

Knowledge, attitudes, and practices of primary health care professionals in coping with COVID-19 in Brazil: a cross-sectional study

Conhecimento, atitudes e práticas de profissionais da atenção primária à saúde no enfrentamento da COVID-19 no Brasil: um estudo transversal

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ABSTRACT | Introduction: The coronavirus disease 2019 (COVID-19) pandemic has posed challenges to healthcare professionals, who needed to quickly adjust impacts on their work processes. Primary health care has become key to fighting the pandemic, as most mild cases seek primary care services as their point of first contact. **Objectives:** To ascertain the knowledge, attitudes, and practices of health professionals working in primary health care in Brazil early in the COVID-19 pandemic. **Methods:** Cross-sectional study of a convenience sample. An online questionnaire was made available from May 1 through May 31, 2020. The sole criterion for inclusion was a response rate greater than 30 respondents per Brazilian state. Data were treated descriptively and statistically. **Results:** Overall, 293 responses were obtained, and the states of Paraná (n = 86), Mato do Grosso do Sul (n = 50) and São Paulo (n = 48) were included in the study. There was a predominance of female respondents (89.1%). Physical therapy (31.6%) and nursing (12.4%) were the most represented occupations. Respondents generally reported moderate knowledge (54.3%) and preparedness (57.6%), with daily information seeking (63.5%) in handbooks and technical guidance publications (89.6%). There was no statistically significant difference between states for the variables knowledge (p = 0.28) and preparedness (p = 0.19). **Conclusions:** The participating states showed similar, positive results regarding knowledge, attitudes, and practices. Previous experiences seem to generate cumulative knowledge; however, greater readiness in training professionals is needed in emergency situations.

Keywords | coronavirus infections; primary health care; health personnel; work; knowledge, attitudes, and practice in health.

RESUMO | Introdução: A pandemia da doença do coronavírus 2019 (COVID-19) trouxe desafios aos profissionais de saúde, que precisaram se ajustar rapidamente aos processos de trabalho afetados. Assim, a atenção primária à saúde tornou-se central no enfrentamento da pandemia, pois a maioria dos casos leves buscam o serviço como primeiro contato. **Objetivos:** Verificar os conhecimentos, as atitudes e as práticas de profissionais de saúde atuantes na atenção primária à saúde no Brasil no começo da pandemia de COVID-19. **Métodos:** Trata-se de um estudo transversal, com amostra de conveniência. Foi disponibilizado formulário *on-line* no período de 1 a 31/05/2020, sendo o critério de inclusão número de respostas superior a 30 por estado brasileiro. Os dados foram tratados de maneira descritiva e estatística. **Resultados:** Foram obtidas 293 respostas, sendo incluídos no estudo os estados do Paraná (n = 86), do Mato do Grosso do Sul (n = 50) e de São Paulo (n = 48). Houve predomínio do sexo feminino (89,1%) e das profissões de fisioterapia (31,6%) e enfermagem (12,4%). Os estados referiram, no geral, conhecimento (54,3%) e preparo (57,6%) moderados, com busca a informações diárias (63,5%) por meio de manuais e notas técnicas (89,6%). Não houve nenhuma diferença estatisticamente significativa entre os estados para as variáveis conhecimento (p = 0,28) e preparo (p = 0,19). **Conclusões:** Os estados participantes demonstraram semelhança nos resultados, indicando conhecimentos, atitudes e práticas positivas. Experiências prévias parecem gerar acúmulo de conhecimento; porém, é necessária maior prontidão na qualificação profissional em situações de emergência.

Palavras-chaves | infecções por coronavírus; atenção primária à saúde; pessoal de saúde; trabalho; conhecimentos, atitudes e prática em saúde.

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Funding: None

Conflicts of interest: None

How to cite: Sumiya A, Pavesi E, Tenani CF, de Almeida CPB, Macêdo JA, de Checchi MHR, et al. Knowledge, attitudes, and practices of primary health care professionals in coping with COVID-19 in Brazil: a cross-sectional study. Rev Bras Med Trab. 2021;19(3):274-282. <http://dx.doi.org/10.47626/1679-4435-2021-775>

INTRODUCTION

In Brazil, the first confirmed case of coronavirus disease 2019 (COVID-19) was recorded in February 2020. Since then, the Unified Health System (SUS) has faced the primary challenge of promoting, preventing, and caring for the population¹ despite a significant reduction in investments that has been taking place since 2016. This reduction was caused by Constitutional Amendment Proposal No. 241, seeking to institute a new tax regime, which, after approval in 2016, became the 95th Amendment to the Constitution.² Thus, primary health care (PHC) has been implementing emergency actions and fulfilling its role as the preferred gateway to the Unified Health System, continuing to strive for universal, comprehensive, equitable, and decentralized care services and efficiently recognizing regional vulnerabilities in its role within the health surveillance system.³

Considering the contradictions and health context of the pandemic, PHC providers were forced to quickly adjust to altered demands and workflows, even as the services themselves have become more and more precarious. These providers were faced with a lack of infrastructure, materials, equipment, security, and training,³ distress caused by the lack of early treatment, and fear of contamination of themselves and their loved ones. Gradually, an increase in workload led to increased rates of infection and absenteeism among health professionals.⁴

In Brazil, the Ministry of Health, government agencies,⁵ nongovernmental organizations, and academia produced materials and content platforms to strengthen frontline workers. These instruments served to support health workers, who could then act as multipliers, disseminating practical information for the general public on the mechanisms of disease transmission and the bare-minimum protective measures which could be followed by any citizen, such as isolation, social distancing, use of face coverings, and good hygiene.

However, despite these measures, it is now well known that knowledge about COVID-19 was initially quite divergent. Thus, the present study raises the hypothesis that the response to the pandemic has

implied changes in the way health care is provided, and that the efficiency in providing such care depends on the knowledge, attitudes, and practices of health professionals. Thus, the study is justified, as identification of determining factors in the acquisition of skills by health professionals can lead to improvements in the planning and organization of their training, which, in turn, can facilitate a faster response to emergency situations. Therefore, the aim of this study was to ascertain the levels of knowledge and preparedness of health professionals working in PHC in Brazil at the outset of the COVID-19 pandemic.

METHODS

This was a cross-sectional study, carried out from May 1 through May 31, 2020, using an online questionnaire (Google Forms[®]) administered to a convenience sample of health professionals working in PHC during the COVID-19 pandemic in Brazil. Cross-sectional studies focus on well-defined populations, with the observation of interest measured only once – thus providing a snapshot of a phenomenon, as in population surveys that use primary data. In descriptive analyses, cross-sectional studies are widely used to promote public policies which involve the recognition of vulnerable groups and the prevalence of high-risk exposures and/or risk surveillance. They are considered inexpensive, simple, and fast, and not require follow-up.⁶

The questionnaire used in the present study used as references web surveys from other countries, such as Canada and England.^{7,8} The inclusion criterion for data analysis was the number of responses (>30 per state), to ensure adequate statistical and descriptive analysis. Data were processed in Microsoft Excel[®] and in GraphPad Prism[®] v8. Incomplete responses and those not from health professionals were excluded.

Twenty questions were prepared, the first six being sociodemographic and the rest related to the level of preparedness and knowledge, training needs, measures adopted, changes in habits, and behavior towards COVID-19. The questionnaire was shared via WhatsApp[®] and Facebook[®] groups of health professionals. The questionnaire took approximately 5

minutes to complete. During data collection, there was no way to record the identity of the participants, thus ensuring anonymity, privacy, and confidentiality.

The study protocol was approved by the Research Ethics Committee of Universidade Federal de Santa Catarina (UFSC), pursuant to National Health Council Resolution no. 466/2012, and approved with opinion no. 4,049,849.

RESULTS

Overall, 293 responses from 16 Brazilian states were recorded. However, the number of responses was lower than expected in most: Paraná (n = 88), Mato Grosso do Sul (n = 61), São Paulo (n = 49), Santa Catarina (n = 18), Minas Gerais (n = 15), Rio Grande do Sul (n = 12), Rio de Janeiro (n = 11), Amazonas (n = 8), Pará (n = 8), Pernambuco (n = 8), Rio Grande do Norte (n = 8), Bahia (n = 2), Goiás (n = 2), Amapá (n = 1), Paraíba (n = 1), and Rondônia (n = 1). Thus, according to the inclusion criteria, only the states of Paraná, Mato Grosso do Sul, and São Paulo were included. Among the respondents, there was a predominance of women overall and of nursing professionals in Mato Grosso do Sul and physical therapists in Paraná and São Paulo. The highest level of education was post-tertiary (specialist), and the time working in PHC ranged from 1 to 5 years (Table 1).

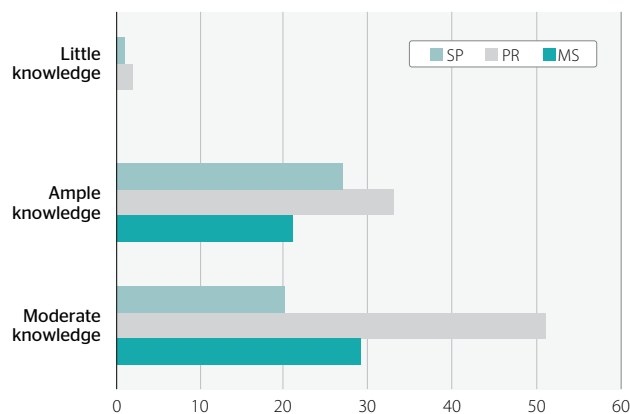


Figure 1. Level of knowledge about modes of contagion.

MS = state of Mato Grosso do Sul; PR = state of Paraná; SP = state of São Paulo.

Even considering that the period of data collection coincided with an upsurge in confirmed cases of COVID-19 in Brazil, most professionals reported only moderate-level knowledge about how the virus spreads (Table 2) (Figure 1). Most searched for information on a daily basis, using handbooks and technical guidance documents as sources. Although most reported using personal protective equipment (PPE), a portion of the respondents reported believing that the prevention measures had only moderate effect.

In apparent agreement with their level of knowledge, only half of the professionals reported having undergone training (Table 3), and felt themselves to be moderately prepared (Figure 2) to deal with the pandemic. The training needs most often reported were clinical management in Paraná and São Paulo and prevention strategies in Mato Grosso do Sul. Most respondents preferred face-to-face training.

On statistical comparison, there was no difference for any of the following variables: level of knowledge ($p = 0.28$), frequency of information-seeking ($p = 0.73$), sourced from which information was sought ($p = 0.73$), belief in prevention measures ($p = 0.29$), changes implemented ($p = 0.99$), use of PPE ($p = 0.99$), training received ($p = 0.54$), feeling prepared ($p = 0.19$), aspects requiring improvement ($p = 0.78$), and training needed ($p = 0.62$).

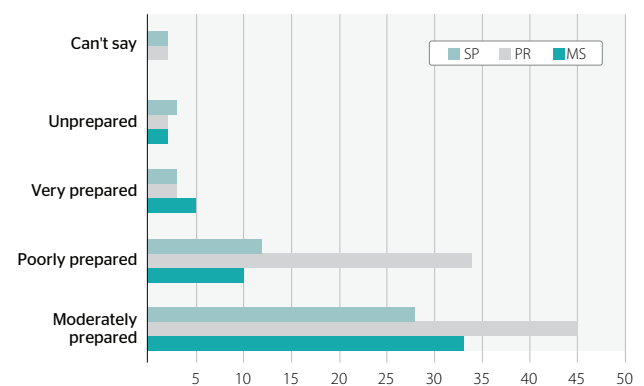


Figure 2. Level of preparedness to respond to coronavirus disease 2019 (COVID-19).

MS = state of Mato Grosso do Sul; PR = state of Paraná; SP = state of São Paulo.

Table 1. Sociodemographic profile of primary health care (PHC) providers

Variable	MS (n=50)	PR (n=86)	SP (n=48)	Total
	n (%)	n (%)	n (%)	n (%)
Age, mean (standard deviation)	37.8 (8.4)	39.31 (8.3)	40.1 (8.2)	-
Sex				
Female	41 (82.0)	80 (93.0)	43 (89.5)	164 (89.1)
Male	9 (18.0)	6 (6.9)	5 (10.4)	20 (10.9)
Educational attainment				
Specialist	23 (46.0)	50 (58.1)	32 (66.6)	105 (57.4)
Undergraduate	18 (36.0)	8 (9.3)	7 (14.5)	33 (18.1)
Master's degree	3 (6.0)	15 (17.4)	5 (10.4)	23 (12.5)
Secondary	6 (12.0)	8 (9.3)	1 (2.0)	15 (8.2)
Doctoral degree	-	5 (5.8)	2 (4.1)	7 (3.8)
Occupation				
Physical therapist	1 (2.0)	39 (45.3)	17 (35.4)	57 (31.6)
Nurse	9 (18.0)	10 (11.6)	4 (8.3)	23 (12.4)
Dentist	7 (14.0)	4 (4.6)	4 (8.3)	15 (8.3)
Community health agent	3 (6.0)	8 (9.3)	-	11 (6.1)
Psychologist	3 (6.0)	2 (2.3)	6 (12.5)	11 (6.1)
Nurse technician	6 (12.0)	3 (3.4)	1 (2.0)	10 (5.6)
Dietitian	4 (8.0)	3 (3.4)	3 (6.2)	10 (5.6)
Social worker	6 (12.0)	1 (1.1)	2 (4.1)	9 (4.9)
Pharmacist	3 (6.0)	4 (4.6)	-	7 (3.8)
Speech and language pathologist	2 (4.0)	2 (2.3)	3 (6.2)	7 (3.8)
Physician	3 (6.0)	-	3 (6.2)	6 (3.3)
Nursing aide	-	4 (4.6)	-	4 (2.2)
Physical education specialist	-	3 (3.4)	-	3 (1.6)
Occupational therapist	-	2 (2.3)	-	2 (1.1)
Dental hygienist	2 (4.0)	-	-	2 (1.1)
Health aide	-	-	2 (4.1)	2 (1.1)
Field disease control officer	1 (2.0)	-	-	1 (0.5)
Veterinarian	-	1 (1.1)	-	1 (0.5)
Biologist	-	-	1 (2.0)	1 (0.5)
Time on job				
1 to 5 years	18 (36.0)	34 (39.5)	17 (35.4)	69 (37.6)
6 to 10 years	10 (20.0)	19 (22.0)	11 (22.9)	40 (21.7)
11 to 15 years	8 (16.0)	13 (15.1)	3 (6.2)	24 (13.1)
20 years and over	3 (6.0)	9 (10.4)	8 (16.6)	20 (10.8)
1 to 12 months	7 (14.0)	4 (4.6)	5 (10.4)	16 (8.7)
16 to 20 years	4 (8.0)	7 (8.1)	4 (8.3)	15 (8.1)

MS = state of Mato Grosso do Sul; PR = state of Paraná; SP = state of São Paulo.

Table 2. Level of knowledge, frequency of information-seeking and sources of information, and implemented changes

Variable	MS (n=50)	PR (n=86)	SP (n=48)	Total
	n (%)	n (%)	n (%)	n (%)
Level of knowledge about modes of contagion				
Moderate knowledge	29 (58.0)	51 (59.3)	20 (41.6)	100 (54.3)
Ample knowledge	21 (42.0)	33 (38.3)	27 (56.2)	81 (44.1)
Limited knowledge	-	2 (2.3)	1 (2.0)	3 (1.6)
Frequency of information-seeking				
Daily	34 (68.0)	50 (58.1)	33 (68.7)	117 (63.5)
3 to 4 times a week	9 (18.0)	20 (23.2)	7 (14.5)	36 (19.6)
Once or twice a week	6 (12.0)	14 (16.2)	8 (16.6)	28 (15.3)
Can't say	1 (2.0)	2 (2.3)	-	3 (1.6)
Sources from which information is sought				
Handbooks and technical guidance documents	48 (96.0)	77 (89.5)	40 (83.3)	165 (89.6)
Scholarly publications	27 (54.0)	45 (52.3)	30 (62.5)	102 (55.4)
Peer conversations	22 (44.0)	45 (52.3)	31 (64.5)	98 (53.2)
Social media	28 (56.0)	45 (52.3)	19 (39.5)	92 (50.0)
Radio and TV	24 (48.0)	45 (52.3)	20 (41.6)	89 (48.3)
Belief in effect of prevention measures				
Large effect	42 (84.0)	69 (80.2)	45 (93.7)	156 (84.7)
Moderate effect	7 (14.0)	16 (18.6)	3 (6.2)	26 (14.2)
Little effect	1 (2.0)	1 (1.1)	-	2 (1.1)
Changes implemented*				
Frequent hand hygiene	47 (94.0)	85 (98.8)	46 (95.8)	178 (96.7)
Social isolation	44 (88.0)	82 (95.3)	47 (97.9)	173 (94.0)
Use of personal protective equipment	45 (90.0)	83 (96.5)	45 (93.7)	173 (94.0)
Avoidance of visits	37 (74.0)	79 (91.8)	44 (91.6)	160 (86.9)
Leaving house only when necessary	38 (76.0)	75 (87.2)	44 (91.6)	157 (85.3)
Coughing/sneezing into elbow	37 (74.0)	64 (74.4)	39 (81.2)	140 (76.0)
Staying 2 m apart from others	27 (54.0)	56 (65.1)	34 (70.8)	117 (63.5)
PPE use (%)				
Yes	49 (98.0)	84 (97.6)	47 (97.9)	180 (97.8)
No	1 (2.0)	2 (2.3)	1 (2.0)	4 (2.2)

MS = state of Mato Grosso do Sul; PPE = personal protective equipment; PR = state of Parana; SP = state of Sao Paulo.

DISCUSSION

Dealing with a pandemic presupposes the existence of health professionals with adequate knowledge and preparedness, as part of a continuous response and strategic readiness plan. Within this context, high-quality PHC has the potential to reduce the incidence of cases in the population, directly impacting morbidity, mortality, and case fatality rates. It is thus a challenge to prevent PHC services from becoming understaffed, as PHC providers are themselves in a high-risk situation.⁹⁻¹¹

As soon as the first case of COVID-19 was detected in Brazil, the media focused almost exclusively on this subject, although many states did not have any officially

notified cases.¹² According to Helioterio et al.,¹³ there is a consensus that health workers are those most affected. As of April 2020, the Brazilian Ministry of Health reported that 31,790 health workers had been infected with COVID-19 in Brazil. Around the same time, 4,576 healthcare providers off work for suspected COVID-19 in the municipal health system of São Paulo, with 13% of these later confirmed as infected. According to Special Epidemiological Bulletin No. 21, issued by the Ministry of Health and its Department of Health Surveillance,¹⁴ as of July 6, 2020, there had been 176 deaths of health professionals in the country. The prevalence of mortality was highest among nursing technicians and aides ($n = 67$), followed by physicians

Table 3. Training, preparedness, and areas where additional training required

Variable	MS (n=50)	PR (n=86)	SP (n=48)	Total
	n (%)	n (%)	n (%)	n (%)
Received training				
Yes	25 (50.0)	49 (56.9)	23 (47.9)	97 (52.7)
No	25 (50.0)	37 (43.0)	25 (52.0)	87 (47.3)
Feels prepared				
Moderately prepared	33 (66.0)	45 (52.3)	28 (58.3)	106 (57.6)
Poorly prepared	10 (20.0)	34 (39.5)	12 (25.0)	56 (30.5)
Very prepared	5 (10.0)	3 (3.4)	3 (6.2)	11 (5.9)
Unprepared	2 (4.0)	2 (2.3)	3 (6.2)	7 (3.8)
Can't say	-	2 (2.3)	2 (4.1)	4 (2.1)
Areas where skills need improvement				
Clinical management	23 (46.0)	56 (65.1)	29 (60.4)	108 (58.6)
PPE	25 (50.0)	40 (46.5)	18 (37.5)	83 (45.1)
Prevention	27 (54.0)	34 (39.5)	18 (37.5)	79 (42.9)
Surveillance	20 (40.0)	35 (40.6)	15 (31.2)	70 (38.0)
Screening	18 (36.0)	32 (37.2)	13 (27.0)	63 (34.2)
Communication	13 (26.0)	23 (26.7)	12 (25.0)	48 (26.0)
No improvement needed	2 (4.0)	-	1 (2.0)	3 (1.6)
Preferred training modality				
Face-to-face	30 (60.0)	56 (65.1)	30 (62.2)	116 (63.0)
Online courses	26 (52.0)	44 (51.1)	32 (66.6)	102 (55.4)
Mobile apps	17 (34.0)	26 (30.2)	22 (45.8)	65 (35.3)
Webinars	13 (26.0)	27 (31.3)	19 (39.5)	59 (32.0)
Lectures	5 (10.0)	24 (27.9)	14 (29.1)	43 (23.3)

MS = state of Mato Grosso do Sul; PPE = personal protective equipment; PR = state of Parana; SP = state of Sao Paulo.

(n = 31) and registered nurses (n = 21), considering deaths from COVID-19 and unspecified causes and deaths under investigation.

Regarding the matter of provider knowledge and preparedness, it was reported that, in China, the contamination of health workers early in the pandemic was facilitated by inadequate use of protective equipment.¹⁵ There is strong evidence of human error of an operational nature, particularly involving false perceptions of an invisible risk and underestimation of individual responsibility, compounded by stress and fatigue.¹⁶ Furthermore, according to Zhang et al.,¹⁷ health professionals who were not on the frontline were less likely to adhere to quarantine measures.

In the states of São Paulo, Mato Grosso do Sul, and Paraná, most health professionals reported having moderate knowledge (54.3%) or ample knowledge (44.1%) about the ways in which COVID-19 spreads, with most seeking information on a daily basis (63.58%), predominantly from handbooks and technical guidance documents (89.6%). A study of 1,357 health professionals in Henan Province, China, near Wuhan, reported that 89% had knowledge deemed “sufficient”, with physicians having the highest scores.¹⁷ Saqlain et al.¹⁸ reported that, in a sample of 414 respondents, the majority reported having good knowledge (93.2%), mostly obtained through social media (87.68%). Mbachu et al.¹⁹ also observed a high prevalence of good knowledge (88.59%) in a sample of 403 participants.

Alsubaie et al.²⁰ conducted a study during the Middle East respiratory syndrome (MERS-CoV) outbreak of 2015 to assess the knowledge, attitudes, and practices of health professionals, and later reapplied the survey to the same sample during the COVID-19 pandemic.²¹ The authors found higher scores during the COVID-19 pandemic (68% vs. 79.7%, $p < 0.001$) and concluded that previous experience with the MERS-CoV outbreak resulted in increased knowledge and adherence to protective hygiene practices, as well as reduced anxiety. Haghighi et al.²² state that sufficient knowledge is evidenced by proper attitudes and practices, corroborating McEachan et al.,²³ who note that level of knowledge influences professional preparedness and creates positive behaviors.

However, the emergency situation imposed by the pandemic, with a reduction in staffing levels, limited the time available for training,²⁴ which does not, however, free health facilities from the responsibility of training their employees. In the present survey, just over half of respondents managed to receive training (52.7%). Conversely, this percentage reveals that a significant portion of professionals remained untrained at the time, as reflected by their overall level of preparedness, which was largely self-rated as moderate (57.6%). The two main training needs mentioned by the respondents were clinical management (58.6%) and use of PPE (45.1%).

Regarding clinical management, according to the Department of Primary Care of the Brazilian Ministry of Health,²⁵ the basic PHC protocol in Brazil consists of assessments of signs and symptoms, diagnosis, telemedicine, creation of a flowchart, case detection, prevention measures, reporting, testing, community programs and surveillance, and severity stratification. In mild cases, PHC leads the care process and recommends home isolation. In severe cases, PHC facilities stabilize the patient and arrange for quick transfer to a referral hospital and/or emergency department.

Regarding the use of PPE, the level of care and type of activity (screening, sample collection for laboratory diagnosis, management of suspected or confirmed cases) must be taken into account. Proper PPE use is a priority recommendation to reduce cross-contamination.²⁶ The most important equipment includes scrub caps, goggles, face shields, masks, aprons/gowns, and gloves.²⁷ Furthermore, knowledge of how to handle, on, and off PPE, in addition to disinfecting it (when applicable) and disposing of it correctly, is essential. Equally essential are the fundamentals of administrative control and awareness of logistical capacity and of the environmental impact of materials.

Soares et al.²⁸ advise against double-gloving and sharing goggles and face shields, which should be individual, available in several sizes, and properly stored. Surgical masks must at the very least cover the nose and mouth area, have flexible and adjustable nose clips, and provide high fluid resistance, good breathability, multiple (inner/outer) layers, and an inner filtering element, and must never be worn over an N95 or equivalent respirator.

N95 respirators can be reused following manufacturer guidelines on durability. General recommendations include checking respirator integrity and seal; checking for saturated creases and soiled, damp, and/or crumpled spots; and ensuring that the respirator was used in conjunction with a face shield.

The participants of this survey reported a preference for in-person training (63%), followed by online courses (55.4%). The Brazilian Unified Health System certainly needs to improve its technological capacity to face epidemics and pandemics. Alwashmi²⁹ notes that digital health produces rapid information, allowing for anticipation, prevention, control, and resolution of emergencies, as seen in previous outbreaks of Ebola, influenza A (H1N1), and severe acute respiratory syndrome. Furthermore, just as telehealth does, digital health has the potential to expand access, improve care, reduce time spent, streamline costs, and support surveillance by aiding in tracking and monitoring. However, as already noted, not all professionals are trained in the use of technologies and/or virtual tools. The heterogeneity of the Brazilian territory, technical limitations, patient inadequacy, data security concerns, and acceptability by providers are all factors that must also be taken into account.³⁰ Thus, it is essential that PHC be valued and strengthened in emergencies, such as that imposed by COVID-19, as approximately 80% of mild cases and the majority of moderate ones seek primary care units as the first point of contact – as has occurred in the dengue, Zika, yellow fever, and Chikungunya epidemics.³¹

Early in the course of the pandemic, PHC providers in Brazil, especially physical therapists and nurses, reported moderate levels of knowledge and preparedness for coping

with COVID-19. Despite challenges, this knowledge was reflected in positive attitudes and practices, considering the information-seeking practices reported, the preventive measures implemented and respondents' recognition of their own needs for skill improvement, with clinical management and the use of PPE as priorities.

The findings of this survey revealed a trend towards accumulation of knowledge, which entails better preparedness of health professionals to face future epidemics and pandemics. However, health institutions must work faster in taking responsibility for training their staff and for improving their infrastructure, thus ensuring efficient service while safeguarding the physical and mental health of workers. The major limitation of this study was its online design; since the expected territorial coverage was not reached, analysis of other Brazilian states was not possible.

AUTHOR CONTRIBUTIONS

AS was responsible for the study conceptualization and project administration, including investigation, formal analysis, supervision, and writing. EP participated in the study investigation, formal analysis, and writing. CFT was responsible for data curation, formal analysis, and writing. CPBA and JAM participated in the study formal analysis and writing. MHRC participated in the study writing. LCFS participated in the study formal analysis and writing. RMR was responsible for data curation, formal analysis, and writing. CST was responsible for the study formal analysis, validation, and writing. All authors approved the final version submitted and assume public responsibility for all aspects of the work.

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