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SPECIAL ARTICLE / *ARTIGO ESPECIAL*

The importance of surveillance in cases of and mortality from the COVID-19 epidemic in Belo Horizonte, Brazil, 2020

A importância da vigilância de casos e óbitos e a epidemia da COVID-19 em Belo Horizonte, 2020

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ABSTRACT: ***Objectives:*** This study aims to describe the actions undertaken by the epidemiological surveillance system in Belo Horizonte to address the COVID-19 epidemic and the timeliness of registered data for detecting transmission in 2020. ***Methods:*** The sources of information used by the epidemiological surveillance of COVID-19 were identified, and temporal distribution and timeliness for detection of confirmed cases were analyzed. ***Results:*** Outpatient, hospital, public and private laboratory notifications are used as data sources. For reporting COVID-19 cases in official information systems, there is also an active search of laboratory results linked to suspected deaths investigated. From January to April 2020, 1,449 hospitalized cases of COVID-19 were reported, the first case being detected in late February 2020. Of the total 1,025 laboratory samples of cases hospitalized after the 8th epidemiological week, 87 (8.5%) were confirmed as COVID-19 cases. The median time between the onset of symptoms and the release of laboratory results was 12 days for the analyzed period. ***Conclusion:*** Epidemiological surveillance uses several data sources to monitor and analyze the transmission of COVID-19. The timeliness of this system to detect cases of the disease is compromised by the delay in the release of laboratory results, which has been a considerable challenge for adequate surveillance.

Keywords: COVID-19. Epidemiological surveillance. Health Service Evaluation. Epidemics.

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RESUMO: ***Objetivos:*** Descrever as ações realizadas pela vigilância epidemiológica da Secretaria Municipal de Saúde de Belo Horizonte para enfrentamento da epidemia de COVID-19 e avaliar a oportunidade para detecção precoce da transmissão da doença no período compreendido entre 1º de janeiro e 24 de abril de 2020. ***Métodos:*** Foram identificadas as fontes de informação utilizadas pela vigilância epidemiológica do município para a COVID-19 e analisadas a distribuição temporal e a oportunidade para detecção dos casos confirmados da doença. ***Resultados:*** A vigilância epidemiológica do município utiliza fontes de notificações ambulatoriais, hospitalares, de laboratórios públicos e privados, além de busca ativa com cruzamento de dados laboratoriais na investigação de óbitos suspeitos, sendo os casos confirmados de COVID-19 informados em sistemas de informação oficiais. Foram notificados 1.449 casos internados, sendo o primeiro caso detectado no fim de fevereiro de 2020. Do total de 1.025 amostras laboratoriais de casos internados após a semana epidemiológica 8, confirmaram-se 87 casos (8,5%) por COVID-19. A mediana de tempo entre o início dos sintomas e a liberação dos resultados laboratoriais foi de 12 dias. ***Conclusão:*** A vigilância epidemiológica utiliza várias fontes de dados para monitoramento e análise da transmissão da COVID-19. A oportunidade para detecção de casos da doença está comprometida pela demora na liberação dos resultados laboratoriais, sendo um desafio para a vigilância.

Palavras-chave: COVID-19. Vigilância epidemiológica. Estudos de Avaliação. Epidemia.

INTRODUCTION

On January 30th2020, the World Health Organization (WHO) declared the outbreak of a new coronavirus, called SARS-CoV-2, identified in Wuhan (China) in December 2019, as a public health emergency of international concern [1] and, by the Brazilian Ministry of Health (MoH), as a public health emergency of national concern on February 3rd, 2020[2]. However, since January 3rd the MoH has already recommended a preliminary definition for the notification of suspected cases of indeterminate pneumonia with epidemiological criteria and, on January 22nd, changed the definition of suspected cases, making it mandatory for immediate notification within 24 hours to the national Center for Strategic Health Surveillance (CSHS) , as planned in events of public health concern[3].

The disease, later called COVID-19 by WHO on February 11th, 2020[4], was detected for the first time in Brazil later that month, after confirmation in São Paulo of the first case imported from Italy. On March 20th, the MoH announced community transmission nationwide, after the occurrence of autochthonous cases epidemiologically unrelated to a confirmed case[5]. Until May 5th, approximately 100,000 cases and 9,897 deaths from COVID-19 had been reported[6].

The opportunity for early detection and notification of individuals infected with SARS-CoV-2, a highly transmittable virus with a huge impact in terms of morbidity and mortality for the population, is an essential factor for the monitoring and control of the epidemic[7]. In this sense, epidemiological surveillance actions play a fundamental role in providing timely and qualified information to managers for decision-making; however, there are

still many gaps regarding the knowledge of the transmission dynamics of this virus in all regions of Brazil, encompassing the great social inequalities, the access to health facilities, the difficulty in testing the population, and the under-registration of cases for the disease[8]. Regarding under-registration, it should be noted that the occurrence of oligosymptomatic individuals not indexed by the MoH information systems and the limited availability of specific laboratory tests compromise the monitoring of the disease in the country.

After the establishment of community transmission of COVID-19 in Belo Horizonte, health services began to focus on interventions in order to avoid severe cases and deaths, monitoring the disease transmission through the mandatory notification of hospitalized patients with severe acute respiratory syndrome (SARS), and also flu-like syndrome (FS) surveillance in sentinel units, as provided for in the State Contingency Plan for Public Health Emergency of Minas Gerais[9].

In Belo Horizonte, as in other municipalities, non-pharmacological containment measures were implemented related to social distancing, awareness campaigns, the adoption of clinical protocols for patient care and the creation of a monitoring committee, among others, as fundamental strategies to face COVID-19[10]. To assess the impact of these actions on the dynamics of disease transmission, it is essential to monitor the occurrence of cases and deaths from the disease, which is also the basis for the definition of risk assessment proposals and relaxation measures to be adopted in due course by states and municipalities[11].

This study aims to analyze the actions carried out by the epidemiological surveillance of the Municipal Health Department of Belo Horizonte (*Secretaria Municipal de Saúde de Belo Horizonte* – SMS-BH) to confront the COVID-19 epidemic in the city and to evaluate the opportunity for timely detection of transmission in the period between January 1st and April 24th, 2020.

METHODS

In Belo Horizonte, the process of epidemiological surveillance of diseases and conditions of compulsory notification is under the coordination of the Board for Health Promotion and Epidemiological Surveillance of the SMS-BH. On this board, the Epidemiological Surveillance Management and the municipal CSHS are strategic areas for the analysis and decision-making process to confront the epidemic based on the dynamics of the disease, in conjunction with other areas of the SMS-BH and other thematic departments of the municipality (Education, Planning and Social Assistance, among others). On March 17th, 2020, the municipality constituted the COVID-19 Epidemic Confrontation Committee in order to monitor the evolution of the epidemiological panorama, in addition to adopting appropriate public health measures for prevention, control of transmission, and treatment of affected people[12].

For the surveillance of COVID-19, SMS-BH has used several sources of data to capture cases and deaths from the disease. The detection of hospitalized cases is made by

use of SARS surveillance. This surveillance was implemented in the country in 2009 by the MoH, after the influenza A (H1N1) pdm09 pandemic, with the objective of monitoring and identifying the occurrence of respiratory viruses in hospitalized patients with severe clinical conditions or suspected deaths from SARS, regardless of hospitalization[13,14]. Compulsory notification of cases of SARS is performed by the care professional, usually the doctor, after clinical suspicion. For that, a standardized form by the MoH ("Individual registration form — Cases of hospitalized severe acute respiratory syndrome") is applied, which contains patient identification data, notifying source, clinical manifestations, specific laboratory exams and evolution, among others. Every notified case is registered in the Flu Epidemiological Surveillance System (*Sistema de Vigilância Epidemiológica da Gripe* – SIVEP-Gripe), developed by DATASUS for the MoH. This system allows for the evaluation of the performance and opportunity of surveillance through the analysis of some variables, such as: notification dates, onset of symptoms, hospitalization, collection of clinical specimens for viral research, release of laboratory results and closing of the case[15]. In this study, notifications that had clinical specimen collection for virus-specific diagnosis with detection of SARS-CoV-2 were selected as confirmed cases of COVID-19 by means of a validated and standardized laboratory technique of real-time polymerase chain reaction (RT-PCR).

The active search for SARS cases is carried out in various data sources, such as in the work of SUS-BH hospital medical audit teams,while in the process of reviewing clinical records for authorization of payment for hospitalization, identify health problems of compulsory notification recorded by doctors, blocking its processing and billing until it is proven that the case has been notified to municipal epidemiological surveillance. The request for hospitalization by the health care units for cases of SARS to the SUS-BH regulation center is also used to capture and monitor COVID-19 cases.

The crossing of data recorded in SIVEP-Gripe with laboratory results made available daily by the Ezequiel Dias Foundation (Fundação Ezequiel Dias – FUNED — Public Health Laboratory of Minas Gerais) and by private laboratories, which perform specific tests for the diagnosis of infections from the new coronavirus, are also applied to identify cases not notified by doctors (passive notification). Concomitantly, all requests for exams to search for respiratory viruses submitted to FUNED with cases registered in SIVEP-Gripe are investigated, identifying underreporting in the latter system. For cases of SRAG captured by active search in these sources, complementary data collection is carried out by the municipality's surveillance team in medical records for the evaluation and insertion of cases in SIVEP-Gripe.

The Health Network — Electronic Health Record (*Sistema Saúde em Rede* – SISREDE) database is another source of information to monitor the occurrence of cases of respiratory diseases in the municipality. This database contains the total number of patients with FS attended by the primary health care network (PHC) in the 152 basic health units (*unidades básicas de saúde* – UBS) and by the 598 Family Health teams (FHT) of SMS-BH. The attendances registered with codes J00-J22 of the 10th revision of the International Statistical

Classification of Diseases and Related Health Problems (ICD-10) are quantified and stratified by week, unit, and FHT of patient care. The same procedure for selecting cases of FS is performed weekly in the nine Emergency Care Units (*Unidades de Pronto Atendimento* – UPA) in the municipality.

In addition to monitoring visits by FS, the FS sentinel surveillance strategy, implemented in the country since 2000, is also used to monitor the influenza virus[13,15]. This strategy aims, among other objectives, to identify and isolate the circulating influenza respiratory viruses that will compose the flu vaccine to be made available to the target population in the following year. In Belo Horizonte, this surveillance is carried out with weekly and systematic collection of clinical specimens (nasopharyngeal swab) in five patients treated for FS in five previously selected UPA.

As for the identification of deaths by COVID-19, SMS-BH actively searches for death certificates (DC) in all health establishments (hospitals, UPA, and others), civil registry offices, Mobile Emergency Service (*Serviço de Atendimento Móvel de Urgência* – SAMU), and Institute of Forensic Medicine (*Instituto de Medicina Legal* – IML). This DC search flow is foreseen in a MoH ordinance, since, currently, the civil registration of death can be performed in the municipality both of the occurrence of death and of the deceased's residence[16]. Each DC is evaluated by the surveillance team to identify diseases and conditions of epidemiological interest declared by the certifying doctors, and subsequently coded and typed in the Mortality Information System (*Sistema de Informação sobre Mortalidade* – SIM)[17]. In addition to DC containing COVID-19 or disease due to the new coronavirus mentioned as one of the causes of death, deaths declared with possible causes related to the disease, such as SARS, respiratory failure, viral pneumonia, and viral infection to be confirmed, among others, are also selected for investigation in SIVEP-Gripe and in laboratories. The causes reclassified after investigation are inserted in the SIM.

In the present study, for cases registered in SIVEP-Gripe (severe hospitalized cases), the temporal distribution by epidemiological week of the onset of symptoms and sources of notification was analyzed. The names of the health establishments notifying SARS cases have been preserved, being grouped into two categories: private/affiliated health units (private establishments plus those affiliated to SUS) and public (including hospitals and UPA managed exclusively by SUS). In order to assess timeliness in detecting COVID-19 cases in the surveillance of SARS, we used the median time in days between the onset of symptoms, the collection of clinical specimens for specific diagnosis of the infection, and the release of laboratory tests results, comparing the cases notified between epidemiological weeks 1 and 8 (before the detection of the transmission of the first case of COVID-19 in the municipality) and weeks 9 and 17 (when community transmission was established). Data from weeks 1 to 16 regarding FS consultations at UBS and UPA were examined.

This study was approved by the Research Ethics Committee of *Universidade Federal de Minas Gerais* (Certificate of Presentation for Ethical Appreciation 75555317.0.0000.5149) and developed in accordance with the ethical precepts established by Ordinance No. 466/12, of the National Health Council

RESULTS

In the period from January 1st to April 24th, 2020, 2,140 cases of SARS were reported to SIVEP-Gripe, of which 1,449 (67.7%) were people living in Belo Horizonte. Of these, 175 cases (12.1%) were reported between weeks 1 and 8 and 1,274 (87.9%) between weeks 9 and 17. Of the 175 cases of SARS reported in the first weeks, 77 laboratory samples were collected for specific diagnosis (44.0%), 13 with detection of influenza virus, 3 with respiratory syncytial virus, and one sample with rhinovirus; 92.6% (n=162) of the total cases from weeks 1 to 8 were classified as unspecified SARS (data not shown).

Figure 1 shows the distribution of cases of SARS (n=1,274) according to the reporting source from week 9, when the first case of the disease was detected in the municipality. Private/affiliated establishments reported 668 cases, with 90.7% of cases with samples collected, while public establishments reported 606 cases, 91.9% of which were with samples (data not shown). During this period, private/affiliated hospitals detected 81.6% (n=71) of COVID-19 cases, while exclusively SUS establishments, 18.4% (n=16). From week 13 onward, there was a progressive increase in the notification of SARS by SUS establishments, with total cases (n = 214) exceeding the cases notified by private establishments (n=188) in weeks 14 and 15.

Of the 1,274 cases of SARS from residents in Belo Horizonte, 1,025 (80.5%) laboratory samples were collected for viral research, 8.5% of which were detected with SARS-CoV-2 (Figure 2). The positivity of these samples ranged from 3.4 (week 9) to 14% (week 13).

The median between the date of onset of symptoms and the collection of samples for the detection of respiratory viruses for cases of SARS was 4 days for the entire period, being slightly higher for weeks 1 to 8 (5 days). Regarding the date of release of the result, the median was 12 days for the entire period (weeks 1 to 17), being 13 days between weeks 1 and 8 and 12 days between weeks 9 and 17 (Figure 3).

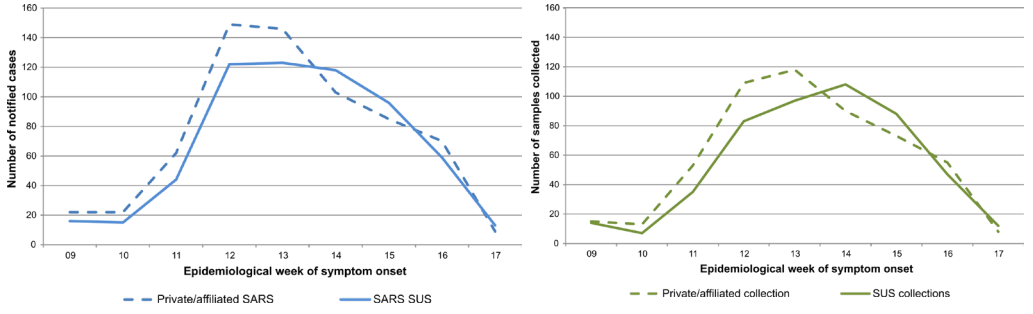

Figure 1. Cases of severe acute respiratory syndrome (SARS) and samples collected for detection of COVID-19 according to category of the notifying health establishment and epidemiological week of symptom onset in residents of Belo Horizonte, 2020.

Figure 4 shows the total number of cases of respiratory disease treated at UBS (n=40,227) and UPA (n=69,985) between weeks 1 and 16, with an increase in the number of cases starting from week 7, with a fall after week 11 in the UPA and week 12 in the UBS.

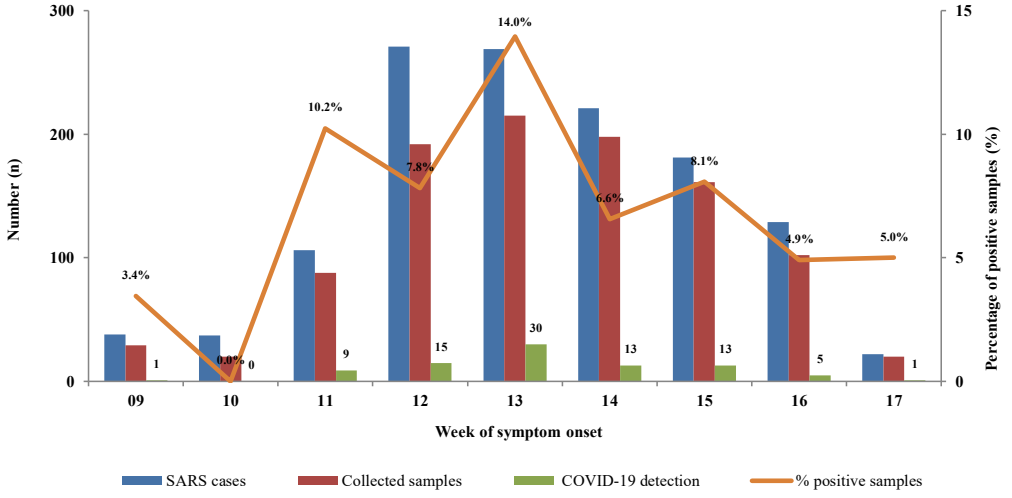

Figure 2. Total cases of severe acute respiratory syndrome (SARS), samples collected, cases of COVID-19 and percentage of positive samples for SARS-CoV-2 according to the epidemiological week of symptom onset. Belo Horizonte, 2020.

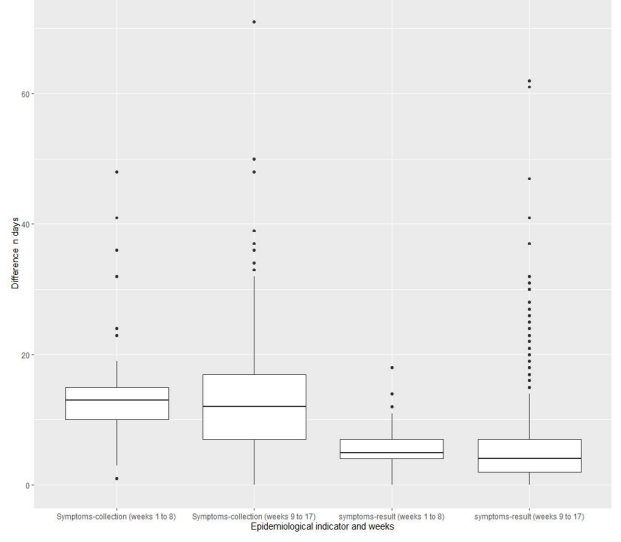

Figure 3. Boxplot with the values of the differences between the dates of symptom onset and sample collection for the exam and the dates of symptom onset and exam result, according to initial (1 to 8) and final (9 to 17) weeks. Belo Horizonte, weeks 1 to 17, 2020.

As for the sentinel surveillance of FS in the five UPA in the municipality, 365 samples were collected between weeks 1 and 17; among them, 114 (31.2%) samples from weeks 10 to 17 were still waiting for processing by the reference laboratory. Of the total processed samples (n = 251), 20 (8.0%) were positive for influenza virus, 19 (7.6%) for other respiratory viroses, and 212 (84.5%) were negative; none of the processed samples detected SARS-CoV-2 (data not shown).

DISCUSSION

The results of this study indicate that, despite the strategies adopted by epidemiological surveillance in Belo Horizonte to face the COVID-19 pandemic, using several sources of information to monitor the dynamics of disease transmission, the opportunity to detect COVID-19 cases is still a problem to be dealt with. The low agility observed in the release of specific laboratory results for the detection of respiratory viruses has been a characteristic since the confirmation of the first case of SARS-CoV-2 in the municipality and occurred both for the surveillance of SARS and the sentinel surveillance of FS.

One of the fundamental attributes of epidemiological surveillance for communicable diseases rapidly spreading in susceptible individuals is the opportunity to detect their introduction and dissemination in the population as early as possible, enabling the adoption of

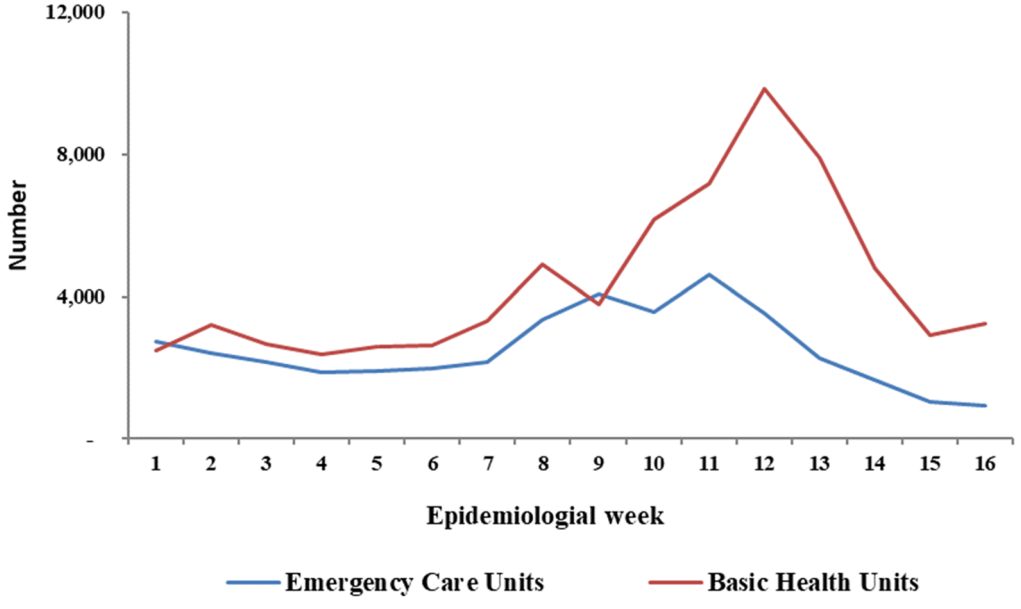

Figure 4. Cases of flu syndrome seen in Basic Health Units and Emergency Care Units according to the epidemiological week of care. Belo Horizonte, 2020.

appropriate control measures. For COVID-19, whose measure of transmission intensity (Rt) in the population is estimated between 1.4 and 3.9, a poor performance in this attribute greatly increases the possibilities of uncontrolled community expansion of the disease, given that surveillance will detect viral circulation at a later moment[18-20].

Currently, syndromic surveillance of acute respiratory disease in Brazil, which includes SARS-CoV-2, influenza and other respiratory viruses, represents a strategic facilitator for assessing the impact of COVID-19 in the country[13]. It also reflects the flexibility of surveillance to incorporate emerging diseases without the need for major changes or the development of new information systems[20,21]. In Belo Horizonte, in addition to this surveillance, the systematic monitoring of the attendance by respiratory conditions in UBS and UPAs and the demand for hospitalization were included as strategies adopted for evaluation and decision making.

However, the improvement in the quality and timeliness of epidemiological surveillance of acute respiratory syndromes is still a major challenge for the country, in view of unresolved operational problems[8]. Despite the existence of SIVEP-Gripe as the official MoH's system, other information systems had to be developed to register cases of COVID-19 at the beginning of its transmission in the country, such as FormSUScap (https://redcap.saude.gov.br), later replaced by e-SUS VE (https://notifica.saude.gov.br), on March 26th, 2020. However, these databases are not yet compatible among one another. In addition, there are problems in defining the criteria for confirming and discarding suspected cases and deaths from the disease, due to the low availability of diagnostic tests[8].

An important aspect to be highlighted in this study refers to the change observed in the weekly distribution of cases of SARS in Belo Horizonte, based on the analysis by the reporting source. Between weeks 9 and 12, of the total of 31 confirmed cases of SARS by COVID-19, 26 cases were reported by private/affiliated establishments, while only three cases were notified by public hospitals. After week 13, 27 cases were reported by exclusively SUS hospitals, out of 92 total cases recorded in the period (data not shown). This increase in notifications in public hospitals could reflect the dynamics of the transmission of COVID-19 and the unequal socioeconomic profile in the municipality. The first reported cases would be related to patients with a history of traveling to transmission areas in other countries/states, and the subsequent cases would be related to community transmission to other population groups with greater social vulnerability. This last group, basically consisted of users of SUS-BH and with less favorable socioeconomic conditions, should subsequently suffer a greater impact of the disease, with an enormous risk of uncontrolled spread of the epidemic due to the difficulty in properly implementing the recommendations of social distancing and personal hygiene[22]. Lower rates of hospitalizations and deaths due to COVID-19 were observed in New York in neighborhoods with better living conditions compared to other ones[23].

Laboratory support is essential for all phases provided for in the plans to face this epidemic. The availability of diagnostic kits for COVID-19, a worldwide problem, has had a huge impact on disease surveillance actions, as the scarcity of this input compromises the knowledge of the transmission dynamics in the population and the definition of criteria that

determine suspected cases and deaths[15,24]. The criterion for discarding suspected deaths from COVID-19, in general using only a nasopharyngeal swab sample with a negative RT-PCR result, can also underestimate the total number of deaths from the disease, considering the possibility of up to 30% of false-negative results. In addition, the quality of the laboratory response depends on complex steps involved in the process, from standardization and validation of kits, material collection, conservation, transportation, processing and release of results, among others[25]. As for the conservation and transport of the collected samples, the media has recently reported serious problems in samples collected for COVID-19 diagnosis, with temperature measured in the means of transportation much higher than that recommended to guarantee the reliability of the processing and examination result, compromising the analysis of the magnitude of the disease[26].

As observed in Belo Horizonte, the surveillance of COVID-19 uses passive (reported directly by health professionals) and active sources (search for cases in public and private laboratories, hospital audit, request for admission to the regulatory center SUS-BH), which makes it possible to monitor the dynamic transmission of the disease in the municipality. It is worth noting that this systematic monitoring allowed for a reduction in the occurrence of severe (SARS) and mild (FS) cases as of epidemiological week 13, probably reflecting the rigorous non-pharmacological interventions adopted in the municipality as of week 12, 2020, among which social distancing and the closure of non-essential activities and services.

A limitation of this study refers to the non-consideration of the death surveillance from COVID-19, which represents an important indicator of the epidemic´s evolution, and which should be the subject of evaluation's timeliness of notification in the SIM as well as identifying the proportion of deaths attributed to other causes.

In this study, the assessment of some epidemiological surveillance performance indicators points to problems related to the final classification of COVID-19 cases. As recommendations for improving surveillance and knowledge of the dynamics of the COVID-19 epidemic in the municipality, the need to provide laboratory surveillance is highlighted, with greater agility in the release of test results for diagnosis of the disease, expansion of RT-PCR testing for all respiratory symptoms, and population-based serological surveys. The broad and continuous dissemination of strategic information on the situation of the epidemic should also be encouraged. Another important initiative is the establishment of partnerships with academic institutions to support the interventions of surveillance and the evaluation of strategies adopted by health services.

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