



Water resources, public policies and the COVID-19 pandemic

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ABSTRACT

The novel coronavirus pandemic has resulted in global socioeconomic impacts; however, there is still a need to improve understanding and data about its form and patterns of propagation. Therefore, studies on the role of water resources and sanitation should be prioritized, given the potential to serve as a means of dispersing the SARS-CoV-2 virus, which causes COVID-19 disease. So far, the RNA of the transmitting virus has been detected in domestic sewage in several countries, but there is, so far, no evidence of contamination by direct contact with these effluents. Even so, poor regions without adequate treatment of water and sewage, as occur in Brazil, must act in order to develop efficient policies to improve water quality aimed at public health. One of the options is the formation of a Hub that aggregates the various interrelated aspects of water and sanitation into a cohesive and actionable whole. It is essential to combine investment, research, and monitoring of water and effluent quality to improve sanitary security, water quality and human health, with an emphasis on the poorest sectors. The Hub would also serve as a means of controlling and monitoring the dispersion of pathogens such as the SARS-CoV-2 virus, thus mitigating economic and societal impacts.

Keywords: integrating Hub, public health, wastewater treatment.

Recursos hídricos, políticas públicas e a pandemia de COVID-19

RESUMO

A nova pandemia do coronavírus resultou em impactos socioeconômicos globais; no entanto, ainda há necessidade de melhorar o entendimento e os dados sobre sua forma e padrões de propagação. Portanto, estudos sobre o papel dos recursos hídricos e do saneamento devem ser priorizados, dado o potencial de servir como meio de dispersão do vírus SARS-CoV-2, causador da doença COVID-19. Até o momento, o RNA do vírus transmissor já foi detectado em esgoto doméstico de vários países, mas não há, no entanto, evidências de contaminação pelo contato direto com esses efluentes. Mesmo assim, regiões pobres e sem tratamento adequado de água e esgoto, como ocorre no Brasil, devem atuar no sentido de desenvolver políticas



eficientes de melhoria da qualidade da água voltadas para a saúde pública. Uma das opções é a formação de um *Hub* que agregue os vários aspectos inter-relacionados de água e saneamento em um contexto coeso e ágil. É essencial combinar investimento, pesquisa e monitoramento da qualidade da água e dos efluentes para melhorar a segurança sanitária, a qualidade da água e a saúde humana, com ênfase nas áreas mais pobres. O *Hub* também serviria como meio de controlar e monitorar a dispersão de patógenos como o vírus SARS-CoV-2, mitigando assim impactos econômicos e sociais.

Palavras-chave: Hub integrador, saúde pública, tratamento de esgoto.

1. INTRODUCTION

The year 2020 was marked by the COVID-19 pandemic, which directly affected the economy, with travel restrictions, closure of cities and borders and the suspension of social and cultural economic activities. These actions resulted almost immediately in an economic recession in several countries, especially those that failed to contain the internal spread of the disease.

COVID-19 is a disease caused by SARS-CoV-2, which belongs to the family of *Coronaviridae* viruses, which is also composed of SARS-CoV, which caused the SARS outbreak in 2003, and the MERS-CoV which caused the outbreak of MERS in 2012. As the most recent strain of this family, SARS-CoV-2 became known as the Novel Coronavirus, capable of causing asymptomatic infections as well as severe respiratory conditions, with consequent death in severe cases. According to Decaro (2011), the main form of transmission of viruses in this family occurs through droplets of saliva, direct contact with contaminated objects or people, contact with aerosols and via the fecal-oral route. Particularly for SARS-CoV-2, Chen *et al.* (2020) state that there is the possibility of transmission occurring through feces, with its spread being increased by contaminated water.

The risks and cases of the transmission of pathogens by water is a well-known topic, and precisely for this reason it is extensively investigated and debated by researchers and public managers from different areas. However, it is worth noting that there is evidence that sewage and water treatment are effective in inactivating coronaviruses (USEPA, 2020a).

According to Cunliffe (2008), since the 70's there has been the emergence and reappearance of water-borne diseases, caused by several vectors, which represents a growing challenge to predict and minimize the impacts for public health and sanitation authorities. Thus, it is vital to monitor the quality of water resources, especially in relation to effluents, which can be a source of contamination for COVID-19. Hart and Halden (2020) highlight the epidemiological monitoring of SARS-CoV-2 in sewers as a tool of great potential due to its cost-benefit and robustness; however, this resource should not be used to replace clinical tests in infected individuals and/or suspected to be contaminated.

In this sense, the World Bank (2020) considers it essential that water, sanitation and hygiene (WaSH) services are managed safely, as a way of preventing and protecting human health during outbreaks of infectious diseases, including the current pandemic of Covid-19. Nevertheless, according to Lavezzo *et al.* (2020), even regions with a low level of hospitalizations due to COVID-19 must remain alert, since approximately 40% of the population is asymptomatic and have the same viral load and potential for infection as those with symptoms.

Based on this information, the objective of this text is to survey the potential contamination of SARS-CoV-2 in water resources and to analyze support systems for research and innovation, highlighting possible mitigations and public policies to be implemented in Brazil.

2. DISCUSSION

2.1. Risk of transmission and contagion of SARS-CoV-2 by water and sewage

While the main form of transmission of coronaviruses is not by water or contact with feces, during the SARS outbreak in 2003, aerosols from domestic effluents were considered as probable means of transmission (Jack, 2006). Yeo *et al.* (2020) and CDC (2020) infer that, despite the low risk, the similarities between SARS-CoV-2 and the SARS and MERS viruses do not rule out transmission and contamination through contact with excreta.

Some studies show the possibility of SARS-CoV-2 survival in feces. According to Wu *et al.* (2020), who analyzed 98 symptomatic hospital patients, on average, the feces incorporated shed virus cells for 27.9 days. However, Duan *et al.* (2003) identified that the SARS virus remains infectious in feces for 4 to 5 days at temperatures of 20°C, which corroborates the findings of Lai *et al.* (2005), who observed that this type of virus survives for 4 days at room temperature in diarrheal stools with alkaline pH.

In domestic sewage, the survival of these pathogens depends on several factors, according to Wang *et al.* (2005), who found that with favorable environmental conditions such as temperature and biofilms, viruses can remain active for up to 14 days. However, Gundy *et al.* (2009) observed that the presence of solvents and detergents in these effluents can damage the viral envelope, inactivating them quickly in between 2 to 4 days.

There is also evidence that sewage treatment technologies are effective in inactivating corona-type viruses. According to Casanova *et al.* (2009), after three weeks, rates above 99.99% are observed in the removal of these pathogens in sludge at room temperature (25°C). The authors pre-pasteurized the sludge, interrupting biological fermentation activity; when there was no pasteurization between 30-38°C, inactivation occurred more quickly. Kampf *et al.* (2020), studying the persistence on inanimate surfaces and the inactivation of the virus by biological agents, observed that high temperatures (between 30°C and 40°C) accelerate the inactivation of coronaviruses.

Studies have pointed out, according to WHO and Unicef (2020), that there is no risk of SARS-CoV-2 remaining in treated water and in groundwater, which supports the claim that there is a low risk of contagion in this way. Studies on the level of presence of Covid-19 in raw and treated sewage are ongoing, as mentioned above, with no evidence of transmission through this medium (WHO and UNICEF, 2020).

Thus, based on the available knowledge, the evidence is quite clear that sewage and water treatment techniques are efficient in inactivating coronaviruses, which provides a safety margin to infer that if the SARS-CoV-2 virus is present in sewage, the sewage treatment process, in particular sludge fermentation, can inactivate it almost completely. This possibly validates the recognition of several respected organizations, that until now there is no evidence or evidence of the presence of the virus in the drinking water supply (CDC, 2020; USEPA, 2020a; GLOBAL WATER RESEARCH COALITION, 2020; WHO and UNICEF, 2020).

Despite this, there is potential for contamination by direct contact with excreta, according to Xing *et al.* (2020), who found that SARS-CoV-2 may exist in the infant gastrointestinal tract for a longer period than the respiratory system, justifying greater attention in the management of solid and liquid waste from children's schools. In addition, Nghiem *et al.* (2020), Quilliam *et al.* (2020), University of Stirling (2020) and Yeo *et al.* (2020) warn that despite the low risk and probability of transmission, contamination by contact with faeces and poor sanitation conditions should not be ruled out, mainly due to the difficulty of obtaining this type of data and the lack of studies in this regard.

Most studies with consolidated data on fecal contamination of SARS-CoV-2 address hospitalized patients Ling *et al.* (2020), Xu *et al.* (2020), Wu *et al.* (2020), Wölfel *et al.* (2020) and Wan *et al.* (2020). Another point to be raised is the lack of data on the behavior of the virus

in asymptomatic people. Thus, Tang *et al.* (2020) studied the presence of the virus in the stool of only one asymptomatic child for 17 days, during 9 days of which the virus was detected. However, there are no data available to state what viral quantity of contaminated excreta would be needed to transmit the disease to other individuals (CDC, 2020). This corroborates concerns that water resources may act as potential sources of contamination.

Nghiem *et al.* (2020), highlights that the long half-life of the virus in materials such as garbage cans and sewage increases the risk of contamination and the potential for aerosol transmission from sewage treatment plants. Meng *et al.* (2020) parallels what happened in the SARS outbreak in Hong Kong, warning of the potential for SARS-CoV-2 contamination by discharge aerosols, specially in rural regions, which use inadequate toilet facilities and lacking of hygienic conditions.

Due to the risk of infection through exposure to domestic sewage, there are safety recommendations and standards for the protective equipment of professionals who work in these environments or who come into contact with domestic effluents or contaminated solid waste. Thus, manuals were prepared with recommendations for preventive and safety measures to be taken by Sewage Treatment Plant operators (Babiano, 2020; Nolasco, 2020).

2.2. Monitoring of viral levels in domestic effluents

Continuous and systematic research and monitoring of viral presence in domestic effluents make it possible to quantify the risk of contagion by direct contact or aerosols and to monitor the behavior and pattern of contamination of the population by SARS-CoV-2. Since testing across the population is a complex and expensive task, the epidemiological methodology for domestic effluents has been very successful in monitoring the hepatitis A virus, polio, Norovirus, and Rotavirus (Asghar *et al.*, 2014; Hellmér *et al.*, 2014; Santiso-Bellón *et al.*, 2020).

According to Lodder and Husman (2020) and Quilliam *et al.* (2020), the epidemiological monitoring of COVID-19 can be performed by monitoring enteric pathogens in domestic effluents. This is a fundamental action to assess the potential risk to public health, as well as a source of valuable data to assess and understand the circulation, behavior and contamination pattern of the virus, as this way it is possible to assess the general population and not only those who are hospitalized.

Daughton (2020) states that it is imperative to develop methods of sewage epidemiology as a form of mass surveillance and early warning, both for the current and future epidemics. Thus, governments should be aware of the vital role of this tool in controlling the dissemination of COVID-19 and therefore national agencies should encourage and allocate resources to enable this monitoring.

However, according to Mallapaty (2020), in order to be able to quantify the scale of infection in a population from domestic effluent samples, it is necessary to find out the amount of viral RNA excreted in the feces in order to extrapolate the number of people infected from viral RNA concentrations in wastewater samples for a given population. As we have seen before, although there are data on hospitalized contaminants, there are still no consolidated data on the viral amount excreted by asymptomatic people or those infected with mild symptoms.

Despite these limitations, there are interesting results of this monitoring in the current epidemic. In the Netherlands, Medema *et al.* (2020) found viral RNA in the city of Amersfoort before infections were reported in the community; and Mallapaty (2020) reports that traces of SARS-CoV-2 were detected in wastewater at Schiphol airport in Tilburg, just four days after the Netherlands confirmed its first case of COVID-19.

Randazzo *et al.* (2020) monitored epidemiological data on domestic sewage in the region of Murcia, Spain, and were able to detect the SARS-CoV-2 RNA from 12 to 16 days before

having confirmed cases in the municipalities of Lorca, Cieza and Totana. Würtzer *et al.* (2020) conducted the monitoring during the implementation of the lockdown in Paris and observed an increase in the RNA concentration of the virus approximately 8 days in advance of the contaminated peak; but despite the contaminated curve having decreased significantly, the viral RNA concentration had slightly decreased and remained stable, which can be explained by asymptomatic contaminants.

Studies involving the identification and potential of contamination can be improved with the development of computational models to improve the monitoring and detection of virus particles per unit in sewers (Casanova, 2009; Casanova and Weaver, 2015). Hart and Halden (2020) highlight the need and difficulty of obtaining information about the potential for contamination of the virus in sewers, due to the current temporary limitations of operation of the research laboratories and biosafety requirements above Level 2 to perform this type of test; they also emphasize that the virus inactivation and detection due to temperature should be better understood.

2.3. Monitoring and risks of contamination by water resources in Brazil

In Brazil, there are projects in progress to monitor the presence of the virus in domestic sewage. A pilot project is conducting “indirect testing” by inferring the number of infected people regionally, identifying symptomatic and asymptomatic hosts and reducing underreporting in the Belo Horizonte and Contagem region in Minas Gerais, three in the sub - Ribeirão Arrudas Basin and five in the Ribeirão do Onça Sub-basin (COPASA *et al.*, 2020a; 2020b). Unlike some foreign experiences, the results so far have not made it possible to provide early warning of contamination peaks, due to the low number of clinical tests. Even so, after 9 weeks of monitoring, the project was able to detect a significant increase in the viral RNA load, after easing the social distance measures in which the estimated number of contaminated people jumped from 20,000 people to 50,000 (COPASA *et al.*, 2020a; 2020c).

Although samples were not taken systematically as in Minas Gerais, the sewers of Florianópolis were also analyzed to detect the presence of the virus. According to Fongaro *et al.* (2020), from a total of 6 samples from the end of October 2019 until the beginning of March 2020, the SARS-CoV-2 virus was detected in a sample of 11/27/2019, 60 days before the first known case of the continent and 90 days before the first known case of the country.

The most recent initiative in Brazil is the SARS-CoV-2 Environmental Surveillance Project in the state of Rio Grande do Sul, which aims to analyze viral circulation and dynamics based on the occurrence and quantification of viral RNA in raw water and wastewater. In the second Monitoring Bulletin (CEVS-RS, 2020) virus was detected in 13 of the 42 samples collected (30.95%) in sewage treatment plants, hospital effluents, raw water collection points and highly impacted water bodies in the cities of Porto Alegre, Novo Hamburgo and São Leopoldo.

However, in Brazil, water and sewage services are not universalized, with large deficits in the collection and treatment of sewage, mainly in the North and Northeast regions and in rural areas (Santos and Kuwajima, 2018), which limits the effectiveness of these methodologies and epidemiological monitoring of domestic effluents. Another implication of the lack of sanitation is the increased risk of contagion and dissemination of pathogens that cause COVID-19, as the treatment of sewage helps in the prevention of disease and in the neutralization of the virus. According to Brasil (2019), in 2018 about 54.2% of the Brazilian population had sewage collection and only 46.3% of the generated sewage was treated (Table 1).

Where there is no regular supply of safe drinking water, there is an increased risk of contagion with COVID-19 and greater risk of death, where the most vulnerable populations live, with less financial resources and reduced access to adequate medical treatment. Sabastiani and Costa (2020) highlight that poorer populations tend to have a higher risk of malnutrition,

which can increase the contagion of infectious diseases in general, including COVID-19. Thus, collection, treatment and training is necessary for the effectiveness of sanitation and public health actions.

Table 1. Indexes of water and sewage services in municipalities participating in SNIS in 2018 - urban areas.

Macroregion	Network service index (%)		Treatment index of generated sewage (%)
	Water Supply	Sewage collection (Total)	
	(IN ₀₅₅)	(IN ₀₅₆)	(IN ₀₄₆)
North	57.1	10.5	21.7
North-east	74.2	28.0	36.2
South-east	91.0	79.2	50.1
South	90.2	45.2	45.4
Centre-west	89.0	52.9	53.9
Brazil	83.6	54.2	46.3

Source: Prepared by the authors with data from the SNIS Historical Series 2018, from Brazil (2019).

Finally, it is alarming that the federal government, despite all the contrary evidence, does not consider water, sewage collection, treatment and distribution as essential activities during the pandemic. Despite being included in the original list of Decree No. 10,282 / 2020 issued on 3/20/2020 (Brasil, 2020a), these activities were revoked about 1 month later by Decree No. 10,329 / 2020, issued on 4/28/2020 (Brasil, 2020b). This condition of a minor role for these provided services, combined with operational risks and contamination of operators and with the increase in default, imposes a risk of interruption of services to the most vulnerable part of the population, which may aggravate the contamination scenario.

With all that is known, the need to monitor water resources in Brazil must be highlighted, in order to contribute information on the level of infection of the population by the SARS-CoV-2 virus and other pathogens. In this way, the country will be able to develop appropriate public policies in the area of sanitation and health, capable of reducing inequalities and social injustices.

2.4. Public policies, Covid-19 and water resources: the research path

The protection of water resources, the treatment and adequate storage of water at all stages and the non-contact with sewage are the essential factors for protection against pathogens. However, in view of the series of other risks of water contamination making it unsuitable for its various uses, it is worth debating the financing of research on this topic as a central point within continental countries such as Brazil. Among the risks already investigated are, in addition to the set of pathogens, chemical substances and elements harmful to human health, life in water and food, including pesticides, hormones and various chemical residues. The Covid-19 pandemic demands attention and calls for new efforts from all. In this sense, the role of the State is essential in financing research and monitoring water resources, sewage and risk prevention.

The unfeasibility of financial returns from basic research and even links in the research and innovation chain in this area make public financing a priority. European Union countries and the United States have support systems for research and innovation in water resources that can indicate paths for the poorest nations, such as Brazil, in order to face and reduce risks.

Therefore, the challenge for governments is to allocate scarce resources with necessary management, planning and coordination, so that the search for answers is focused on priorities and makes use of knowledge networks and integrated research systems.

2.5. Support systems for research and innovation in water resources in the United States of America

The United States (USA) has about 20 federal agencies that fund research on water resources in several subthemes (NRC, 2004), with emphasis on the National Science Foundation (NSF), the United States Geological Survey (USGS) and Environmental Protection Agency (EPA). The water resources research structure was set up in the 1960s and 1970s, with changes and an increase in the budget since then. Still, the answers to questions such as those brought up with Covid-19 are not easy to obtain, requiring joint efforts and subsidies for research and measures that serve vulnerable communities (USEPA, 2020b).

Although there is a system to promote research and management of water in the United States, in several situations, support for research is fused with protection measures and environmental rules for access to water; it is a complex and robust system. This structure has allowed the set of federal programs to have a history of allocations in research with a regional focus, decentralized, and aimed at all states. At the time of the pandemic, new contributions are offered in both directions, as is the case with the promotion of care with Covid-19 for tribal populations (USEPA, 2020c).

In the USA, the traditional water research support system is structured in the states, in addition to the aforementioned federal agencies that finance the studies. There are 50 state research institutions (reaching the four districts), as provided for in The State Water Resources Research Act Program, that at the time of the pandemic are eligible for new research resources (USEPA, 2020c; NRC, 2004). The system was instituted in 1984 in the Water Resources Research Act, which structures the model based on cooperation between federal agencies and state water resources research institutes or centers for planning, promoting and transferring technologies, training, competitiveness in use water supply and subsidies, among others. Regional research coordination is the responsibility of the institutes or centers, with annual subsidies, in addition to contributions for specific topics. There is also the possibility of forming a Hub involving several development agencies, research institutes, universities and the private sector, when there is a technological bottleneck to be overcome.

2.6. Support systems for research and innovation in water resources in the European Union

The European Union (EU) has shown considerable advances in the standardization of uses, protection and support for research on water resources. In addition to the laws of the countries, the European Union, through the 2012 European Commission Communication nr. 673 to the European Parliament, deals with “point and diffuse sources of chemical or other pollution of the aquatic environment through various legislative instruments” (EC, 2012). Among the indicative measures are the Directives for: Urban Wastewater Treatment (DTARU), Nitrates (DN), Plant Protection Products (DPF), Industrial Emissions (IPPC-DEI), Floods. Together, they aim to protect health, human life and water resources from pollution by nutrients and / or other chemicals in agriculture, housing and industry. The EU document indicates progress and limitations, such as non-compliance with part of the norms or ignorance of the chemical status of 40% of its waters and risks of eutrophication in 30% of the freshwater body in 17 countries in the bloc, due to the increase in nutrient load.

In the EU, actions such as sustainable infrastructure (green) in sanitation works, fighting drought and water reuse in cities are indicated. The focus on post-Covid-19 pathogens has evolved, to include restructuring support for research and drawing attention to the water-health-life focus in the first place, as does the Institut Pasteur (Paris) and the Institut Pasteur

International Network¹.

Legislation on chemicals, plant protection products and biocides tends to be more restrictive from marketing authorization to the way of use, disposal and monitoring, in line with the Sustainable Development Goals.

European experience in management and research initiatives, for example the Knowledge Hub and Research Hub, can be avenues to support studies on ecosystems, demand water pollution, governance and integrated uses, as well as monitoring Covid-19 in sewers and in water. In addition to large independent national institutes, the platform for the dissemination of initiatives, lines of research, consultancy, and the dissemination of standards, among other actions, is facilitated in the European system by the Joint Research Center (JRC), an initiative linked to the European Commission that fosters science in several areas. The theme of water is very prominent, as noted on the JRC website².

2.7. Support systems for research and innovation in water resources in Brazil

Brazil has faced difficulties in carrying out research, as well as in providing water and sewage services. Santos (2012) analyzed contributions from the Sectorial Fund for Technological Innovation in Water Resources (CT-Hidro), the main source of public funds from the federal government for scientific research on water in Brazil, pointing to discontinuity of supported lines, the low rate of disbursement of resources contractors and an incipient chain generating knowledge and innovations. As one of the components of the National Fund for Scientific and Technological Development (FNDCT), the main source of funds for CT-Hidro is the collection for Financial Compensation for the use of Water Resources (CFUR), paid by the hydroelectric sector (Law 9.648 / 1998, amended by Law 1.3661 / 2018), which has generated annual revenue close to R \$ 100 million.

Managers and members of the CT Hidro Sectorial Fund, of the then Ministry of Science and Technology (MCT) interviewed by Santos (2012) have already indicated the need to increase the research capacity on persistent organic pollutants (POPs) and viruses in water. Budget execution data from CT-Hidro show that in 2015 the approved budget was only R \$ 17.7 million, with execution below R \$ 4 million, the same amount budgeted for the following year. Thereafter, the CT-Hidro Fund ran out of new projects, the last public call for MCTI / FINEP CT-Hidro taking place in 2013.

Specifically, for sanitation, the resources for research are currently restricted to applied and decentralized themes (such as losses and energy efficiency, from the Ministry of Regional Development), sporadic initiatives by the National Water Agency and allocations from the productive sector (water supply and sanitation services utilities). The Basic Sanitation Research Program (Prosab), a joint initiative by government agencies and universities that had calls from 1983 to 2010, this being the last major initiative in this area in Brazil. Operated by Caixa Econômica, Finep and CNPq, in addition to BNDES, Abes, association of municipalities and CT-Hidro in different years, the studies of Prosab covered important contributions in water and sanitation, including on pathogens and types of waterborne disease transmission.

Currently, initiatives of this nature and new financing are again essential, mainly due to the lack of sanitation in some regions of Brazil. This is justified, because research on sewage indicates an incidence of the new coronavirus in between 72% and 100% of the samples collected (COPASA *et al.*, 2020a), requiring greater monitoring in places of greater social vulnerability. Further studies are necessary in order to cover the analysis of open sewers, with possible ways of transmitting pathogens such as Coronavirus, including in water systems

¹List of themes and projects available at: <https://www.pasteur.fr/en/all-covid-19-institut-pasteur/research-projects/coronavirus-covid-19-research-projects>

²More information and publications available at: <https://ec.europa.eu/jrc/en/research-topic/water>.

without the necessary treatment processes and without necessary chemical products.

Therefore, the participation of the State to guarantee the financing and continuity of research actions is essential, in order to include studies on unresolved issues such as impacts of the discharge of sewage by the productive sector (mining, diverse industries and agriculture), in addition to human action and domestic sewage. The certainty of water-use best practices and integrated and participative management are the way to reduce future expenses of liabilities that continue to be generated daily.

3. FINAL REMARKS

The full extent of the impact of COVID-19 is as yet immeasurable, but the need to move forward with research involving water resources and better water treatment and distribution is already clear. Even though mass contamination by SARS-CoV-2 through water has not yet been confirmed, there must be an efficient effluent treatment policy that allows for the monitoring of effluents and the quality of water bodies to prevent and reduce the spread of both new and existing pathogens.

COVID-19 showed that there is a great need to improve the management of water resources and access to clean water in regions with vulnerable populations that do not have access to water supply and sewage collection services, as is common in many areas of Brazil. These populations are exposed to various pathogens and can be more easily contaminated due to the lack of infrastructure that guarantees basic hygienic conditions.

As these are the poorest regions, their inhabitants often do not have private health plans; they have more health problems due to an unbalanced diet and they may have more risk factors due to the lack of periodic monitoring by doctors. Thus, prioritizing resources to solve water and sewage problems is to invest directly in the quality of life and health of this population.

All aspects covered in this text are premised on the existence of research and data production on a continuous basis, which, in turn, is only possible with adequate, predictable financing. Thus, a public policy option for Brazil, which encompasses this moment when Covid-19 generates uncertainty, causes hundred thousand deaths in the country and impacts on the economy, is the formation of a Hub that aggregates the various interrelated aspects of water and sanitation into a cohesive and actionable whole.

Thus, we consider that the idea, though not necessarily the models of Science Hub and Water Hub of the European Union and the United States, can be replicated with adaptations for countries like Brazil. In fact, there are clear possibilities for this to be done through partnerships between governments, academia and companies, in order to make financing for studies feasible. To this end, it is important to adopt the understanding that actions cannot be promoted only on specific issues, such as Covid-19, but as a robust management, governance and research model that has guaranteed budget and independent agenda.

The focus should be on reaching those lacking assistance from sanitation systems, as these are the most vulnerable, and therefore lives and financial resources are spared with such a focus. This may arise from an initiative of the Ministry of Science, Technology and Innovation (MCTI) and the Ministry of Health (MS), under the execution of CT-Hidro and CT-Saúde, supported by CNPq and Finep.

In the future, the support of the Technical Chambers of the National Water Resources Council (CNRH) and its leadership will be essential to coordinate actions in the states and the Federal District. This configuration enables long-term actions, aligning planning with research, integrated management and a robust cooperative system. Legislation allows for such a design and the resources already exist, and should be allocated as established and complemented through partnerships and cooperative agreements.

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