



COVID-19 and zoonoses in Brazil: Environmental scan of one health preparedness and response

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Abbreviations: AMR, Antimicrobial Resistance; EMBRAPA, Brazilian Agricultural Research Corporation (Empresa Brasileira de Pesquisa Agropecuária); IBAMA, Brazilian Institute for the Environment and Renewable Natural Resources (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis); E-SISBRAVET, Brazilian Veterinary Surveillance and Emergencies System (Sistema Brasileiro de Vigilância e Emergências Veterinárias); CIEVS, Center for Strategic Information in Health Surveillance (Centro de Informações Estratégicas em Vigilância em Saúde); ICMBio, Chico Mendes Institute for Biodiversity Conservation (Instituto Chico Mendes de Conservação da Biodiversidade); CAQ, Coordination of Aquatic Animals (Coordenação de Animais Aquáticos); CAT, Coordination of Terrestrial Animals (Coordenação de Animais Terrestres); DSA, Department of Animal Health (Departamento de Saúde Animal); DEA, Department of Environmental Education (Departamento de Educação Ambiental); DSASTE, Department of Environmental Health, Workers and Surveillance of Public Health Emergencies (Departamento de Saúde Ambiental, do Trabalhador e de Vigilância das Emergências em Saúde Pública); DRQA, Department of Environmental Quality and Waste Management (Departamento de Qualidade Ambiental e Gestão de Resíduos); DEIDT, Department of Immunization and Communicable Diseases (Departamento de Imunização e Doenças Transmissíveis); DIPOA, Department of Inspection of Products of Animal Origin (Departamento de Inspeção de Produtos de Origem Animal); DAEVS, Department of Strategic Coordination of Health Surveillance (Departamento de Articulação Estratégica da Vigilância em Saúde); DRH, Department of Water Resources (Departamento de Recursos Hídricos); BEm, Emergency Employment and Income Maintenance Benefit (Benefício Emergencial de Preservação do Emprego e da Renda); AE, Emergency Aid (Auxílio Emergencial); NASF, Family Health Support Centers (Núcleo de Apoio à Saúde da Família); LFDAs, Federal Agricultural Defense Laboratories (Laboratórios Federais de Defesa Agropecuária); CFMV, Federal Council of Veterinary Medicine (Conselho Federal de Medicina Veterinária); STF, Federal Supreme Court (Supremo Tribunal Federal); SFA, Federal Superintendences of Agriculture (Superintendências Federais de Agricultura); GDP, Gross Domestic Product; CGSA, General Coordination of Animal Health (Coordenação Geral de Saúde Animal); CGARB, General Coordination of Arbovirus Surveillance (Coordenação Geral de Vigilância de Arboviroses); CGEMSP, General Coordination of Public Health Emergencies (Coordenação Geral de Emergências em Saúde Pública); CGLAB, General Coordination of Public Health Laboratories (Coordenação Geral de Laboratórios de Saúde Pública); CGZV, General Coordination of Surveillance of Zoonoses and Vector-borne Diseases (Coordenação Geral de Vigilância de Zoonoses e Doenças Transmitidas por Vetores); CGPZ, General Coordination of Zoonosis Planning and Evaluation (Coordenação Geral de Planejamento e Avaliação Zoonosológica); SVS, Health Surveillance Department (Secretaria de Vigilância em Saúde); IACHR, Inter-American Commission on Human Rights; ILO, International Labor Organization; GAL, Laboratory Environment Manager (Gerenciador de Ambiente Laboratorial); UVL, Local Veterinary Units (Unidades Veterinárias Locais); MAPA, Ministry of Agriculture, Livestock and Supply (Ministério da Agricultura, Pecuária e Abastecimento); ME, Ministry of Economy (Ministério da Economia); MMA, Ministry of Environment (Ministério do Meio Ambiente); MS, Ministry of Health (Ministério da Saúde); PAN-BR, National Action Plan for the Prevention and Control of Antimicrobial Resistance (Plano de Ação Nacional de Prevenção e Controle da Resistência aos Antimicrobianos); FUNASA, National Health Foundation (Fundação Nacional de Saúde); ANVISA, National Health Surveillance Agency (Agência Nacional de Vigilância Sanitária); PNCRH, National Herbivore Rabies Control Program (Programa Nacional de Controle da Raiva dos Herbívoros); PNSA, National Poultry Health Program (Programa Nacional de Sanidade Avícola); PNCEBT, National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis (Programa Nacional de Controle e Erradicação da Brucelose e da Tuberculose Animal); SISLAB, National Public Health Laboratories System (Sistema Nacional de Laboratórios de Saúde Pública); SINAN, Notifiable Diseases Information System (Sistema de Informação de Agravos de Notificação); OH, One Health; OHWG, One Health Working Group; Fiocruz, Oswaldo Cruz Foundation (Fundação Oswaldo Cruz); PANAFOTSA, Pan American Center for Food-and-Mouth Disease and Veterinary Public Health; PAHO, Pan American Health Organization; CRMVs, Regional Councils of Veterinary Medicine (Conselhos Regionais de Medicina Veterinária); SDA, Secretariat of Agricultural Defense (Secretaria de Defesa Agropecuária); SAIC, Secretariat of Institutional Articulation and Environmental Citizenship (Secretaria de Articulação Institucional e Cidadania Ambiental); SRHQ, Secretariat of Water Resources and Environmental Quality (Secretaria de Recursos Hídricos e Qualidade Ambiental); SVE, State Veterinary Services (Serviços Veterinários Estaduais); SUS, Unified Health System (Sistema Único de Saúde); CETAS, Wild Animal Screening Centers (Centros de Triagem de Animais Silvestres); WHO, World Health Organization; OiE, World Organization for Animal Health; UVZs, Zoonoses Surveillance Units (Unidades de Vigilância de Zoonoses).

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ABSTRACT

The emergence of the COVID-19 pandemic reinforced the central role of the One Health (OH) approach, as a multisectoral and multidisciplinary perspective, to tackle health threats at the human-animal-environment interface. This study assessed Brazilian preparedness and response to COVID-19 and zoonoses with a focus on the OH approach and equity dimensions. We conducted an environmental scan using a protocol developed as part of a multi-country study. The article selection process resulted in 45 documents: 79 files and 112 references on OH; 41 files and 81 references on equity. The OH and equity aspects are poorly represented in the official documents regarding the COVID-19 response, either at the federal and state levels. Brazil has a governance infrastructure that allows for the response to infectious diseases, including zoonoses, as well as the fight against antimicrobial resistance through the OH approach. However, the response to the pandemic did not fully utilize the resources of the Brazilian state, due to the lack of central coordination and articulation among the sectors involved. Brazil is considered an area of high risk for emergence of zoonoses mainly due to climate change, large-scale deforestation and urbanization, high wildlife biodiversity, wide dry frontier, and poor control of wild animals' traffic. Therefore, encouraging existing mechanisms for collaboration across sectors and disciplines, with the inclusion of vulnerable populations, is required for making a multisectoral OH approach successful in the country.

1. Introduction

Zoonoses are infectious diseases that can be spread between animals and humans by food, water, fomites, or vectors [1]. Currently, the frequent emergence and reemergence of these diseases represent a serious public health problem with negative impacts on economies and livelihoods [2,3]. Among the main reemerging and emerging infectious diseases of zoonotic potential in Brazil are yellow fever, sporotrichosis, visceral leishmaniasis, and COVID-19 [4–6]. Other public health problems related to OH approach in the country are endemic zoonoses, accidents caused by venomous and poisonous animals and antimicrobial resistance [7,8].

Brazil has a public health system, the SUS, which is one of the largest and most complex public health systems in the world. While some inequalities in the provision of services and health outcomes have been mitigated by the expansion of SUS services, especially in primary care, the coexistence of a public system, based on the guideline of universality, with a private sector, which competes for State resources, reproduces social stratification and inequalities in health [9]. Preparedness and response actions for public health emergencies in Brazil are coordinated by the MS and carried out by the CIEVS at the state and municipal levels in compliance with the WHO's International Health Regulations [10]. Despite recent budget cuts, it was expected that Brazil's health system would place the country in a good position to mitigate the COVID-19 pandemic [11]. Nevertheless, Brazil has become a global hotspot for the pandemic, reporting more than 21 million cases and 600,000 deaths to October 2021, 12% of the reported global COVID-19 deaths, while comprising only 2.7% of the world population [11]. Factors such as the lack of federal coordination of the response, delay in the purchase of vaccines and heterogeneous non-pharmacological measures in the country may have contributed to this scenario.

Initiatives to address zoonotic diseases using a OH approach have been undertaken in some countries over the last decade [1] and the emergence of the COVID-19 pandemic reinforced the central role of a multisectoral and multidisciplinary perspective to tackle health threats at the human-animal-environment interface. In a globalized world, the social, economic, and health impacts of human action contribute to the complex situation involving the emergence of zoonotic diseases, such as the growing demand for animal protein, intensive and unsustainable agricultural expansion, increased wildlife exploitation and the climate crisis, also harming the lives of traditional communities. [12].

We aimed to draw on Brazilian preparedness and response to COVID-19 and zoonoses to assess if OH principles and equity considerations influence health policy response during infectious disease outbreaks.

2. Methods

We conducted an environmental scan using a protocol developed as part of a multi-country study on OH preparedness and response to COVID-19 (Fig. 1) [13]. A coding scheme was developed for thematic analysis of OH and equity dimensions with the following nodes: (1) OH domain - barriers, enablers, infrastructure, preparedness and response plans, international and regional health obligations; (2) equity domain - disaggregated data, equity dimension of fiscal policy, gender, vulnerable populations, and targeted interventions (Appendix A). Two independent researchers did the coding, and the disagreements were resolved by discussion and consensus.

Brazilian government official documents for preparedness and response to COVID-19, from national level were retrieved from the MS website; inclusion criteria were all documents and technical bulletins on COVID-19 response published up to October 2020. Regarding subnational levels the following criteria were adopted: one state from each of the five macro regions of the country, and a COVID-19 contingency plan prepared and available. All documents were coded even if OH initiatives were not explicitly stated. The documents retrieved were also analyzed to assess the government's response to the COVID-19 pandemic regarding vulnerable populations (afro-descendants and indigenous populations), gender, and fiscal policy (business and population-oriented programs).

We also conducted online research for additional relevant literature and grey literature. The selection was performed by two authors independently for each theme: 'OH' and 'equity' and disagreements were resolved by consensus. We consulted Medical Literature Analysis and Retrieval System Online (MEDLINE) and Scientific Electronic Library online (SCIELO) databases. Regarding "grey literature", we included bulletins elaborated by research and civil society institutions; government information systems; legal documents issued by the National Congress (Chamber of Deputies and Senate), and the STF; and institutional websites of different public agencies. Inclusion criteria were defined as articles and documents on COVID-19 and zoonoses response. The following combination of keywords was used: (ncov2019, COVID-19, SARS-CoV-2, zoonoses, zoonotic diseases) and (one health); (Public Policy, Public Health Policy, Public Expenditures on Health, Health Expenditures; socioeconomic, unequal, inequality, equity, race, gender, deprivation) and (One Health). References were inserted in a Zotero database [14]. The complete list of documents coded is available in the Appendix B. We also communicated with stakeholders (academic and governmental officials) to identify additional resources (government documents on OH and any institutional OH approach initiative).

A description of the documents according to the coding scheme

proposed for thematic analysis was performed. We used Nvivo12 software for data analysis [15]. The main actors at the national and subnational level that work in the preparedness and response to zoonoses, and in the prevention and control of antimicrobial resistance were described according to the principles of OH approach. The Brazilian surveillance for zoonoses in humans and animals was described and we outlined the barriers and enablers of OH governance in the country.

3. Results and discussion

We retrieved 81 official federal documents and 13 documents from subnational levels. The coding scheme was used to determine inclusion criteria, and resulted in 45 documents for analysis. These documents generated 79 files (total number of documents coded in one or more nodes) and 112 references (coded document excerpts) on OH; and 41 files and 81 references on equity (Table 1). The term “one health” was not mentioned in any document related to COVID-19, while the term “equity” was explicitly referenced only once, in a document of the state of Maranhão referring to ‘quilombola individuals’, which are the descendants and remnants of communities formed by runaway slaves (the quilombos), between the 16th century and 1888 (when slavery was abolished in Brazil). Content analysis of the documents and literature focused on assessment of Brazilian OH governance and infrastructure for preparedness and response to COVID-19 and other zoonoses and various equity issues.

3.1. One Health governance and infrastructure in Brazil

The MS along with the MAPA, and MMA and their respective sectors at national and subnational level are responsible for the preparedness and response to zoonoses (Table 2 and Fig. 2) and prevention, and control of antimicrobial resistance in the country (AMR) (Fig. 2). The MMA is the ministry least integrated, and its actions are limited to the surveillance of some zoonoses; control of wild boar; control of dumps and waste disposal; monitoring of antimicrobial resistance and management of the waste of antimicrobials through the PAN-BR (Fig. 2) [7]. Both human and animal cases are notified by the MS and MAPA according to the surveillance flowchart of zoonotic diseases (Fig. 3) [16].

Although those actions involve a multisectoral perspective, the OH approach is not fully consolidated or widespread among health professionals, especially physicians, and there is no specific legislation for

this issue. Some initiatives such as the legal recognition of veterinarians as health professionals since 1997 [17] and their inclusion as members of the health team in the NASF [18,19] by the national primary care policy of the Brazilian government mark important developments in providing a base for stronger OH programming in Brazil. The barriers or enablers of better OH governance in Brazil are described in the Table 3.

3.2. One Health preparedness and response plans to COVID-19

The MS created the Inter-ministerial Executive Group on Public Health Emergency of National and International Importance (GEI-ESPII) after the onset of COVID-19 epidemic [20] together with MAPA, other Brazilian government ministries, and the National Health Surveillance Agency. Integrated actions were developed involving health surveillance, health care, and public health measures for the prevention and control of the SARS-CoV-2. Capacity for rapid risk assessment, effective information monitoring, and intersectoral investigation and response to suspected cases of human infection was also enhanced. Joint actions between the MS and other border agencies including the Federal Revenue, Federal Police, Agriculture and Livestock Surveillance, Civil Aviation Authority, Water Authority and Terminal Administrators were undertaken to deepen surveillance at entry points [20].

The MAPA, together with the MS, has been monitoring the epidemiological situation in the country to prevent and reduce the risk to human health of use of animal products, and to reduce the prevalence of animal diseases. In addition, a multi-sector coordination was established involving MAPA, the ME, and the MS aiming at the prevention, control, and mitigation of COVID-19 transmission risks in work environments, in order to permanently guarantee the safety and health of workers, and the security of the population’s food supply, jobs, and economic activities [21].

Another important measure taken was expansion of the capacity of the LFDA for the diagnosis of COVID-19 [22]. To date, SARS-CoV-2 positive RT-PCR cats and dogs in the country have been reported to MAPA and to the OiE.

3.3. One Health preparedness and response plans to zoonoses and antimicrobial resistance

In line with a OH approach, Brazilian government plans for preparedness and response to zoonotic influenza, yellow fever, and rabies

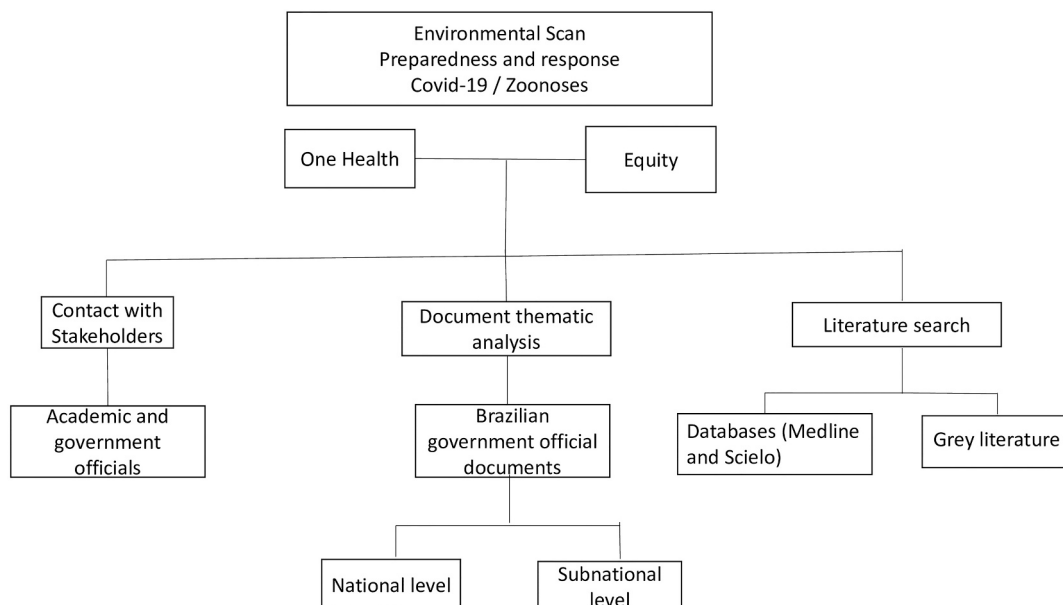


Fig. 1. Flowchart of data sources used for environmental scan on the One Health preparedness and response to COVID-19 and zoonoses in Brazil.

Table 1

Nvivo coding results on Brazilian preparedness and response to COVID-19 pandemic according to One Health and Equity aspects.

Node	Files*	References**	Types of documents
One Health			
Enablers of One Health	8	8	3 Decrees, 1 Normative Instruction, 1 Guideline, 1 Technical Note, 1 Ordinance, 1 Law
OH Infrastructure	5	5	3 Decrees, 1 Technical Note, 1 Collegiate Board Resolution
Communication and Education	1	1	1 Technical Note
Human resources	1	1	1 Law
Laboratories	1	1	1 Collegiate Board Resolution
Multi-sectoral Coordination Mechanisms	4	4	3 Decrees, 1 Technical Note
Public Private OH Partnerships	1	1	1 Law
Sector-specific OH structures, programs, plans and activities	1	1	1 Technical Note
Subnational OH initiatives	1	2	1 State Contingency Plan
Surveillance	5	11	1 National Contingency Plan, 1 Decree, 2 Technical Notes, 1 Website
OH Preparedness and Response Plans	17	32	3 Decrees, 1 National Contingency Plan, 1 State Contingency Plan, 3 Technical Notes, 1 Normative Instruction, 1 Website, 4 Ordinances, 1 Guideline, 1 Resolution, 1 Collegiate Board Resolution
Existing Frameworks, protocols and plans	9	12	1 Decree, 3 Technical Notes, 1 National Contingency Plan, 1 State Contingency Plan, 1 Ordinance, 1 Normative Instruction, 1 Resolution
Participation of sectoral stakeholders in development	7	7	1 National Contingency Plan, 1 State Contingency Plan, 3 Decrees, 1 Technical Note, 1 Ordinance
Resourcing of frameworks, protocols and plans	7	9	3 Ordinances, 1 Guideline, 1 Technical Note, 1 Collegiate Board Resolution, 1 Website
Roles and responsibility for stakeholders	11	17	3 Decrees, 1 National Contingency Plan, 3 Technical Notes, 1 Resolution, 1 Guideline, 1 Ordinance, 1 Collegiate Board Resolution
Equity			
Equity dimension of fiscal policy response	1	1	1 Decree
Business bailouts	2	3	2 Laws
Emergency funding	3	9	2 Laws, 1 Decree
Gender	3	7	1 Decree, 1 Law, 1 Ordinance
Right to health	3	3	3 State Reports
Identification of vulnerable populations	20	48	3 Epidemiological Bulletins, 1 Decree, 2 Laws, 1 Bill, 1 Veto Message, 5 Ordinances, 3 State Contingency Plans, 1 Allegation, 3 State Reports
Targeted interventions	9	10	2 State Contingency Plans, 3 State Reports, 2 Laws, 2 Ordinances

*“Files” - total number of documents coded in one or more nodes ** “References” - coded document excerpts. It is possible to find more than one reference in a single file.

Table 2

Main institutions at the national and subnational level that work in the surveillance, prevention, and control of zoonoses in Brazil, using the principles of OH approach.

Agencies	Sectors	Activities and governance related to OH approach
MS	SVS	Coordination of zoonoses and other infectious diseases surveillance, control, and prevention actions, including emerging and reemerging ones with standardized actions throughout the national territory.
		CIEVS Capture of rumors and strategic information on possible public health events timely, as well as handling and analyzing data relevant to the practice of health surveillance in emergencies and to develop appropriate responses to reduce and contain health risks.
	Fiocruz	Development of research, education, technology, innovation, technological production (e.g.: vaccines) and services (e.g.: it has reference laboratories for the diagnosis of infectious diseases), as well as supports public health policies.
		ANVISA Sanitary control of the production and consumption of products and services, as well as the control of ports, airports, borders, and bonded areas.
	SISLAB	National laboratory network responsible for surveillance in environmental health, health surveillance and medical care.
		UVZs Surveillance, prevention, and control of zoonoses and accidents caused by venomous and poisonous animals in municipal, regional and/or state level
	NASF	Specialized and matrix support to Family Health Strategy teams, through the work of a multidisciplinary team, including veterinarians, sharing practices and health knowledge in the territories.
		OHWG Responsible for classification criteria for UVZs, financing guidelines for the improvement and expansion of these units, legislation assessment, and zoonoses surveillance and control actions in collaboration with MAPA, PANAFTOSA and CFMV.
	MAPA	SDA/DSEA/CGSA Coordination of programs for the prevention, control, and eradication of diseases of terrestrial and aquatic animals, with some programs aimed at zoonoses such as PNCEBT, PNCRH, and PNSA.
		SDA/DSEA/CGPZ Responsible for data management of e-SISBRAVET, along with the MS to respond to any zoonoses emergency.
SFA Supervision of the SVEs and DIPOA in the Federative Units.		
SVE Surveillance, control, and prevention of diseases in farm animals, focusing on animal health protection and inspection of products of animal origin at subnational level.		
MMA	LFDA's Network responsible for providing technical data and results of laboratory analysis, for decision-making in the field of agricultural defense	
	DIPOA Responsible for the inspection of products of animal origin based on the legislation, which regulates standards and criteria for quality and safety products of animal origin.	
MMA	ICMBio	Responsible for the implementation, management, protection, inspection and monitoring of Federal Conservation Units. The combat against the trafficking and illegal hunting of wild animals is carried out along with IBAMA, the Federal Police, the Environmental Military Police of the states, CETAS, and other official rehabilitation centers.

(continued on next page)

Table 2 (continued)

Agencies	Sectors	Activities and governance related to OH approach
	IBAMA	Development of several activities to preserve the natural heritage and to control and inspect the use of natural resources at national and regional levels.
EMBRAPA	-	Development of agricultural research, which includes zoonoses linked to farm animals. It also has several diagnostic laboratories.
CFMV and CRMVs	-	Supervision of the practice of the veterinary and zootechnical professions. Important actors regarding the recognition of the veterinarian as a health professional and in the dissemination of the OH concept to society.
Federal and Private Universities	-	Inclusion of the OH concept in the new curriculum of around 355 veterinary medicine courses in activity.
Army	-	Actions in biosafety against biological risks with support of two BSL-3 laboratories. It has a multiprofessional health staff, including veterinarians, who perform diagnosis, prevention, and control of zoonoses especially in remote regions of the country.
PANAFTOSA	-	Originally dedicated exclusively to Foot and Mouth Disease in ruminates, currently it also provides technical cooperation in zoonoses and food safety to the countries of the region.

MS: Ministry of Health. SVS: Secretariat of Health Surveillance. CIEVS: Center for Strategic Information in Health Surveillance. Fiocruz: Oswaldo Cruz Foundation. ANVISA: National Health Surveillance Agency. SISLAB: National Public Health Laboratories System. UVZs: Zoonoses Surveillance Units. NASF: Family Health Support Centers. OHWG: One Health Working Group, which is an administrative organization located in the headquarters of MS and mainly composed by veterinarians. MAPA: Ministry of Agriculture, Livestock and Supply. SDA: Secretariat of Agricultural Defense. DSA: Department of Animal Health. CGSA: General Coordination of Animal Health. CGPZ: General Coordination of Zoonoses Planning and Evaluation. PNCEBT: National Program for the Control and Eradication of Brucellosis and Animal Tuberculosis. PNSA: National Poultry Health Program. PNCRH: National Herbivore Rabies Control Program. e-SISBRAVET: electronic information system of MAPA. SFA: Federal Superintendence of Agriculture. SVE: State Veterinary Services. DIPOA: Department of Inspection of Products of Animal Origin. LFDAs: Federal Agricultural Defense Laboratories. MMA: Ministry of Environment. ICMBio: Chico Mendes Institute for Biodiversity Conservation. IBAMA: Brazilian Institute for the Environment and Renewable Natural Resources. CETAS: the Wild Animal Screening Centers. EMBRAPA: Brazilian Agricultural Research Corporation. CFMV: Federal Council of Veterinary Medicine. CRMVs: Regional Councils of Veterinary Medicine. PANAFTOSA: Pan American Center for Food-and-Mouth Disease and Veterinary Public Health.

proposed collaborative, multidisciplinary, and multisectoral approach at national, subnational, and global levels [1]. The Brazilian Plan of Preparedness for Influenza Pandemic involves several governmental agencies including the MS, MAPA and MMA [4,23]. The Plan was recently applied in a human case of influenza A H1N2 virus detected in 2020 [24].

In 2017–2018, Brazil experienced a yellow fever epidemic from a wild transmission cycle. A preparedness and response plan was developed by the MS in partnership with the MMA [25], based on sentinel surveillance in non-human primates as well as on surveillance, diagnosis, treatment, and prevention of yellow fever in humans. It also included an immunization plan with a national vaccine manufactured at Fiocruz, Brazil [25]. These measures controlled the epidemic and prevented the urbanization of the disease.

Rabies surveillance is carried out through the National Program for Rabies Control in Herbivores, a joint action of the MS and MAPA, which share information on cases of rabies in dogs, cats, bats, and domestic herbivores [4]. The program also promotes mass vaccination of dogs and cats against rabies with a free of charge vaccine, which has ensured

urban rabies control in the country [4]. For prevention and control of AMR, several governmental agencies have come together to develop the PAN-BR [7], a five-year plan (2018 to 2022), annually evaluated, designed to assess AMR in the country.

Despite these initiatives, practical implementation of the OH approach has proven challenging. Brazil is considered an area of high risk for emergence of zoonoses mainly due to climate change, large-scale deforestation and urbanization, high wildlife biodiversity, wide dry frontier, and poor control of wild animals' traffic [26–28]. Furthermore, there is still little interaction between government agencies and lack of resources in some sectors, as well as a need for a better information system on OH that can act as a trigger for the activation of contingency plans when a zoonotic disease event is detected [1]. Our findings are in line with a PAHO survey of the status of zoonoses programs in 31 Latin American and the Caribbean countries, which identified the need for a formal regional network, better regional communication and collaboration, improved relationships among governmental agencies, and integrated surveillance [29].

3.4. Equity dimensions in the response to COVID-19

In the 20th century, Brazil experienced significant economic development and growth, coming out of the 1970s possessing a relatively strong, industrially oriented, and diversified economic structure. In the first decade of the 21st century Brazil adopted a 'social developmentalism' strategy, where sustained growth and distributive results were interwoven [30].

Since 1988, Brazil has strengthened its governance structure on issues related to citizenship, environment, human and minority rights, a structure invariably supported by new laws and regulations. In recent years, however, the country is undergoing a neoconservative dismantling of different public policies, negatively affecting the most vulnerable populations, notably Afro-descendants, Indigenous people, women, and the poor, among others [31].

3.4.1. Afro-descendants

Afro-descendants represent more than half of the population and constitute one of the most vulnerable groups in Brazil. Among them, there are 6.000 remaining "quilombola" communities in the country with approximately 16 million people [29]. Although the existing norms require the record of disaggregated data on race/color in the health information systems [33,34], the epidemiological information about race/color remains largely ignored in the official bulletins [32,35].

In 2020 the federal government under the present administration issued a Resolution [36], authorizing the removal of "quilombola" communities from Alcântara, in the state of Maranhão, violating both the Federal Constitution and the Convention 169 of the ILO [32]. Unlike the federal government, the state government of Maranhão developed specific measures to tackle COVID-19 in "quilombola" communities in July 2020, ensuring health care with a multidisciplinary team that tested and treated more than 500 people in these territories [37].

3.4.2. Indigenous people

In Brazil, according to the 2010 population census there were 817 thousand Indigenous peoples, corresponding to 0.26% of the total Brazilian population, with approximately 503 thousand living in rural areas and 315 thousand living in urban areas [38,39].

Between January and June 2020, the federal government published 1.536 norms to respond to the coronavirus impact, but only seven of them (0.5%) referred to the Indigenous population [40]. The emergency plan for preparedness and response to COVID-19 in Indigenous territories was created; however, it had some of its provisions vetoed by the President [41,42]. Pressures from the Indigenous movement and the IACHR, in addition to interventions of the STF overturned the presidential vetoes [43]. In August, the STF required the federal government to adopt measures to contain the advance of COVID-19 in Indigenous

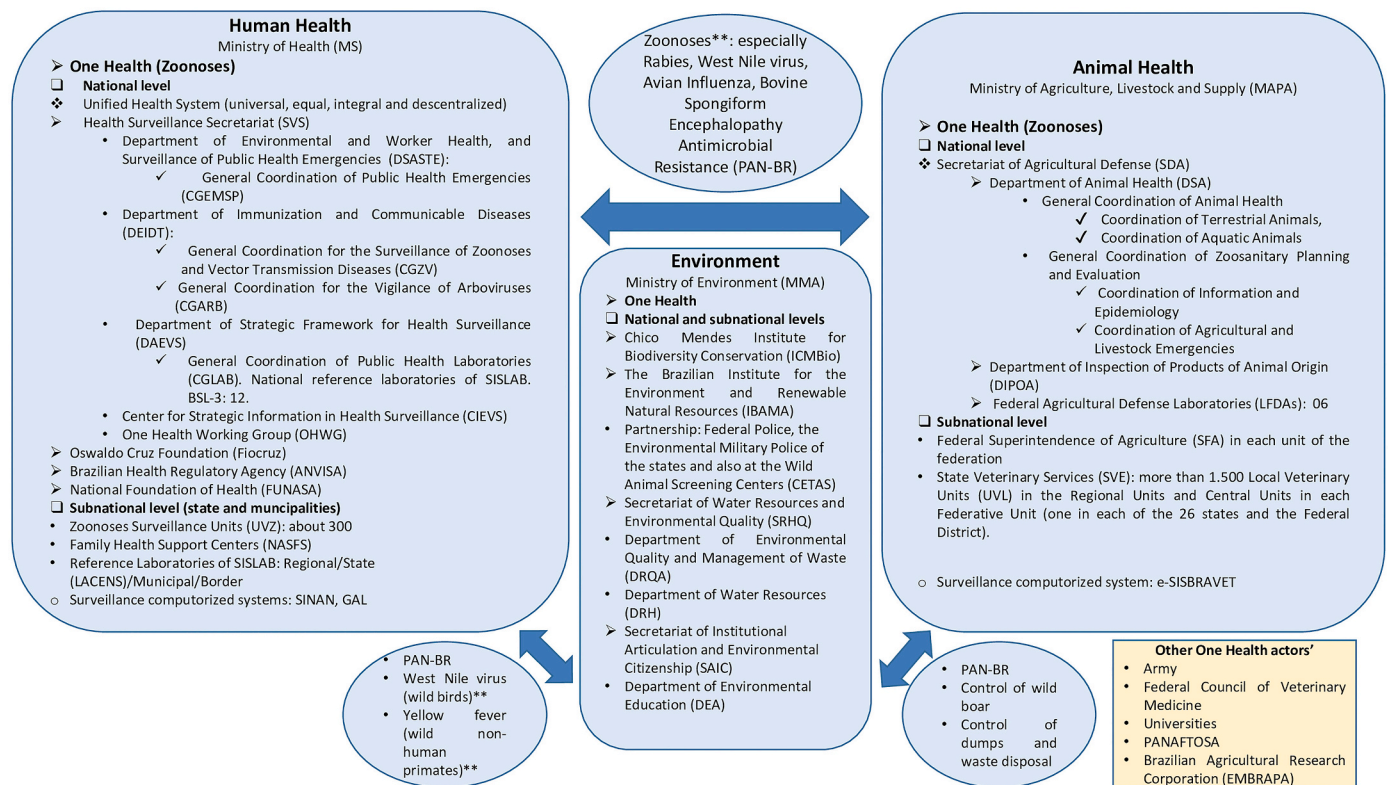


Fig. 2. The main actors of One Health governance in Brazil.

** Zoonotic diseases with inter-ministerial plans for preparedness and response that involve collaborative, multidisciplinary, and multisectoral approach at national, subnational, and global levels.

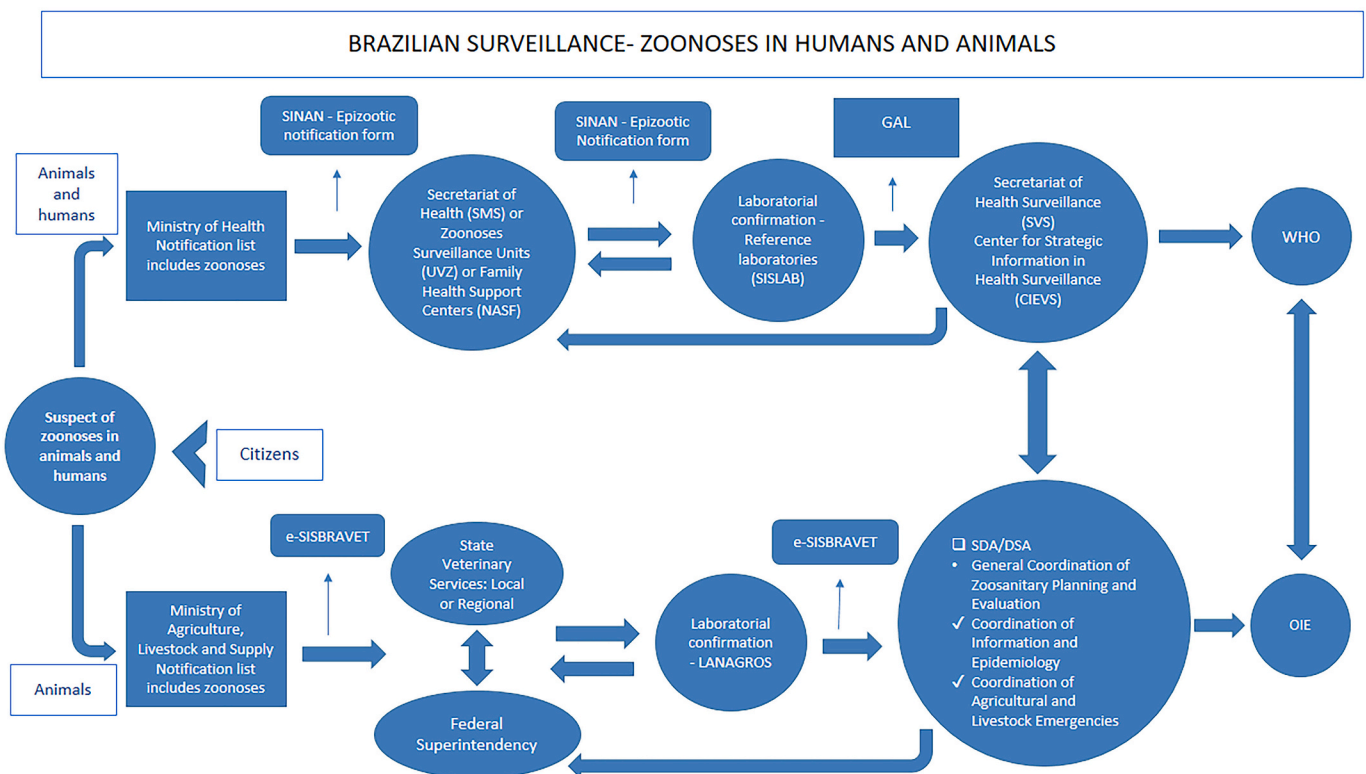


Fig. 3. The Brazilian surveillance for zoonoses in humans and animals.

Table 3
Barriers and enablers of One Health governance in Brazil.

Barriers	Enablers
<ul style="list-style-type: none"> ✓Lack of specific one health structures, legislation, or official guidelines. ✓Limited joint action between MAPA and MS regarding the surveillance and control of zoonoses. ✓Limited joint action between the MS and the MMA, restricted to yellow fever and West Nile fever surveillance. ✓The Information systems - e-SISBRVET (MAPA) and SINAN (MS) are not integrated which harms information exchange between MAPA and MS. ✓Lack of intersectoral articulation at the level of municipalities and states to face local problems like raising animals in an urban area, or helping small producers. ✓The number of decentralized zoonoses surveillance units (UVZs) is not enough because they are only present in about 300 of the 5570 Brazilian municipalities. ✓Lack of surveillance data for zoonoses in animals in MS. ✓Veterinarians do not report cases routinely ✓The “One Health” concept is not widely known by healthcare professionals. ✓The “One Health” theme is neither on the public health agenda nor in the funding priorities of research agencies. ✓Poor control of trafficking and illegal hunting of wild animals as well as illegal deforestation. 	<ul style="list-style-type: none"> ✓The Unified Health System (SUS) is decentralized throughout the Brazilian territory reaching most of the municipalities. ✓The recognition by legislation of veterinary as a health professional and his inclusion in the Primary health care in 2011. ✓Health information systems are well consolidated in the MS and may be useful for surveillance and control of zoonoses, even if not integrated to other systems. ✓The implementation of MAPA’s information for notification of diseases in animals: e-SISBRVET. ✓Joint actions of MAPA and MS in the surveillance, control and prevention of rabies and influenza. ✓Joint actions of the MS, MMA and MAPA and other government agencies in the PAN-BR, in convergence with the objectives defined by the tripartite alliance. ✓Initiatives like the Wild Health Information System (SISS-Geo), a computational platform which operates the Wild Health Information Center – CISS to report diseases and deaths of wild animals through a mobile application.

communities [44].

The accumulated lethality of Indigenous people due to acute respiratory distress syndrome resulting from COVID-19 in Brazil reached 41.8% (as of August 2020), 19% higher than that experienced by non-Indigenous people [45]. The virus transmission in territories occupied by isolated and recently contacted peoples is alarming and worsened by the increase of illegal invasions by farmers, miners, and loggers [46].

3.4.3. Gender

The pandemic has affected Brazilian women in different ways. Between April 2019 and April 2020, reports of violations of women’s rights and safety increased by 36%, not to mention the underreporting of the phenomenon of violence against women in the country [47]. It has also aggravated the attack on women’s sexual and reproductive rights in Brazil. In June 2020, the Women’s Health Coordination of the MS published a technical note with guidelines for ensuring access to sexual and reproductive health services during the pandemic [48]. A few days later, the note was suspended by the federal government and members of the technical team were dismissed. As a result, nearly half of the few legal abortion services suspended their activities. Moreover, in August 2020, the MS published ordinance 2282/20 [49], further restricting access to abortion for pregnancy resulting from rape, imposing on health professionals to notify the case to the police, regardless of woman’s will [48].

In the period 2009–2019, the maternal mortality ratio in the country presented a downward trend ranging from 72.4 per 100,000 live births to 57.9 per 100,000 live births. In 2020 and 2021 there were almost 2000 maternal deaths from COVID-19 alone, and an estimated increase in the maternal mortality ratio to 73.8 per 100,000 live births in 2020 and 107.8 per 100,000 live births in 2021 [50,51].

3.4.4. Fiscal policy

The COVID-19 pandemic exposed the country to unprecedented challenges regarding not only health but also the economy, reducing economic activity and income while unemployment increased. In Brazil, the fiscal package to deal with the COVID-19 pandemic was designed to protect household income and well-being, with economic policies intended to support companies (Table 1). The total cost of fiscal policies was around 12% of GDP in 2020, higher than Brazil’s neighbors (e.g. 6.5% in Argentina) but lower than some developed high-income countries (e.g., 20.9% in Japan) [52].

The Brazilian government conceived four programs to offer credit to Micro and Small Companies during the crisis, but their effectiveness has been limited [53]. Only a relatively small number of companies adopted government programs due to coordination and design difficulties. The number of requirements imposed by banks and the reluctance of companies themselves to choose the program that would best suit their needs are examples of those difficulties.

Two population-oriented programs, the BEm and AE program, had important effects on mitigating inequality and poverty during the pandemic, although their implementation was challenging. The government opened a website and an app for people to apply for the AE electronically. This channel option excluded millions of eligible Brazilians who lacked access to the internet and had to submit applications in person at overwhelmed locations with limited opening hours, producing long lines [54,55]. Data show that in July 2020 44.1% of Brazilians households received AE [56]. In 2019, the poverty rate was 18.7%, and during the pandemic, it dropped down to 16.1%. Without the programs, it would have increased to 29.8% [54]. Accordingly, in 2020 the Gini coefficient of income inequality decreased from 0.543 to 0.492 due to epidemic programs, a historical lower level, and would have rocketed to 0.596 without them [54].

However, there is no indication of the sustainability of these indices once the emergency measures are suspended. Given the current economic and labor market conditions, the tendency is for the beneficiaries of these specific programs to remain in a vulnerable situation without a new source of income to support them.

3.5. Limitations

A limitation of the study is that most of the results are based on a review of existing documents. Informal interviews, however, helped to identify institutional OH initiatives that can support further investigations.

4. Conclusion

The results of the present literature and document scan suggest that Brazil’s health system has some capacity to deal with emerging or re-emerging infectious diseases and for addressing zoonoses with a potential to utilize a OH approach. However, the equity and OH aspects are poorly represented in the official documents regarding COVID-19 response, at both the federal and state levels.

In short, Brazil has a state structure that allows for the response to infectious diseases, including zoonoses, as well as the fight against antimicrobial resistance through a OH approach. However, the response to the pandemic did not fully utilize the existing resources of the Brazilian state, due to the lack of central coordination and articulation between the sectors involved. The country’s response to COVID-19 was neither prompt nor equitable, in a context of historical and social inequalities. Formally adopting and strengthening a OH approach with associated legislative and regulatory change could contribute to preventing or reducing such social and health inequalities in the future.

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Author contributions

RL, AR, VGL, MDW conceptualized the project, RCM, SP, TN, SLSP, JCALS, MDW performed data collection and data analyses. All authors contributed to writing and revising the manuscript.

Ethics approval and consent to participate

Not applicable.

Availability of data and materials

All relevant data that support the findings of this study are within the manuscript.

Disclosure statement

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Appendix A. Supplementary data

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