Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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ORIGINAL ARTICLE

Challenges for Peritoneal Dialysis Centers Before and During the COVID-19 Pandemic in Mexico

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Aim. We aimed at performing a situation analysis to identify challenges that Mexico's peritoneal dialysis centers (PDCs) have faced before and during the COVID-19 pandemic.

Methods. From May–August 2021, we conducted a cross-sectional nationwide online survey with the heads of 136 PDCs at the Mexican Institute of Social Security. The survey gathered information about PDCs characteristics and the adaptations and challenges they faced before and during the COVID-19 pandemic. The response rate to the survey was 79.5% (136 out of 171 PDCs). We used descriptive statistics to analyze the data.

Results. The survey responses suggest wide variations between PDCs regarding their number of patients, healthcare staff availability, and compliance with the International Society for Peritoneal Dialysis recommendations. In the pre-pandemic period, PDCs faced staff shortages (71.3%); scarcity of supplies (39.0%); catheter dysfunctions (29.4%); poor patient adherence to peritoneal dialysis (PD) (28.6%); and lack of patient support networks (25.7%). During the pandemic, PDCs faced emergent challenges, such as losing designated PDC areas within hospitals (61.0%), and staff and supply shortages (60.2%, 41.1%, respectively) because of a reallocation of human and physical resources towards the COVID-19 response. The pandemic prompted 86.7% of PDCs to implement preventive public health measures, delay non-urgent consultations and procedures (63.6%), and introduce telemedicine (37.3%). Additionally, fewer patients visited PDCs because of their fear of COVID-19 contagion (36.0%).

Conclusions. Actions are urgently needed to ensure adherence to evidence-based PD guidelines and sufficient resources, including trained staff, supplies, and designated spaces to strengthen PDCs and provide safe and effective PD.

Key Words: Peritoneal dialysis, Needs assessment, COVID-19, Mexico.

Introduction

The magnitude of the COVID-19 pandemic and the high risk of severe morbidity and mortality related to this infection are creating new challenges for health services. Healthcare for patients with chronic kidney disease (CKD) is critical given that CKD patients infected with SARS-COV-2 are at a high risk for severe complications and death (1,2).

Patients with end-stage CKD require renal replacement therapy to improve their quality of life and chances of survival. Renal replacement therapy comprises peritoneal dialysis (PD), hemodialysis (HD), and renal transplantation. The widespread shortage of kidneys for transplantation leads to a greater reliance on PD and HD. PD has been shown to increase survival, quality of life, and satisfaction rates at lower costs than HD (3–7). Additionally,

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unlike patients receiving HD, those on PD are trained by health providers to perform their dialysis procedures at home. Indeed, PD reduces the overuse of health services and increases access to this procedure for patients living in remote areas (8,9). These characteristics have made PD particularly useful during the COVID-19 pandemic because it avoids unnecessary potential exposure to SARS-CoV-2, thus reducing the risk of infection and related morbidity and mortality (8).

The Mexican Institute of Social Security (IMSS) is the largest national public institution in Mexico that covers 68 million people, more than half of Mexico's population. IMSS provides healthcare to 73% of people with end-stage CKD who need renal replacement therapy; 53% are treated with PD (10). In 2018–2019, end-stage CKD was the sixth most frequent cause of hospital admissions and the third chronic disease with the highest financial impact (10). The COVID-19 pandemic severely affected health care of CKD patients. In 2019, there were 72,237 CKD patients receiving renal replacement treatment at IMSS facilities; by 2020 the figure fell to 69,528. This decline was accompanied by a reduction in IMSS spending on chronic diseases from US $3.8 billion in 2019–US $2.8 billion in 2020 (11). IMSS has 212 dialysis centers nationwide. According to IMSS recommendations, in the absence of contraindications, PD should be the first line of treatment for CKD patients.

In Mexico, CKD patients with COVID-19 are at a higher risk of mortality (12) and peritoneal dialysis centers (PDCs) are the cornerstone of their treatment. Although there have been reports of critical shortages of dialysis staff and equipment during the COVID-19 pandemic in high-income countries (HICs) (13), this information is still scarce in low- and middle-income countries (LMICs). Therefore, the objective of this study was to perform a situation analysis to identify the challenges that IMSS PDCs have faced before and during the COVID-19 pandemic.

Methods

We conducted an online mixed-device cross-sectional nationwide survey from May 10 to August 10, 2021in IMSS PDCs.

Participants

The study participants were heads of PDCs. They were invited to participate through email messages and were granted access to the survey after signing an electronic informed consent form. The form described the purpose of the study, the contents of the survey, the approximate time needed to complete it (25–35 min), and the voluntary nature of participating. It also specified that participants could end the survey at any time and that there was no monetary or other type of incentive to participate.

Sample Size and Sampling

IMSS has 212 registered dialysis centers nationwide, located within hospital facilities. In 2021, 41 out of 212 dialysis centers did not have PD patients under their care. Therefore, the sample frame consisted of 171 active PDCs that have been providing health care for patients with PD. We obtained the contact information of PDC heads of these 171 centers and invited them to participate. This decision was supported by the study's exploratory nature and the possibility to invite and include the whole studied population.

Study Questionnaire

The structured questionnaire collected information on the characteristics of PDCs and identified the challenges to providing PD services. Three researchers with expertise in health services and chronic diseases assessed the survey's questionnaire face validity and reviewed the questions and answer choices (14). The questionnaire included six open-ended questions on the number of patients receiving care at the respective PDCs and their available staff; changes within the PDCs during the COVID-19 pandemic; and general and COVID-19-specific challenges that PDCs were facing. The questionnaire also had close-ended questions related to PD clinical processes. The questionnaire was pre-tested with three heads of PDCs to ensure its comprehensibility.

The electronic questionnaire was created using Google Forms, which allowed for the automatic capture of responses. Cookies were used to assign a unique user identifier. The survey was accessible via mobile device, personal computer, laptop, and tablet and displayed in four sections, as presented in the variables section. Each participant had access to the electronic questionnaire on one occasion; there was no option to return to complete unanswered questions after submitting the questionnaire. However, the response time was not restricted to 30 min, allowing for checking the PDCs' local statistics. We checked the completeness of responses after each questionnaire had been submitted and eliminated duplicate observations from the same IP address (5.4%), keeping the first complete entry for analysis.

Variables

The study variables comprised:

a) Participants' general characteristics: sex; age; professional background; number of years working at the PDC.
b) Characteristics of the PDCs: number of patients receiving care at the center; available health personnel (number of PD patients per one physician and nurse); usual

Table 1. General characteristics of the participants.

Characteristics	***n* = 136**	
Participants general characteristics	***n***	**(%)**
Sex		
Women	97	(71.3)
Men	39	(28.7)
Age (years), mean (standard deviation)	41.6	(6.5)
Professional background		
Medicine	55	(40.4)
Nursing	81	(59.6)
Specialty in nephrology	59	(43.4)
Length of work experience in the peritoneal dialysis center		
≤1 year	20	(14.7)
1–5 years	58	(42.7)
6–10 years	32	(23.5)
11–15 years	18	(13.2)
≥16 years	8	(5.9)

clinical processes performed in each PDC, including frequency of appointments with a physician or nurse; the technique used for catheter insertion, catheter type, frequency of antibiotic prophylaxis for catheter implantation, use of control radiography for catheter implantation, usual time elapsed between catheter insertion and PD initiation, type of initial PD prescription, characteristics of the standardized prescription, peritoneal equilibration test (PET), PET type, communication between the PDC and the family doctor, diagnostic test for peritonitis, and empirical treatment of peritonitis. The variables related to PD clinical processes were selected and analyzed in accordance with the International Society for Peritoneal Dialysis (ISPD) recommendations (15,16) and IMSS guidelines (17,18).

c) Usual patients and caregivers PD training: its duration (hours), number of sessions, number of participants per training group, main topics of the training.
d) Modifications to PDC services and processes during the COVID-19 pandemic.
e) Challenges for PDCs before and during the COVID-19 pandemic. PDC challenges were defined as the difficult situations or barriers that a PDC has been facing to provide care for patients with PD. The PDCs challenges were measured using two open-ended questions, one for the challenges before the COVID-19 pandemic (before March 2020) and another for the challenges during the pandemic (from March 2020 until the time of the survey). We did not predefine the answers for these two questions due to the exploratory nature of the study.

Data Analysis

We performed descriptive analyses calculating the percentages for categorical variables, the mean and standard deviation for numeric variables with a normal distribution (skewness near zero and kurtosis near the value of 3), and median with minimum and maximum for those variables that do not meet normal distribution criteria. We used IBM SPSS Statistics 25 to analyze the data. The open-ended responses were assessed separately by two researchers (DPM and SVD), who went through every answer to identify response categories one-by-one. After that, the response categories produced by each researcher were cross-checked through their discussion to ensure consistency of the categorization.

Results

One hundred thirty-six heads of IMSS PDCs (79.5%) from 171 hospitals in 31 Mexican states participated in the study. Hospitals in the state of Oaxaca were the only ones that did not respond (Supplementary Table 1). Most PDC heads were men (71.3%), with a mean age of 41.6 years and standard deviation of 6.5 years. More than half had nursing training (59.6%) and 43.4% were specialized in nephrology. Only 14.7% had worked at their respective PDC for a year or less, while 42.7% had worked there between 1 and 5 years and the rest for more than 5 years (Table 1).

Table 2 describes the characteristics of the participating IMSS PDCs. The number of patients varied between centers. Most centers were providing care to more than 50 patients and most of their patients were receiving continuous ambulatory PD. The median percentage of patients undergoing continuous ambulatory PD was 62.3%. Most centers had two physicians and two nurses dedicated to PD. The median number of patients per physician was 94; the corresponding number of patients per nurse was 69. However, nine PDCs (6.6%) reported not having medical or nursing staff. Most patients visited the program physician or nurse every one to three months (65.4% and 82.4%, respectively).

The most frequently used catheter design was coiled (61.8%) and the most applied insertion technique was sur-

Table 2. Characteristics of the peritoneal dialysis centers.

Characteristics	***n* = 136**	
Number of patients per PD center	***n***	**(%)**
≤50	15	11.0
51–100	30	22.1
101–200	35	25.7
201–300	27	19.9
>300	29	21.3
PD type	median	(min–max)
Percentage of patients with continuous ambulatory PD per center	62.3	(0–100)
Percentage of patients with automated PD per center	37.6	(0–100)
Available health personnel		
Number of PD patients per one physician	94	(4–742)
Number of PD patients per one nurse	69	(4–742)
Usual frequency of consultations		
Consultations with PD's physician	*n*	(%)
Every 1–3 months	89	(65.4)
Every 4–6 months	47	(34.6)
Consultations with PD's nurse		
Every 1–3 months	112	(82.4)
Every 4–6 months	24	(17.6)
Usually performed clinical processes		
Catheter type		
Coiled	84	(61.8)
Straight	5	(3.7)
Both	47	(34.5)
Catheter implantation technique		
Surgical	104	(76.5)
Percutaneous	5	(3.7)
Both	27	(19.8)
Control radiography for catheter implantation	69	(50.7)
Antibiotic prophylaxis for catheter implantation		
Always[a]	43	(31.6)
Sometimes	75	(55.2)
Never	18	(13.2)
Average time between catheter implantation and PD initiation		
≤14 d	59	(43.4)
15–30 d[a]	49	(36.0)
> 30 d	28	(20.6)
Type of initial PD prescription		
Standardized	77	(56.6)
Personalized[a]	59	(43.4)
Characteristics of the standardized prescription	*n* = 77	(%)
4 exchanges of 1.5% glucose solution	37	(48.0)
4 exchanges, alternating 1.5% and 2.5% glucose solutions	20	(26.0)
Intensive dialysis[b]	20	(26.0)
Performing peritoneal equilibration test (PET)	71	(52.2)
PET type	*n* = 71	(%)
Simplified peritoneal balance test[a]	48	(67.6)
Twardowski rapid test	12	(16.9)
Both	11	(15.5)
Diagnostic test for peritonitis	*n* = 136	(%)
Cell count of PD effluent	26	(19.1)
Bacterial culture of PD effluent	18	(13.2)
Both[a]	92	(67.7)
Empirical treatment of peritonitis[a]	117	(76.5)
Antibiotic used for empirical treatment of peritonitis	*n* =117	(%)
Cephalosporin combined with aminoglycoside or vancomycin[a]	77	(65.8)
Monotherapy of cephalosporin	29	(24.8)
Monotherapy of aminoglycoside or vancomycin	11	(9.4)
Communication of the PDC staff with the patient's family doctors	53	(39.0)

(*continued on next page*)

Table 2 (*continued*)

Characteristics	***n* = 136**	
Number of patients per PD center	***n***	**(%)**
Usual patients and caregivers PD training	median	(min–max)
Complete training duration (hours)	15.5	(10–32)
Number of sessions	5	(2–10)
Number of participants per training group	3	(1–15)
Main training topics	*n* = 136	(%)
PD technique	136	100
PD complications management	119	87.5
Personal hygiene (e.g., hand washing) and household cleaning	97	71.3
Kidney function and chronic kidney disease	77	56.6
Others[c]	121	89.0

[a]Standard recommended by the International Society for Peritoneal Dialysis.
[b]Intensive dialysis: more than 10 continuous replacements, with less than 2 h of staying in the cavity, with a period of rest of 7–10 d, until the conditions for home PD are achieved.
[c]Care of PD catheter, nutrition of patients on PD, physical exercise, sexuality, vacations.

gical (76.5%), which was guided by radiography in half of the PDCs (50.7%). Antibiotic prophylaxis at the time of catheter implantation was inconsistently administered in more than half of the PDCs (55.2%) and 13.2% reported not administering it, despite the ISPD's recommendations and IMSS guidelines. Only 36% of PDCs reported that the average time between catheter insertion and PD initiation was 15–30 d as recommended by the ISPD, while 43.4% reported starting before 2 weeks or after 30 d (20.6%). Half of the PDCs started with a standardized PD (56.6%), while the rest (43.4%) started with a personalized PD.

Among the standardized PD, 48.0% of patients were usually provided four exchanges of 1.5% glucose solution or four exchanges alternating between 1.5% and 2.5% glucose solutions (26%). However, 26% of PDCs used intensive dialysis with more than ten continuous replacements and less than two hours of permanence in the cavity every 10 d even though the ISPD does not recommend this practice. Only 52.2% of the PDCs performed PET to evaluate peritoneal membrane function and to perform dialysis adjustments; simplified PET was used most often.

Regarding peritonitis management, 67.7% of PDCs diagnosed peritonitis based on cell count and bacterial culture in the PD effluent, as recommended by the ISPD, while the rest used only the cell count (19.1%) or bacterial culture (13.2%) to determine diagnosis. Most PDCs reported empirical treatment with antibiotics (76.5%)—mainly cephalosporins combined with glycopeptides or aminoglycosides (65.8%), as suggested by the ISPD. Only 39% of PDCs had communication with the patient's family doctors.

One of the important activities of the PDCs is providing patients and caregivers with PD training. The typical training duration was 15.5 h, ranging from 10–32 h. It usually includes five sessions with a minimum of two and a maximum of ten sessions and 3 participants per training group, ranging from one to 15 participants. The most frequently implemented training topics were how to perform the PD technique (100%), PD complications management (87.5%), personal hygiene (e.g., hand washing) and household cleaning (71.3%), and kidney function and CKD (56.6%).

IMSS adapted the PDCs to respond to the COVID-19 pandemic context (Table 3); 86.7% of PDCs reported taking measures to reduce the risk of COVID-19 spread. Such measures included providing hand sanitizers in common areas (89%); ensuring physical distancing in waiting rooms (84.7%); and providing staff with personal protective equipment (72.9%). There was also an increase in time intervals between consultations to reduce contact among patients (72%); thorough disinfection of common areas (71.2%); prioritization of patients with medical emergencies (65.3%); and rescheduling or postponement of non-urgent consultations and procedures (63.6%). PDCs also implemented telehealth to monitor PD patients' health status (37.3%) and signs and symptoms of COVID-19 among PD patients (11.0%). Follow-up care was predominantly carried out through telephone calls (86.3%) and text messages (50.0%).

Table 4 identifies challenges for PDCs before and during the COVID-19 pandemic. Before the pandemic, the main burdens on PDCs were a lack of trained staff (71.3%); supply shortages, particularly dialysis bags and peritoneal catheters (39.0%); catheter dysfunction due to migration, obstruction, or twisting (29.4%); poor patient adherence to PD management instructions (28.6%); insufficient support networks for patients (25.7%); infectious complications, such as peritonitis or exit site infections (17.6%); urgent HD initiation due to delayed referral or patient refusal of PD (16.9%); lack of patient training (13.2%); errors in laboratory tests (e.g., high rates of false-negative cultures due to low volumes of materials or errors

Table 3. Modifications to PDC services during the COVID-19 pandemic.

	$n = 136$	
	n	**(%)**
PD centers modified to adapt to the COVID-19 pandemic	118	(86.7)
Modifications to PDC services during the COVID-19 pandemic.	$n = 118$	(%)
Provision of hand sanitizers in common areas	105	(89.0)
Ensuring physical distance between patients in the waiting rooms	100	(84.7)
Use of personal protective equipment by health staff	86	(72.9)
Increased interval appointments between consultations to reduce contact among patients	85	(72.0)
Thorough disinfection of common areas	84	(71.2)
Emergency care prioritization	77	(65.3)
Postponement of non-urgent consultations/procedures	75	(63.6)
Introduction of telehealth for monitoring of patients with peritoneal dialysis	44	(37.3)
Introduction of telehealth for monitoring of signs and symptoms of COVID-19 in patients with peritoneal dialysis	14	(11.0)
Other	13	(9.5)
Type of telehealth follow-up activities	$n = 44$	(%)
Phone call	38	(86.3)
Text message (SMS)	22	(50.0)
Video call	3	(6.8)
Other (e.g., email, social media)	5	(11.3)

Table 4. Challenges for PDCs before and during the COVID-19 pandemic.

Pre-pandemic PD centers' challenges	$n = 136$	
	n	**(%)**
Lack of trained staff	97	(71.3)
Shortages of PD supplies (e.g. dialysis bags, peritoneal catheters)	53	(39.0)
Catheter dysfunction	40	(29.4)
Poor patients' adherence to PD	39	(28.6)
Insufficient support networks for patients	35	(25.7)
Peritonitis or exit site infections	24	(17.6)
Urgent HD initiation due to delayed referral or PD refusal by patient	23	(16.9)
Lack of patient training	18	(13.2)
Failures in laboratory tests (e.g., high rates of false-negative cultures due to low volume of material or errors in laboratory techniques)	17	(12.5)
Incompatible peritoneum cavity	11	(8.1)
Failures in performing connection and disconnection techniques (e.g., omission of the mask, inadequate hand washing, etc.)	11	(8.1)
Lack of follow-up by the PD staff at patients' homes	8	(5.9)
Challenges during the COVID-19 pandemic		
Losing designated PDC areas within hospitals due to repurposing of hospital to treat COVID-19	83	(61.0)
Additional reduction of staff due to reallocation to COVID-19 health care settings	82	(60.2)
Cancellation or postponement of consultations and procedures in PD centers	65	(47.8)
Additional PD supplies shortages	56	(41.1)
Patient nonattendance due to fear of COVID-19 contagion	49	(36.0)
Closure of the PD center	36	(26.4)
Decrease in training activities of patients and caregivers	20	(14.7)
Insufficient COVID-19 preventive measures	11	(8.0)

Generally, in each of the 136 hospitals the center chiefs reported more than 3 challenges.

in laboratory techniques) (12.5%); an incompatible peritoneum cavity due to multiple abdominal surgeries or low peritoneal transport; failures in performing the connection and disconnection technique, such as imprecisely joining the PD twin bag system with the patient's transfer line (8.1% both); and a lack of follow-up by the PD staff at patients' homes (5.9%).

The COVID-19 pandemic strained PDCs in several ways. Emergent challenges included losing designated PDC spaces within hospitals (61.0%); a further reduction in PDC personnel due to reassignment to COVID-19-related health services (60.2%); temporary cancellation or postponement of consultations and procedures, including scheduled catheter insertions or line changes (47.8%); further shortages of PD supplies (41.1%); patient nonattendance at consultations due to fear of COVID-19 contagion (36.0%); temporary PDC closures due to hospital reconversions (26.4%), which occurred in 36 hospitals in

20 states; and decreases in training activities for patients and caregivers (14.7%).

Discussion

The present study revealed that PDCs had pre-pandemic health personnel shortages, variability in their adherence to evidence-based clinical recommendations, and limited supplies and infrastructure. The COVID-19 pandemic further strained PDCs and exacerbated these limitations. For example, IMSS closed some PDCs because of hospital reconversions implemented to care for patients with COVID-19, which resulted in the reallocation of health staff and reduced supplies for PD. Moreover, fewer patients visited PDCs due to fear of COVID-19 contagion and training activities for CKD patients and caretakers were reduced. As a response, PDCs implemented preventive measures to protect patients and health personnel from SARS-CoV-2 and mitigate the disruption to PD services, such as postponing non-urgent consultations and introducing telehealth services.

It is critical to overcome the PDCs shortages and strengthen the competencies of their health personnel to avoid PD complications and improve patients' experiences with care and their quality of life (15–19). The heads of IMSS PDCs who participated in this study recognized the lack of trained staff as the primary challenge for high-performing PDCs. The COVID-19 pandemic exacerbated this adversity because IMSS reallocated the already scarce staff to the pandemic response.

In most PDCs, there were 94 patients per physician and 69 patients per nurse; however, these numbers ranged from 4–742 patients per physician or nurse, while 6.6% of PDCs reported not having medical or nursing staff. These figures highlight the unequal distribution of the patient/doctor and patient/nurse among PDCs. This finding is not unusual. A global survey on the status of care for end-stage CKD identified the dearth of health professionals trained to provide care for this condition. LMICS have higher shortages when compared with HICs (20). The global survey also recognized that the number of nephrologists per country increases with income level, with low-income countries having the lowest prevalence (0.4 per million people [pmp]), followed by lower-middle (5.0 pmp), upper-middle (13.5 pmp), and HICs (26.5 pmp) (20). Consistent with the studies from other LMICs (21), personnel insufficiencies frequently coexisted with PD supply shortages, highlighting the need for better staffing, management, and funding of PDCs.

In line with ISPD recommendations (15,16), IMSS issued two evidence-based clinical guidelines to standardize and improve PD for patients with CKD (17,18). However, we found low adherence to several processes of care recommended by these guidelines. For instance, only a third of IMSS PDCs reported always performing antibiotic prophylaxis with catheter implantation, while only 76% performed empirical peritonitis treatment. Other examples included failure to perform radiographic control of catheter implantation; extremely short (<14 d) or long durations (>30 d) between catheter implantation and PD initiation; and not performing the peritoneal equilibration test, among others. The low adherence to evidence-based PD clinical guidelines was reflected in several challenges reported by health professionals, such as catheter dysfunction and frequent peritonitis and exit site infections. Inconsistencies between evidence-based PD clinical guidelines and clinical practices is widespread in countries with low healthcare expenditure (22), where health professional training, digital support, and routine quality of care monitoring are limited. To ensure safe and effective PD care, increased staff training and monitoring of their adherence to evidence-based PD guidelines through regular evaluations with validated indicators are imperative (23).

The COVID-19 pandemic generated new challenges and imposed modifications on PD care, such as implementing COVID-19 preventive measures and telehealth to monitor PD patients. These modifications are essential for future progress in PD care; most could prevent other infections in PD patients besides COVID-19 (24) and telehealth could be beneficial to facilitating and improving PD care. Previous studies have shown that telehealth provided to PD patients allows for remote monitoring, partially replacing in-person visits (25,26) and avoiding unnecessary contacts to prevent COVID-19 transmission and related morbidity and mortality. Telehealth has also demonstrated potential in improving patient perceptions of PD care (27). Unfortunately, only a third of PDCs in this study implemented telehealth strategies, pointing to the need for broad institutional adoption of telehealth in PD care. According to the Telehealth Observatory of the National Center for Technological Excellence in Health in Mexico, from January to November 2020, 5,741,033 telehealth services were provided in 20 states; the majority focused on the COVID-19 patients triage, medical consultations, and follow-up and tele-education of health professionals (28). However, to date, in Mexico, there is no public information about the effectiveness of telehealth services, including for patients with PD, highlighting the need for research on this topic.

Survey participants also identified postponement of non-urgent consultations and procedures as another common PD care modification in response to the COVID-19 pandemic that adversely affected care. Postponement of consultations and procedures was frequently accompanied by the loss of designated areas for PDCs within hospitals or their temporary closure due to hospital reconversions. Similar healthcare challenges for patients with chronic conditions (diabetes, hypertension, cancer, etc.) during the first year of the COVID-19 pandemic have been reported worldwide (29). Such measures resulted in treatment delays or discontinuation and poor health outcomes (30–32). In Mex-

ico, a study from IMSS identified a substantial decline in the provision of maternal and child health services and those for patients with diabetes and hypertension. For instance, it was estimated that in 2020, breast and cervical cancer screening dropped by 79% and 68%, followed by sick child visits (–66%), contraceptive services (–54%), child vaccinations (–36%), diabetes and hypertension care (–32% in both) and antenatal care (–27%) (33). Yet the present study is a first that explores the situation faced by the PDCs in Mexico.

Public health emergency preparedness is an essential characteristic of resilient health systems (34). National and institutional plans should be developed to organize an effective response to public health emergencies without weakening essential health services, such as those for patients with CKD.

Patient non-attendance at consultations due to their fear of COVID-19 contagion was another challenge that emerged with the pandemic, pointing to the importance of effective COVID-19 preventive measures in the context of providing continuous healthcare to patients with chronic diseases. The World Health Organization issued an operational guidance for maintaining essential health services during the COVID-19 pandemic, highlighting how strengthening communication strategies to support the population's appropriate use of essential services is a crucial part of an effective response (35).

Patients and caregivers PD training is a critical PDC activity that aims to ensure that the patients can perform PD at home safely. The usual patients and caregivers PD training reported by the heads of the PDCs was congruent with the ISPD recommendations (36). However, during the COVID-19 pandemic, a decrease in patient and caregiver training on PD treatment was identified as another challenge which can be explained by PD staff shortages, the cancelation of non-urgent visits to health facilities, and the fear associated with attending PDCs for both patients and caregivers. Virtual distance training can be a valuable tool in this regard.

The primary limitation of this study is that it only includes the opinions of the heads of PDCs on characteristics and challenges of these services; it did not collect the views of health services users. Additionally, although the heads of the PDCs are responsible for preparing monthly performance reports based on the actual statistics and for resolving the challenging situations in their services, we cannot ensure that the local statistics backed all participants' responses or that the responses are totally free from the recall bias that can be presented in any survey. Yet, the time to answer the electronic questionnaire was not restricted, allowing checking of the PDCs' local statistics if necessary. Moreover, the study focuses on IMSS; therefore, future research should include other Mexican health institutions to have a broader perspective on PDCs challenges in Mexico. Finally, the study did not evaluate the quality of care that PDCs provide, as it was not among the study objectives. Given the heterogeneity of certain process of care observed in the studied PDCs, it would be advisable to evaluate their quality of care.

We conclude that existing heterogeneity in PD care and the multiple challenges faced by PDCs merit a series of plans and programs to ensure the availability of competent health personnel and to establish mechanisms to ensure that PDCs have sufficient supplies. Providing health personnel with continuous training and implementing performance evaluations and targeted interventions should increase adherence to evidence-based guidelines, which will promote the safe and effective delivery of PD care. The findings of this study may be of interest to decision-makers and healthcare providers involved in PD in Mexico and other LMICs that are facing similar challenges. Finally, to have a complete picture of the situation in PDCs, future studies should gather information on the health outcomes of patients with PD, such as peritonitis and catheter dysfunction rates and their quality of life, as these indicators are not routinely gathered, analysed, and reported.

Ethical Approval

The IMSS Research and Ethics Committee approved the study protocol (Register number: R-2020-785-163).

Consent to Participate

All participants provided written informed consent.

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Conflict of Interest

The Authors declares that there is no conflict of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.arcmed.2022.04.005.

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