

# Environmental health surveillance as a response to the tailing dam disruption disaster in Brumadinho

## *A vigilância em saúde ambiental como resposta ao desastre do rompimento da barragem de rejeitos em Brumadinho*

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**ABSTRACT** Environmental health is the field of public health responsible for public policies related to the interaction between human health and environmental factors. Disaster risk management involves a process of anticipating, planning, and preparing for a response, with actions from different areas of the government, such as the health sector. This experience report had the objective of describing the actions developed by the environmental health surveillance of the Minas Gerais State Department of Health in response to the rupture of the B1 dam in Brumadinho. Among the actions developed, the monitoring of the quality of water for human consumption in the affected municipalities, the participation in meetings in spaces for decision and deliberation, and the production of technical documents are highlighted. The experiences lived by the team, during the disaster response actions, motivated reflections on the need to strengthen the development of the actions in an intra and intersectoral way, as well as the importance of qualifying the data recorded in the information systems, and knowledge of the local information of each territory, in order to subsidize the performance of the health sector in a timely manner in disaster situations.

**KEYWORDS** Public health surveillance. Man-made disasters. Environmental health.

**RESUMO** A saúde ambiental se constitui o campo da saúde pública responsável pelas políticas públicas relacionadas com a interação entre a saúde humana e os fatores do meio ambiente. A gestão de risco de desastres envolve um processo de antecipação, planejamento e preparação para resposta, com atuação de diferentes áreas de governo, como o setor saúde. Este relato de experiência teve o objetivo de descrever as ações desenvolvidas pela vigilância em saúde ambiental da Secretaria de Estado de Saúde de Minas Gerais em resposta ao rompimento da barragem B1 em Brumadinho. Entre as ações desenvolvidas, destacam-se o monitoramento da qualidade da água para consumo humano nos municípios atingidos, a participação em reuniões em espaços de decisão e deliberação e a produção de documentos técnicos. As experiências vivenciadas pela equipe, durante as ações de resposta ao desastre, motivaram reflexões sobre a necessidade de fortalecer o desenvolvimento das ações de forma intra e intersectorial e a importância de qualificação dos dados registrados nos sistemas de informação e de conhecimento das informações locais de cada território, a fim de subsidiar a atuação do setor saúde de modo oportuno em situações de desastre.

**PALAVRAS-CHAVE** Vigilância em saúde pública. Desastres provocados pelo homem. Saúde ambiental.

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## Introduction

Based on the debates that took place at the 8th National Health Conference (1986), the expanded concept of health was adopted, which defines it as the result of a set of conditions, among them, the environment. Health surveillance is considered to be one of the essential functions of public health, as provided by the Unified Health System (SUS) in the Federal Constitution of 1988 and in Law nº 8.080 of 1990, responsible for informing action and intervention that reduce risks and promote health in the territories, considering the complex economic, environmental, social and biological phenomena that determine the level and quality of the population's health. Law nº 8.080/1990 also reaffirms the relationship between health and the environment, since it establishes that the environment and basic sanitation are determining and conditioning factors of health, including as one of the fields of action of SUS, collaboration in the protection of the environment, as well as the control of water for human consumption and of toxic and radioactive substances<sup>1</sup>.

Environmental health surveillance is defined as one,

[...] set of actions and services that provide knowledge and the detection of changes in the determining and conditioning factors of the environment that interfere in human health, in order to identify, recommend and adopt measures to promote environmental health, prevention and control of risk factors related to diseases or other health problems<sup>2(45)</sup>.

According to Normative Instruction 01/SVS, of March 7, 2005, among the factors, water for human consumption, natural disasters and accidents with dangerous products stand out<sup>2</sup>. Thus, environmental health is the public health field responsible for public policies related to the interaction

between human health and environmental, anthropic and/or natural factors<sup>2</sup>.

Disaster risk management involves a process of anticipation, planning and preparation for response, with the participation of different sectors and spheres of government at the municipal, state and federal levels, as well as organized society and susceptible communities. The health sector has great responsibility in this process, since the impacts of disasters result in direct short, medium and long term and indirect effects on the population's health<sup>3</sup>.

The occurrence of technological disasters, caused by the intervention of man in nature and by technological development, has gained prominence in Brazil, in recent years, due to its magnitude. As examples, the mining dams in Minas Gerais that occurred in 2015 in Mariana and 2019 in Brumadinho stand out. These disasters are characterized as emergency situations in public health and have major impacts that go beyond the municipalities of occurrence, including environmental impacts with emphasis on contamination of water sources, degradation of the quality of raw water and, consequently, of the quality of water for human consumption that can occur in the long term, that is, beyond the immediate post-disaster period. In addition, they generate an abrupt change in the social organization and in the ways of living and working historically constituted in the territories, with effects on the health of the population<sup>4</sup>.

Therefore, there is a great interface between the actions developed by the Environmental Health Surveillance of risks associated with disasters (Vigidesastres) and the actions of the National Water Quality Surveillance Program for Human Consumption (Vigiagua).

Thus, this experience report aims to describe the actions developed by the environmental health surveillance of the State Health Department of Minas Gerais (SES-MG) in response to the rupture of the B1 dam in Brumadinho.

## Material and methods

This study consists of the description of the main actions developed within the scope of SES-MG by the team of the Coordination of Non-Biological Risk Factors (CVFRNB), structured in five major axes.

The first presents a brief characterization of the disaster and the hydrous body affected. The second refers to the characterization of environmental surveillance at SES-MG according to the organic structure, team composition and activities developed. The third describes monitoring the quality of water for human consumption. The fourth consists of information about meetings in decision and deliberation spaces in which the CVFRNB team participated. The fifth mentions the technical documents produced to guide the Regional Health Units and other actors involved in the activities.

It is expected that the experience of

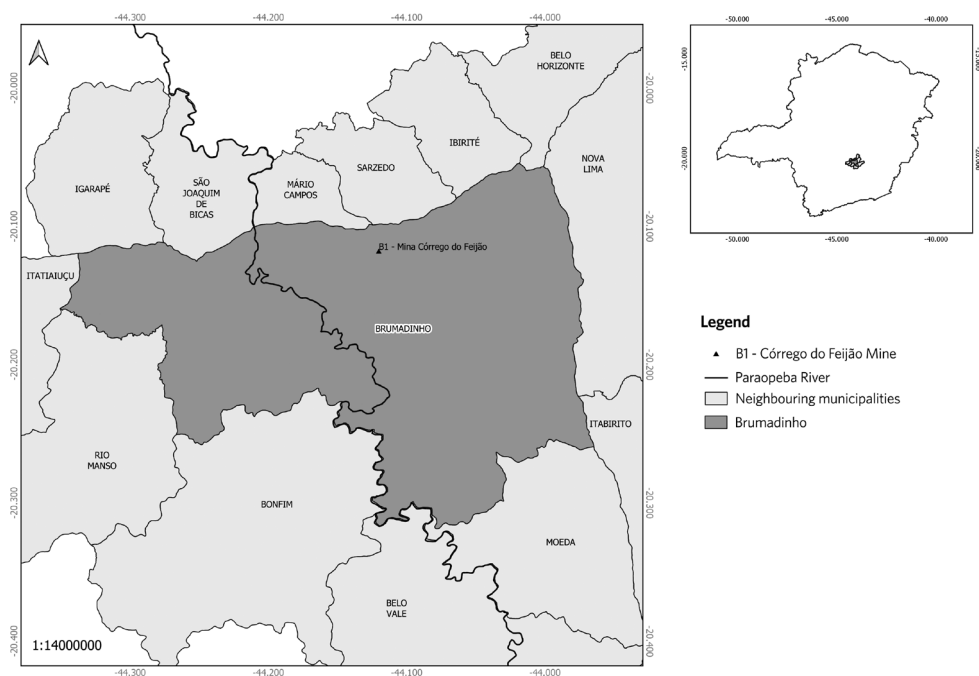
environmental health surveillance in the state of Minas Gerais will contribute to subsidize the actions of other states and municipalities in situations of environmental disasters.

## Characterization of the disaster and the scenario reached

The B1 mining tailings dam of the Córrego do Feijão Mine Complex was located in the municipality of Brumadinho, in the Metropolitan Region of Belo Horizonte, between coordinates 20° 07' 07" "S and 44° 07' 13" W, occupying a total area of approximately 27 hectares, 87 meters high.

The municipality of Brumadinho is located approximately 19 km from Belo Horizonte and has neighboring municipalities: Igarapé, São Joaquim de Bicas, Mário Campos, Sarzedo, Ibirité, Belo Horizonte, Nova Lima, Itabirito, Coin, Belo Vale, Bonfim, Rio Manso and Itatiaiuçu (*figure 1*).

Figure 1. Map of Brumadinho and neighboring municipalities, Minas Gerais



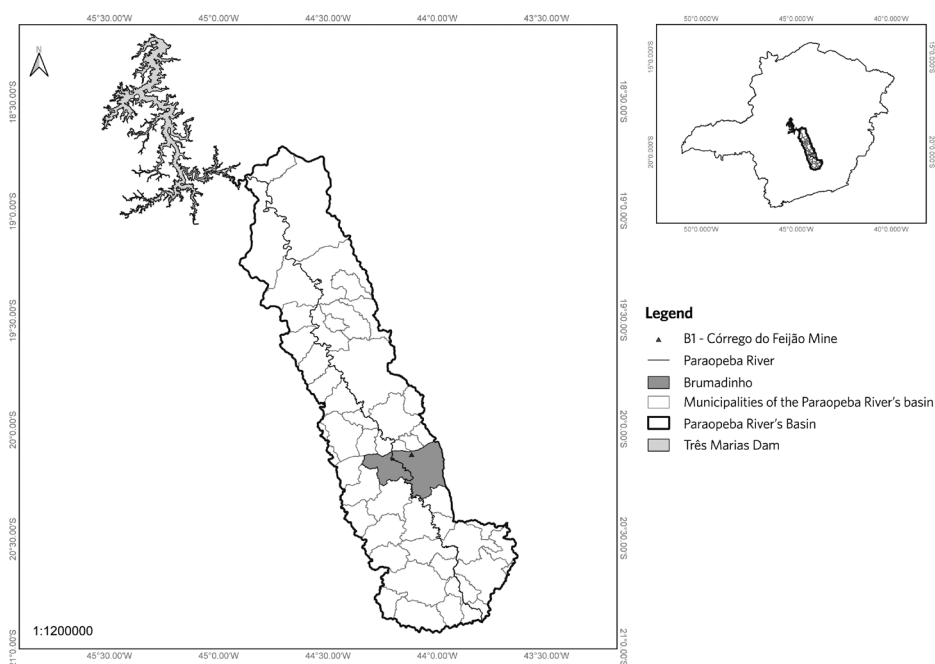
Source: Brazilian Institute of Geography and Statistics. State System of Environment and Water Resources<sup>5,6</sup>.

The access to the B1 dam can be made through the BR-381, BR-262 and the MG-040 highway. Subsequently to these highways, access is via the Alberto Flores and José Ribeiro Filho roads.

According to the Water Management Institute of Minas Gerais (Igam), the B1 dam is located in the São Francisco River Hydrographic Region, in the Ferro-Carvão stream basin, an

affluent of the Paraopeba River. The Paraopeba River Basin has the Paraopeba River as its main body of water, which is one of the main tributaries of the São Francisco River, its source located in the municipality of Cristiano Ottoni, and its mouth, in the Três Marias dam. The territory bounded by the basin is occupied by 48 municipalities, 35 of which have urban headquarters at the limit of the hydrographic basin<sup>7</sup>.

Figure 2. Paraopeba River Hydrographic Sub-basin, Minas Gerais, 2019



Source: Brazilian Institute of Geography and Statistics. State System of Environment and Water Resources<sup>5,6</sup>.

It is noteworthy that the Paraopeba River Basin plays a significant role in supplying water for human consumption in the Metropolitan Region of Belo Horizonte, with three of its tributaries having reservoirs used for this supply: Manso River (Manso), ribeirão Juatuba (Serra Azul) and Betim River (Várzea das Flores)<sup>8</sup>.

According to information from the Mineral Resources Research Company (CPMR – Geological Survey of Brazil), the main uses

found in the Paraopeba River basin are related to mining, industrial, irrigation, urban and rural supply and energy generation activities<sup>9</sup>.

The Córrego do Feijão Mine Complex is located in the Iron Quadrangle, a region that represents an area of about 7 thousand km<sup>2</sup> that has great economic importance for the state, due to large reserves of Iron and Gold.

On January 25, 2019, between 12:25 pm and 1:00 pm, there was the rupture of the B1 dam at the Córrego Feijão Mine Complex, belonging

to Mineradora Vale/S.A. in the municipality of Brumadinho. About 12 million cubic meters of tailings from mineral production were released, spreading a thick mass of tailings, which generated human and material losses<sup>10</sup>. According to information from the Civil Defense of Minas Gerais, on July 4, 2019, among the people directly affected by the disaster, there were 395 located, 23 missing and 247 deaths<sup>11</sup>.

The plant facilities, the loading terminal, the maintenance workshops and the administrative buildings of the Córrego de Feijão mine were affected, as well as blockages in the road access from the mine to the Córrego do Feijão village and access from the gatehouse to the interchange Alberto Flores. It can be considered that the entire municipality was affected, since there was a restriction of access routes, overload in transport and traffic in the city, in health care, alteration of the calendar of some educational institutions, lack of water and electric power due to short periods at some points, increased flow of people<sup>10</sup>.

The tailings plume reached the Ferro-Carvão stream, until it flowed into the Paraopeba River, went until the Retiro Baixo Hydroelectric Power Plant, located in the municipality of Pompéu, where it has been retained until now, as monitored by Igam<sup>12</sup>. Along the stretch of the Paraopeba river reached by the tailings, there are 20 municipalities, belonging to the Belo Horizonte, Divinópolis and Sete Lagoas Regional Health Units. It is noteworthy that three of these municipalities (Belo Horizonte, Pará de Minas and Paraopeba) were partially or totally supplied by the waters of the Paraopeba River, and interrupted the collection activities soon after the event occurred.

### **Characterization of environmental surveillance in the State Health Department of Minas Gerais**

At SES-MG, according to Decree nº 45.812, of December 14, 2011, CVFRNB is linked to

the Board of Environmental Surveillance – Superintendence of Epidemiological, Environmental and Occupational Health Surveillance – Undersecretary for Surveillance and Health Protection. In 2019, the coordination team presents a multidisciplinary structure, formed by professionals in the areas of geology, geography, environmental management, chemistry, nursing and speech therapy<sup>13</sup>.

CVFRNB aims at the knowledge and the detection or prevention of any change in the determining and conditioning factors of the environment that interfere in human health through environmental health surveillance activities related to water for human consumption, air, soil and environmental contaminants of importance and repercussion for public health, as well as the risks arising from natural disasters, accidents with dangerous products and other events capable of causing diseases and harms to human health. The actions are developed with the purpose of recommending and adopting measures to promote environmental health, prevention and control of risk factors related to diseases and other health problems.

The activities are carried out with dialogue and support to the 28 Regional Health Units defined by Resolution SES nº 0811, of December 30, 2005, and have an intra and intersectoral interface related to the state surveillance programs on non-biological risk factors of surveillance in environmental health<sup>14</sup>.

Among the main bodies where there is an interface, the following stand out: the State Secretariat for the Environment and Sustainable Development (Semad) and its related bodies (Water Management Institute of Minas Gerais, State Environment Foundation); the State Civil Defense Coordination; the Regulatory Agency for Water Supply and Sanitary Sewer Services of the state of Minas Gerais; the Sanitation Company of Minas Gerais (Copasa); the Integrated Sanitation North and Northeast of

Minas Gerais S/A (Copanor) and other autonomous water and sewage concessionaires; in addition to bodies related to sanitation policy, such as the State Secretariat for Development and Integration of the North and Northeast of Minas Gerais; the State Secretariat for Planning and Management and the Cities and Regional Integration Secretariat.

#### **WATER QUALITY MONITORING FOR HUMAN CONSUMPTION**

In response to the rupture of the B1 dam, in order to assess the impact of the tailings plume, considering the risk associated with the mobilization and transport of contaminants from the tailings to the underground spring, the SUS started monitoring water for consumption of alternative underground solutions in the municipalities that are bathed by the Paraopeba river after the confluence with the Ferro-Carvão stream up to the municipality of Três Marias.

According to the 'Guidelines for prioritizing areas with populations at risk of exposure to chemical contaminants', the distance of the population in relation to the contaminated area in meters is one of the parameters used to identify areas with exposed or potentially exposed populations, from 1 to 15 points, per category, for distances up to a thousand meters. For this monitoring, which aims to verify the quality of the water used for human consumption, collective and individual alternative solutions were identified, which capture from underground sources, located up to 100 meters from the banks of the Paraopeba River, affected by the tailings from the breach. This

distance was established in a joint discussion between the SES-MG team and the Ministry of Health team considering the characteristics of low mobility of the possible contaminants present in the tailings.

Health professionals from Fortuna de Minas, Igarapé, Maravilhas and Pequi did not identify forms of supply that met these criteria; therefore, these municipalities were not included in the monitoring.

The planning of the sampling procedures for the points for monitoring the quality of water for human consumption was carried out considering the following criteria: the representativeness of the sampled place in the extension of the water course; the logistics of access to the localities, since they are mostly distant, with demographic spacing and rare and deficient road networks; the available resources, as professionals in the scope of the health sector, mainly from the municipalities, for identification and selection of the sampled points, conducting the collections, handling, conditioning and transporting the samples.

Initially, monitoring was carried out in the collective underground alternative solutions registered by the Municipal Health Department of Brumadinho. Concomitantly, surveys and characterization of communities and respective populations were carried out in the other affected municipalities whose collective and individual alternative solutions for water supply for human consumption present their abstractions located at a distance of up to 100 meters from the banks of the Paraopeba River. This information was used to support the sampling of points and the elaboration of the monitoring plan (*table 1*).



Table 1. Information from the water quality monitoring plan for human consumption in response to the rupture of the B1 dam in Brumadinho by municipality, Minas Gerais, 2019

Municipality	Starting date of collection	Points included in the initial monitoring	Current sampling plan points*	Amount of campaigns*	Quantitative of samples collected*
Betim	03/28/19	7	7	17	108
Brumadinho	01/29/19	13	4	40	180
Curvelo	03/13/19	5	5	19	82
Esmeraldas	02/21/19	13	9	22	180
Felixlândia	03/14/19	6	5	19	68
Florestal	03/28/19	7	5	17	90
Juatuba	02/22/19	5	5	22	104
Mario Campos	03/28/19	11	5	17	59
Morada Nova de Minas	03/14/19	5	5	19	80
Papagaios	03/14/19	5	5	19	90
Pará de Minas	03/14/19	18	6	18	89
Paraopeba	02/28/19	4	3	21	51
Pompéu	03/14/19	4	3	19	40
São Joaquim de Bicas	03/28/19	11	8	17	100
São José da Varginha	03/14/19	14	10	18	168
Três Marias	03/14/19	6	6	19	104
Total	-	134	91	323	1593

Source: Own elaboration.

\*Information regarding 10/30/2019.

The frequency adopted in this monitoring to assess the risks arising from the rupture of the B1 dam in Brumadinho is higher than that established for routine actions, since, in emergency situations in public health, the monitoring of water quality can be expanded emergency; and new parameters or specific agents, even if they do not make up the current potability standard, can be analyzed in order to identify their presence in water<sup>15</sup>.

The collection of water samples for this monitoring is carried out by SUS health professionals, technical references from the Regional Health Units (Belo Horizonte, Divinópolis and Sete Lagoas) and technical references of environmental health surveillance in the municipalities. The collections began on January 29, 2019 in Brumadinho and were sent for analysis by the Central

Public Health Laboratory of the Ezequiel Dias Foundation (Funed). In addition, as of February 21, 2019, a laboratory was contracted by Vale S.A., in compliance with the decision of the Federal Court after an audience with representatives of the Attorney General's Office and the Ministry of Health, to carry out analyzes of the other affected municipalities, including some points of Brumadinho's sampling plan.

At the beginning of the monitoring, the frequency of collections in each form of supply was weekly; and, as of April, collections started to be carried out every 15 days (*table 1*).

The sampling plan is constantly reassessed by health surveillance teams, with the necessary adjustments being made during the execution of activities. There was the

inclusion of points identified after the start of the monitoring that also fit the previously defined technical criteria. Points that did not meet the criteria were excluded, such as distance greater than 100 meters from the riverbank after geoprocessing conference. In addition, complications were recorded that motivated the exchange of points or that made collection impossible on specific dates, such as refusals by residents to receive health technicians at the time of collection, wells that dried up due to the drought period, and failures in operation of the well pump (*table 1*).

*Chart 1* shows the parameters analyzed in each sample and the respective Maximum Allowable Values (VMP), established in annex XX of Consolidation Ordinance n° 5, of September 28, 2017 (*chart 1*). It is noteworthy that these parameters and VMP are part of the potability standard and, by definition, must be observed in water for human consumption<sup>16</sup>. Although the collections were carried out in wells, it is recognized that almost all of them are used for human consumption without treatment, therefore, the results obtained were compared with the potability standard.

Chart 1. Parameters analyzed in the water quality monitoring plan for human consumption in response to the rupture of the B1 dam in Brumadinho and reference values

Parameter	Unity	Maximum Permitted Value
Total Aluminum	mg Al/L	0.2
Total Antimony	mg/L	0.005
Total Arsenic	mg/L	0.01
Total Barium	mg Ba/L	0.7
Total Cadmium	mg Cd/L	0.005
Total Lead	mg Pb/L	0.01
Total Copper	mg Cu/L	2
Total Coliforms (Qualitative)	-	Absent
Apparent Color	mg Pt/L	15
Total Chrome	mg Cr/L	0.05
Escherichia coli (Qualitative)	-	Absent
Total Iron	mg Fe/L	0.3
Total Manganese	mg Mn/L	0.1
Total Mercury	mg/L	0.001
Total Nickel	mg Ni/L	0.07
pH	-	6-9.5
pH In Situ	-	6-9.0
Total Selenium	mg/L	0.01
Sample Temperature	°C	-
Air Temperature	°C	-
Turbidity	NTU	5
Total Zinc	mg Zn/L	5

Source: Annex XX of Consolidation Ordinance n° 5, of September 28, 2017<sup>16</sup>.



The results are reported, by the Municipal Health Secretariats, directly to the owner of the locality who had his/her form of water supply for human consumption monitored. The families are guided by the health teams, with support from the Water Quality Surveillance team for Human Consumption, which, regardless of the results of the analyzes (satisfactory or unsatisfactory), the initial precautionary measure to suspend the use of the water in the solutions remains individual and collective alternatives (wells and cisterns) for human consumption located in the defined risk area (up to 100 meters from the river bank) according to joint recommendations by the State Department of Health; from Semad; and the State Secretariat of Agriculture, Livestock and Supply (Seapa)<sup>17</sup>.

Based on the results of the monitoring, it is intended to verify the quality of the water used for human consumption, with the objective of characterizing these forms of supply and assessing health risks, subsidizing the adoption of preventive and health promotion measures. A technical meeting was held with the Regional Health Units of Belo Horizonte, Divinópolis and Sete Lagoas to characterize the monitoring and alignment points for discussion with the Ministry of Health team on the measures that should be adopted according to the identified scenarios, considering the results of the first quarter of monitoring. In addition, in January 2020, SES-MG published the Information Bulletin – Monitoring of water quality for human consumption in the municipalities affected by the Vale/S.A. disaster, municipality of Brumadinho, Minas Gerais, with analysis of the results to inform the population on the quality of water for human consumption of the forms of supply monitored. The results of this monitoring of the quality of water for human consumption were also presented by the Ministry of Health, in the special edition of January 2020, in the epidemiological bulletin – One year of Vale's disaster – Organization and Response of the Ministry of Health.

This experience report extends from the date of the disaster to October 30, 2019. It should be noted that, in March 2020, monitoring is ongoing with a fortnightly frequency and will be carried out until the set of results can subsidize the decision of its interruption.

Due to the possibility of transporting metals to the groundwater, mainly during the rainy season, the monitoring of the forms of supply continues, as well as the periodic evaluation of their results to assist in the decision making of the health sector.

From the analysis of the historical series and depending on the results identified in the samples collected, some forms of supply may be used again for human consumption without risk to health, while others must undergo an appropriate treatment process to offer safe water.

### **Participation in spaces for deliberation and decision**

To subsidize decision-making and deliberations aiming at an immediate response to the rupture of the B1 dam, of the Vale's Córrego do Feijão mine in Brumadinho, on January 25, 2019, the Command Post was established in the municipality of the occurrence, coordinated by the State Civil Defense Coordination of Minas Gerais (Cedec/MG), with the participation of bodies and agencies involved in disaster response actions, including SES-MG.

Concomitantly, the Health Emergency Operations Center (Coes) of SES-MG was activated on January 25, 2019, which integrated the essential areas for response and emergency: Undersecretary for Health Policies and Actions; Undersecretary for Regulation of Access to Health Services and Supplies; Secretariat for Health Surveillance and Protection; Undersecretary for Innovation and Logistics in Health and Undersecretary for Regional Management. The active participation of representatives of the technical areas in these spaces contributed to the decision making taking place in a more agile and efficient way.

Initially, the meetings were daily; and, depending on demand, the frequency was reduced until it was deactivated. Within the scope of the Ministry of Health and the Municipal Health Secretariat, Coes was also activated. It is noteworthy that there was daily communication between the committees, with an update on the emergency situation, identification of demands and progress of actions identified as necessary.

In parallel to these spaces, technical meetings were held between the State Health Departments, Semad and Seapa, the Water Management Institute of Minas Gerais and Copasa, in order to evaluate the actions that should be taken in relation to possible contamination of the Paraopeba River, implications for its multiple uses, such as human consumption, irrigation and animal feed, in addition to evaluating the data that were being obtained in monitoring water quality.

On February 26, 2019, through the Decree with special numbering 176, the Pro-Brumadinho Management Committee was created, which brings together various government agencies of the state of Minas Gerais and aims to coordinate the actions of recovery, mitigation and compensation for damage caused by the rupture of Vale's B1 dam. This structure ensures the effective sharing of information on the actions under development and promotes synergy between the bodies involved<sup>18</sup>.

## Document production

As a way to subsidize the performance of health professionals from Regional Health Units and Municipal Health Secretariats of the municipalities affected by the break of the B1 dam in Brumadinho and to establish guidelines for repair actions developed by Vale S.A., forms, technical documents were prepared and information notes described below:

1. Minimum bases: guidelines for the supply of water for human consumption to population groups in the municipalities affected by the rupture of the B1 dam of the Córrego do Feijão Mine, by Vale S.A., in Brumadinho, on January 25, 2019.
2. Technical Note nº 3/SES/SUBVPS-SVEAST-DVA-CVFRNB/2019: emergency plan for monitoring the quality of water for human consumption for the municipalities affected by the rupture of the B1 dam of the Córrego do Feijão Mine, by Vale S.A., in Brumadinho, on January 25, 2019.
3. Technical Note nº 4/SES/SUBVPS-SVEAST-DVA-CVFRNB/2019: approach with families for risk assessment of the forms of water supply for human consumption near the Paraopeba River, area affected by the rupture of the dam of the Córrego do Feijão Mine, by Vale S.A. in Brumadinho.
4. Form to identify water consumption in the municipalities affected by the rupture of the B1 dam of the Córrego do Feijão mine, by Vale S.A., in Brumadinho, on January 25, 2019.
5. Standardized spreadsheet to consolidate the survey of nearby forms of supply up to 100 meters from the Paraopeba River in the municipalities downstream of the point of confluence between the tailings and the Paraopeba River.
6. Letter to providers of water supply for human consumption (Copasa, Copanor), requesting weekly sending of analysis reports from the point of capture on the Paraopeba River downstream from the point of confluence with the Ferro-Carvão stream.
7. Informative notes for the population and the press with guidance on necessary care with the mud and tailings from the rupture of the Brumadinho dam, published on the website: <http://www.saude.mg.gov.br/brumadinho>.

8. SES/Semad/Seapa joint information notes for the population and printed with guidelines on necessary care with the Paraopeba river water, published on the website: <http://www.saude.mg.gov.br/brumadinho>.
9. Joint technical note SES/Igam nº 1 for the analysis of the water quality of the Paraopeba river downstream of the B1 dam after the rupture of the B1 dam operated by mining company Vale.
10. Joint technical note SES/Igam nº 2 for the analysis of the water quality of the Paraopeba River after disaster at the B1 dam.
11. Joint technical note SES/Igam nº 3 for the analysis of the water quality of the Paraopeba River after disaster at the B1 dam.
12. Information Bulletin: Monitoring of water quality for human consumption in the municipalities affected by the Vale/S.A. Disaster, Brumadinho, Minas Gerais.
13. Brazil. Ministry of Health. One year of Vale's disaster: Organization and response by the Ministry of Health. *Epidemiological Bulletin*. 2020; 51 (n.esp.): 1-35.

## Final considerations

The performance of environmental health surveillance, in response to the rupture of the B1 dam in Brumadinho, enabled the development of actions with important intra-sectoral articulation, with the involvement of professionals from different areas of the health sector in the affected municipalities, regional health units and the central level of SES-MG and the Ministry of Health. In addition, the inter-sector partnerships with Semad and its related agencies (Institute for Water Management of Minas Gerais, State

Environment Foundation); Seapa; the State Civil Defense Coordination; the Military Fire Brigade of Minas Gerais, essential for the planning and execution of actions that are the responsibility of the health sector.

The identification and mapping of alternative underground water solutions for human consumption used by the population affected by the disaster were challenges experienced during this process, since the lack of updating and the incompleteness of this information in the Drinking Water Quality Surveillance Information System (Sisagua) is a weakness for the use of data. Thus, it was necessary to carry out on-site visits, which increases the complexity of the actions carried out and increases the time necessary for the development of these activities.

The experiences lived by the team during this performance motivated reflections on the need to strengthen the development of actions in an intra and intersectoral way, in the routine of environmental health surveillance and, mainly, in disaster situations since, in many work activities developed in the routine, fragmentation is still present. In addition, the importance of qualifying the data recorded in Sisagua and knowledge of the local information of each territory in the routine is emphasized in order to provide timely support, in disaster situations, the identification of the forms of water supply for human consumption and the development of an emergency sampling plan for monitoring water quality.

## Collaborators

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