



Personal protective equipment: Analysis of supply among midwives during the COVID-19 pandemic in Peru

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ABSTRACT

Objective: To report the details of provision of personal protective equipment to midwives during the COVID-19 pandemic in Peru

Methods: This is a non-experimental, descriptive, cross-sectional study. An online survey of 679 midwives working at public healthcare centres was conducted via questionnaires. The following aspects were outlined: method of supply and frequency of delivery of personal protective equipment, type of personal protective equipment provided by the institution, and self-purchase. Furthermore, features of the midwives' workplace were described. For statistical analysis, absolute frequencies and relative proportions were used for categorical variables, and mean and standard deviation were used for numerical variables.

Measurements and findings: The most important finding of this study is that a large proportion of midwives (66.6%) did not receive new personal protective equipment for each shift; 41.9% of midwives who received personal protective equipment during each shift exclusively provided services in the COVID-19 ward, whereas 27.6% did not. The least received supplies were of N95 respirator masks (41.7%) and disposable isolation suit gown (50.5%). Only a certain proportion of midwives (38.6%) were trained by their own institutions on the use of personal protective equipment.

Key conclusions: The provision of personal protective equipment to midwives and training on personal protective equipment were insufficient at all workplaces. Therefore, measures must be taken to increase the supply of this material to midwives who are essential workers in reproductive health.

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Introduction

The current COVID-19 pandemic has deeply impacted health systems and uncovered the lack of hospital capacity and manpower (Gilbert et al., 2020; Emanuel et al., 2020) and poses huge challenges and risks for healthcare providers, who are not only exposed to a higher risk of infection but also have high workload and mental stress due to several moral dilemmas (Chersich et al., 2020). In Italy, overall 20% of the healthcare workers have been infected (Lancet, 2020). In the Americas, 1,208,370 confirmed cases in healthcare providers and 5,780 deaths were reported up to 14 January 2021 (World Health Organization, 2021).

In this framework, the use of personal protective equipment (PPE) is a crucial aspect of working conditions during such emergencies. PPE effectively protects healthcare workers and patients against COVID-19 by reducing the probability of transmission (Ağalar et al., 2020; Cook, 2020). This is becoming increasingly relevant with the increase in mortality rate among healthcare workers due to the lack of equipment (Browden et al., 2020). However, disruption of production chain and increased demand has severely limited PPE supply during the COVID-19 pandemic (Morales-Contreras et al., 2021; Armendáriz and Sierra, 2021).

According to the World Health Organization (WHO), PPE includes items such as gloves, surgical masks, safety glasses, face shields, and medical gowns. Additionally, for certain procedures, a respirator mask (N95, FFP2, FFP3, or equivalent) and medical gowns are necessary (World Health Organization, 2020). However, PPE availability decreased as the pandemic progressed, which

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led to further increase in the incidence of infection in healthcare providers; consequently, transmission rate between healthcare workers, patients, and relatives increased (Zhang et al., 2020).

In the Americas, approximately 139,016 cases of pregnant women with COVID-19 and 802 deaths (1%) were reported in 19 countries until the first half of January 2021, whose data are available. In Peru, since the first confirmed case of COVID-19, 40,468 pregnant women have been diagnosed with COVID-19 (Pan American Health Organization, 2020). Despite this, midwives have continued to provide maternal, reproductive, and sexual healthcare services, in many circumstances, without adequate PPE to provide patient care. Furthermore, in developing countries, it is impossible to perform a COVID-19 test for all pregnant women, and asymptomatic cases may exist within this group (The Royal College of Midwives, 2020), thereby increasing the risk of infection in healthcare providers (Sharma and Sharma, 2020). According to the Peruvian College of Midwives (Colegio de Obstetras del Perú, 2020), 2,890 midwives were infected with COVID-19 as of 23 September 2020, of whom 30 died.

This study aims to understand and attempts to elucidate care measures received by midwives as an early first approach; hence, it attempts to answer the following questions: How often did Peruvian midwives get PPE during the COVID-19 pandemic? Who supplied PPE to them during the pandemic? Have they been trained on the use of PPE by their own institution or were they self-taught? How frequently did they have a COVID-19 test and what type of test was it according to their workplace type?

Methods

This non-experimental, descriptive, cross-sectional study included midwives working at public health centres.

To estimate the sample size, assuming an infinite population, a 95% confidence interval was selected, as well as a 50% approximate proportion with the event and a margin of error of 5%. Accordingly, the sample size required was 384 participants, but 843 participants were initially included, of whom 164 were subsequently excluded (58 had administrative positions, 39 were part of COVID-19 rapid response teams, 36 provided SERUMS care, 17 were in the private health sector, 13 responses had incomplete data, and 1 refused to participate in the study). Finally, 679 midwives fulfilled all selection criteria. Non-probability convenience sampling was employed.

The primary outcome variable was the characteristics of provision of PPE, including the frequency of supply, type of PPE provided by institutions, and whether PPE was provided by institutions or self-purchased. Furthermore, training on the use of PPE,

frequency of COVID-19 screening, and workstation features of midwives were secondary outcome variables.

Workstation features include hospital capacity where the midwives worked (based on whether the hospital was primary, secondary, or tertiary, primary healthcare is considered to have the lowest capacity); healthcare services, referring to the work area, such as labour room, where midwives provide healthcare and help in delivery; health offices, referring to areas where they provide prenatal care and sexual and reproductive health care; gynaecology and obstetrics emergency rooms; and hospitalisation wards where high-risk pregnancies and postpartum period are monitored. In addition, exclusive COVID-19 services were included because many healthcare centres had set up services for the exclusive care of pregnant and postpartum women with this diagnosis.

The questionnaire was prepared using the structured survey method and adapted to a virtual form using Google Forms application. This survey had 23 questions divided into four sections: method of supplying PPE (11 questions), self-purchase of PPE (3 questions), training on the use of PPE (2 questions), COVID-19 screening test (2 questions), and workplace features (5 questions). This form included an informed consent statement. It is important to mention that the survey was created at the researchers' own expense, and content validation was performed by three experts to obtain a reliable Cohen's kappa coefficient of 0.78. In addition, a pilot test was conducted on 15 midwives to measure reliability in the instrument, and a reliable Kuder Richardson value of 0.8 was obtained.

Instrument sharing and promotion were initiated from 27 August to October 2020 through the researchers' social networks and in the official media of 'Colegio de Obstetras del Perú'. Finally, the database was downloaded for processing.

The downloaded database underwent a quality assessment of the records, and those that did not fulfil the eligibility criteria were deleted. The final database was exported to a statistical processing program. Descriptive statistics were required; absolute frequencies and relative proportions were used for categorical variables, and mean and standard deviation were used for numerical variables.

The current research project received approval from the Ethics Board of the Hospital Nacional Docente Madre Niño San Bartolomé. Moreover, an online informed consent form was used to ensure voluntary participation and confidentiality of participant data; a number was assigned as ID to each participant.

Results

The mean age of the midwives was 42.7 ± 9.39 years. A large proportion of them (66.6%) did not receive a new PPE for each

Table 1
Frequency of supply of personal protective equipment (PPE) to Peruvian midwives during the COVID-19 pandemic (n = 679).

Workplace Features	Total n (%)	PPE supply frequency				
		Each shift n (%)	Weekly n (%)	Biweekly n (%)	Monthly n (%)	More than a month n (%)
Hospital capacity						
Primary	465 (68.5)	124 (26.7)	117 (25.2)	86 (18.5)	82 (17.6)	56 (12.0)
Secondary	146 (21.5)	60 (41.1)	35 (24.0)	23 (15.8)	17 (11.6)	11 (7.5)
Tertiary	68 (10.0)	43 (63.2)	9 (13.3)	6 (8.8)	9 (13.2)	1 (1.5)
Healthcare services						
Obstetric centre	131 (19.4)	57 (43.5)	26 (19.8)	15 (11.5)	24 (18.3)	9 (6.9)
Consultation room	341 (50.2)	60 (17.6)	95 (27.9)	74 (21.7)	62 (18.1)	50 (14.7)
Emergency room	131 (19.4)	73 (55.7)	27 (20.6)	15 (11.5)	14 (10.7)	2 (1.5)
Hospitalisation	76 (11.2)	37 (48.7)	13 (17.1)	11 (14.5)	8 (10.5)	7 (9.2)
Exclusive COVID-19 service						
Yes	277 (40.8)	116 (41.9)	61 (22.0)	37 (13.4)	39 (14.0)	24 (8.7)
No	402 (59.2)	111 (27.6)	100 (24.9)	78 (19.4)	69 (17.2)	44 (10.9)
Total	679 (100)	227 (33.4)	161 (23.7)	115 (16.9)	108 (15.9)	68 (10.0)

Table 2

Institutional supply and self-acquisition of personal protective equipment (PPE) items to Peruvian midwives during the COVID-19 pandemic (n = 679).

PPE items	Institutional supply			Self-acquisition	
	Never n (%)	Sometimes n (%)	Always n (%)	Yes n (%)	No n (%)
N95 mask	283 (41.7)	285 (42.0)	111 (16.3)	385 (56.7)	294 (43.3)
KN95 mask	311 (45.8)	238 (35.1)	130 (19.1)	292 (43.0)	387 (57.0)
Surgical mask	57 (8.4)	109 (16.1)	513 (75.5)	222 (32.7)	457 (67.3)
Safety glasses	238 (35.1)	341 (50.2)	100 (14.7)	357 (52.6)	322 (47.4)
Disposable cap	30 (4.4)	135 (19.9)	514 (75.7)	135 (19.9)	544 (80.1)
Surgical gloves	157 (23.1)	166 (24.5)	356 (52.4)	135 (19.9)	544 (80.1)
Disposable surgical gown	26 (3.8)	213 (31.4)	440 (64.8)	165 (24.3)	514 (75.7)
Face shield	271 (39.9)	281 (41.4)	127 (18.7)	546 (80.4)	133 (19.6)
Protective coverall	343 (50.5)	225 (33.1)	111 (16.4)	442 (65.1)	237 (34.9)
Disposable boots	177 (26.1)	193 (28.4)	309 (45.5)	107 (15.8)	572 (84.2)

Table 3

Supply of personal protective equipment (PPE) items to Peruvian midwives in exclusive COVID-19 service (n = 679).

Item received *	Exclusive COVID-19 service	
	No n (%)	Yes n (%)
N95 mask	219 (54.5)	177 (63.9)
KN95 mask	211 (52.5)	157 (56.7)
Surgical mask	365 (90.8)	257 (92.8)
Safety glasses	244 (60.7)	197 (71.1)
Disposable cap	378 (94.0)	271 (97.8)
Surgical gloves	296 (73.6)	226 (81.6)
Disposable surgical gown	382 (95.0)	271 (97.8)
Face shield	239 (59.5)	169 (61.0)
Protective coverall	163 (40.5)	173 (62.5)
Disposable Boots	277 (68.9)	225 (81.2)

* Estimate based on midwives who report having received 'sometimes' or 'always' some PPE item.

Table 4

Training and self-training on the use of personal protective equipment (PPE) to Peruvian midwives during the COVID-19 pandemic (n = 679).

Workplace Features	Training and self-training on the use of PPE			
	Institutional training		Self-training	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)
Hospital capacity				
Primary	164 (35.3)	301 (64.7)	407 (87.5)	58 (12.5)
Secondary	60 (41.1)	86 (58.9)	128 (87.7)	18 (12.3)
Tertiary	38 (55.9)	30 (44.1)	60 (88.2)	8 (11.8)
Healthcare services				
Obstetric centre	58 (44.3)	73 (55.7)	115 (87.8)	16 (12.2)
Consultation room	118 (34.6)	223 (65.4)	297 (87.1)	44 (12.9)
Emergency room	55 (42.0)	76 (58.0)	118 (90.1)	13 (9.9)
Hospitalisation	31 (40.8)	45 (59.2)	65 (85.5)	11 (14.5)
Exclusive COVID-19 service				
Yes	124 (44.8)	153 (55.2)	237 (85.6)	40 (14.4)
No	138 (34.3)	264 (65.7)	358 (89.1)	44 (10.9)
Total	262 (38.6)	417 (61.4)	595 (87.6)	84 (12.4)

shift. Only those working at tertiary healthcare centres (63.2%) received a new PPE every shift. According to the type of workplace, almost 18% of midwives who worked in the labour ward and healthcare office received a new PPE monthly. On the other hand, the proportion of midwives who received a new PPE every shift was higher if they provided exclusive care for women with COVID-19 (41.9%) (Table 1).

Based on the PPE type provided by the institution, most midwives reported that they did not receive isolation suit gowns (50.5%), KN95 masks (45.8%), and N95 respirator masks (41.7%). The mean expense for self-purchased PPE was 97.37 ± 127.36 dollars (USD). Moreover, face shields (80.4%), isolation suit gowns (65.1%), and N95 respirator masks (56.7%) were most frequently purchased (Table 2).

Midwives who worked solely in COVID-19 care, compared with those who did not, received a higher number of different PPE items such as surgical masks (92.8% vs. 90.8%) and disposable caps (97.8% vs. 94.0%). In addition, the least supplied items in both groups were N95 (63.9% vs. 54.5%) and KN95 masks (56.78% vs. 52.5%) (Table 3).

A substantial proportion of midwives (61.4%) were not trained in the use of PPE by their own institution; of the midwives who received training, 55.9% worked at tertiary healthcare centres. Furthermore, 55.2% of midwives who worked solely in COVID-19 care were not trained. On the other hand, 87.6% of them were self-trained in the use of PPE (Table 4).

Regarding the frequency of COVID-19 screening tests, 87.2% of midwives were screened using the rapid test kit at least once. Meanwhile, 11.6% of midwives who worked solely in the COVID-19 ward were never screened by rapid testing. With respect to the

molecular test method, 81% of midwives had never undergone this screening (Table 5).

Discussion

A total of 679 midwives included in this study were asked about the method of PPE supply. More than half of them did not receive a new PPE for every shift. In addition, major items such as N95 respirator masks and isolation suit gowns were never supplied in nearly half of the cases, forcing them to acquire it by themselves. Despite the importance of training on PPE use, only 38.6% of midwives were trained by their institutions and the other 87.6% were self-trained. With regard to exposure levels to SARS-CoV-2 in midwives, screening tests have become the main focus of healthcare centres. In most cases, this is performed using a rapid test method.

The use of PPE is a fundamental aspect of care measures for healthcare providers during the COVID-19 pandemic because it plays an important role in reducing the risk of transmission. Maintaining efficient and sustainable distribution of PPE has represented a challenge for the Peruvian public health system.

The most important finding of this study was that a large number of midwives did not receive a new PPE for each shift; hence, it is evident that PPE supply is inefficient in all workplace environments. Due to the lack of PPE, midwives' biosecurity measures were not guaranteed (World Health Organization, 2020). The Royal College of Midwives (2020) reported that 35% of midwives did not feel secure in their workplace, of whom 61% reported that this was due to the lack of proper PPE.

Table 5
SARS-CoV-2 screening to Peruvian midwives during the COVID-19 pandemic (n = 679).

Workplace Features	Rapid test screening (frequency)				Molecular screening test (frequency)					
	Never n (%)	Weekly n (%)	Biweekly n (%)	Monthly n (%)	More than a month n (%)	Never n (%)	Weekly n (%)	Biweekly n (%)	Monthly n (%)	More than a month n (%)
Hospital capacity										
Primary	66 (14.2)	47 (10.1)	63 (13.5)	106 (22.8)	183 (39.4)	386 (83.0)	6 (1.3)	6 (1.3)	16 (3.4)	51 (11.0)
Secondary	18 (12.3)	4 (2.7)	21 (14.4)	38 (26.1)	65 (44.5)	110 (75.3)	1 (0.7)	1 (0.7)	6 (4.1)	28 (19.2)
Tertiary	3 (4.4)	6 (8.8)	14 (20.6)	14 (20.6)	31 (45.6)	54 (79.4)	3 (4.4)	3 (4.4)	3 (4.4)	5 (7.4)
Healthcare services										
Obstetric centre	9 (6.9)	10 (7.6)	22 (16.8)	32 (24.4)	58 (44.3)	102 (77.9)	2 (1.5)	3 (2.3)	5 (3.8)	19 (14.5)
Consultation room	58 (17.0)	32 (9.4)	38 (11.2)	83 (24.3)	130 (38.1)	300 (87.9)	3 (0.9)	2 (0.6)	7 (2.1)	29 (8.5)
Emergency room	11 (8.4)	11 (8.4)	25 (19.1)	25 (19.1)	59 (45.0)	94 (71.8)	3 (2.3)	3 (2.3)	10 (7.6)	21 (16.0)
Hospitalisation	9 (11.8)	4 (5.3)	13 (17.1)	18 (23.7)	32 (42.1)	54 (71.1)	2 (2.6)	2 (2.6)	3 (4.0)	15 (19.7)
Exclusive COVID-19 service										
Yes	32 (11.6)	32 (11.6)	45 (16.2)	67 (24.2)	101 (36.4)	222 (80.1)	6 (2.2)	8 (2.9)	29 (10.5)	
No	55 (13.7)	25 (6.2)	53 (13.2)	91 (22.6)	178 (44.3)	328 (81.6)	4 (1.0)	2 (0.5)	13 (3.2)	55 (13.7)
Total	87 (12.8)	57 (8.4)	98 (14.4)	158 (23.3)	279 (41.1)	550 (81.0)	10 (1.5)	10 (1.5)	25 (3.6)	84 (12.4)

In different European countries, midwives requested greater protection and efficient working conditions to maintain biosecurity measures during healthcare during the COVID-19 pandemic. (Vermeulen and Jokinen et al., 2020). Similar conditions were observed in a study in Japan, where only 7% of midwives were provided with full PPE to provide labour care services (Umazume et al., 2020). These results contrast with those of our study, where 4 out of 10 midwives who provided labour care services received PPE for each shift. However, this supply frequency is considerably lower than the standard.

At the same time, our study revealed the lack of PPE items, such as N95 respirator masks, which approximately half of the midwives never received. Martin-Delgado et al. (2020) reported similar outcomes, where 70% of healthcare providers in three Latin American countries reported a lack of PPE, including N95 respirator masks (Arana Andrés, 2020). However, Self et al. (2020) and Rebman et al. (2021) showed that this situation was different among medical staff, and only a few of them related that this respirator mask (N95 type) was in shortage. This is a cause for concern because it could lead to the reuse of some PPE items, as mentioned by Boškoski et al. (2020), Company et al. (2021), Mtetwa et al. (2021), and the World Health Organization (2020). The importance of provision of N95 respirator masks to midwives resides on biosecurity measures during labour delivery, according Palatnik et al. (2020). The International Society of Ultrasound in Obstetrics and Gynaecology reported that reuse of PPE items generates aerosol spray, which leads to a higher risk of COVID-19 transmission.

Due to the inadequate provision of PPE, self-purchases of PPE items reached a mean expenditure of US \$100. A study of U.S. physicians estimated a substantially lower expenditure of \$14.33 in self-purchase (Ahmed et al., 2020). This difference may be due to the reduced need to acquire these items on their own, since the provision of PPE in this group would be more adequate in quantity and frequency, considering the nature of their functions and greater exposure to COVID-19 infections.

One study demonstrated that there may be a reduction in transmission risk as long as healthcare workers wear PPE correctly (Liu et al., 2020). For this, training of healthcare workers in PPE use is essential (Cash et al., 2021). However, slightly more than half of the midwives were not trained in PPE use, which increased to approximately 90% when it came to self-motivated training. This information was similar to that reported by Savoia et al. (2020) and Cash et al. (2021), wherein most physicians did not receive training on PPE use.

In addition to PPE as a biosecurity measure to protect healthcare workers, COVID-19 screening tests must be performed periodically. However, the findings outlined that a large proportion of midwives never received the molecular test, in contrast with the rapid serological test, which was more frequent. A similar scenario was reported by Zhao et al. (2020), who noted that almost three-quarters of health workers were screened using rapid tests.

One of the main strengths of this study is the first approach taken to describe the form of PPE provision to workers related in sexual and reproductive health and maternal health, where PPE is part of the measures applied during the COVID-19 pandemic. On the other hand, one may be related to response bias, as the survey was based on the subjective perceptions of healthcare workers.

In summary, PPE supply was inefficient because as most participants were not provided for each shift. However, the situation was better for participants who worked at tertiary healthcare facilities, such as the hospitalisation ward and COVID-19 exclusive service station. N95 respirator mask was one of the items least frequently provided to midwives. Moreover, the vast majority of mid-

wives were not trained in the use of PPE by their institutions, and COVID-19 screening was mainly performed using rapid tests.



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Ethical approval

It was approved by the Ethics Committee from San Bartolome National Teaching Hospital (Hospital Nacional Docente Madre Niño San Bartolomé). Lima - Peru.

Declaration of Competing Interest

The authors declare that we have no conflict of interest

CRediT authorship contribution statement

Natalia Valverde-Espinoza: Conceptualization, Visualization, Formal analysis, Writing – original draft. **John Barja-Ore:** Conceptualization, Visualization, Formal analysis, Writing – original draft. **Mirian Solis Rojas:** Conceptualization, Visualization, Methodology, Writing – original draft. **Margarita Pérez-Silva:** Conceptualization, Data curation, Methodology, Writing – original draft. **Rocío Herrera-Málaga:** Data curation, Methodology, Writing – original draft. **Lizardo Huamán Angulo:** Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Brenda Rodríguez López:** Methodology, Writing – original draft, Writing – review & editing.

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Supplementary materials

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