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A remote management program in automated peritoneal dialysis patients in Colombia

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Abstract

Background: *Remote monitoring technology that is specifically designed to be integrated into automated peritoneal dialysis (APD) systems gives both patients and their clinical team a powerful tool that can enhance communication, potentially improve adherence to the treatment, optimize fluid balance, and address potential complications of therapy in near real time.* **Objective:** *The objective of this study was to describe the implementation and early stages of an APD remote monitoring program as well as some early outcomes associated with this program.* **Methods:** *A cross-sectional study in incident and prevalent APD patients older than 18 years, who utilized remote monitoring and was enrolled to Renal Therapy Services Colombia network during the period from January 1 to December 31, 2017. For the analysis, we used descriptive statistics.* **Results:** *A program was implemented to provide training in the operation of both the device and the remote monitoring platform. Monitoring indicators were identified for the remote monitoring program to improve the safety and quality of the treatment; these indicators refer to characteristics of the APD prescription, adherence to the APD prescription, and blood pressure control. The adherence to APD treatment was 90.1%.* **Conclusions:** *A remote monitoring program for APD patients may be easily and efficiently implemented in health-care settings and may become a useful tool for the continuous improvement of the therapy through the development and monitoring of key clinical indicators.*

Key words: *Peritoneal Dialysis. Remote Sensing Technology. Telemedicine. Colombia.*

Programa de monitoreo remoto en pacientes de diálisis peritoneal automatizada en Colombia

Resumen

Introducción: *La tecnología de monitoreo remoto integrada en los sistemas de diálisis peritoneal automatizada (DPA) brinda a los pacientes y a su equipo clínico una herramienta que mejora la comunicación y la adherencia al tratamiento, optimiza el equilibrio de líquidos y permite abordar las posibles complicaciones de la terapia casi en tiempo real.* **Objetivo:** *Describir la implementación de un programa de monitoreo remoto en DPA y sus principales resultados durante las primeras etapas.* **Método:** *Estudio descriptivo de corte transversal en pacientes mayores de 18 años, incidentes y prevalentes en DPA con*

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monitoreo remoto, inscritos a la red Renal Therapy Services Colombia durante el período comprendido entre el 1 de enero y el 31 de diciembre de 2017. Para el análisis se utilizó estadística descriptiva. **Resultados:** *Se elaboró un programa de entrenamiento y capacitación y se crearon indicadores para el programa de monitoreo remoto enfocados en mejorar la seguridad y la calidad del tratamiento; estos indicadores se refieren a características de la prescripción, el cumplimiento de la prescripción y el control de la presión arterial. Se halló que el 90.1% de los pacientes eran adherentes al tratamiento.* **Conclusiones:** *Un programa de monitoreo remoto en DPA puede implementarse de manera fácil y eficiente. Adicionalmente, puede convertirse en una herramienta para la mejora continua a través del desarrollo de nuevos indicadores clínicos.*

Palabras clave: *Dialisis peritoneal. Tecnología de sensores remotos. Telemedicina. Colombia.*

Introduction

Since the introduction in the 1960s of the first automated, intermittent peritoneal dialysis (APD) cycling devices for the treatment of end-stage renal disease (ESRD)[1], there have been remarkable technological improvements which have enabled many patients worldwide to perform this procedure[2]. This has provided ESRD patients good health outcomes, greater versatility in therapy, and improved adherence[3]. In addition to the above, home renal replacement therapies (i.e., peritoneal dialysis and home hemodialysis) have shown a number of benefits for the patient, compared with in center hemodialysis[4,5].

Regarding automated peritoneal dialysis (APD), the European Automated Peritoneal Dialysis Outcome Study found that this treatment modality may be successfully utilized for anuric patients who typically may have problems reaching clearance goals with other modalities of peritoneal dialysis[6]. At 2 years into this study, patient survival was 78% and technique survival was 62%. Furthermore, APD demonstrated better quality of life in several domains measured in this study[7,8].

The recent launch of remote monitoring technology specifically designed to be integrated into APD systems (such as ShareSource™, Baxter Healthcare) gives both patients and their clinical team a powerful tool that can enhance communication, potentially improve adherence to the treatment, optimize fluid balance, and address potential complications of therapy in near real time[9]. Recently, it has been shown that remote monitoring for APD may improve outcome parameters such as technique failure rates and hospitalization rates[10]. However, more data are necessary to understand the exact role of remote patient monitoring and how to best implement this tool[11].

The aim of this article is to outline the implementation of an APD remote monitoring program in the Renal Therapy Services (RTS) network in Colombia and to describe the main findings and outcomes during the early stages of its implementation.

Materials and methods

This is a descriptive analysis of the implementation and early experience with the Sharesource™ remote patient monitoring system for both incident and prevalent patients on APD. We describe the components of the program's implementation including technology training, setting of the alarms in the remote monitoring platform, and adherence indicators. We used a cross-sectional design intended to report key outcome indicators for patients older than 18 years receiving this type of therapy from the RTS Colombia network during the period from January 1 to December 31, 2017. A statistical description was prepared of all the variables including calculations of the central trend measures and dispersion for quantitative variables and determinations of absolute frequencies for qualitative variables. Stata 14 statistical software was used to perform statistical data analysis (StataCorp LP, College Station, TX, USA). The study was also reviewed and approved by a research ethics committee.

Results

Program implementation

Technology

To implement remote patient monitoring for APD patients, we used technology available in Colombia - i.e., Home Choice Claria and Sharesource™ - consisting of a Home Choice™ APD cycler connected to a cellular modem device that transfers data at the end of each treatment session to the Sharesource™ connectivity platform. The system also provides a two-way communication tool for the clinical team to program the cycler and to detect events that could be interfering with the outcome of the treatment session (such as PD catheter inflow and outflow time profiles). Data from each device are sent encrypted to ensure confidentiality and are stored in a cloud-based repository where they remain available on request for query by the clinical team.

Table 1. Monitoring platform alarm code

Type of alarm	Alarm	Description		
Length of treatment	Lost treatment time	It is activated when the actual treatment time is lesser than the programmed time	30 min	No treatment
Changes in treatment	Lost dwell time	It is activated when the actual dwelling time is lesser than the programmed time	15 min	30 min
	Lost treatment volume	It is activated when the actual volume delivered is lesser than the total volume programmed to be delivered	5%	10%
	Drain completed early	It is activated when a drain is bypassed	1 bypass	More than 1 bypass
	Change in initial drain	It is activated when the actual initial drain volume differs from the programmed initial volume	None	≥ 50%
Fluid control	High drain volume	It is activated when it is ≥ 200% of the standard prescription or ≥ 190% of the small fill volumes	None	Event
Patient	# Bypass during infusion/dwelling	It is activated when the number of bypass is equal to or greater than the set value	None	2 bypasses
System alarm	Events occurred during treatment	It is activated when the total number of events is equal to or greater than the set value	10 events	15 events

Expert consensus

A consensus meeting was held to develop clinical guidelines for remote monitoring of patients receiving APD with the Home Choice Claria and Sharesource™ technology. This is critical to establish alarm criteria, define roles and responsibilities of the clinical team, and set clinical goals for the program. Drawing on the icons used by the Sharesource™ platform, criteria for alerts were established (Table 1).

Based on a PD nurse/patient ratio of 1:50 and a nephrologist/patient ratio of 1:125, the tasks to be completed were defined by the consensus meeting of experts as follows: a review of each patient's platform by the PD nurse on a daily basis and a comprehensive review by the entire clinical team on a weekly basis. Platform alarms that required immediate nursing intervention were a patient who misses a treatment, patient without network connectivity, patient with three[3] yellow flags, or patient with a red flag. The alarm code for the flags is presented in table 1.

Training and implementation

A program was implemented to provide training in the operation of both the device and the platform. Training addressed topics such as device programming, report creation, clinical data management, alarm interpretation, and APD prescription management. It also included quick guides on patient monitoring, nurse's daily menu of reports and tasks, device programming, and a patient's guide on how to start home therapy. Training was

Table 2. Demographic characteristics at baseline

Characteristic	Patients, n = 396 (%)
Age (mean; SD), years	56.6 (17.3)
Male	237 (59.8)
Cause of CKD	
Hypertension	130 (32.8)
Diabetes	129 (32.6)
Other	42 (10.6)
Glomerular disease	95 (24.0)
Charlson index	
0 to 3	348 (87.9)
> 3	48 (12.1)
Vintage on therapy	
0-1 year	112 (28.3)
1-3 years	161 (40.7)
> 3 years	123 (31.0)
Caregiver	259 (65.4)
Educational level	
None	22 (5.6)
Elementary school	97 (24.5)
High school diploma	173 (43.7)
Technical diploma	28 (7.0)
University degree	54 (13.6)
Postgraduate degree	11 (2.8)
No data available	11 (2.8)

SD: standard deviation, CKD: cause kidney disease

Table 3. Indicators for program monitoring

Indicators	Measurement	Results (%)
Treatment prescription	Percentage of patients with dwelling times < 1.5 h	7.8
	Percentage of anuric patients with dry days	24
Adherence to treatment	Total adherence - percentage of sessions performed versus prescribed	90.1
	Time on cycler - percentage of delivered time versus prescribed time	89.6
Clinical indicator	Percentage of sessions with BP > 140 mmHg and/or > 90 mmHg	44.5
	Percent of patients with BP < 90 mmHg y/o < 60 mmHg	8

BP: blood pressure

conducted in a regional manner. On average, 20 people attended each training session.

Results of the APD remote monitoring program

The program was implemented in a clinic with a staffing ratio of one full-time equivalent of PD specialized nurse for each 50 patients in the program. The mean daily time invested by the nurse in review the remote monitoring platform is of 30 min per each 25 patients.

A total of 396 patients were evaluated to the study. The mean (standard deviation) age was 56.6 (17.32) years, 59.8% was men, and 65.4% had caregiver. Demographic data are summarized in table 2.

Indicators of all APD patients on remote monitoring - i.e., 396 patients - after the 1st year of the implementation of the therapy with cutoff date at the end of 2017 are reported below, the adherence to APD treatment was 90.1% (Table 3).

Discussion

Remote patient monitoring for APD is a relatively new feature and thus clinical experience in how to apply this technology is limited. Thus, it is very important to have a description of the key elements needed to implement a remote APD patient monitoring program, and how to best apply these measures to improve outcomes. This paper describes our implementation plan as well as initial descriptive experience with the Sharesource remote patient monitoring platform. As has been described by others, there are initial difficulties experienced by the clinical team in monitoring and interpreting all the data provided by this technology[11,12]. In that regard, it is important to note that the staff of the renal units required a refresher educational program on the different aspects of the APD therapy as well as on technology implementation protocols. We must highlight here that this implementation was conducted in a renal care center network and although they do have consistent protocols and management guidelines, they serve diverse populations in environments that may be affected by poverty and inequality[13]. The nurse/patient (1:50) and doctor/patient (1:125) ratios help us understand the feasibility of the adoption and the effective use of this technology in settings with significant workloads for the health-care teams. These workloads are likely similar to other countries around the world with limited resources and thus our implementation plan and experience with remote patient monitoring are likely representative of more resource-constrained centers.

Critical features of our program and training were the development of alarm standardization and response protocols, which may facilitate the effective use of this technology[12]. The analysis of the initial indicators of the adherence yielded from the remote monitoring platform reported higher levels of this characteristic than those found in other similar studies[14-16]. This could be related to the emphasis placed on educational programs aimed at patients and therapeutic teams when this new technology was introduced, although it should be noted that there is susceptibility to bias, in particular, from the observed subjects (the patients) as they feel that they are being more monitored. On the other hand, it was observed that a significant proportion of blood pressure readings were out of target, which should be addressed in an improvement plan.

Since this is a report on results of the implementation and early monitoring, its main goal is to show how a home-based remote APD monitoring solution can be implemented and efficiently used.

Further, evidence is required concerning effectiveness outcomes, costs, and likely a qualitative analysis of the value give to this technology by patients and therapeutic teams.

Conclusions

A remote monitoring program for APD patients may be easily and efficiently implemented in health-care settings and may become a useful tool for the continuous improvement of the therapy through the development of new clinical indicators.

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Ethical disclosures

Protection of human and animal subjects. The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

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