

# An ISN-DOPPS Survey of the Global Impact of the COVID-19 Pandemic on Peritoneal Dialysis Services



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**Introduction:** Home dialysis may minimize SARS-CoV2 exposure risks compared to center-based dialysis. We explored how the pandemic may have introduced challenges related to peritoneal dialysis (PD) supply availability, routine patient care, and how facility practices changed during this time.

**Methods:** The PD/Dialysis Outcomes and Practice Patterns Study (PDOPPS/DOPPS) and International Society of Nephrology (ISN) administered a web-based survey from November 2020 to March 2021. Medical director responses were compared across 10 ISN regions.

**Results:** One hundred sixty-five PD facilities in 51 countries returned surveys. During the initial COVID-19 wave, the reported frequency of in-person patient visits decreased in 9 of 10 ISN regions. Before the pandemic, most facilities required a mask during PD exchanges which continued over the course of the pandemic. Although most facilities in different regions did not report PD supply disruptions, sites in Africa and South Asia reported major disruptions. Reductions in laparoscopic surgical procedures for PD catheters were reported by facilities in 9 of 10 regions whereas nonsurgical percutaneous procedures increased in facilities in 6 regions. Training of new PD patients declined in facilities in each region. Increased use of remote technology by patients to communicate with clinics was observed in all regions compared to prepandemic levels.

**Conclusion:** Marked within-region and across-region variability was noted in PD facility burden, clinical practice, and adaptation to the COVID-19 pandemic. This study highlights opportunities to improve routine PD care, adapt to the ongoing pandemic, and increase preparedness for potential future interruptions in PD care.

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## See Commentary on Page 2119

COVID-19 caused by SARS-CoV-2 has been associated with high mortality worldwide,<sup>1</sup> with the pandemic placing a huge burden on health care

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systems worldwide. Consequently, many jurisdictions have been forced to make changes to the delivery of health care to the general patient population, particularly with the necessity to introduce telemedicine and other remote modes of patient communication on a large scale.<sup>2,3</sup> Patients with kidney failure receiving maintenance dialysis treatment are at high risk for severe COVID-19 infection due to their immunocompromised state and multiple comorbidities.<sup>4</sup> With many countries initially instituting nationwide lockdowns

to curb the spread of the infection, in-center hemodialysis (HD) patients are a uniquely vulnerable group during this pandemic because their exposure risks are heightened due to the need for regular travel to the dialysis facility and frequent interaction with fellow patients and health care staff on a weekly basis.<sup>5</sup> Whereas patients on home-based dialysis, in particular PD, are at a potentially lower risk for nosocomial exposure, there are specific challenges faced with preventing the disruption of treatment, including the following: ensuring a continued supply of personal protective equipment, PD solutions, and supplies to continue to perform PD safely at home. To determine the impact of the COVID-19 pandemic on various practices and PD delivery across different health care settings, the ISN and the PDOPPS/DOPPS at Arbor Research Collaborative for Health initiated a global study involving PD facilities across different ISN regions. The aims of our study were as follows: (i) to understand how the pandemic may have introduced challenges related to availability of PD supplies and routine patient care, and (ii) to describe how PD facility practices may have changed during this time.

## METHODS

A survey to assess the impact of COVID-19 on international dialysis services was developed by DOPPS and ISN investigators, including a module focusing on PD practices. The ISN requested country member-societies and registries to provide a list of dialysis facilities in their country, including HD and PD, private and public, university affiliated and nonaffiliated, and hospital and satellite-based facilities. The adapted survey was subsequently disseminated to facilities in all countries in 2 stages as follows:

### Stage 1 (Stratified Random Sample)

For countries with fewer than 40 HD facilities, all facilities (regardless of having a PD program) were invited to participate. For countries with more than 40 HD facilities, a stratified (by region or province and facility size) random sample of 20 facilities (regardless of having a PD program) was selected. The survey was open for completion between November 18, 2020 and March 13, 2021. Responses were received from 43 of 113 invited countries and a total of 222 surveys (including facilities without a PD program) were returned.

### Stage 2 (Convenience Sample)

Responding to concerns that some adverse patient or staff experiences may be overlooked by a stratified random sampling approach, the survey was opened to all HD and PD facilities between March 3, 2021 and

March 13, 2021. A total of 152 surveys from 78 countries were returned (including facilities without a PD program).

Returned questionnaires with the PD module answered from stage 1 of the ISN survey ( $n = 97$ ), and stage 2 of the ISN survey ( $n = 68$ ) were combined for a total of 165 responses in 51 unique countries. Results are presented descriptively by ISN region. The Ethical & Independent Review Services approved the study (IRB000007807) before its commencement. We ensured that digital personal identifiers were not requested so no responses could be traced back to individuals or facilities completing the survey. Participants consented to deidentified responses being securely stored on ISN and Arbor Research servers. Additional details have been previously published.<sup>6</sup>

## RESULTS

### Country Outreach and Responses Received

Of the 165 surveys returned with the PD module of the questionnaire completed, representation from each of the 10 ISN regions ranged from 5 facilities in the Middle East to 41 facilities in Western Europe (Figure 1). Country representation from each ISN region is shown in Supplementary Table S1 and facility characteristics by ISN region are shown in Table 1.

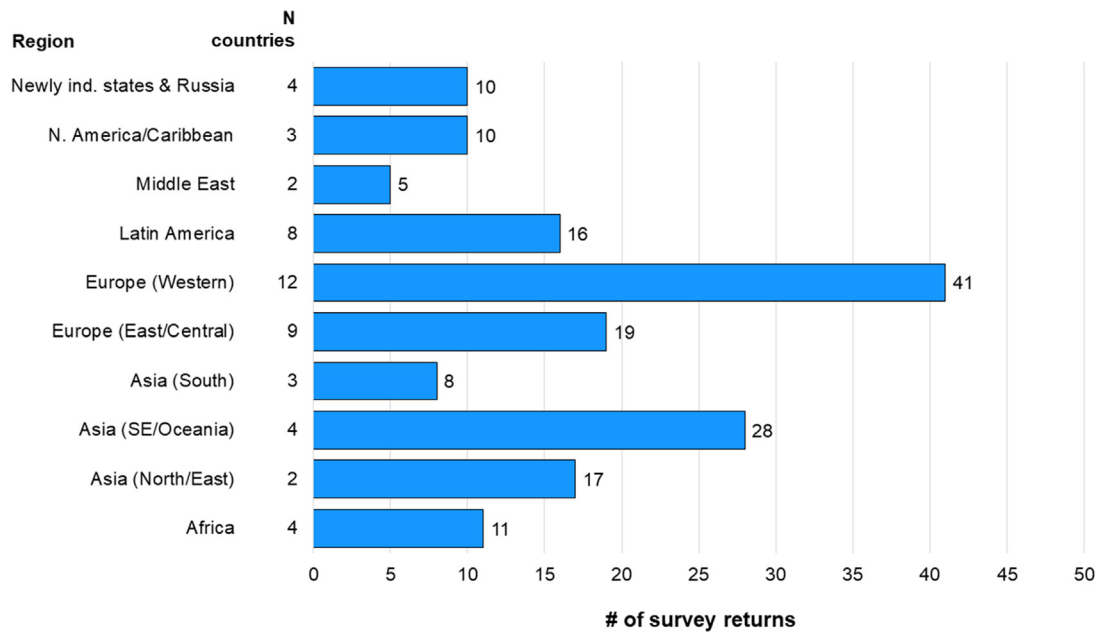
### Burden and Fatality

Within region and across-region variation was observed in the reported facility percentage of PD patients with a confirmed or suspected SARS-Cov-2 infection (Figure 2). At least 1 facility in the majority of regions reported COVID-19 infection among more than 50% of patients whereas most facilities reported infection rates less than 10%. In Africa, higher infection rates were seen with the majority of facilities reporting rates greater than or equal to 10%. Most facilities across ISN regions reported that greater than or equal to 50% of their PD patients with a COVID-19 infection required hospitalization (Figure 3).

Patient mortality was reported to be less than 30% in most facilities across ISN regions (Figure 4). Nevertheless, 60% of respondents in the Middle East region reported a mortality rate greater than 50% among their PD patients infected with COVID-19.

### Frequency and Location of Routine Dialysis Care

The frequency of in-person clinic visits for PD patients decreased in many clinics during the initial pandemic wave (Figure 5). Monthly visits were most common pre-pandemic; during the initial pandemic wave the percentage of facilities reporting monthly visits decreased in all regions except in the North



**Figure 1.** Survey returns with peritoneal dialysis section answered, by ISN region. N. America, North America; SE, south east.

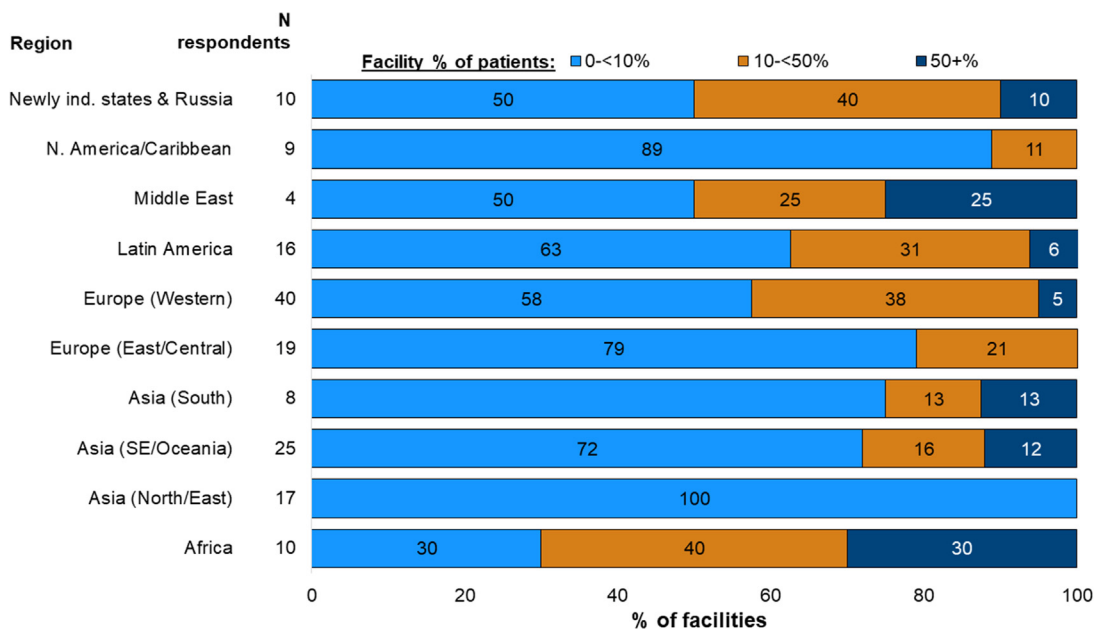
America/Caribbean region. The location of routine blood work generally remained at the PD clinic during the pandemic peak compared to prepandemic (Figure 6). Similarly, the location of erythropoiesis-stimulating agents injection administration (in clinic

vs. home) was generally unchanged during the pandemic peak compared to prepandemic; most facilities already promoted home erythropoiesis-stimulating agents injections before the pandemic (Figure 7).

**Table 1.** Peritoneal dialysis facility characteristics, by ISN region

Facility characteristics	ISN Region										
	All	Africa	Eastern and Central Europe	Western Europe	Middle East	NIS and Russia	South Asia	Oceania and South East Asia	North and East Asia	North America and Caribbean	Latin America
Facilities <i>n</i>	165	11	19	41	5	10	8	28	17	10	16
Countries <i>n</i>	78	4	9	12	3	4	3	4	2	3	8
World bank classification											
Low-income	1%	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Lower-middle income	10%	27%	0%	0%	0%	20%	100%	4%	0%	0%	13%
Upper-middle income	33%	64%	21%	0%	0%	80%	0%	68%	24%	0%	81%
High income	56%	0%	79%	100%	100%	0%	0%	29%	77%	100%	6%
Health care sector											
Public health care	55%	55%	42%	73%	100%	80%	50%	68%	0%	40%	44%
Private health care	10%	18%	5%	3%	0%	0%	25%	0%	0%	40%	38%
Academic/university hospital	35%	27%	53%	25%	0%	20%	25%	32%	100%	20%	19%
Location											
Rural area	6%	9%	5%	12%	0%	0%	0%	7%	0%	10%	0%
Urban area	81%	73%	90%	73%	80%	100%	100%	89%	71%	40%	100%
Suburban area	13%	18%	5%	15%	20%	0%	0%	4%	29%	50%	0%
Services offered											
Adults only	71%	73%	79%	98%	60%	100%	50%	32%	59%	100%	50%
Children only	3%	0%	5%	0%	0%	0%	0%	11%	0%	0%	6%
Both	26%	27%	16%	2%	40%	0%	50%	57%	41%	0%	44%
Modalities available											
HD only	1%	0%	5%	2%	0%	0%	0%	4%	6%	10%	0%
PD only	2%	0%	11%	0%	0%	0%	0%	0%	0%	0%	13%
HD and PD	97%	100%	84%	98%	100%	100%	100%	96%	94%	90%	88%

HD, hemodialysis; ISN, International Society of Nephrology; NIS, newly independent states; PD, peritoneal dialysis.



**Figure 2.** Facility confirmed/suspected patient COVID cases\* in PD program, by ISN region as of survey completion date (November 2020 – March 2021). N. America, North America; SE, south east. \*As proportion of PD program size.

### Dialysis Procedures at Home

The majority of facilities required patients to mask for manual PD exchanges and when connecting to a cyclor during the pandemic (ranging from 50% to 100% of facilities by ISN region); several facilities did report an increase in masking requirements (Figure 8).

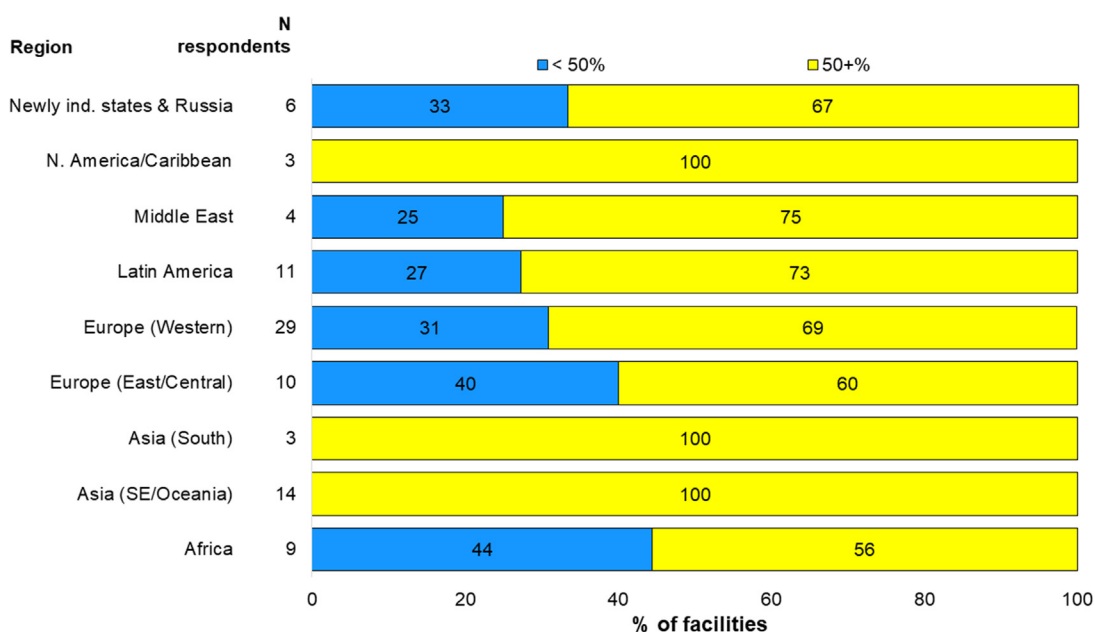
### PD Supplies

During the COVID-19 pandemic, disruptions in PD supply delivery were reported by PD facilities in

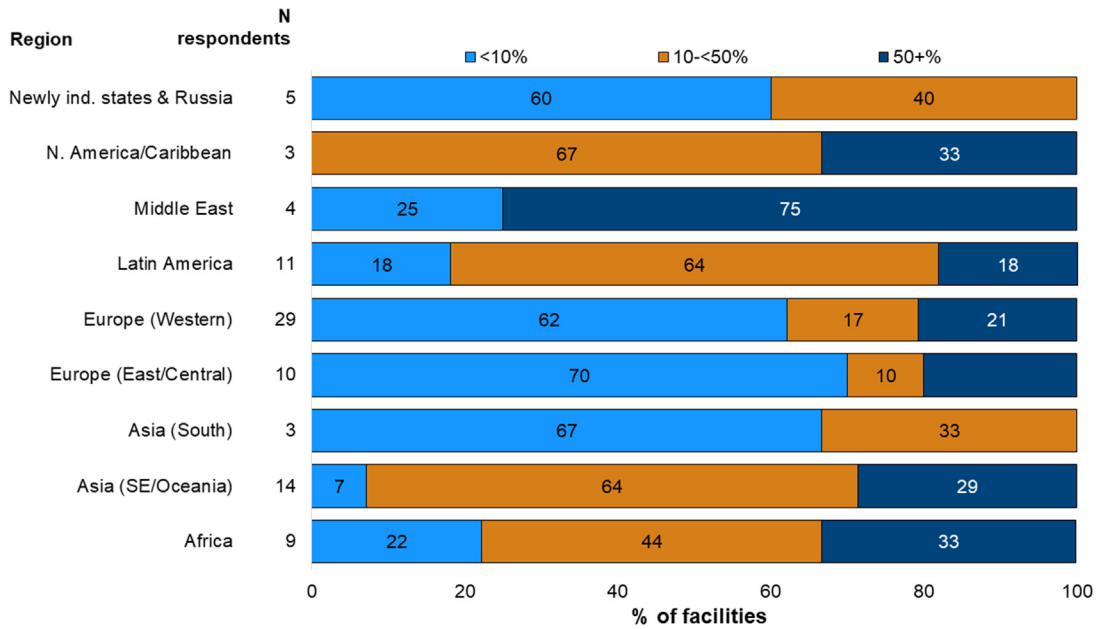
Africa (80% any; 20% major disruption) and South Asia (88% any; 13% major disruption). In contrast, most of the other regions reported that supply delivery was not (or minimally) disrupted (Figure 9).

### Training and Procedures

Training of new PD patients during the COVID-19 pandemic compared to prepandemic varied widely within region and across regions, with many facilities reporting a decline or even cessation (ranging from 13% in North/East Asia to 76% in South Asia) whereas



**Figure 3.** Facility percent of patients hospitalized among confirmed/suspected patient COVID cases in PD program, by ISN region as of survey completion date (November 2020 – March 2021). N. America, North America; SE, south east.



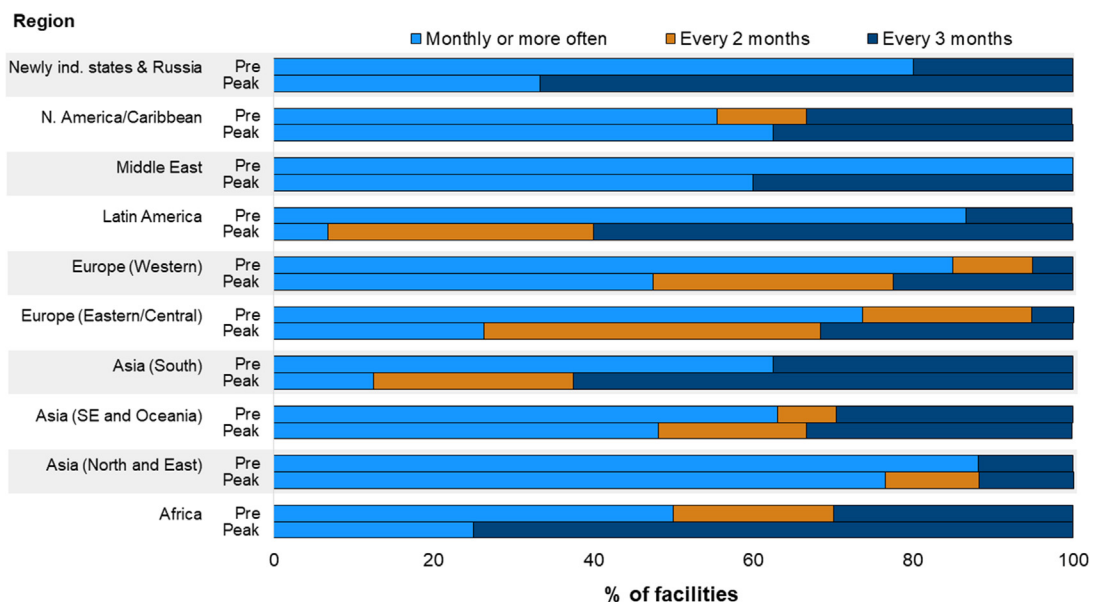
**Figure 4.** Facility percent of patients who died among confirmed/suspected patient COVID cases in PD program, by ISN region as of survey completion date (November 2020 – March 2021). N. America, North America; SE, south east.

a smaller number of facilities reported an increase in PD patient training (ranging from 5% in Western Europe to 33% in North America/Caribbean; Figure 10).

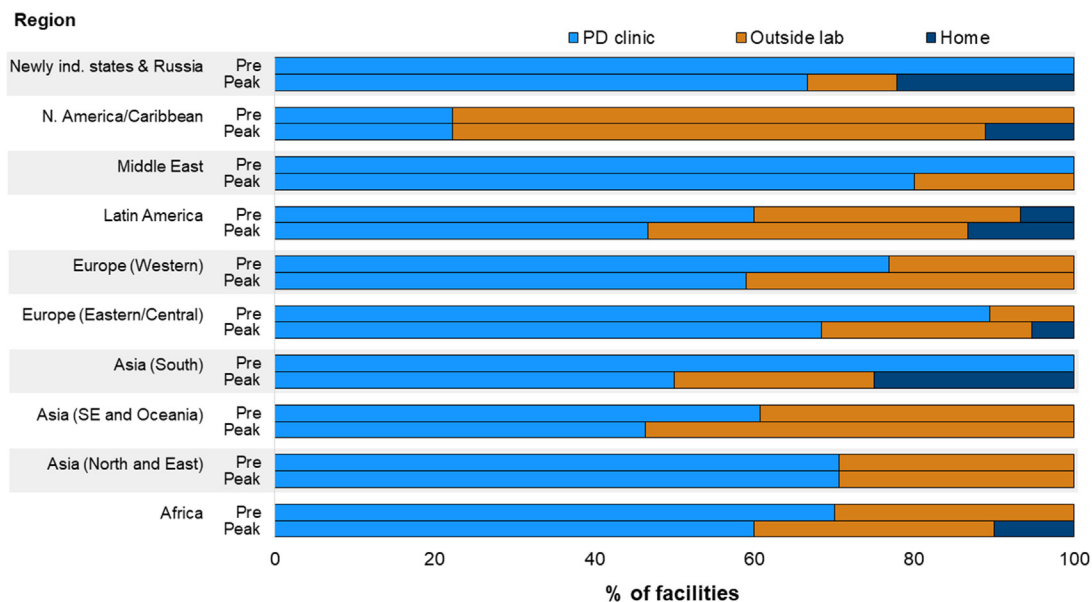
Facilities from 6 of 10 regions reported increasing nonsurgical percutaneous procedures for PD catheters during the COVID-19 pandemic (ranging from 13% of facilities in Western Europe to 43% in Africa) whereas facilities in 9 of 10 regions reported reductions in laparoscopic surgical procedures (ranging from 9% of facilities in North and East Asia to 86% in Africa; Figure 11).

### Remote Technology for Communicating With Patients

During the first wave of the COVID-19 pandemic, the proportion of clinics reporting that more than 50% of their patients used remote technologies to communicate with the clinic was 49% (ranging from 13% in South Asia to 87% in Latin America) compared to 36% of clinics prepandemic (Figure 12). At survey completion, most facilities indicated that they did not have the ability to use the following remote communication technologies: remote monitoring (52%), video chat



**Figure 5.** Frequency of routine clinic visits (in-person or remote visits) before versus during initial COVID-19 pandemic peak, by ISN region. N. America, North America; SE, south east.



**Figure 6.** Location of routine lab draws before versus during the initial COVID-19 pandemic peak, by ISN region. N. America, North America; SE, south east.

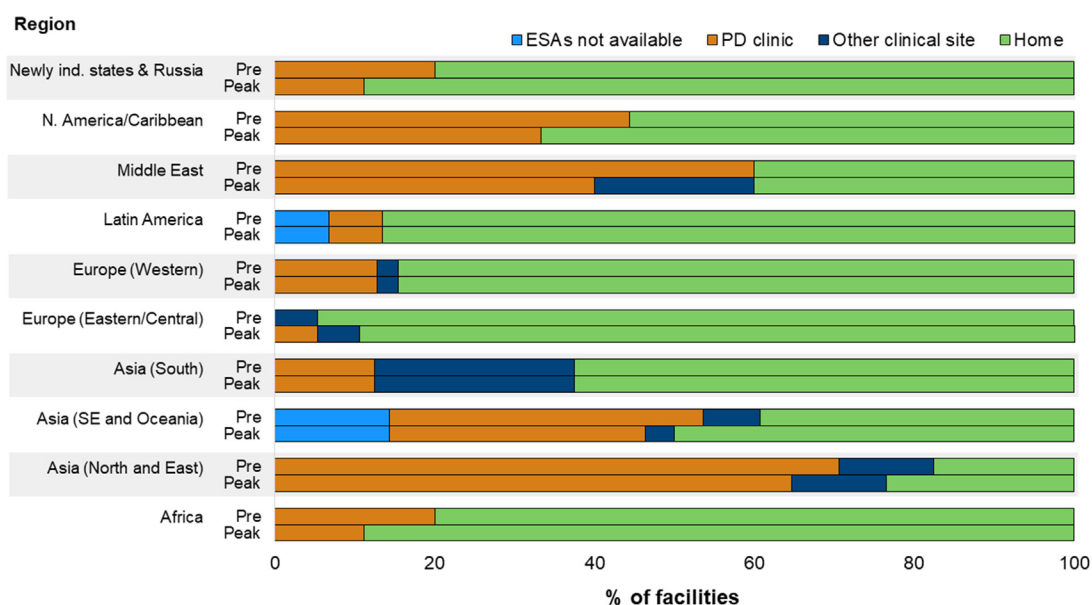
(57%), and web-based patient portals (78%) (Table 2; note that table results are presented as the proportion of facilities reporting that the tool was available and in some use). Finally, 69% of facilities reported that they were trying to increase their use of remote technology for communicating with patients, ranging from 50% in the Middle East, Russia and the newly independent states, and South Asia, to 93% in Latin America.

## DISCUSSION

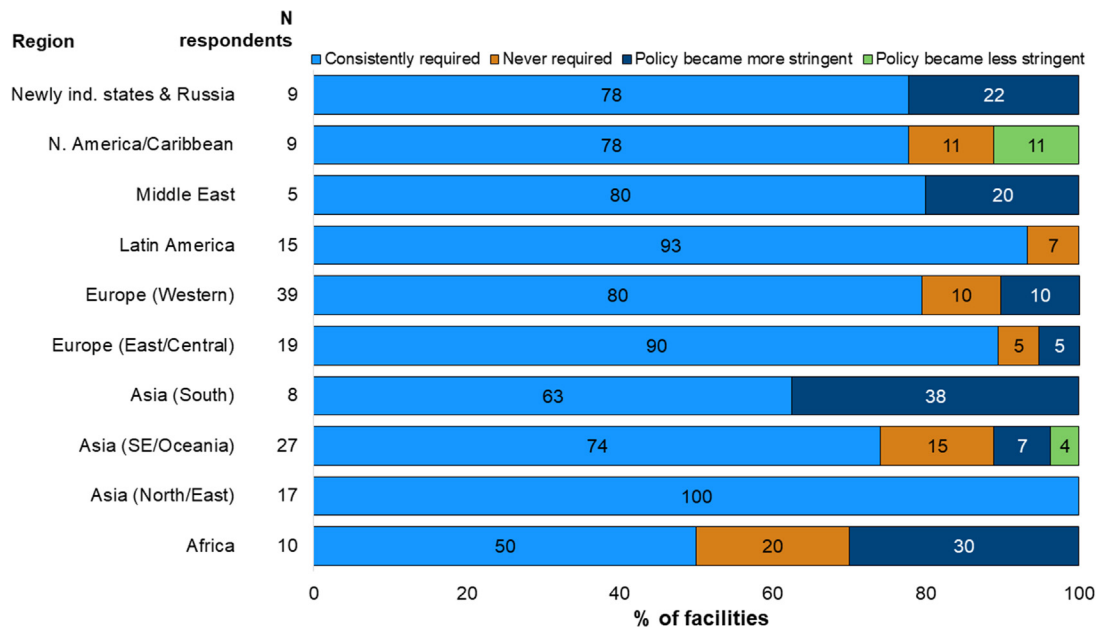
In this international survey of over 165 facilities across 51 countries, a high rate of morbidity and mortality

due to COVID-19 among maintenance PD patients was reported, consistent with previous reports.<sup>7-10</sup> The novel findings of the present report relate to changes in clinical care and practice variation in response to COVID-19 across PD facilities in a multinational cohort. Major findings relate to the use of remote technologies to connect with PD patients, which was consistent across countries and regions.

Our survey reported a reduction in the routine visits from the standard monthly to every 3 months or more. There is limited evidence-based data about the optimal frequency of routine clinic visits and blood work in PD



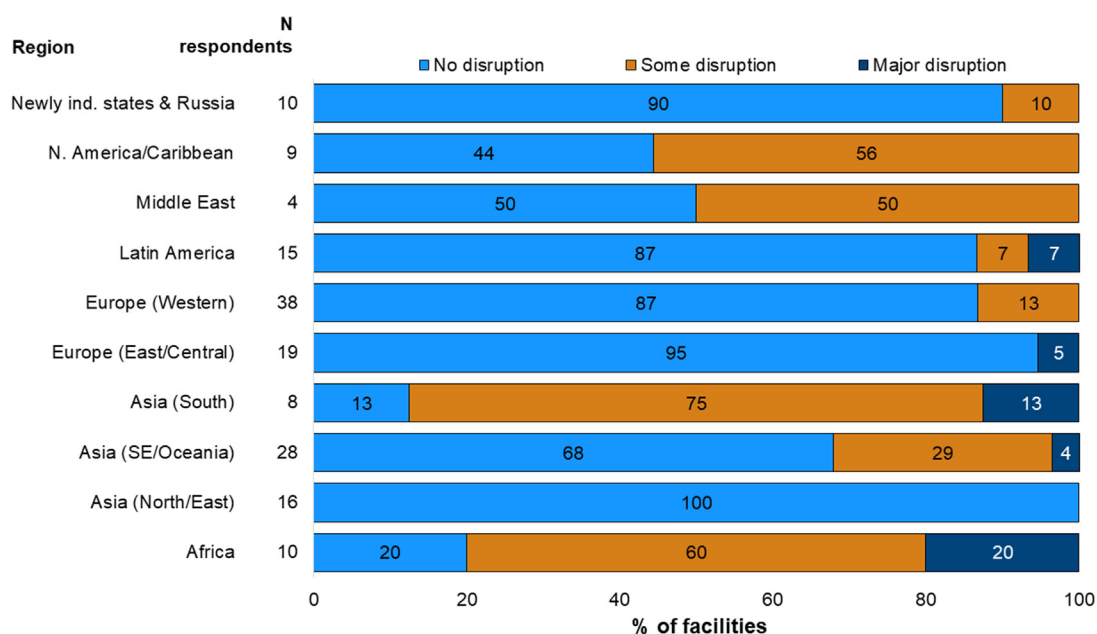
**Figure 7.** Location of erythropoiesis-stimulating agent injections before versus during the initial COVID-19 pandemic peak, by ISN region. N. America, North America; SE, south east.



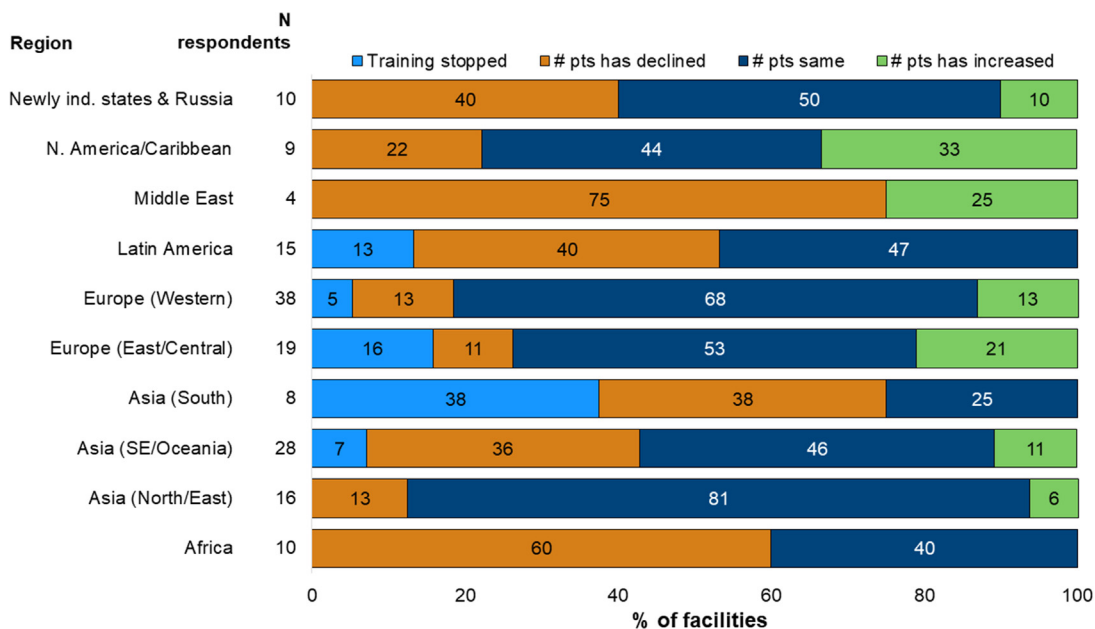
**Figure 8.** Changes in facility policy for patient use of masks when performing manual PD exchange or connecting to aycler as a result of the COVID-19 pandemic, by ISN region. N. America, North America; SE, south east.

patients. Thomas *et al.*<sup>11</sup> found that more frequent blood testing in HD patients was not associated with lower risk of death, hospitalization, or cardiovascular events compared to blood testing every 6 weeks. Based on our findings, further studies are needed to better understand if the reduction in the frequency of PD routine clinic visits, as observed in the present study, may negatively impact clinical outcomes. This information may inform practice in situations that require changes in clinic visit schedules such as during pandemics.

Variability among different countries in policies and practices surrounding individuals wearing masks in performing PD exchanges was noted. We have limited evidence-based data about the beneficial use of a mask during the performance of PD exchanges in decreasing the risk of PD peritonitis.<sup>12</sup> Prowant *et al.*<sup>12</sup> found that the incidence of peritonitis was similar in patients who routinely used masks for PD exchanges compared to those not adopting this practice. Future work could focus more deeply on the impact of mask use on reduction of PD peritonitis



**Figure 9.** Disruptions to the delivery of peritoneal dialysis fluids at any time during the first year of the COVID-19 pandemic, by ISN region. N. America, North America; SE, south east.



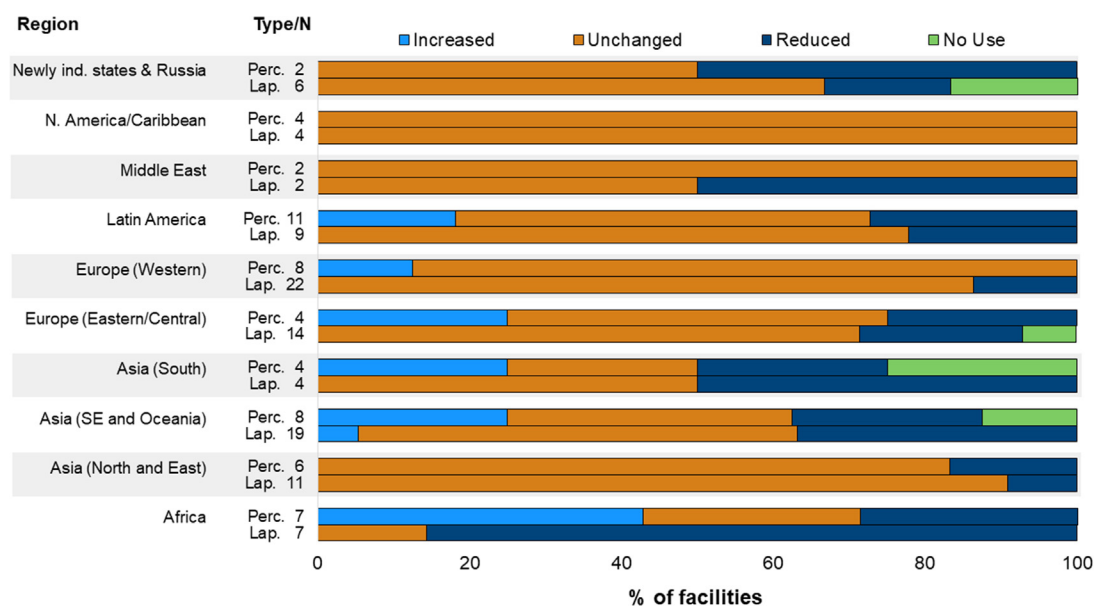
**Figure 10.** Training of new peritoneal dialysis patients – at survey completion versus before the COVID-19 pandemic, by ISN region. N. America, North America; SE, south east.

especially in situations requiring ongoing mask preservation.

Another prominent impact of the pandemic that was identified in this survey is the disruption of provision of PD supplies, especially in low-income countries such as in Africa. Compared to high income countries, low-income countries traditionally have struggled with PD supply availability and availability of PD in general (even before the pandemic) with a recent survey demonstrating that among 30 countries that cited no

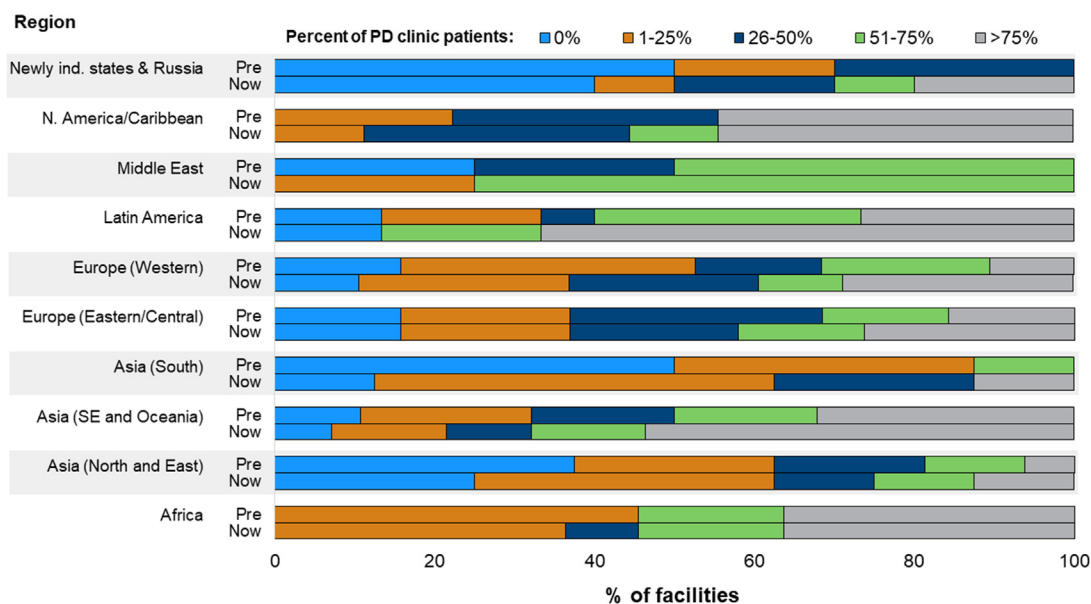
availability of PD, 67% were in Africa.<sup>13</sup> Unfortunately, the pandemic magnified these disparities. Therefore, our finding emphasizes the importance of investing in locally produced, low-cost PD fluids, particularly in low-income and middle income countries, to ensure PD practices in these countries are sustainable and resilient.<sup>14</sup>

Moreover, our survey identified a decline in PD training, and PD related procedures during the pandemic. During the pandemic when resources were



**Figure 11.** Change in laparoscopic and nonsurgical percutaneous peritoneal dialysis catheter insertion/revision procedures—at survey completion versus before the COVID-19 pandemic, by ISN region. Lap., Laparoscopic surgical procedures; N. America, North America; perc., nonsurgical percutaneous procedures; SE, south east.





**Figure 12.** Estimated percent of facility peritoneal dialysis patients who use remote technology to communicate with the clinic at survey completion versus before the COVID-19 pandemic, by ISN region; remote technology includes texting, email, video chat, health system portal, or remote monitoring via APD cyclers. N. America, North America; SE, south east.

constrained and operating rooms closed, programs that had no nonsurgical PD catheter placement options may have been the most susceptible to lack of availability of PD catheter placement. Given the potential advantages of PD during pandemics, enabling and building capacity for increasing PD use is important. Strategies to facilitate PD catheter insertion include prioritizing PD catheter insertion as a lifesaving procedure, increasing use of percutaneous PD insertion obviating the need for resource-limited operating room/theater time while expanding the use of earlier and elective placement of embedded PD catheters at higher levels of kidney function.<sup>15</sup>

Among the effects of the pandemic identified, the most prominent was increases in the reported use of remote technologies by patients to communicate with their health care providers. Interestingly, the methods most commonly used differ by region and include mostly video chat, or web-based patient communication tools. We noticed that some low-income countries such as those in Africa lagged behind in using remote communication technologies which might be related to the many barriers such as availability, financial, and organizational barriers.<sup>16</sup> Nevertheless, the use of remote communication technologies in Africa has increased compared to early during the COVID-19 pandemic.<sup>17</sup> The use of telemedicine in providing care to kidney disease patients had been implemented in some countries even before the COVID-19 pandemic,<sup>18,19</sup> and has increased markedly during the pandemic.<sup>3,20</sup> It is essential to continue expanding these novel modes of communication. Although telemedicine potentially provides

benefits to patients and providers, there is limited evidence to support its use as a replacement to traditional in-person visits in terms of clinical and patient-reported outcomes. The pandemic has stressed the importance of the need to evaluate the impact of the utilization of various modes of telehealth on patient-reported and clinical outcomes.

There are limitations to this report. Less than optimal returns among the initial stratified random sample required a subsequent convenience sampling that may not be regionally representative (e.g., clinics impacted most severely by COVID-19 may have been less likely to respond or the other way around). Facility practices and experiences were reported by a single health care provider at each PD facility whose perception may not match the perception of other providers in their practice. Finally, the survey was only completed at a single time point earlier in the pandemic (November 2020–March 2021). Therefore, practices may have changed over time in response to the fluctuating burden of COVID-19 and availability of vaccines or antiviral treatments.

Several strengths of the current study are worth noting. This is the largest international survey to assess the impact of the COVID-19 pandemic on PD practices. Significant within and across-region variations in practices and experience were noted. Responses were received from 51 unique countries from all 10 ISN regions. Responses were also received from facilities in settings that are often underrepresented in nephrology research, including facilities from low and lower-middle income countries, facilities in public health care settings, and rural facilities.

**Table 2.** Availability of remote communication tools, by ISN region

Remote communication tool	ISN Region										
	All	Africa	Eastern and Central Europe	Western Europe	Middle East	NIS and Russia	South Asia	Oceania and South East Asia	North and East Asia	North America and Caribbean	Latin America
Facilities <i>n</i>	159	11	19	39	4	10	8	28	16	9	15
Regional proportion of facilities reporting that the tool was available and in some use											
Text	73%	90%	84%	58%	100%	70%	71%	89%	38%	56%	100%
Email	50%	40%	68%	72%	50%	44%	14%	43%	6%	67%	53%
Video chat	43%	33%	47%	36%	0%	13%	0%	71%	25%	78%	53%
Patient portal	22%	20%	42%	23%	0%	0%	0%	18%	19%	56%	13%
Remote monitoring	48%	50%	37%	70%	100%	38%	0%	19%	69%	56%	47%
Telephone only	96%	100%	100%	100%	100%	100%	88%	89%	88%	100%	93%

ISN, International Society of Nephrology; NIS, newly independent states.

The COVID-19 pandemic brought to light important practice variation in terms of routine PD care. In particular, PD procedures were limited at a time when home-based over facility-based dialysis growth may have been preferred. This may reflect the limited availability of resources for surgical PD catheter insertion. In this regard, percutaneous options for PD access insertion practices may have been important to compensate for a decrease in surgical PD access procedures. The pandemic further called into question the need for routine masking during PD procedures which is that much more relevant in the face of limited availability of personal protective equipment by patients and providers. The change in clinic visit frequency and use of telemedicine offer important insights into how to shape and evaluate the future of routine PD care, in particular during challenging times, by examining the optimal frequency of visits, investigations, and modes of communication. Lastly, service disruptions, particularly in low and lower-middle income countries, were much more magnified during the pandemic with a call to action to develop low cost and sustainable PD solutions in these countries.

## DISCLOSURE

JP reports grants from AHRQ, during the conduct of the study; personal fees from Baxter Healthcare, Fresenius medical care, Davita Healthcare Partners, US Renal Care, Bayer, Otsuka, Astra Zeneca Canada and is on the advisory board for Liberdi, outside of the submitted work. VJ reports grants paid to institution from Baxter Healthcare, GSK, NephroPlus, Biocon, honoraria paid to institution from Astra Zeneca, Baxter Healthcare, participation on a Data Safety Monitoring Board or Advisory Board (Zydus, GSK), and leadership at International Society of Nephrology. EKT reports an ISN grant for WCN in 2017 and 2019. AL is a Member of ISPD ExCom; ISPD Secretary; Chair of ISN Renal Disaster

Preparedness Working Group. BB, RLP, BMR, and RP-F are employees of Arbor Research Collaborative for Health, which administers the DOPPS Program. Global support for the ongoing DOPPS Programs is provided without restriction on publications by a variety of funders. For details see <https://www.dopps.org/AboutUs/Support.aspx>. Funding is provided directly to Arbor Research Collaborative for Health. BMR has received consultancy fees or travel reimbursement since 2019 from AstraZeneca, GlaxoSmithKline, Kyowa Kirin Co., and Monogram Health, all paid directly to his institution of employment. RP-F has received research grants from Fresenius Medical Care, consulting fees paid to Arbor Research Collaborative for Health from Astra Zeneca, Bayer, Novo Nordisk, Boeringer-Lilly, Rethrophin, honoraria from Astra Zeneca, Bayer, Novo Nordisk, Boeringer-Lilly, Rethrophin, and is in a leadership role at ISN, KDIGO. All other authors declared no conflict of interest.

## ACKNOWLEDGMENTS

The authors thank the national society and registry countries and ISN regional board leaders who provided the lists of dialysis centers that we were then able to contact. **Supplementary Appendix S2** lists these contributors and surveyed respondents who wished to be acknowledged (NB, we are unable to link respondents with individual responses). We are grateful to Charu Malik and Paul Laffin at ISN for their support and Silvia Salaro at ISN who assisted with contacting the country leaders and deploying the survey. We are grateful to staff at Arbor Research Collaborative for Health for supporting survey development and deployment. This research has previously been reported at Kidney Week 2021 (American Society of Nephrology).

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## AUTHOR CONTRIBUTIONS

RAI, BB, RA, FC, GD, RE, MG, RPF, RLP, BMR, ET, AL, JP, VJ, VL, CP, and DSS conceived and/or designed the work that led to the submission. RAI, BB, RA, RPF, BMR, AL, JP and acquired data, and/or played an important role in interpreting the results. RAI, BB, FC, RE, RPF, RLP, BMR, ET, AL, and JP drafted or revised the manuscript. RAI, BB, RA, FC, GD, RE, MG, RPF, RLP, BMR, ET, AL, JP, VJ, VL, CP, and DSS approved the final version. JP confirms that he has had full access to the data in the study and final responsibility for the decision to submit for publication.

## SUPPLEMENTARY MATERIAL

Supplementary File (PDF)

Questionnaire.

**Table S1.** Country representation in each ISN region.

**STROBE Checklist.**

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