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Primary Health Care and COVID-19 patient care across regions in Brazil

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Abstract *The aim of this study was to describe the role of PHC in the delivery of care to COVID-19 patients, identifying facilitating factors and constraints to the response of PHC teams to the pandemic. We conducted a cross-sectional survey-based study with a nationally representative sample of primary health care centers (PCCs). A total of 907 PCCs from the country's five regions participated in the study. Data was collected between July and November 2021 using an online survey. The results show that PCCs in the South and Southeast were better prepared to respond to the pandemic in terms of availability of personal protective equipment and communications facilities, while PCCs in the North and Northeast performed better for health surveillance actions, educational activities, contact tracing, case monitoring and notification of cases in the influenza surveillance system. Seventy per cent of PCCs administered COVID-19 vaccines at national level and 28% and 25% had to suspend the first and second doses of the vaccine, respectively. The findings show that primary care services played an important role in the response to the pandemic despite challenges caused by the lack of national coordination.*

Key words *Primary Health Care, SARS-CoV-2, COVID-19, Health care, Working conditions*

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Introduction

The COVID-19 pandemic is the most serious health crisis in the last 100 years, resulting in more than 700,000 deaths in Brazil and 6.9 million worldwide, according to official data. However, the World Health Organization (WHO) estimates that the real number of deaths directly or indirectly attributed to the pandemic may amount to 15 million[1].

It was expected that countries with universal public health systems would have responded best to the pandemic, largely due to the structure of these systems, which are made up of expansive service networks[2]. However, better performance has been associated with high income countries[3], countries with a population of up to 14 million inhabitants, countries with higher rates of healthcare spending as a percentage of GDP and countries with good public governance[4].

Although the Brazilian government has been reckless in its management of the health crisis, by adopting a strategy to contain the spread of SARS-CoV-2[5], the country's public health system, *Sistema Único de Saúde* (SUS) or Unified Health System, has been recognized by all sectors of society as playing an essential role in preventing an even greater death toll.

Despite the important role of hospitals and increased investment in hospital care, with the expansion of beds and the capacity of intensive care units and purchase of ventilators, in most municipalities in Brazil primary health care (PHC) was the frontline the care system during the pandemic The responses to the pandemic in primary healthcare services in Brazil and other countries were influenced by organizational care models and their integration into national healthcare systems, as well as local socio-political circumstances. With few exceptions, it could be said that an opportunity to strengthen the role of PHC was missed[6].

This article seeks to describe the role of PHC in the delivery of care to COVID-19 patients, identifying facilitating factors and constraints that may have influenced the response capacity of PHC teams.

Methods

This article is part of the study titled "Primary care challenges in the SUS response to the COVID-19 pandemic - phase two". We conducted a cross-sectional survey-based study using a nationally representative sample of primary care centers (PCCs) registered in the *National Registry of Healthcare facilities* (CNES) in December 2020.

The strata were considered study domains for the purposes of sample size calculation. In each region, sample size was calculated using the following *algebraic expression* for estimating proportions:

$$n = \frac{P\,(1 - P)}{(d/z)^2}$$

where P is the population proportion to be estimated, tolerable sampling error is 0.5 and the normal curve value is z=1.96, corresponding to a 95% confidence interval[7].

The sample sizes were as follows: North and Midwest, 100 PCCS; South, 150 PCCs; and Southeast and Northeast, 200 PCCs, corresponding to a sampling error of 10, 8 and 7 points, respectively.

A total of 945 PCCs were randomly selected based on an estimated response rate of 80%. A number of PCCs were randomly selected in advance in each region as a reserve in case losses were higher than expected. The 945 randomly selected PCCs were considered the sample size to be obtained and centers excluded because they did not belong to the study population were replaced by centers from the reserve, meaning that 985 centers were contacted.

The sampling process fraction in each strata i was calculated using the following equation:

$$f_i = \frac{n_i}{N_i}$$

where n_i is the size of the randomly selected sample and N_i is the population size. The different random sampling odds used in the strata to select the services in the sample were compensated by introducing sampling weights in the data analysis stage, which were the inverse of the sampling fractions. The following sampling weights were used: North, 20.74056; Northeast, 50.73106; Southeast 39.18846; South 23.04500; and Midwest, 19.59848.

The selected PCCs were contacted by telephone to define the respondent, who was either the center manager or a health professional with a degree-level qualification. Where neither type of professional wanted to participate, the center was considered a loss. The questionnaire was made available on the REDCap[8] data capture platform between July and November 2021. For the purposes of this article, we used the data from the questions about the size and physical struc-

ture of the PCC, availability of personal protective equipment (PPE), availability of materials, communication facilities, care taken in relation to COVID-19 patient follow-up strategies, work organization, team training, patient transport, health surveillance and vaccination process.

The study variables were analyzed by region and nationally using descriptive statistics (percentages and respective 95% confidence intervals). The statistical significance of differences between regions was assessed using the chi-squared test with Rao-Scott correction for complex samples, adopting a 5% significance level and considering the sampling weights applied to the sample units, which were the inverse of the sampling fractions used in the strata.

The study protocol was approved by the ethics committee of the School of Public Health, São Paulo University (reference numbers CAAE 31414420.8.0000.5421 and 4.827.811, July 5, 2021).

Results

A total of 907 of the 945 PCCs (95.8%) participated in the study: 125 in the North, 226 in the Northeast, 248 in the Southeast, 186 in the South and 122 in the Midwest. Over half the respondents (64%; 95%CI: 61-67) were center managers and 52% (95%CI: 48-55) were professionals who had been working in the center for more than three years.

Table 1 presents information on physical structure and communication facilities. Sixty-three per cent (95%CI: 59-66) of the PCCs had only one Family Health Strategy (FHS) team and 42% (95%CI: 39-45) had two or less consulting rooms. Twenty-five per cent (95%CI: 23-29) of PCCs nationally and 46% (95%CI: 37-54) in the North and 39% (95%CI: 32-45) in the Northeast did not use an electronic health record system. Nationally, 50% (95%CI: 48-53) of PCCs had a landline telephone and 28% (95%CI: 25-31) had a cellphone. The smallest percentages were found in the Northeast, with only 15% (95%CI: 11-20) of PCCs having a landline telephone and 20% (95%CI: 16-26) having a cellphone. However, the use of online platforms for COVID-19 patient follow-up was most frequent in the Northeast, with 73% (95%CI: 67-78) of PCCs using WhatsApp and 27% (95%CI: 22-33) using video-calling devices. Improvements were made to PCC communication facilities nationally to expand the use of remote access technologies by patients and internet was installed or improved in 31% of PCCs (95%CI: 28-34) nationally and 39% of PCCs in the Northeast (95%CI: 33-46).

Table 2 presents the results of the questions on availability of PPE and materials and team training. Nationally, 45% (95%CI: 42-48) of respondents confirmed availability of all items of PPE (N95 masks, surgical masks, face shields/goggles and waterproof aprons). The worst results were found in the North (34%; 95%CI: 26-42) and Northeast (36%; 95%CI: 30-42). The region with the poorest and best availability of materials were the Northeast and South (8%; 95%CI: 5-12 and 31%;95%CI: 24-38, respectively). PPE and COVID-19 response training was provided in 57% (95%CI: 56-60) and 54% (95%CI: 50-57) of PCCs, respectively. The regions with the lowest percentages were the North and Northeast

Face-to-face consultations continued to be available in 64% (95%CI: 60-67) of the PCCs in Brazil. According to 85% (95%CI: 83-88) of the respondents, special COVID-19 centers were created in the municipality where the PCC was located. Specific patient flows were defined for suspected and confirmed cases of COVID-19 in 90% (95%CI: 87-92) of the PCCs. Family health support teams (NASF-AB) and oral health teams participated in care actions in 73% (95%CI: 69-77) and 81% (95%CI: 78-84) of PCCs, respectively. Forty-eight per cent of PCCs in the South (the highest rate across all regions) provided treatment for patients with severe COVID (95%CI: 41-55). There was referral of COVID-19 cases in 98% (95%CI: 97-99) of PCCs, with 73% (95%CI: 70-76) making the necessary referrals. Transport of patients with severe COVID was performed by the state government in 96% (95%CI: 94-97) of the PCCs (Table 3).

Regarding health surveillance, the highest percentages were found for the promotion of social isolation (98%; 95%CI: 97-99), case monitoring (90%; 95%CI: 87-91) and follow-up of patients in isolation (81%; 95%CI: 82-87). The lowest percentages were observed for RT-PCR and rapid antigen test sample collections (30%; 95%CI: 39-33 and 31%; 95%CI: 28-33, respectively) (Table 3).

Concerning the COVID-19 vaccination process, 70% (95%CI: 67-76) of PCCs in Brazil administered vaccines at the time when the survey was responded. The national rate was significantly different to the rate in the Midwest, where only 39% (95%CI: 30-47) of PCCs administered vaccines. While the cold chain was reported to be a problem in only 4% (95%CI: 3-6) of PCCs, the

Table 1. Physical structure and communication facilities available in the PCCs. Brazil, 2021.

			North % (CI95%)	Northeast % (CI95%)	Southeast % (CI95%)	South % (CI95%)	Midwest % (CI95%)	Brazil % (CI95%)
Number of teams	0	p<0.001	2 (0-6)	2 (1-5)	15 (11-20)	11 (7-17)	2 (1-7)	7 (6-9)
	1		58 (50-67)	71 (65-78)	57 (51-63)	57 (50-64)	60 (51-68)	63 (59-66)
	2		21 (15-29)	10 (7-15)	10 (7-15)	16 (11-22)	17 (11-25)	13 (11-15)
	3		11 (7-18)	6 (3-10	6 (3-9)	9 (6-14)	11 (6-18)	7 (6-9)
	4 or more		8 (4-14)	11 (8-16)	12 (8-16)	6 (4-11)	10 (6-17)	10 (8-13)
Number of consulting rooms	2 or less	p<0.001	47 (39-56)	51 (44-57)	34 (29-40)	32 (26-39)	41 (33-50)	42 (39-45)
	3 or more		53 (44-61)	49 (43-56)	66 (60-71)	68 (61-74)	59 (50-68)	58 (55-61)
Electronic health records system	Yes, e-SUS	p<0.001	48 (39-57)	53 (46-59)	55 (49-61)	41 (35-49)	69 (60-77)	53 (49-56)
	Yes, other system		6 (3-12)	9 (6-13)	27 (21 - 32)	56 (49 - 63)	20 (14-29)	22 (19-25)
	No		46 (37-54)	39 (32-45)	19 (14-24)	2 (1-6)	11 (6-18)	25 (23-29)
Communication facilities (availability)	Telephone landline	p<0.001	18 (13-26)	15 (11-20)	79 (73-84)	93 (88-96)	62 (53-70)	50 (48-53)
	Cellphone	p<0.001	26 (19-35)	20 (16-26)	29 (24-35)	41 (35-49)	35 (27-44)	28 (24-31)
	Internet connection	p<0.001	77 (69-83)	91 (86-94)	98 (95-99)	98 (95-99)	98 (93-99)	93 (91-95)
	Adequate internet quality	p<0.001	58 (50-67)	78 (73-83)	77 (72-82)	82 (75-87)	71 (63-79)	76 (73-79)
Improvements in PCC infrastructure after COVID-19	Cellphone	p=0.001	18 (13-26)	12 (9-17)	19 (15-25)	26 (20-33)	26 (19-35)	18 (16-21)
	Telephone landline	p<0.001	5 (2-10)	6 (4-10)	26 (21-32)	30 (24-37)	21 (15-30)	17 (15-30)
	New computers	p=0.337	18 (13-26)	16 (12-21)	21 (17-27)	18 (13-25)	23 (16-31)	19 (16-22)
	Internet installed or improved	p<0.001	24 (17-32)	39 (33-46)	25 (20-31)	23 (17-29)	34 (27-43)	31 (28-34)
	Access to Zoom, Meet, Teams made available by management	p=0.060	33 (25-42)	35 (29-41)	44 (38-50)	44 (37-51)	37 (29-46)	39 (36-46)

Source: Authors.

administration of the first dose was suspended due to vaccine shortages in 28% (95%CI: 25-31) of PCCs. This rate was highest in the South (40%; 95%CI: 33-48). The second dose was suspended in 25% (95%CI:22-28) of PCCs (Table 3).

The Midwest was the region with the lowest percentage of PCCs performing contact tracing among priority groups (81%; 95%CI: 67-90) and individuals who had not received the second dose (77%; 95%CI: 62-87). The Northeast was the region with the lowest percentage of PCCs that reported adverse effects (68%; 95%CI: 61-74) (Table 3).

Discussion

While the results illustrate the important work done by primary care services in Brazil, they also emphasize some of the challenges faced during the pandemic, which were exacerbated by poor national coordination. The findings also highlight regional disparities and differences in the work processes of family health teams across the country. PHC plays an essential role in ensuring the delivery of quality care for usual common infections and COVID-19, performing essential public health functions. Appropriate, evidence-based guidelines play a key role in ensuring that the quality of care is maintained, particularly during pandemics[9].

With regard to the organization of care for suspected and confirmed cases of COVID-19, in general, the findings reveal a gradient between the South and other regions, especially the North and Northeast. The Midwest and Southeast showed middling results. The Sul stood out predominantly in individual care actions and

Table 2. Availability of PPE, materials and COVID-19 response training in PCCs. Brazil, 2021.

Variables			North % (CI95%)	Northeast % (CI95%)	Southeast % (CI95%)	South % (CI95%)	Midwest % (CI95%)	Brazil % (CI95%)
PPE (availability in PCC)	N95 masks	p<0.001	47 (39-56)	50 (44-57)	67 (61-73)	75 (68-80)	66 (58-74)	60 (57-63)
	Surgical masks	p=0.028	82 (75-88)	85 (80-89)	91 (87-94)	94 (90-97)	91 (84-95)	88 (86-91)
	Face shield/ goggles	p<0.001	60 (51-68)	62 (55-68)	78 (72-83)	89 (84-93)	73 (64-80)	72 (68-75)
	Waterproof apron	p<0.001	57 (48-65)	61 (55-67)	74 (68-79)	74 (70-82)	61 (52-69)	67 (64-70)
	All items of PPE	p<0.001	34 (26-42)	36 (30-42)	53 (47-59)	58 (51-64)	43 (35-52)	45 (42-48)
Materials (sufficiency in PCC)	Oximeter	p=0.012	74 (65-80)	73 (67-79)	75 (69-80)	84 (78-88)	75 (67-82)	75 (72-78)
	Oxygen	p<0.001	28 (21-37)	23 (18-29)	62 (56-68)	79 (73-84)	54 (45-63)	46 (43-49)
	Infrared thermometer	p<0.001	46 (37-54)	50 (43-56)	59 (53-65)	68 (61-75)	61 (53-69)	56 (53-59)
	Teste RT-PCR	p<0.001	30 (23-39)	43 (37-50)	46 (40-53)	66 (58-72)	43 (34-52)	46 (43-49)
	Rapid antigen tests	p=0.031	48 (39-57)	47 (41-54)	48 (42-54)	56 (49-63)	45 (36-54)	49 (45-52)
	All materials	p<0.0001	10 (6-17)	8 (5-12)	19 (15-24)	31 (24-38)	22 (16-30)	16 (14-18)
Training	PPE training	p=0.008	49 (40-58)	51 (45-58)	64 (58-70)	57 (50-64)	65 (56-73)	57 (54-60)
	COVID-19 response training	p=0.020	45 (36-54)	49 (42-55)	61 (55-67)	52 (45-60)	57 (48-66)	54 (50-57)

Source: Authors.

services, showing better capacity, availability of equipment and testing materials, and infrastructure.

On the other hand, the North and Northeast regions stood out in relation to the collective aspects of PHC and teamwork in educational and community actions, monitoring of cases, as well as vaccination against COVID-19 and the active search for users overdue for the second dose.

A study by Castro *et al.*[10] revealed distinct patterns in the spread of COVID-19 across Brazil, resulting in what they called "concurrent COVID-19 epidemics". They found that as the virus moved to inland areas, demand for scarce and distant resources intensified, meaning that it was not possible to prevent fatalities. The authors underlined regional differences, highlighting the case of the state of Ceará in the Northeast, which experienced the silent circulation of the virus for around one month (end of April to the middle of May 2020) before the first case was officially reported. Although the state witnessed a high rate of COVID spread, it ranked third-last in deaths, suggesting that, despite the continued spread of the virus, local actions were successful in preventing deaths.

The results of the present study also indicate that care actions and surveillance were more frequent in PCCs in the Northeast. The fact that prevention and mitigation actions were implemented as soon as the first cases were identified lessened the effects of the pandemic. Although responses differed markedly across states due to the absence of centralized federal government measures, there was a significant reduction in the number of COVID-19 deaths in this region as a result of the social distancing measures and health actions implemented by state governments[11].

PPE shortages, especially at the beginning of the pandemic, have been described in the literature. Strategies used to address PPE shortages included prioritizing professionals in direct contact with confirmed cases of COVID-19[12-15]. Based on our findings, it is evident that PCCs suffered shortages of PPE, especially N95/FFP2 masks, during spikes in COVID-19 transmission.

A study by Giovanella *et al.*[16] found that availability of PPE in primary care services in June 2020 was sufficient in only 24% of cases. In the present study, this percentage was 45% (95%CI: 42-48). The same study showed that essential

Table 3. Work organization, surveillance and vaccination in PCCs in response to the COVID-19 pandemic. Brazil, 2021.

Variables			North % (CI95%)	Northeast % (CI95%)	Southeast % (CI95%)	South % (CI95%)	Midwest % (CI95%)	Brazil % (CI95%)
Care (Forms of COVID-19 case monitoring and follow-up)	Creation of specific COVID unit	p=0.485	90 (83-94)	85 (79-89)	83 (78-88)	88 (83-92)	85 (78-91)	85 (83-88)
	Telephone	p<0.001	70 (61-77)	81 (75-86)	90 (85-93)	89 (84-93)	91 (84-95)	85 (82-87)
	WhatsApp	p<0.001	66 (57-73)	73 (67-78)	56 (50-62)	71 (64-77)	66 (57-73)	66 (63-69)
	Video calls	p=0.007	19 (13-27)	27 (22-33)	17 (13-22)	17 (12-23)	16 (11-24)	21 (18-24)
	Face-to-face consultations in the PCC	p=0.127	74 (65-81)	60 (54-66)	67 (60-72)	63 (56-70)	61 (53-70)	64 (60-67)
	Home visits	p=0.018	77 (69-83)	70 (64-76)	67 (60-72)	59 (52-66)	58 (49-67)	67 (64-70)
	NASF-AB team support	p=0.460	71 (60-79)	76 (69-82)	71 (63-77)	68 (58-76)	76 (65-84)	73 (69-77)
	Oral health team support	p=0.590	81 (72-87)	84 (78-88)	79 (73-83)	82 (75-87)	80 (72-86)	81 (78-84)
Work organization	Extending opening hours	p<0.001	30 (22-38)	27 (21-33)	15 (11-19)	20 (15-27)	18 (12-26)	21 (19-24)
	Specific COVID-19 patient flows	p<0.001	82 (74-87)	86 (81-90)	95 (91-97)	94 (89-96)	89(82-94)	90 (87-92)
	Treatment of severe COVID-19 patients	p<0.001	38 (30-46)	20 (15-26)	30 (24-36)	48 (41-55)	34 (27-43)	30 (27-33)
	Reference for referral	p=0.506	99 (94-99)	98 (95-99)	98 (96-99)	97 (94-99)	96 (90-98)	98 (97-99)
	Manages to refer	p=0.067	69 (60-76)	71 (65-77)	78 (73-83)	69 (62-75)	69 (60-76)	73 (70-76)
Transport (severe cases)	Provided by state government	p=0.619	94 (89-97)	95 (91-97)	97 (94-98)	97 (94-97)	96 (90-99)	96 (94-97)
Surveillance	PCC is informed of cases confirmed by other services	p=0.259	71 (63-78)	80 (74-84)	80 (75-85)	77 (70-82)	73 (64-80)	78 (75-81)
	PCC is informed of hospitalization of its patients	p=0.007	55 (46-64)	72 (66-78)	69 (62-74)	62 (55-69)	58 (49-67)	67 (64-70)
	PCC registers cases in the e-SUS VE	p=0.035	76 (69-83)	72 (65-77)	72 (66-77)	60 (53-67)	65 (56-73)	70 (67-73)
	RT-PCR material collection	p<0.001	22 (16-31)	20 (16-26)	35 (29-41)	49 (42-56)	27 (20-36)	30 (27-33)
	Material collection rapid antigen test	p=0.0001	29 (22-37)	22 (17-28)	36 (31-42)	40 (33-47)	37 (29-46)	31 (28-34)
	Encourages social isolation	p=0.504	98 (94-99)	99 (96-99)	98 (95-99)	98 (95-99)	96 (90-98)	98 (97-99)
	Contact tracing	p<0.001	80 (72-86)	88 (83-92)	82 (77-87)	73 (66-79)	76 (68-83)	82 (80 -85)
	Follow-up of isolated patients	p=0.088	83 (76-89)	89 (84-92)	81 (76-85)	83 (77-88)	83 (75-87)	84 (82-87)
	Case monitoring	p<0.001	92 (86-96)	94 (90-97)	85 (81-89)	84 (78-88)	91 (84-95)	90 (87-91)
	Educational activities	p<0.001	91 (85-95)	96 (92-98)	81 (75-85)	80 (73-85)	86 (79-91)	87 (86-89)

it continues

materials for the care of COVID-19 patients were also scarce and that 34% of the respondents reported there were enough oximeters, 35% reported that there was sufficient oxygen, 19% reported there were enough infrared thermometers and 45% reported there were sufficient RT-PCR tests. In comparison, the present study showed that oximeters were available in 75% (95%CI: 72-78) of PCCs, oxygen in 46% (95%CI: 43-49), infrared thermometers in 56% (95%CI: 53-59) and RT-PCR tests in 46% (95%CI: 43-49).

The need to provide care for COVID-19 patients led to changes in the day-to-day functioning of health centers. Studies[17,18] reveal changes

Table 3. Work organization, surveillance and vaccination in PCCs in response to the COVID-19 pandemic. Brazil, 2021.

Variables			North % (CI95%)	Northeast % (CI95%)	Southeast % (CI95%)	South % (CI95%)	Midwest % (CI95%)	Brazil % (CI95%)
Vaccination COVID-19	PCC administers vaccination against COVID-19	p<0.001	70 (62-78)	80 (74-85)	71 (65-76)	62 (55-69)	39 (30-47)	70 (67-73)
	Use of leftover vaccines	p=0.154	50 (40-60)	40 (33-48)	46 (39-54)	41 (32-50)	55 (41-69)	44 (40-48)
	All PCC professionals vaccinated	p=0.123	95 (88-98)	95 (91-97)	99 (96-100)	95 (89-98)	89 (77-96)	96 (94-97)
	Problems in the cold chain	p=0.309	7 (3-14)	5 (3-9)	4 (2-8)	2 (0-7)	2 (0-14)	4 (3-6)
	First dose suspended due to vaccine shortages	p<0.001	14 (9-22)	30 (24-36)	24 (19-30)	40 (33-48)	30 (23-39)	28 (25-31)
	Second dose suspended due to vaccine shortages	p=0.103	17 (11-24)	26 (21-32)	25 (20-30)	30 (23-37)	25 (18-33)	25 (22-28)
	Vaccination suspended due to syringe shortages	p=0.546	0	3 (1-7)	3 (1-7)	1 (0-6)	0	2 (1-4)
	Contact tracing priority groups	p=0.011	93 (86-97)	96 (92-98)	89 (83-93)	90 (82-94)	81 (67-90)	92 (90-94)
	Contact tracing for people who have not received second dose	p=0.019	89 (80-94)	95 (91-97)	89 (83-93)	87 (79-92)	77 (62-87)	91 (88-93)
	List of patients with high blood pressure/diabetes was used	p<0.001	92 (84-96)	95 (91-97)	84 (78-89)	82 (74-88)	85 (72-93)	89 (86-91)
	Notifies adverse effects	p<0.001	73 (62-81)	68 (61-74)	89 (84-93)	92 (86-96)	87 (74-94)	79 (75-82)
	Staff expansion	p=0.181	49 (39-59)	45 (38-53)	39 (32-47)	39 (31-48)	28 (17-42)	42 (38-46)

Source: Authors.

in patient flows and the creation of specific areas and teams to treat cases in order to minimize circulation and streamline treatment.

Different approaches to patient care and surveillance were widely adopted in PCCs across Brazil, especially in the Northeast. These approaches focused on COVID-19 patient monitoring using different means of communication, such as the telephone and WhatsApp, encouraging social isolation and contact tracing. Similar strategies, especially screening and monitoring of the clinical evolution of cases, were encouraged by health bodies in other countries[10,19-23]. The surveillance actions developed by primary care services in Brazil were also encouraged in countries such as China, Canada, Malaysia, Ethiopia, Nigeria and India[10,24-29].

Fernandez *et al.*[30] describe the use of telemedicine and social media to monitor families, highlighting that digital exclusion is one of the challenges faced by PHC professionals. Lotta *et al.*[31] stress that these technologies should not replace face-to-face contact and the close relational approach adopted by family health teams.

The use of telemedicine facilitated continuity of care for COVID-19 patients, but not without challenges. Adequate IT infrastructure is essential to optimize remote consultations[32]. Low levels of education and digital literacy, together with language barriers, are common barriers for patients. Providers have concerns related to digital literacy, clinical process flows and legal liabilities. The lack of an integrated telehealth care model covering diagnostics, prescriptions, and medication supply mirrors the existing fragmentation of care delivery[33].

Different strategies were adopted at the beginning of the vaccination process. In the Midwest, this process took place largely outside PCCs. While vaccination points were created in some municipalities[34], it is noteworthy that only 39% of PCCs (95%CI: 30-47) in this region

administered vaccinations. There was a need to suspend the administration of both the first and second dose of the vaccine in all regions. In the South, the first and second dose was suspended in 40% and 30% of PCCs, respectively. According to Hallal[35], if the federal government had given due priority to vaccine purchases, 75% of the lives lost to COVID-19 could have been saved.

In a study conducted in Tunisia, Melki *et al.*[36] report that PHC played an important role in the early stages of the pandemic, even though it was marginalized from the national COVID-19 strategy, as occurred in Brazil, where priority was given to strengthening the structure of the hospital system. A study undertaken by Yang *et al.*[37] in China highlights that primary care doctors should immediately refer suspected cases to specialized hospitals for diagnosis and treatment because primary care services lack adequate infrastructure and technical capacity to deal with cases.

However, the capillarity of PCCs and the FHS in Brazil are strengths that could have been better harnessed in the country's response to the COVID-19 pandemic[17,18]. A study by Cirino *et al.*[38] showed that despite challenges related to the reorganization of local processes and ambience, equipment and supplies shortages, institutional communication problems and lack of coordination with other health services, PHC played an important role in the response to the COVID-19 pandemic.

Conclusion

The present study provides a broad overview of the role played by PHC in the response to the COVID-19 pandemic and patient care. The findings reveal that more than one year after the start of the pandemic in Brazil, substantial challenges remain in the provision of materials, equipment and PPE, with the worst results being found in the North and Northeast.

It was necessary to adapt care practices in PCCs to respond to the pandemic, adopting remote care methods, changes in work processes, treating patients with respiratory syndrome separately from other patients, and remote consultation and monitoring. Health surveillance actions such as encouraging social isolation and case monitoring were one of the positive aspects, although diagnostic testing was less than ideal. With regard to the vaccination process, availability of doses was a challenge.

The results highlight the need for greater investment in PCC infrastructure and facilities, especially in the most vulnerable regions of the country, to strengthen communication, improve the availability of PPE and materials, provide staff training, increase testing capacity and enhance surveillance. While this study provides a snapshot of a specific period and may therefore not capture changes implemented as the pandemic progressed, such as changes in policy and PCC organization, the results provide health managers and decision-makers important insights that can contribute to the formulation of policies to tackle the COVID-19 pandemic and plan for future pandemics.

Collaborations

PHS Mota: study design and planning, data collection, analysis and interpretation, and drafting and revising the manuscript. FR Santana: data collection, analysis and interpretation, and drafting and revising the manuscript. MLF Rizzotto: data collection, analysis and interpretation, and drafting and revising the manuscript. GC Cury: study design and planning, data collection and revising the manuscript. L Giovanella: study design and planning, data collection and revising the manuscript. LA Facchini: study design and planning, data collection and revising the manuscript. A Bousquat: study design and planning, data collection, analysis and interpretation, and revising the manuscript.

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