








# Deaths due to COVID-19 in Brazil: how many are there and which are being identified?

## *Óbitos por COVID-19 no Brasil: quantos e quais estamos identificando?*

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COVID-19 was initially notified in February 2020, in Brazil, and the first death was reported on March 17<sup>1</sup>. Since then, national spread has been rapid, with over 9,000 deaths reported less than two months later<sup>2</sup>. These deaths refer to people who tested positive for the polymerase chain reaction test (PCR), which detects the genetic material of SARS-CoV-2 and establishes the presence of the virus. This figure, however, represents only the tip of the iceberg, because the PCR test has been performed with priority on hospitalized patients under suspicion of having the disease and, in some states, as a *post-mortem* exam<sup>3</sup>. It can be deduced that there are certainly many deaths from suspected cases without a confirmed diagnosis. Thus, two major challenges are how to estimate the degree of underreported deaths due to COVID-19 and what the actual number is.

## DEATH CERTIFICATE, INFORMATION SYSTEMS AND COVID-19

Cause of death information is gathered from the death certificate (DC), a standard international document that should be filled out by doctors in Brazil. In a DC, the cause(s)

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of death is(are) declared in Part I (immediate, intervening, and underlying cause). For mortality statistics purposes, the underlying cause of death (COD) is selected, which should be the cause stated on the lowest used line of the DC, if the causal sequence leading to death was filled in correctly. The underlying COD is the disease or circumstances of injuries that initiated the chain of events leading to death<sup>4</sup>. In the case of disease due to SARS-CoV-2, the COD must be reported as COVID-19, and clinical suspicion without laboratory results, as suspected COVID-19. Pre-existing comorbidities responsible for worsening the disease should not be considered the underlying COD<sup>5</sup>.

The DC form is issued in three copies, the first (white) copy for the municipal, state and federal health services, responsible for monitoring causes of death with the Mortality Information System (*Sistema de Informações Sobre Mortalidade – SIM*). The second copy (yellow) is destined for the Civil Registry (CR) notary offices for the registration of the death and the drawing up of a copy of the DC to the family, which is essential to proceed with the burial. The third copy (pink) must be retained by the issuing institution<sup>4</sup>.

For the insertion of deaths in the SIM, the death surveillance service of the health municipal department performs an active search for the DC in hospitals and other establishments, and/or notary offices, and uses international standardized rules for selecting the underlying COD. In the case of deaths that have not yet been confirmed as COVID-19, an attempt is made to streamline the routine process of investigating unspecified causes with an active search in medical records of hospitals and laboratories for the qualification and confirmation of the disease. Deaths captured at the municipal department are transferred to the state and to the federal level, to consolidate the national base<sup>6</sup>. Because of qualification processes in the mortality information system, there is a delay in the final registration in the system, which may vary according to different municipalities and causes.

Deaths registered in notary offices across the country make up the CR statistics system, coordinated by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística – IBGE*). This system, based on data from notary registrations, does not have the function of monitoring vital events occurring in the territory, but it contributes for the timely detection by municipal, state and federal health services of atypical occurrences in the various locations throughout the country.

Over the last 10 years, it is estimated that the two systems, CR and SIM, have captured almost the total number of deaths that occur in large urban centers where the epidemic is concentrated. However, for a substantial proportion the cause of death is still ill-defined or imprecise (35% of deaths investigated in 60 cities in 2017)<sup>7</sup>. In the case of COVID-19, it is most likely that there is an expressive underreporting of deaths due to the difficulty in identifying the cases, considering that many did not have material collection for the PCR test. Even with samples collected, countless individuals evolve to death before having their results released. In addition, collection quality problems, since collecting specimens late or very early in the infection period as well as not handling and shipping them appropriately, may be responsible for false negative results<sup>8</sup>. Therefore, the timely inclusion of confirmed

cases of COVID-19 in the SIM depends on the physician having adequate results of the PCR test available when filling in the DC.

The major problem, however, concerns the criterion for deaths due to suspected COVID-19 cases. Given the delay in the release of a national protocol by the Brazilian Ministry of Health to standardize the adequate completion of DCs due to the disease, some institutions<sup>3</sup> have issued guidelines that differ from those recommended by the World Health Organization (WHO). The WHO proposes to consider as death due to COVID-19 all cases with clinically compatible disease even without confirmatory laboratory results.<sup>5</sup> In the epidemic, the poor completion of the DC is reinforced by the limited or non-existent medical care during the terminal illness and by the precarious working conditions of physicians in urgent and emergency settings. Thus, a high proportion of deaths from COVID-19 stated as other causes could compromise the understanding of the real magnitude of mortality from this specific cause.

## **DEATHS FROM PNEUMONIA, SEVERE ACUTE RESPIRATORY SYNDROME, RESPIRATORY FAILURE, SEPTICEMIA AND ILL-DEFINED CAUSES CAN ALSO OCCUR DUE TO THE NEW CORONAVIRUS**

The disease caused by the new coronavirus was initially detected in China with the investigation of seven cases of pneumonia of unknown etiology that occurred in late December 2019 in hospitalized patients, and which evolved into a severe acute respiratory syndrome (SARS)<sup>9</sup>. Therefore, pneumonia and SARS are causes that are part of the causal sequence of severe cases of COVID-19 which progress to death, and sepsis is also a possible complication<sup>10</sup>.

Deaths classified as respiratory failure or ill-defined/undetermined causes conceal other causes, and the underlying COD can be any other specific cause. Research results for investigation of respiratory failure performed in 2017 on medical records, indicate that this diagnosis is the result of different underlying CODs, from chronic diseases, such as cardiovascular diseases (24% of 518 reclassified cases) to external causes<sup>11</sup> (Table 1). Ill-defined causes and sepsis had a similar pattern in previous investigations, indicating that they also hide a huge variety of underlying CODs<sup>12,13</sup>.

The CR data on death in the recent COVID Registral panel, made available by the National Association of Natural Persons Registers (*Associação Nacional dos Registradores de Pessoas Naturais* – ARPEN Brasil)<sup>14</sup>, come from the country's notary offices. A single cause of death was selected according to hierarchical criteria for the causes stated in the certificate. Endeavouring to measure mortality from coronavirus, deaths that had COVID-19 mentioned in the DC were identified, followed by deaths with mention of acute respiratory syndrome and those with pneumonia mentioned with no mention of SARS; finally, those with respiratory failure (with or without mentioned sepsis), and sepsis and ill-defined causes when they were the unique stated causes<sup>14</sup>. It appears that SARS increased in capital cities where there was an increase in confirmed cases of COVID-19 (data not shown) in 2020.

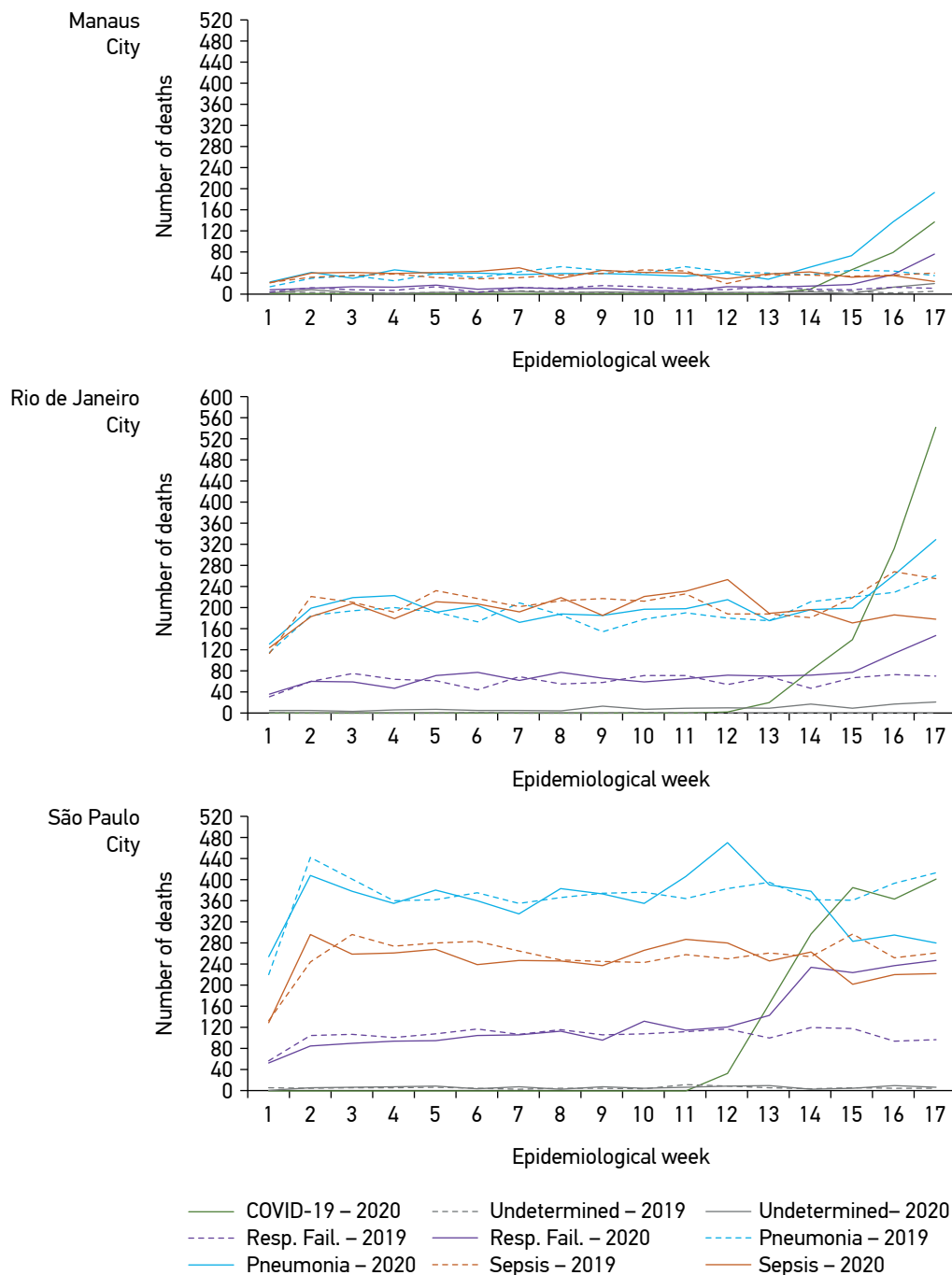
When analyzing three capital cities with a higher increase in cases of COVID-19 (Figure 1), an important rise in respiratory failure is observed as cause of death in São Paulo and Rio de Janeiro, whereas there was also an increase in mentioned pneumonia deaths in Manaus.

The CR data, despite having some limitations, indicate that deaths from the new coronavirus are probably included among deaths registered as other causes, with different behavior patterns in the municipalities. It then becomes urgent and necessary to face the challenge of building a picture closer to reality about the epidemic, which heavily impacts the life of the Brazilian population. In addition to expanding laboratory tests of suspected cases and

Table 1 Deaths according to underlying causes after investigation of causes registered as respiratory failure. Brazil, 2017.

Underlying cause of death	Age range							Total	%
	< 20	20–39	40–49	50–59	60–69	70–79	80 and+		
Ischemic heart disease, hypertensive heart disease, cerebrovascular and other cardiovascular diseases	0	3	3	9	13	28	70	126	24.3
Neoplasms	0	2	6	8	13	15	7	51	9.8
Pneumonia and other respiratory infections	5	0	0	5	6	7	25	48	9.3
Chronic obstructive pulmonary disease	0	1	0	3	9	11	12	36	6.9
Diabetes and chronic kidney disease	0	2	3	2	3	9	17	36	6.9
Falls and other external causes	6	3	0	0	3	7	16	35	6.8
Tuberculosis, diarrhea and other communicable diseases	1	3	3	4	5	5	10	31	6.0
Alzheimer's disease and other dementias	0	0	0	1	0	2	24	27	5.2
Urinary tract disease and other natural causes	12	9	5	5	8	7	19	65	12.5
Ill-defined causes and other garbage codes	6	5	6	3	11	11	21	63	12.2
<b>Reclassified causes after investigation (total)</b>	<b>30</b>	<b>28</b>	<b>26</b>	<b>40</b>	<b>71</b>	<b>102</b>	<b>221</b>	<b>518</b>	<b>53.8</b>
Maintained respiratory failure	34	28	43	31	41	79	189	445	46.2
<b>Total</b>	<b>64</b>	<b>56</b>	<b>69</b>	<b>71</b>	<b>112</b>	<b>181</b>	<b>410</b>	<b>963</b>	<b>100.0</b>

Source: raw data from the Mortality Information System<sup>11</sup>.



\*For COVID-19 and pneumonia, deaths were considered with mention of the cause in the death certificate.

Source: COVID Registral panel, made available by the National Association of Natural Persons Registers (*Associação Nacional dos Registradores de Pessoas Naturais – ARPEN Brasil*)<sup>14</sup>.

Figure 1 Number of deaths due to COVID-19, pneumonia, respiratory failure and septicemia per epidemiological week. Manaus, Rio de Janeiro and São Paulo Cities, 2019 and 2020\*.

deaths with a higher quality control of performance<sup>15</sup>, two additional approaches are recommended to enable a rapid assessment and better knowledge of the situation of deaths from COVID-19 in the country's municipalities:

- Consider as a suspected death of COVID-19 all deaths registered as SARS as from March 2020;
- Consider municipalities with probable underreporting of deaths from COVID-19 those with a number of deaths due to pneumonia, respiratory failure, sepsis or ill-defined causes higher than the expected maximum limit for the number of weekly occurrences of each cause, based on statistical process control charts for deaths from these causes.

These two approaches will allow health municipal departments to conduct investigations of deaths due to COVID-related causes and, thus, have a better estimation of the real number of deaths from the disease. In a study in cooperation with Universidade Federal de Minas Gerais and Vital Strategies, health departments of three municipalities in the country started, with priority, an investigation process based on these guidelines last March. The results of this study should provide the degree of probable underreporting of deaths due to COVID-19 with greater precision.

In an epidemic such as COVID-19, reliable and timely cause-of-death data are essential to define measures in order to control the spread of the disease and for better management of health services. It is estimated that when a single death occurs in one place, hundreds of cases are probably present in the population<sup>16</sup>. Hence, we suggest that the protocols for investigating causes of death already found in the routine of the municipal health departments include the proposal presented in this article. It is essential that federal, state and municipal governments and society have a greater understanding of the risks involved and take the necessary effective measures to prevent them.

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