible to address these concerns through various means, such as transparent communication, adherence to ethical practices and regulations, and an emphasis on community involvement as it is key to creating and maintaining public trust in the use of technology.

4.4 MHEALTH AND HEALTH WEARABLES

Akter and Ray (2010) define mobile health services (mHealth) as the general use of mobile or portable devices, such as smartphones, tablets and wireless technologies, in the provision of health services and health data management. mHealth is considered a personalized and interactive service that is strongly linked to eHealth, or electronic health...
services, as a subset of it.

mHealth encompasses a wide variety of applications and services that take advantage of mobile technology resources, such as mobile apps, text messaging and telemedicine consultations, with the aim of improving health outcomes, enhancing the delivery of health services and empowering individuals to take an active role in managing their health. This technology emerges as a response to inadequate services in emerging countries, and the focus on it is its own capacity as a powerful tool for gathering information, such as symptoms, cases and emergencies, as well as disseminating it, such as vaccination campaigns or health advice through alerts and push notifications.

For the health sector itself, this technology can be used for mobile surveys or feedback collection, data aggregation and analysis, supply chain management, multilingual and accessible communication, and as logistical support for health professionals, all of which are of interest to a health observatory, especially since telemedicine is already employed by SUS as of 2022 (Law 14.510/2022).

Linked to mHealth is the concept of wearable health technology. Dunn et al. (2018) define wearables, as devices that allow continuous health monitoring outside a clinic, enabling the development of algorithms for automated prediction of health events, especially in chronic conditions such as arrhythmia, also known as irregular heartbeat. These devices are equipped with sensors and similar technology that track various physiological parameters, activities and behaviors.

Sandvik (2019) further explores that wearables can also be passive apps that can be downloaded to smartphones, tablets and smartwatches to help with geographical orientation or more sophisticated multifunctional devices that also record various data streams, including biomarkers (such as heart rate).

These apps and devices can be designed to allow users to keep a record of their online activity or communicate with third-party websites that monitor and analyze activity, to facilitate data synchronization. Operating at the evolving interfaces between biological and sensor technology, wearable devices provide measurement, selection, sorting, readability, calculability and visibility. Increasingly, they are also instruments for drug delivery or reproductive control, such as menstrual cycle tracking apps.
Wearables have gained significant popularity in recent years due to their potential, such as promoting proactive health management among enthusiasts, providing real-time health information for patients in chronic situations (DUNN et al., 2018).

Wearables can offer distinct advantages, such as remote monitoring of patients, early detection and alerts of abnormalities, information for public health surveillance in aggregate form, and communication and coordination between emergency teams and individuals. Aggregated data is of particular interest to an observatory, but there are significant financial barriers to using and relying on it in a major way, especially given the lack of proliferation of these wearables in Brazil due to their high local cost.

Many of the potential problems with the technologies listed are those of privacy and the ethical use of confidential and private information, which is of great interest in the health area. Although there are ethical practices and legislation protecting citizens, there is no universal guarantee that malicious actors will not gain undue access to benefit financially, especially since many of these actors are interconnected to the technology being used. The sale of health data, ad targeting and marketing, employment and insurance discrimination, the creation and sale of health dossiers, fraudulent misrepresentation and ransomware attacks are just a few examples of seriously harmful actions that bad faith actors can commit.

5 GUIDELINES FOR THE IMPLEMENTATION OF A PUBLIC HEALTH OBSERVATORY

Cross-referencing the technologies employed, their ethical concerns, public trust and existing observatories that serve as examples of robust and long-lasting health data centers leads to proposing guidelines for possible future Public Health Emergency Observatories (PHEO). Planning for public health emergencies is a complex process that can require a great deal of logistical and inter-agency coordination, depending on the level of the crisis. These guidelines will serve to answer future questions, such as what characteristics, functionalities and elements an OESP should possess to assist and collaborate with government agencies during public health emergencies, aligning the
observatory's goals with the needs of the government and the public.

Table 4 - Guidelines for Implementation

<table>
<thead>
<tr>
<th>Fundamental Based on the observatories studied and the technologies used</th>
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<tbody>
<tr>
<td>Guidelines</td>
</tr>
<tr>
<td>• Contemplate data and information to support measures in all phases of a public health emergency, including the prevention phase, the response phase, the mitigation phase and the recovery phase;</td>
</tr>
<tr>
<td>• Define a chain of command and clear communication channels within the observatory to ensure coordination and seamless decision-making during emergency situations;</td>
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<tr>
<td>• Influence health policymakers using up-to-date data;</td>
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<tr>
<td>• Implement quality assurance measures to ensure the accuracy and reliability of the data collected;</td>
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<tr>
<td>• Accept, manage and adequately communicate to the public and its target audiences policies, strategies, legislation, coordination plans, human resources, financial disclosures, risks, state of health infrastructure and logistics, availability of health and related services, community health capacities;</td>
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<tr>
<td>• Use risk assessment tools and modeling techniques to predict the potential impact of health emergencies;</td>
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<tr>
<td>• Provide training in effective risk communication strategies to equip responders to communicate complex health information to diverse audiences;</td>
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<tr>
<td>• Integrate with existing public health systems to facilitate a seamless response to emergencies;</td>
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<td>• Coordinate efforts with healthcare providers, laboratories and other relevant entities;</td>
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<tr>
<td>• Analyze data to identify trends, patterns and emerging health issues;</td>
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<tr>
<td>• Using easy-to-use and understand platforms and tools to share information;</td>
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<td>• Promoting health education to empower individuals and communities to make informed decisions and proactively prepare for emergencies;</td>
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<tr>
<td>• Regularly evaluate the effectiveness of emergency response measures and adjust strategies based on evaluations to improve future response capabilities;</td>
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<tr>
<td>• Conduct thorough analysis after each emergency and identify successes and areas for improvement to refine future response strategies;</td>
</tr>
<tr>
<td>• Integrate innovative technologies for data collection, analysis and communication and stay ahead of technological advances to enhance observatory capabilities;</td>
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<tr>
<td>• Be able to manage a comprehensive knowledge database while monitoring and evaluating current and future public health emergencies;</td>
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<tr>
<td>• Incorporate all its data into its measures, plans and risk assessments;</td>
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<tr>
<td>• Be aware of possible accessibility inequalities in information, plans and measures.</td>
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<tr>
<td>• Facilitate international collaboration by actively sharing information with neighboring countries;</td>
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<tr>
<td>• Engage in joint efforts to deal with health threats that transcend national borders</td>
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<tr>
<th>Fundamental Based on the effects of communication on the reputation, longevity and efficiency of an observatory</th>
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<td>Guidelines</td>
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• Actively participate in global research networks focused on public health emergencies and contribute to the collective knowledge base through collaborative research initiatives;
• Collaborate with communication experts to ensure that information is clear, accurate and accessible;
• Create and maintain an online presence that encourages community engagement while being strongly monitored for off-topic, unproductive, inflammatory and harmful discussions;
• Establish open communication and assist in establishing communications between and with government bodies, health institutions and other observatories.

Source: Author (2024).

Table 5 - Guidelines for Implementation (continued)

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<thead>
<tr>
<th>Fundamental Based on the effects of public confidence in the health sector</th>
<th>Guidelines</th>
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<tbody>
<tr>
<td>• Earn, cultivate and maintain public trust through frequent communications, transparent reports and recommendations;</td>
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<tr>
<td>• Involve the community in the design, implementation and evaluation of public health programs.</td>
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<tr>
<td>• Comply with ethical standards and strictly defined laws to handle public data without creating a conflict of interest that damages public trust</td>
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Source: Author (2024).

Finally, in proposing these guidelines, we reiterate the importance of integrating proven technologies and best practices in the development of any future observatory.

5 CONCLUSIONS

In this article, a gap was identified in the public health sector dealing with emergencies, and while there have been government and community measures to combat infodemics and coordinate efforts during most PHEs, there is a financial, moral and legal incentive to mitigate future pandemics in any proven effective way.

By studying existing international success models and considering technological aspects and collaboration, it is possible to shape a public health information ecosystem that not only informs government responses, but also combats the proliferation of misinformation, promoting a more participatory, honest and inclusive society.

Observatories serve as a frontline tool for public authorities, and the creation of one specifically for public health emergencies is plausible. It is very likely that there will be a significant return on the efficiency of the Brazilian health system and on improving the quality of response to public health emergencies from health surveillance systems in
this investment in mitigating public health emergencies and crises, but more research on the subject will be needed to determine concrete data.

The proposed guidelines can help in proposing a public health emergency observatory, meeting the needs of society.

This work has also identified that there are opportunities for future studies to obtain answers regarding the real damage that disinformation can cause, how far the consequences of letting infodemics be born and grow can go, and the public's general knowledge on the subject of observatories, public health measures, the value of public data and much more.

The lack of concrete data on these issues was a gap in the development of the work. Many scientific articles that analyzed and collected details and data on health observatories were also out of date, even though it had only been a few years, which could mean a dangerous lack of longevity for these types of projects, probably due to a lack of visibility. It is hoped that by drawing attention to this issue, it may encourage new perspectives in the public health sector and in the prevention of future pandemics, as well as the creation of a proper model of observatories for public health emergencies.
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