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Editorial

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Through the Storm: Automated Peritoneal Dialysis with Remote Patient Monitoring during COVID-19 Pandemic

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Coronavirus disease 19 (COVID-19) is a pandemic that has generated a global public health crisis with significant clinical, social, and economic repercussions. Elderly as well as hypertensive, diabetic, and immunosuppressed patients are at higher risk of having fatal outcomes after a severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection [1–3]. It is evident that patients with chronic kidney disease (CKD) and dialysis are at increased risk for adverse health outcomes during this pandemic [4]. In this context, home therapy with peritoneal dialysis, particularly automated peritoneal dialysis with remote patient management programs (APD-RPM), emerges as an enabling technology to reduce and prevent risks of infection, as recommended by the International Society of Peritoneal Dialysis (ISPD) and others [5, 6].

The Baxter Renal Care Services Colombia (BRCS®) APD model has been described by Sanabria and others [7]. The program is based on a patient's regular monthly comprehensive evaluation and additional on-site visit for pre-emptive consultations and Continuous Quality Improvement (CQI) approach to the delivery of care. The APD treatments were performed following individualized needs per patient to achieve the adequacy goals including daily sessions, using glucose-based and icodextrin solutions. The remote patient monitoring (RPM) program is based on a Homechoice Claria™ APD cycler connected to a 3G-4G modem device that transfers data to Sharesource™ platform. Clinical teams have the possibility to review everyday important aspects of the APD therapy including significant alerts related to specific findings, lost treatment time, lost dwell time, lost treatment volume, drain completed early, total ultrafiltration, and blood pressure [7]. During the last 3 years, BRCS has successfully implemented this remote monitoring program [8].

Current exceptional circumstances allowed us to change the model of care after March 2020, once the pandemic was declared, with the main goal of reducing the risk of SARS-COV2 infection for APD patients, while continuing the same quality of care. Changes in the model included the following:

– Telehealth for at least the first 3 months of the pandemic

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– On-site evaluation only in specific cases requiring a medical evaluation related with an acute complication, medicine administration, after hospital discharge, and initial training of new patients
– Weekly telephonic triage to evaluate COVID-19 contacts or symptoms for patients done by nurses or social workers
– Daily review of APD treatments through remote monitoring platform
– PD technique review performed through videos sent by the patient or using video call
– Monitoring by videos or photos any changes in the PD fluid, exit site, and/or foot in diabetic patients
– Delivery of medications to patients at home or pick up options to registered caregivers at the dialysis clinics

By performing these changes during quarantine, the APD remote monitoring model of care implemented inside BRCS clinics has become the best option for patients in chronic dialysis, reducing risks of exposure to the hospital environment, transportation, and contact with healthcare personnel. The model has allowed the clinical team to

– Track patient´s adherence, blood pressure, ultrafiltration, and weight daily
– Perform proactive telephone interventions anticipating possible urgent care requirements
– Adhere to the international recommendations to prevent the virus spread

We reviewed data of the APD RPM program before and after the appearance of the pandemic (January to April of 2020), with an analysis of the subsequent changes in the pattern of care and APD outcomes. For the statistical analysis, a comparison was made between January 2020 (baseline) and April 2020 data using test for means and proportion differences as appropriate. The rate of peritonitis was also calculated with its respective 95% confidence interval.

A total of 1,023 APD patients with RPM program in 42 BRCS dialysis clinics were included in this report; the main characteristics are presented in detail (Table 1). None of these patients was diagnosed with COVID-19; at the time of analysis, there were 6,507 cases and 293 deaths in Colombia due to COVID-19.

We evaluated adherence to APD, which showed improvement over the follow-up time (see Table 2). At the same time, a decrease in on-site evaluations was observed in the renal clinics with consequent increase in remote interactions (Table 2).

No statistically significant differences were observed in peritonitis rates (see Table 3). The proportion of patients with poorly controlled hypertension decreased significantly (see Table 3), although the proportion of patients with hypotension increased slightly.

Table 1. Baseline characteristics of the study population

Characteristics	*N* = 1,023
Age, median (IQR), years	63 (51, 72)
Sex, *n* (%)	
Male	623 (60.9)
Female	400 (39.1)
CKD cause, *n* (%)	
Diabetes	395 (38.6)
Hypertension	273 (26.7)
Glomerulonephritis	169 (16.5)
Unknown	58 (5.7)
Others	52 (5.1)
Polycystic kidney disease	39 (3.8)
Urinary tract obstruction	37 (3.6)
History of cardiovascular disease, *n* (%)	84 (8.2)
Urine output, mL/day, *n* (%)	
<100	426 (41.6)
100 to 249	149 (14.6)
≥250	448 (43.8)
ESRD comorbidity index, median (IQR)	2 (0, 3)
Dialysis vintage, years, *n* (%)	
<1 year	375 (36.7)
1–3 years	377 (36.8)
>3 years	271 (26.5)

IQR, inter quartile range; CKD, chronic kidney disease; ESRD, end-stage renal disease.

These findings suggest that home care for patients on APD with RPM program could be successfully implemented by maintaining and even increasing interaction between the patient and the renal clinic staff. Adjustments to the patient care plan process reduced on-site evaluations inside the dialysis clinics and were associated with good performance indicators in terms of adherence, peritonitis rates, and blood pressure control. Taking advantage of connectivity tools, this new way of delivering care in PD, can improve the clinical staff's availability and quality of time dedicated to patient care while tracking changes with the remote monitoring model. However, one possible confounder lies in, the SARS-COV2 pandemic itself, which could have increased the level of patient self-care due to fear and negative consequences associated with suboptimal PD care. In general, although a very short period of time was included in the analysis, the current data suggest that a remote management of patients is easy to adapt to changing needs within APD programs, safe, and could be associated with increased adherence to therapy.

Table 2. Adherence and remote attention indicators

Indicator	Time	*N*	Indicator	Change from January, % [95% CI]	*p* value
Adherence, % (performed sessions, *n*/prescribed sessions, *n*)	January	26,913*	93.2	–	–
	February	26,749*	94.3	1.1 [0.6, 1.5]	<0.01
	March	28,707*	94.5	1.3 [0.8, 1.7]	<0.01
	April	28,216*	95.2	2.0 [1.6, 2.3]	<0.01
Proportion of patients with >10% of prescribed sessions missed per month, %	January	859	18.6	–	–
	February	883	21.6	3.0 [−0.1, 6.7]	0.94
	March	915	14.2	−4.4 [−7.8, −0.9]	<0.01
	April	932	15.7	−2.9 [−6.3, 0.6]	0.05
Proportion of patients with missed dwell time above 5% per treatment, per month, %	January	859	4.1	–	–
	February	883	5.8	1.7 [−0.3, 3.7]	0.94
	March	915	3.7	−0.4 [−2.2, 1.4]	0.33
	April	932	3.2	−0.9 [−2.6, 0.8]	0.15
Teleconsultations per patient/month, mean, *n*	January	859	0.46	–	–
	February	883	0.44	0.02 [0.01, 0.02]	<0.01
	March	915	1.2	0.79 [0.78, 0.80]	<0.01
	April	932	4.9	4.48 [4.47, 4.49]	<0.01
On-site evaluations per patient/month, mean, *n*	January	859	5.1	–	–
	February	883	5.0	−0.1 [−0.1, −0.09]	<0.01
	March	915	4.4	−0.7 [−0.7, −0.6]	<0.01
	April	932	1.0	−4.1 [−4.2, −4,09]	<0.01

APD, automated peritoneal dialysis. * Sessions of APD, per month.

Table 3. Clinical outcomes

Outcomes	Time	*N*	Events	Estimate	*p* value
Peritonitis rate, per patient/month	January	859	21	0.02	Reference
	February	883	24	0.03	0.36
	March	915	23	0.02	0.46
	April	932	24	0.02	0.43
Proportion of patients with BP >140/90 mm Hg, during >40% of the days	January	859	39.8	Reference*	–
	February	883	37.5	−2.3 [−6.8, 2.2]	0.16
	March	915	37.7	−2.1 [−6.6, 2.4]	0.18
	April	932	34.9	−4.9 [−9.3, −0.4]	0.01
Proportion of patients with BP <90/60 mm Hg, during >10% of the days	January	859	19.6	Reference*	–
	February	883	22.3	0.3 [−1.1, 6.5]	0.91
	March	915	21.8	2.2 [−1.5, 5.9]	0.87
	April	932	22.4	2.8 [−0.1, 6.5]	0.92

BP, blood pressure. * Change from January with 95% CI.

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Conflict of Interest Statement

A.B. and R.C. are full-time employees of Renal Therapy Services-Latin America, Bogotá, D.C., Colombia; F.A. is a full-time employee of Renal Therapy Services-Colombia, Bogotá, Colombia;

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Author Contributions

Mr. Bunch, Ms. Quiñonez, and Ms. Corzo: original research project conception and design, data acquisition, and data interpretation. Mr. Ardila and Mr. Castaño: original research project conception and design and data interpretation. All authors have been involved in the drafting of the manuscript or revising it critically for important intellectual content and provided final approval of the version to be published. All authors verify that they have met all the journal's requirements for authorship. All authors agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of the publication. All authors approved the final manuscript draft submitted for publication. The authors received no financial compensation for the development of this manuscript.

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