


# Maternal Perinatal Telemonitoring in the Context of the Coronavirus Disease 2019 Pandemic in a Tertiary Health Center in Peru

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## Abstract

**Objective** This study aimed to describe the characteristics of a telemonitoring program that was rapidly implemented in our institution as a response to the coronavirus disease 2019 (COVID-19) pandemic, as well as the maternal and perinatal outcomes of women who attended this program.

**Study Design** Retrospective study of patients via phone-call telemonitoring during the peak period of the COVID-19 pandemic (May 2020–August 2020). Maternal and perinatal outcomes were collected and described. Health providers' satisfaction with the telemonitoring program was assessed via an email survey.

**Results** Twenty-three (69.7%) health providers answered the survey. The mean age was 64.5 years, 91.3% were OB/GYN (obstetrician-gynecologist) doctors, and 95% agreed that telemonitoring is an adequate method to provide health care when in-person visits are difficult. The 78.7% of scheduled telemonitoring consultations were finally completed. We performed 2,181 telemonitoring consultations for 616 pregnant women and 544 telemonitoring consultations for puerperal women. Other medical specialties offering telemonitoring included gynecology, reproductive health, family planning, cardiology, endocrinology, and following up with patients with reactive serology to severe respiratory syndrome coronavirus 2 (SARS-CoV-2). The majority of the population attending our telemonitoring program were categorized as the lowest

## Keywords

- ▶ telemonitoring
- ▶ telemedicine
- ▶ prenatal care
- ▶ COVID-19
- ▶ pandemic
- ▶ perinatal outcomes

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strata, i.e., III and IV, according to the Human Development Index, and approximately 42% were deemed as high-risk pregnant women. Additionally, we reported the perinatal outcomes of 424 (63%) pregnant women, the most relevant finding being that approximately 53% of them had cesarean sections.

**Conclusion** Telemonitoring is an adequate method of continuing the provision of prenatal care when in-person visits are difficult in situations such as the COVID-19 pandemic. Telemonitoring is feasible even in institutions with no or little experience in telemedicine. The perinatal outcomes in women with telemonitoring seem to be similar to that in the general population.

## Key Points

- Telemonitoring for prenatal care is feasible even in low-income countries and in a critical scenario.
- OB/GYN doctors agreed with that telemonitoring is an adequate method to provide prenatal care.
- Maternal and perinatal outcomes are similar in women attending a telemonitoring program.

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe respiratory syndrome coronavirus 2 (SARS-CoV-2) that has posed a great challenge to every national public health system, particularly those in low-income countries. A recent systematic review has reported some adverse maternal and perinatal outcomes such as higher admission to maternal intensive care units and preterm birth.<sup>1,2</sup> Telemedicine is the practice of medicine that remotely exchanges medical information from one place to another using communication technologies to improve the health of the population.<sup>3,4</sup> In the current pandemic scenario, telemedicine plays a crucial role in delivering orientations in the absence of in-person visits.<sup>5,6</sup> A crucial problem in Peru is unequal access to health care due to geographical, cultural, and economic difficulties. In this scenario, the government focused all resources on the management of the COVID-19 pandemic given priority to people with the infectious disease. Additionally, all institutions closed the outpatient clinics, and the medical care was given in the emergency departments. Routine prenatal care was also interrupted, and pregnant women could have some health assistance exclusively in the emergency obstetric unit.

Thus, telemedicine has emerged as an opportunity to overcome such difficulties in different medical areas.<sup>7</sup> The main objective of telemedicine is to assist with the process of consultation but does not replace the in-person visit. The Instituto Nacional Materno Perinatal is the largest tertiary hospital in South America fully dedicated to providing health care to women, particularly to high-risk pregnant women and their newborns, and houses approximately 20,000 deliveries per year. We have a dedicated program of telemedicine that essentially includes teleconsultation between our medical staff and other doctors from different institutions of our country. However, we have not had any experience in the telemonitoring of patients. As this was the chosen strategy to fight COVID-19, a local telemedicine program was launched, which has been adopted by many other hospitals, whose main activity is the telemonitoring of patients via phone calls to primarily provide orientation and counseling. Similarly,

other health institutions around the world have implemented smart telemedicine programs.<sup>8,9</sup> We believe that telemonitoring is a feasible method of continuing the provision of prenatal care in the context of COVID-19 pandemic. Herein, we present our data regarding our experience in telemonitoring during the most critical periods of the COVID-19 pandemic in the setting of a tertiary hospital in Lima, Peru.

## Materials and Methods

### Telemonitoring Context in the COVID-19 Pandemic

A national document updating the telemedicine program in Peru was launched in March 2020,<sup>10</sup> which essentially defines telemonitoring as the group of activities performed by a health provider, using any telecommunication system to provide patients with orientation and counseling with the goal of promoting health and preventing disease. The Peruvian government declared a national status of emergency on March 16, 2020. As a result, those in our institutional staff who had some risk factors were identified and sent home as part of a rapid response to protect them from acquiring COVID-19. After coordinating actions with the Ministry of Health, our hospital established a local telemonitoring program to continue the provision of prenatal caregiving priority to virtual appointments.<sup>11</sup>

### Telemonitoring Protocol

We described the beginning of the telemedicine system in the context of the COVID-19 lockdown. We prepared a list of potential patients to have telemonitoring consultations by searching our institutional database for women with an ongoing pregnancy, who were identified before the COVID-19 pandemic, and by accepting direct requests of patients via phone calls or text messages. A nurse coordinator contacted every woman to get their general information, which included their national ID, insurance provider, and other demographical characteristics. These patients were assigned an appointment with an OB/GYN (obstetrician-gynecologist)

doctor. Since our hospital aims to provide comprehensive prenatal care, we primarily focused on obstetric patients. However, other medical specialties also offered telemonitoring consultations, including a special COVID-19 clinic run by internal medicine doctors. The telemonitoring was essentially performed via phone calls, and the data, which included general and respiratory symptoms, were recorded. Only a minority of teleconsultations were performed by video calls or by Zoom calls. Additionally, we collected data on obstetric characteristics, risk factors, previous ultrasound images, and laboratory tests. Each dataset was entered into a customized Excel-based chart. Every consultation was arranged to last at least 30 minutes. Orientation about nutritional facts and general symptoms in pregnancy, as well as any eventual alarm signs, such as fetal movements, uterine contractions, bleeding, or rupture of membranes, was provided. Supplemental vitamins were indicated as per our local protocol. Additional ultrasound scan examinations and laboratory tests were requested as needed. In cases of patients requiring medication or any unexpected condition, they were sent to the emergency department, because we had not yet implemented the in-person consultations due to the strict quarantine imposed by the government. A subsequent telemonitoring consultation with an OB/GYN doctor or other specialist was arranged as needed. Restricted in-person visits began in August and they were planned to be completed in one-stop clinic.

### Survey Sent to Health Providers

We sent an email survey to doctors to collect epidemiological data and to assess health provider satisfaction. The epidemiological data included provider age, gender, medical specialty, risk factors, self-reported COVID-19 infection, and previous experience in telemonitoring. The satisfaction survey was based on a previous instrument validated in a telehealth obstetric program by Bhandari et al.<sup>12</sup> It was built on a 9-item questionnaire that was scored on a 5-point Likert scale of “strongly agree,” “agree,” “undecided or do not know,” “disagree,” and “strongly disagree.”

### Patients

We reviewed our cohort of pregnant women who had access to our institutional telemonitoring program in the period between May 2020 and August 2020, searching for data regarding demographic characteristics such as maternal age, gestational age, insurance modality, and obstetric risk factors. Social and economic status was used to categorize patients into four strata according to the Human Development Index (HDI),<sup>13</sup> which is a statistic composite of life expectancy, education, and per capita income developed by the United Nations, computed as the geometric mean of normalized indices of achievement in three dimensions of human development: first, a long and healthy life; second, a knowledgeable being; and third, having a decent standard of living. In a previous study, Lima was stratified into four groups according to the HDI. Stratum I had the highest HDI (0.82), Stratum II had an HDI of 0.73, Stratum III had an HDI of 0.69, and Stratum IV had the lowest HDI of 0.66.<sup>14</sup> We

searched every clinical record to collect data on the main diagnosis, according to the International Classification Disease, Tenth Revision (ICD-10), and the maternal and perinatal outcomes including cesarean sections, preterm deliveries, low birth weight, Apgar scores, and maternal complications of patients who were admitted into the emergency department. Additionally, some outcomes were collected via phone call.

### Data Analysis

The database was cleaned to eliminate repeated values, assign lost values, and recategorize variables for the final analysis. We performed a descriptive analysis and calculated the distribution of the absolute and relative frequencies of categorical variables. For numerical variables, summary measures were applied as averages and ranges. All the information from returned paper surveys was transferred into MS Excel 2013. The health provider satisfaction surveys were evaluated by adding the answers of all providers for each point of the Likert scale, which was then represented in a stacked bar chart for the nine-item questionnaire (→ Fig. 1). Statistical analysis was performed using Stata Statistical Software 14.0.

### Ethical Approval

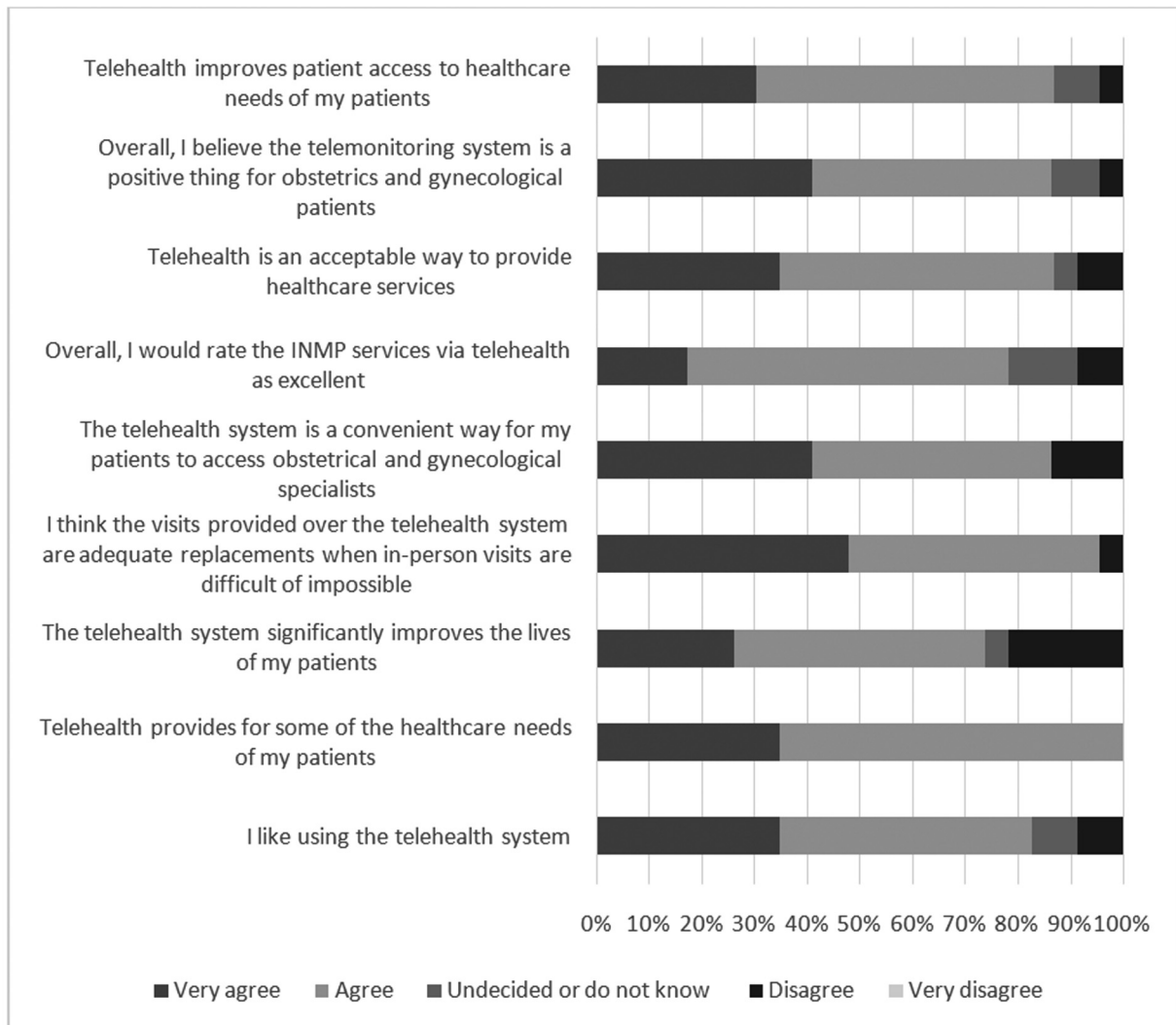
This study was part of a larger institutional study on COVID-19 which was approved by the local Ethical Institutional Board (reference number: 015–2020-CIEI/INMP).

## Results

### Epidemiological Characteristics and Satisfaction of the Telemonitoring Program among Health Providers

→ Table 1 details the characteristics of the health providers. There were 33 providers but only 23 answered our survey instrument. Twenty (87.0%) of the responders were married. The mean age was 64.5 years and 16 (69.6%) were male. Twenty-one (91.3%) were OB/GYN doctors. The mean amount of experience as a specialist was 30.1 years. At least 16 (69.6%) providers had a risk factor and among them, 11 (47.8%) reported hypertension. No health providers reported having had COVID-19 at the time of answering the survey. We explored their capability of using technology by asking how friendly the doctors are with the apps on their mobile phones. Eight (34.8%) health providers reported the need for some help in managing mobile technology. Only seven (30.4%) providers had previous experience in telemonitoring consultations. They reported an average telemonitoring time of 20.1 minutes.

→ Fig. 1 shows the health providers' perception of the telemonitoring program. Although only 86% responded positively to the telemonitoring program, the vast majority (95.7%) argued that telemonitoring is an adequate method to assist patients when in-person visits are difficult or impossible. Additionally, 87% thought that telemonitoring improved the access of patients to the health system, including obstetric and gynecological services. Out of 23 doctors, 21 (91.3%) responded to be in favor of continuing telemonitoring after the pandemic.



**Fig. 1** Satisfaction survey of telemonitoring among health providers ( $n = 23$ ).

### Medical Specialties that Provided Telemonitoring

The medical specialties that provided telemonitoring in this study are summarized in [Table 2](#). A total of 4,589 telemonitoring consultations were initially scheduled, of which 3,613 (78.7%) were finally completed. The main reason for not completing all telemonitoring consultations was due to a wrong telephone number and unanswered calls. We performed 2,181 telemonitoring consultations for 616 pregnant women, with an average of 3.5 consultations per patient and a maximum of 14 for one patient. We evaluated 258 puerperal women in 544 telemonitoring consultations, with an average of 2.1 per patient and a maximum of 9 for one patient. Other medical specialties that offered telemonitoring included gynecology, reproductive health, and family planning, with a total of 189 telemonitoring consultations. The major reasons for gynecology consultations were abnormal uterine bleeding, amenorrhea, endometriosis, urinary incontinence, and breast pain. Out of the 53 patients who had cardiology telemonitoring consultations, 45 (84.9%) had a presurgical evaluation for an elective cesarean section, 5 (9.4%) had a consultation due to cardiac disease, and 3 (5.7%)

were for follow-up due to preeclampsia. Endocrinology telemonitoring was performed for 75 patients, which included 56 (74.7%) obstetric patients, 11 (14.6%) patients with gynecological diseases, and 8 (10.7%) pediatric patients. Additionally, 478 telemonitoring consultations for a follow-up of a clinical course were performed for 452 patients with reactive serology to SARS-CoV-2, who were admitted to our institution during the study period. Among them, 8 (1.8%) were immunoglobulin M (IgM)-reactive, 316 (69.9%) were IgM- and IgG-reactive, and 128 (28.3%) were IgG-reactive. Out of the 452 patients, 275 (60.8%) of them were asymptomatic. Among the symptomatic women, 76 (42.9%) reported headaches, 75 (42.3%) nasal congestion, 69 (38.9%) fever, 61 (34.5%) ageusia, 59 (33.3%) anosmia, and 52 (29.4%) reported coughs and sore throats.

### Demographic and Maternal Characteristics

[Table 3](#) details the demographic characteristics based on the 669 patients who had obstetric telemonitoring consultations, either because they were pregnant or in the postpartum period. The mean maternal age was 29.5 years.

**Table 1** Epidemiological characteristics among the health providers (*n* = 23)

	<i>n</i>	%
Age in years, range	64.5 (40–69)	
Gender		
Male	16	69.6
Female	7	30.4
Specialist		
OB/GYN	21	91.3
Other	2	8.7
Risk factors		
Hypertension	11	47.8
Obesity	2	8.7
Diabetes	1	4.3
Others	5	21.7
Without risk factors	6	26.1
Not reported	1	4.3
Experience in telemonitoring		
Yes	7	30.4
No	16	69.6

Abbreviations: OB/GYN, obstetrician-gynecologist.

**Table 2** Medical specialties providing telemonitoring

Medical specialty	Number of telemonitoring	Number of patients
Obstetrics	2,725	669
Gynecology	86	46
Reproductive health	30	15
Endocrinology	121	75
Cardiology	100	53
Family planning	73	40
COVID-19 clinic	478	452

According to the HDI, 33 (4.9%) patients were categorized into Stratum I, 252 (37.7%) into Stratum II, 311 (46.5%) into Stratum III, and 23 (3.4%) into Stratum IV. There were 286 (42.8%) patients with at least one risk factor, including previous cesarean sections (*n* = 192, 28.7%), multiple pregnancies (*n* = 28, 4.2%), fetuses with malformations (*n* = 19, 2.8%), hypothyroidism (*n* = 17, 2.5%), histories of hypertension or preeclampsia (*n* = 13, 1.9%), and diabetes (*n* = 9, 1.4%).

**Primary Diagnosis at the Emergency Department**

– **Table 4** shows data on the admission of the obstetric population to the emergency department. There were 354 (52.9%) patients followed by telemonitoring who needed evaluations at the emergency department, which came up to a total of 669 visits (an average of 1.9 per patient). Two patients (0.6%) were IgM-reactive to SARS-CoV-2, 68 (19.2%)

**Table 3** Demographic and maternal characteristics (*n* = 669)

	<i>n</i>	%
Maternal age in years, range	29.5 (15–47)	
Gestational age at first appointment in weeks, range	28.7 (5–41)	
Human Development Index		
Stratum I	33	4.9
Stratum II	252	37.7
Stratum III	311	46.5
Stratum IV	23	3.4
Not reported	50	7.5
Insurance modality		
National health insurance	403	60.3
Not national health insurance	120	17.9
Not reported	146	21.8
Risk factors		
Previous cesarean section	192	28.7
Multiple pregnancy	28	4.2
Fetus with structural abnormalities	19	2.8
Hypothyroidism	17	2.5
History of hypertension/preeclampsia	13	1.9
Diabetes	9	1.4
Short interpregnancy interval	8	1.2
Mother Rh negative	7	1.1
Uterine myomatosis	7	1.1
Previous placenta	5	0.8
Mother with HIV infection	4	0.6
History of LEEP procedure	4	0.6
Previous fetal death	4	0.6
In vitro fertilization	3	0.5
Asthma	3	0.5
Maternal cancer	3	0.5
Others	12	1.8

Abbreviations: HIV, human immunodeficiency virus; LEEP, loop electrical excision procedure.

were IgM- and IgG-reactive, and 36 (10.2%) were IgG-reactive. Among the diagnosis at the emergency department, 358 (50.5%) were deemed as false labor. The disposition of the emergency evaluations was as follows: 345 (51.6%) were discharged home, 286 (42.8%) were admitted to the hospital, 8 (1.2%) were voluntary discharges, and 1 (0.1%) was referred to another hospital.

**Maternal and Perinatal Outcomes**

Maternal and perinatal outcomes are listed in – **Table 5**. Out of the 669 women in prenatal telemonitoring, 424 (63.3%)

**Table 4** Primary diagnosis at the emergency department (n = 669)

	n	%
False labor after 37 weeks	221	33.0
False labor before 37 weeks	137	20.5
Labor	83	12.4
Previous cesarean section	59	8.8
Premature rupture of membranes	19	2.8
Pregnancy-induced hypertension	17	2.5
Urinary infection	13	1.9
Hyperemesis gravidarum	9	1.3
Vaginal infection	6	0.9
Breech fetus	6	0.9
Abortion threat	5	0.7
Postsurgical evaluation	3	0.4
Other diagnostics	91	13.6

delivered during the study period. The main maternal complications were pregnancy-induced hypertension in 39 out of 358 deliveries (10.9%), premature rupture of membranes in 25 cases (7.0%), and hemorrhaging in 10 women (2.8%). Cesarean sections were reported in 224 (52.8%) women and vaginal delivery in 161 (38.0%). There was no report on the delivery route in 39 (9.2%) cases. Out of 362 cases with complete data on the perinatal outcome, 357 were born alive (98.6%), 1 (0.3%) was a neonatal death, 1 (0.3%) was a stillbirth, and 3 (0.9%) were miscarried. The mean birth weight was 3,383 g.

## Discussion

Herein, we report the characteristics of the providers and patients of a telemonitoring program in a tertiary hospital, as well as the perinatal outcomes of the women who attended this program during the most critical period of the COVID-19 pandemic in Peru. Although 70% of attending physicians reported no previous experience with any telehealth system, a vast majority of them (95%) agreed that telemonitoring is an adequate method to provide health care when in-person visits are difficult. The majority of the population who attended our telemonitoring program were categorized as the lowest strata, i.e., III and IV, according to the HDI, and approximately 42% were deemed as high-risk pregnancy. Additionally, we reported the perinatal outcomes of 424 (63%) pregnant women, the most relevant finding being that approximately 53% of them had cesarean sections.

The Peruvian government declared a strict lockdown on March 16, 2020, due to the COVID-19 pandemic. As a result of that, every outpatient clinic in our country was shut down and health care was offered exclusively in the emergency departments of the health centers. Telemonitoring has proved to be an effective method of providing health care in such critical situations.<sup>15</sup> However, our institution has not had any previous experience in telemonitoring, and it was

**Table 5** Maternal and perinatal outcomes

	n	%
Perinatal outcome		
Miscarriage	3/424	0.7
Intrauterine death	1/424	0.2
Born alive	357/424	84.3
Neonatal death	1/424	0.3
Not reported	62/424	14.6
Cesarean section	224/424	52.8
Preterm delivery < 37 wk	34/350	9.7
Low birth weight < 2,500 g	32/355	9.0
Apgar score < 7 at 5 minutes	3/357	0.8
Maternal complications		
Pregnancy-induced hypertension	39/358	10.9
Premature rupture of membrane	25/358	7.0
Hemorrhage	10/358	2.8
Place of birth		
INMP	273/424	64.4
Other hospital	94/424	22.2
Home delivery	1/424	0.2
Not reported	56/424	13.2

Abbreviation: INMP, Instituto Nacional Materno Perinatal.

forced to establish an urgent telemonitoring program to assure the continuity of health care provision, particularly to pregnant women.<sup>11</sup> We believe that this telemonitoring program in our institution is unique since it is provided by doctors who were sent home as they were considered to be vulnerable to COVID-19. They all were above 40 years of age and the majority of them reported that they were not completely familiar with computer technology and had no previous experience with telemonitoring. Madden et al<sup>16</sup> reported a different population of telehealth providers, where only 19% were older than 45 years. However, both Madden et al and our institution reported that telemonitoring is an adequate method to provide prenatal care in the COVID-19 pandemic scenario, regardless of the age of the provider.

Futterman et al<sup>17</sup> studied a smaller cohort of women attending virtual consultations and they reported 28% of women being at high risk and the most frequent risk factor was having a cesarean section in 17% of them. Our report lists 42% of patients requesting telemonitoring to be deemed as high risk and the most frequent risk factor being cesarean section in 29%. The main reason for this difference is that our institution is a tertiary referral center in the country. Additionally, we believe that most patients were directed to our institution since the other general hospitals were busy with COVID-19 patients. The majority of patients came from a low social stratum and 60% of them had access to national health insurance. These two characteristics are known factors for accessing the telemonitoring program. Limaye et al<sup>18</sup>

reported that having private insurance ensures better access to the telemonitoring program, principally in those areas affected by COVID-19.

Our patients did not have the option of in-person visits during the study period. The only chance to be evaluated was to be admitted into the emergency department. Thus, it is no surprise that almost 50% of those who went to the emergency department did not show any serious condition and were discharged home. Interestingly, approximately 30% of the women seeking attention at the emergency department tested positive for COVID-19 antibodies. With the current evidence, we believe that there was no need for interrupting the in-person consultations.

Unfortunately, we do not have data on real time polymerase chain reaction (RT-PCR) testing since due to the shortage of resources, RT-PCR tests were performed only for patients with respiratory symptoms. Thus, we believe that our data do not reflect the real prevalence of COVID-19. Previous reports found that the prevalence of COVID-19, by universally testing pregnant women who were admitted to the emergency department, was 15.4%.<sup>19</sup> A previous report on the prevalence of the antibody test in our country revealed that in the general population of those who exhibited symptoms, the prevalence of antibodies was around 10%.<sup>20</sup> The maternal and perinatal outcomes reported are similar to those of the general population prior to the COVID-19 pandemic in our institution.<sup>21</sup> Similarly, Justman et al<sup>22</sup> found that the maternal and perinatal outcomes were similar in the period of COVID-19 with or without lockdown. A recent meta-analysis reported that telemedicine could reduce the risk of maternal and perinatal complications for women at high risk.<sup>23</sup> Even when comparing the telemonitoring with traditional models of prenatal care, there is no increased risk for maternal and perinatal complications.<sup>24</sup>

Telemedicine aims to ensure equitable services to everyone, is cost-effective, provides safety to both patients and doctors during pandemics, and offers timely and faster care. Telemonitoring has been used previously to monitor pregnancies, including those at high risk, such as preeclampsia, fetal growth restriction, premature rupture of membranes, etc.<sup>25</sup> Additionally, other authors have reported that telemedicine is a useful tool for monitoring patients with COVID-19, particularly in areas with a high number of COVID-19 infections.<sup>26,27</sup>

The main strength of our study is that we collected a high number of patients during the most critical period of COVID-19 in Peru, and additionally, we reported some outcomes of the women who attended our telemonitoring program. We agree that our study has some limitations. First, this is a retrospective review of a local telemonitoring program that was rapidly implemented due to the health crisis of the current pandemic in a country with barriers to universal health access. Second, our telemonitoring program is unique, since it was provided exclusively via phone calls and by doctors with known risk factors who stayed at home. However, this system of phone calls has been reported to be equivalent to video-call consultations.<sup>28-30</sup> Third, some patients delivered in other hospitals, and therefore, the outcomes were obtained by phone call,

which means that there was a potential for self-report bias. Fourth, the diagnosis of COVID-19 infections was based on the rapid antibody test and therefore our study does not pretend to report any information on the prevalence of COVID-19. Lastly, our design did not allow us to test any association between telehealth and maternal perinatal outcomes.

We learned during the COVID-19 pandemic that the rapid implementation of telemonitoring is plausible and well accepted by doctors and patients, even in a low-income country where access to technology is limited. We are currently working on implementing a new hybrid model of prenatal care that combines in-person visits and telemonitoring supported by mobile technology. We believe that this could be a unique opportunity to change the way prenatal care is offered in Peru.

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#### Conflict of Interest

None declared.

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