

Satisfaction and Improvements in Peritoneal Dialysis Outcomes Associated with Telehealth

Manya Magnus¹; Neal Sikka²; Teena Cherian⁴; Susie Q. Lew³

¹Department of Epidemiology and Biostatistics, Milken Institute School of Public Health, George Washington University;

²Department of Emergency Medicine, George Washington University;

³Department of Medicine, George Washington University;

⁴Formerly with the Department of Medicine, George Washington University at the time of this study

Keywords

Chronic kidney failure, peritoneal dialysis, telemedicine, tele-education, patient satisfaction, patient outcome assessment, telehealth, end stage renal disease, remote biometric monitoring

Summary

Background and Significance: End stage renal disease (ESRD) affects approximately 660,000 persons in the US each year, representing a significant financial burden to the health care system and affected individuals. Telehealth approaches to care offer an important means of reducing costs as well as increasing autonomy for patients. Understanding patient satisfaction with telehealth provides a key towards eventual scalability.

Materials and Methods: Quarterly surveys were conducted to characterize satisfaction with remote biometric monitoring (RBM) for blood pressure, weight, glucose and peritoneal dialysis (PD)-specific educational online videos for ESRD patients using PD.

Results: Of 300 participants, 67% participated in the surveys and provided baseline and at least one follow-up assessment. The majority were 45 to 64 years of age (50.5%), Black (64.5%), married or living with significant other (52.0%), and had more than a high school degree (73.0%). RBM was associated with perceived autonomy and confidence in health care activities and decreased negative perceptions of PD care and ESRD. The majority of participants (80.1%) indicated that they were satisfied or completely satisfied with the system. Participants found that the interface increased confidence, reduced frustration, and related perceptions were significantly and positively altered ($p < 0.05$) for each of the separate telehealth components. Educational videos were well utilized with nearly half of the participants (42.5%) reporting that they watched at least one of the videos, and the majority reporting that the videos seen had an overall positive impact on health.

Discussion and Conclusions: Supplementing PD with telehealth has the potential to have a positive impact on patient perceptions of PD care and consequently improve clinical outcomes.

Correspondence to:

Manya Magnus, PhD, MPH
Department of Epidemiology and Biostatistics
Milken Institute School of Public Health
George Washington University
950 New Hampshire Avenue, NW Suite 507
Washington, DC 20052
Phone 202 994 3024
Fax 202 994 0082
Email: manyadm@gwu.edu

Appl Clin Inform 2017; 8: 214–225

<https://doi.org/10.4338/ACI-2016-09-RA-0154>

received: September 12, 2016

accepted: December 19, 2016

published: March 1, 2017

Citation: Manya Magnus, Neal Sikka, Teena Cherian, Susie Q. Lew. Satisfaction and improvements in peritoneal dialysis outcomes associated with telehealth.

Appl Clin Inform 2017; 8: 214–225

<https://doi.org/10.4338/ACI-2016-09-RA-0154>

Funding

This project was supported by a Center for Medicare and Medicaid Innovation grant # 1C1CMS331004. The funding period started July 1, 2012 and ended on June 30, 2015.

The contents of this publication are solely the responsibility of the authors and do not necessarily represent the official views of the U.S. Department of Health and Human Services or any of its agencies. The research presented here was conducted by the awardee. These findings may or may not be consistent with or confirmed by the independent evaluation contractor.

Background and significance

End stage renal disease (ESRD) affects approximately 660,000 persons in the United States each year, representing a significant financial and structural burden to the health care system; Medicare fee-for-service spending for ESRD cost \$30.9 billion in 2013, accounting for 7.1% of the overall Medicare paid claims costs [1]. Approaches to caring for patients with limited or no kidney function include hemodialysis and peritoneal dialysis (PD). Of these, PD has potential to enhance autonomy for patients by allowing at-home dialysis that does not require multiple weekly visits to outpatient dialysis centers but rather monthly assessments only during maintenance therapy. PD allows patients relative independence with minimal changes to their schedule with overall cost-savings when compared to other methods of dialysis [1–4].

Although relatively straightforward as a procedure, patient PD support often becomes necessary. Patients have questions about volume status, cyclor alarms, clinical symptoms, or signs of exit site or peritoneal infection; as a result, ongoing education functions as a critical component of PD care. Patients must be reminded frequently about fluid volume maintenance, blood pressure monitoring and documentation, fluid exchange and aseptic technique, methods for travel precautions, and other instructions regarding PD administration. New methods to support PD patients have been developed in recent years in order to facilitate adherence to PD regimens and ensure ongoing safety and effectiveness of the method including telehealth [2–4]. For the purposes of this paper, we define telehealth as including all components of the electronic exchanges of information for health care, specifically combination of remote patient monitoring of weight, blood pressure, and glucose, video consultation, and online education [5].

Objectives

The purpose of this study was to evaluate patient satisfaction with and outcomes associated with use of telehealth for PD patients.

Methods

PD patients 18 years and older from participating dialysis units in the Mid-Atlantic region were eligible to participate in a Center for Medicaid and Medicare Studies (CMS) Innovation Challenge Grant sponsored telehealth research study. Participants had to be current PD patients at one of ten participating dialysis centers in the region. The region included urban, suburban, and rural areas within a 3 hour radius of the District of Columbia. Participants were excluded if they could not provide informed consent, were incarcerated, admitted to a skilled nursing facility, non-English speaker, or enrolled in another research study. Following provision of informed consent, participants were offered the telehealth intervention, which included remote biometric monitoring (RBM) of blood pressure, weight, glucose (if diabetic), video chat and free access to online educational videos. At the enrollment visit, participants were given a 30 minute tutorial on how to use the equipment by the research coordinator. Biometric data from the blood pressure monitor and scale were audibly announced by the HealthPal® device (MedApps, dba Alere Connect, LLC; Scottsdale, AZ) to the participant; readings were transmitted via Bluetooth® technology to a hub located in the participant's home and then via 2G/3G cellular signal to a Telehealth call center. The information was also transmitted to PD nurses at the participants' respective clinics who viewed the results on computers located in their facility or were alerted to abnormal results by the telehealth call center. Each component of the intervention was optional and participants could add or subtract intervention capacity throughout the study period in order to examine feasibility, acceptability, and correlates of uptake. For example, participants could choose to have just the BP RBM, just the videos, or all parts of the intervention (all RBM, all videos, etc.). The brief educational videos specific to PD topics were made by the research staff, were optional, and were rolled out during the duration of the study period. Each one was available by a secure link, viewable on a mobile device or desktop, and about 5 minutes in length. Study activities were conducted in the context of their current dialysis locations of

care. Study staff conducted all informed consent activities separate from participant providers and, for those who enrolled, all data collection activities. Participants were informed that the RBM information (BP, weight, glucose) would be returned in real-time to their dialysis providers as well as to a study-operated call center. Survey information was not provided to dialysis providers and maintained by study staff only. Study staff received no incentive or other payment to recruit or retain study participants.

Participants completed surveys using REDCap, an electronic data capture tool hosted by Children's National Medical Center. REDCap (Research Electronic Data Capture) [6] provides a secure, web-based Computer-Administered Self-Interview (CASI) application designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources. Survey instrumentation was adapted from validated PD-related, quality of life, and impact of telemedicine standardized instruments [7, 8]. Baseline data included demographic, behavioral, and clinical characteristics related to PD delivery and outcomes. Quarterly data were collected to assess utilization of intervention and healthcare, user-defined satisfaction with the telehealth interface and video, and perceptions of self-efficacy related to PD. Demographic, behavioral, intervention, educational video, and healthcare utilization, and satisfaction measures were examined using chi-square and Fisher's exact test (when required by small cell size). Logistic regression was used to examine characteristics associated with uptake of the intervention with respect to baseline characteristics. The purpose of the analysis was to describe satisfaction with the telehealth interface and self-reported attitude and perception-related outcomes associated with the intervention, using primarily a descriptive, hypothesis-generating approach with bivariate methods. Follow up data were ascertained at quarterly surveys via a secure survey link, sent to the participants by study staff and independently of clinic or nursing staff, who never could access the results. For the purpose of this study, only participants with at least one follow up were included and follow up data were aggregated (i.e., participants may have had more than one follow up visit each, and all follow up visit data were pooled). Analyses were conducted in Stata version 13.0SE (College Station, TX). All methods and materials were approved by the George Washington University Institutional Review Board (IRB) prior to implementation.

Results

Three hundred participants (N=300) from 10 participating dialysis centers were recruited from 419 PD patients approached (72%) over the study period; of enrollees, 89.7% accepted the full complement of study activities and the majority utilized the BP and weight RBM capacity at least once during the study (86.2% and 84.4%, respectively) demonstrating favorable uptake of the technology. Of those enrolled, while all 300 participants had a baseline survey, only 200 (67%) participants provided at least one follow up assessment. ► Table 1 displays participant characteristics at baseline and only those participants with at least one follow up measurement were analyzed in this study. The majority of participants were 45 to 64 years of age (50.5%), Black (64.5%), married or living with significant other (52.0%), had more than a high school degree (73.0%); only a third were currently employed (33.2%). Most had been on hemodialysis previously (60.5%) and had been on any type of dialysis for less than 3 years (69.4%).

Healthcare utilization and satisfaction outcomes associated with telehealth for PD:

► Table 2 displays baseline and follow up experiences of PD-related healthcare utilization, attitudes, and perceptions. Of particular note is the prevalence of emergency department (ED) visits and hospitalizations and frequency of exit site infections. At baseline, participants indicated they were already using the phone to contact healthcare providers, with 86.5% having talked by phone with their PD nurse or physician in the 3 months prior to entering study and, of those who did, the majority

stating they were either satisfied or completely satisfied with the care provided over the phone (73.4%). At follow up, when pooled, more persons were satisfied or completely satisfied (90.7%) than at baseline ($p < 0.001$) with phone contacts with providers, though there were no significant differences in the specific categories (i.e., satisfied pre/post vs. completely satisfied pre/post). In addition, persons completely unsatisfied with phone contact with their providers significantly decreased in follow up when compared with baseline (24.9% vs. 6.7%, $p < 0.001$). Among those who had a phone call with their provider, the proportion who completely agreed it prevented an in-person visit decreased in follow up (37.3% vs. 28.1%, $p < 0.05$), consistent with the addition of telehealth interface which added more information than the phone call alone and may have influenced perception of usefulness or satisfaction with the calls alone relative to the intervention.

► Table 2 also displays attitudes and perceptions of ESRD and care, revealing significant changes from baseline to follow up overall, with increases in perceived autonomy and confidence and decreased perception of 'being a burden to the family' or 'having kidney disease take too much time from the patient's life.' The following questions revealed significant increases in positive responses: "When all is said and done, I am the person who is responsible for managing my health condition," "Taking an active role in my own health care is the most important factor in determining my health and ability to function," and "I am confident that I can follow through on medical treatments I need to do at home." The following questions revealed significant decreases in negative responses: "I am worried about my health," "My family is worried about my health," and "In general, how would you rate your health = poor?" Consistency was observed for each of this when pooling answers (e.g., agree combined with completely agree). Trends in the same direction were observed in all categories although those other than the above did not attain statistical significance.

► Table 3 displays participant perception of each component of the telehealth interface. The majority of participants (80.1%) indicated that they were satisfied or completely satisfied with the components of the system; one fifth of the participants experienced technical difficulties with any part of the interface and almost half were resolved by the time the questionnaire was taken.

► Table 4 displays uptake of optional educational videos. The videos were rolled out over time so it is important to note that each video was not able to have equal viewing opportunity. After adjustment for confounders, there were no significant differences with regard to demographic or clinical characteristics of those who viewed or did not view the videos (data not shown in table). Nearly half of the participants (42.5%) watched at least one of the videos, with the BP monitoring the most common (21.6%) ranging to the Weather, Hygiene, and Surgery video the least common (4.9%). When asked whether the participants agreed or completely agreed that viewing the video had an overall positive impact on health, the range was from 91.7% of those viewing the Weather, Hygiene, and Surgery video to 52.4% of those viewing the Travel video. ► Table 5 underscores the positive effect of the videos overall, and particularly among those who used the remote biometric monitoring. As shown in ► Table 4, when comparing confidence, frustration, and related perceptions between baseline and follow up, each of these significantly ($p < 0.05$) improved.

Discussion

This study suggests that the use of telehealth to remotely collect daily blood pressure, weight, and glucose measurements for PD patients, and accompanying educational videos, can improve not only collection of more accurate measurements to guide clinical care, but are associated with improvements in perceptions of PD-related care and autonomy measures. As discussed by other authors [9–11], PD monitoring was facilitated by telehealth; this study contributes to the body of literature suggesting that the interface of available remote biometric monitoring also supports patients' sense of self-efficacy and autonomy, reduces perception of being a burden to family, and increases confidence in self-care procedures. Educational videos, which were initially intended to be a method to maintain skills related to PD, ultimately also contributed to improvements in these domains as well. Uptake on the video chat component of the intervention was not sufficient to be able to draw any conclusions. Video chat offers remote visualization, perhaps allowing the patient to remain at home rather than making a trip to the dialysis unit and we expected that this would be a primary feature of the telehealth intervention. Interestingly however, we found video chat uptake was limited and

nurses did not report much activity, either patient or nurse initiated. It was not possible to determine whether the limited video chat use was due to lack of need or because the other component of the interventions met participant needs. Future research should examine the use of video chat in home dialysis further.

Although the majority of ESRD patients exceed age 65 years, only a handful of patients do not own or know how to operate a computer [12]. PD patients who employ the PD cyclers quickly learn and adopt its use. It has been reported that PD patients in general are more satisfied with their overall care and believe that their treatment has less impact on their lives than HD patients [13–15]. Our study echoes these findings and suggests that PD patients adopt electronic equipment with adequate support and training, and ultimately – particularly in concert with adjunctive supports such as educational videos – perceive that they increase self-care and autonomy. Telehealth can play a positive role for education and home-based therapy for PD as has been demonstrated for other chronic diseases.

Limitations and Strengths

This study has several limitations and strengths. Although a pre-/post-test evaluation strategy was used which allows comparison of each participant with him- or herself, non-random allocation of the telehealth intervention and use of the educational videos necessarily limits our ability to infer causality. There are benefits of this approach however. Use of a self-comparison allows us to compare participant experience before and after the intervention, using each participant as their own controls, allowing us to infer that changes are attributable to the intervention. This supports our understanding of the role of the intervention in the outcomes of interest, and a rationale for randomized trials to be pursued in the future. Future studies will be well-poised to use randomization to assess the direct impacts of these telehealth interventions on PD outcomes of interest. Both the telehealth intervention and educational videos were deployed over time, resulting in differential lengths of follow up for all participants. This may have attenuated our findings so that these results underestimate the true associations because not all participants were followed for the same duration. At the same time, it may be that the novelty of the program weakens over time, so this may overestimate the impact. It will be important for future research to investigate changing impact of the intervention over time and sustainability of the positive impact we observed. Self-report of intervention and video use were applied for this analysis. Due to the increased availability of data in the survey with regard to the videos (no objective measure of video exposure existed for analysis by person), self-report data were used. When compared with data from the blood pressure, weight, and glucometer journal audit systems which provide a more objective measure of use, we found that the self-report data overestimated actual use for several participants but by less than 10% overall. Sensitivity analyses were conducted to explore differences based on type of utilization reported and we found no significant differences between them. Future studies, however, should maximize use of demonstrated utilization and clinical outcomes to enhance our understanding of this association. Although the participants were derived from ten diverse dialysis centers which increases our confidence in the generalizability of our findings, this is only a convenience sample. Random samples of large, clinical populations may be useful in future studies to ensure representativeness of those included in the research. Finally, participants may have been biased towards indicating satisfaction or impact with the interventions and videos due to a desire to appeal to providers and study staff. Use of a CASI approach in which participants knew the answers were not available to study staff has been shown to limit such social desirability bias and increase the validity of response patterns.

Despite these limitations, these data are useful in demonstrating the unique benefit of telehealth with remote biometric monitoring and ongoing brief educational videos through a web-based portal. Participants experienced increases in positive attitudes and perceptions of their chronic PD care, decreases in negative attitudes and perceptions, and a high prevalence of perceiving that there was an overall positive impact to their health as a result of the interventions and videos. The longitudinal nature of this study using a real-world model for care that was located in each participant's PD clinic, rather than in a research clinic, lends confidence to our results and potential for generalizable impact on future care.

Conclusions

At-home treatments associated with PD have allowed ESRD patients to carry out medical tasks without having to allocate time and resources associated with attendance of multiple weekly clinic visits. Our results suggest that the use of telehealth increased patients' perceived autonomy and confidence regarding dialysis treatments as well as satisfaction with the care their health professional provided over the phone and via remote biometric monitoring. At follow-up, participants were less likely to report being concerned about their health or rate their health status as being poor. The majority of the study participants were also satisfied or completely satisfied with the telehealth interface, suggesting that patients are likely to adopt its components. Supplementing PD with telehealth has the potential to have a positive impact on patient perceptions of PD care and consequently improve clinical outcomes.

Questions

Telehealth may offer an effective support approach for persons with ESRD receiving peritoneal dialysis. This pilot study demonstrated associations with improvements in which of the following when using a multi-pronged telehealth intervention?

- A Clinical outcomes
- B Comprehension of kidney disease
- C Autonomy regarding management of PD and kidney disease
- D Emergency room visits.

The correct answer is C above, Our study suggests telehealth may offer a means to improve perceptions of autonomy as measured in numerous ways for those using PD compared to each person's experience without telehealth. Future studies should utilize experimental designs to examine this research question further, based on these hypothesis generating data.

Clinical Relevance Statement

Telehealth offers substantial opportunity to improve access to care and routine health monitoring required by PD, yet its uptake and resulting benefits are largely dependent on whether patients are satisfied with the technology, and whether they perceive and experience improvements in care. This study demonstrates that telehealth for PD with RBM was associated with patient satisfaction and improved outcomes. In addition, ancillary educational support with educational videos was associated with positive health outcomes.

Conflicts of Interest

The authors declare that they have no conflicts of interest in the research.

Protection of Human Subjects

All protocols, procedures, and instruments were approved by The George Washington University Institutional Review Board (IRB) prior to implementation. Participation was voluntary and all participants provided active informed consent prior to participating in the study.

Acknowledgements

The authors are grateful for the support of the research coordinators Nadia Mikhail, Mona Hariri, and research associate Erica Jones, Davita, and the individual Davita clinicians, nurses, and patients for participating in the study.

Table 1 Baseline characteristics of participants by self-report (N=200).

	n	%		n	%
Age (years)			Currently lives alone		
18–44	49	24.5	Currently lives alone	40	20.0
45–64	100	50.0	Currently employed	66	33.2
>64	51	25.5	Has medical insurance (can have more than one)	196	98.0
Gender			If yes, type		
Male	102	51.0	Private or self-pay	106	52.5
Female	98	49.0	Medicare Part A	127	62.9
Race			Medicare Part B	117	57.9
White	52	26.0	Medicare Part C	16	7.9
Black	129	64.5	Medicare Part D	50	24.8
Hispanic/Latino/a	5	2.5	Medicaid	31	15.4
Asian	14	7.0	Other	28	14.0
Highest level of school completed			Site type		
Some high school or below	15	7.5	Urban	138	69.0
High school or equivalent	39	19.5	Suburban	43	21.5
Vocational school or some college	53	26.5	Rural	19	9.5
College degree	45	22.5	How long been on dialysis*		
Some graduate school	23	11.5	< 1 year	52	26.5
Graduate degree	25	12.5	1-<2 years	46	23.5
Marital status			2-<3years	38	19.4
Married or living with significant other	104	52.0	3-<5 years	33	16.8
Never married	41	20.5	>5 years	27	13.8
Separated/divorced	38	19.0	Ever has been on hemodialysis	115	60.5
Widowed	17	8.5	*Missing responses less than 3% for all questions; percentages reflect percentages of valid responses.		

Table 2 Unadjusted clinical and utilization characteristics and attitudes and perceptions regarding PD, baseline vs. follow-up (N=200).

	Baseline N=200 n (%)		Follow-up N=241 n (%)	
Clinical and Utilization Characteristics				
Had an exit site issue in last 3 months	13	7.3	24	10.5
Hospitalization in last 3 months	41	20.8	36	15.1
ED visit in the last 3 months	52	26.1	50	20.8
Talked with nurse or PD physician by phone in last 3 months	167	86.5	196	82.7
If yes, satisfaction level				
Completely unsatisfied***	41	24.9	13	6.7
Satisfied	0	0	2	1.0
Neither satisfied nor unsatisfied	3	1.8	3	1.6
Satisfied	29	17.6	65	33.5
Completely satisfied	92	55.8	111	57.2

Table 2 Continued

	Baseline N=200 n (%)		Follow-up N=241 n (%)	
If yes, do you feel that the conversation(s) you had with your PD nurse or doctor via the phone prevented you from having to go in and see the PD doctor or nurse in person?				
Completely disagree	16	9.9	10	5.1
Disagree	13	8.1	16	8.2
Neither disagree nor agree	25	15.5	43	21.9
Agree	47	29.2	72	36.7
Completely agree*	60	37.3	55	28.1
Attitudes and Perceptions of ESRD and Care				
When all is said and done, I am the person who is responsible for managing my health condition.				
Definitely false	3	1.1	1	0.42
Mostly false	4	2.0	0	0
Don't know	2	1.0	1	0.42
Mostly true*	41	20.6	72	30.4
Definitely true	149	74.9	163	68.8
Taking an active role in my own health care is the most important factor in determining my health and ability to function.				
Definitely false	3	1.5	1	0.42
Mostly false	0	0	0	0
Don't know	5	2.5	3	1.3
Mostly true*	32	16.2	72	30.5
Definitely true*	157	79.7	160	67.8
Too much of my time I spent dealing with my kidney disease.				
Definitely false	23	11.7	20	8.5
Mostly false	52	26.4	69	29.4
Don't know	17	8.6	34	14.5
Mostly true	80	40.6	85	36.2
Definitely true	25	12.7	27	11.5
My kidney disease interferes too much with my life.				
Definitely false	17	8.7	19	8.1
Mostly false	68	34.7	80	34.2
Don't know	12	6.1	26	11.1
Mostly true	76	38.8	83	35.5
Definitely true	23	11.7	26	11.1
I am worried about my health.				
Definitely false	18	9.1	32	13.6
Mostly false	46	23.4	72	30.6
Don't know	9	4.6	23	9.8
Mostly true*	87	44.2	76	32.3
Definitely true	37	18.8	32	13.6
My family is worried about my health.				
Definitely false	8	4.1	21	8.9
Mostly false*	18	9.2	37	15.6
Don't know*	18	9.2	43	18.1
Mostly true*	100	51.3	88	37.1
Definitely true	51	26.2	48	20.3
I feel like a burden on my family.				
Definitely false	51	25.9	52	21.9
Mostly false	54	27.4	81	34.0
Don't know	28	14.2	21	8.8
Mostly true	45	22.8	61	25.6
Definitely true	19	9.6	23	9.7
I am confident that I can take actions that will help prevent or minimize some symptoms or problems associated with my health conditions.				
Definitely false	2	1.0	1	0.4
Mostly false	1	0.5	1	0.4
Don't know	11	5.6	16	6.8
Mostly true	79	40.3	108	46.0
Definitely true	103	52.6	109	46.4
I am confident that I can follow through on medical treatments I need to do at home.				
Definitely false	1	0.5	0	0
Mostly false	0	0	2	0.9
Don't know	1	0.5	3	1.3
Mostly true*	49	24.8	79	33.5
Definitely true*	147	74.2	152	64.4

Table 2 Continued

	Baseline N=200 n (%)		Follow-up N=241 n (%)	
I am confident that I can figure out solutions when new situations or problems arise with my health condition.				
Definitely false	1	0.5	0	0
Mostly false	4	2.1	0	0
Don't know	9	4.6	22	9.5
Mostly true	78	40.2	105	45.5
Definitely true	102	52.6	104	45.0

	Baseline N=200 n (%)		Follow-up N=241 n (%)	
In general, how would you rate your health?				
Excellent	3	1.5	5	2.1
Very good	43	21.8	56	23.3
Good	91	46.2	115	47.9
Fair	41	20.8	54	22.5
Poor*	19	9.6	10	4.2
CES-D > 16	161	82.6	184	78.6

*p<0.05; **p<01; ***p<0.001
 NB: Missing responses less than 5% for all questions; percentages reflect percentages of valid responses

Table 3 Satisfaction with telehealth interface at follow-up surveys (N=200*)

	n	%
Satisfaction with BP equipment		
Did not use	21	8.8
Completely unsatisfied	4	1.7
Unsatisfied	11	4.6
Neither satisfied nor unsatisfied	12	5.0
Satisfied	81	33.8
Completely satisfied	111	46.3
Satisfaction with scale equipment		
Did not use	21	8.8
Completely unsatisfied	6	2.5
Unsatisfied	8	3.4
Neither satisfied nor unsatisfied	7	2.9
Satisfied	86	36.0
Completely satisfied	111	46.4
Satisfaction with glucometer equipment		
Did not use	173	78.6
Completely unsatisfied	3	1.4
Unsatisfied	5	2.3
Neither satisfied nor unsatisfied	11	5.0
Satisfied	15	6.8
Completely satisfied	13	5.9

	n	%
Satisfaction with phone call to PD nurse in last 3 months		
Completely unsatisfied	13	6.7
Unsatisfied	2	1.0
Neither satisfied nor unsatisfied	3	1.6
Satisfied	65	33.5
Completely satisfied	111	57.2
If yes, did that conversation prevent a visit?		
Completely disagree	10	5.1
Disagree	16	8.2
Neither agree nor disagree	43	21.9
Agree	72	36.7
Completely agree	55	28.1
Difficulties with telemedicine last 3 months		
	42	18.0
If yes, were they resolved?		
	16	40.0

*Participants usually had more than one follow up; responses are aggregated.

Table 4 Utilization of educational videos and proportion perceiving a positive impact on overall health (N=200).

Video Watched	n	%	If saw, % agree or completely agree had positive impact on overall health
Any video watched	102	42.5	
BP monitoring	52	21.6	64.5
Exit site	43	17.8	76.9
Preventing peritonitis	40	16.6	89.2
Exercise	33	13.7	90.6
Weight	31	12.9	71.0
Nutrition	30	12.5	83.3
Travel	23	9.5	52.4
Hemoperitoneum	19	7.9	77.8
Catheter complications	17	7.1	81.3
Shortness of breath	16	6.6	87.5
Cycler	12	4.9	66.7
Weather, hygiene, and surgery	12	4.9	91.7

Table 5 Participant response to educational videos (N=200).

	Agree (%)	Completely agree (%)
Easier to collect blood pressure measurements ^{*1,2}	38.9	38.1
More secure in blood pressure measurement ^{*1}	38.0	30.8
I feel I am taking my health in my own hands ¹	51.9	21.3
I feel more confident about taking care of myself ^{*1,2}	47.7	28.5
Feel more confident with use of computer [*]	23.5	9.4
Computer was easy to use ^{*1}	34.8	29.2
Liked watching educational videos [*]	31.5	11.5
Prevented trip to doctor or nurse	16.5	10.1
Like using computer to communicate with medical personnel	17.5	8.5
Feel like I am getting more support from clinicians with the extra technology ^{*1}	28.2	11.1
I feel less frustrated with my kidney disease using the telemedicine [*]	23.7	9.8

*p<0.05 for association between self-report use of blood pressure cuff and perception

¹p<0.05 for association between self-report use of scale and perception

²p<0.05 for association between self-report use of glucometer and perception

References

1. Saran R, Li Y, Robinson B, Ayanian J, Balkrishnan R, Bragg-Gresham J, Chen JT, Cope E, Gipson D, He K, Herman W, Heung M, Hirth RA, Jacobsen SS, Kalantar-Zadeh K, Kovesdy CP, Leichtman AB, Lu Y, Molnar MZ, Morgenstern H, Nallamothu B, O'Hare AM, Pisoni R, Plattner B, Port FK, Rao P, Rhee CM, Schaubel DE, Selewski DT, Shahinian V, Sim JJ, Song P, Streja E, Kurella Tamura M, Tentori F, Eggers PW, Agodoa LY, Abbott KC. US Renal Data System 2014 Annual Data Report: Epidemiology of Kidney Disease in the United States. *Am J Kidney Dis* 2015; 66(1 Suppl. 1): S1-S305.
2. Cargill A, Watson AR. Telecare support for patients undergoing chronic peritoneal dialysis. *Perit Dial Int* 2003; 23(1): 91-94.
3. Gallar P, Vigil A, Rodriguez I, Ortega O, Gutierrez M, Hurtado J, Oliet A, Ortiz M, Mon C, Herrero JC, Lentisco C. Two-year experience with telemedicine in the follow-up of patients in home peritoneal dialysis. *J Telemed Telecare* 2007; 13(6): 288-292.
4. Harrington DM, Myers L, Eisenman K, Bhise V, Nayak KS, Rosner MH. The use of a tablet computer platform to optimize the care of patients receiving peritoneal dialysis: a pilot study. *Blood Purif* 2014; 37(4): 311-315.
5. Health Care. In *Connecting America: The National Broadband Plan*. Retrieved from <http://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf> Page 200 CH 10
6. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)--a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009; 42(2): 377-381.
7. Hibbard JH, Mahoney ER, Stockard J, Tusler M. Development and testing of a short form of the patient activation measure. *Health Serv Res* 2005; 40(6 Pt. 1): 1918-1930.
8. Bakken S, Grullon-Figueroa L, Izquierdo R, Lee NJ, Morin P, Palmas W, Teresi J, Weinstock RS, Shea S, Starren J. Development, validation, and use of English and Spanish versions of the telemedicine satisfaction and usefulness questionnaire. *J Am Med Inform Assoc* 2006; 13(6): 660-667.
9. Nakamoto H. Telemedicine system for patients on continuous ambulatory peritoneal dialysis. *Perit Dial Int* 2007; 27 (Suppl. 2): S21-S26.
10. Nayak A, Karopadi A, Antony S, Sreepada S, Nayak KS. Use of a peritoneal dialysis remote monitoring system in India. *Perit Dial Int* 2012; 32(2): 200-204.
11. Rosner MH, Ronco C. Remote monitoring for continuous peritoneal dialysis. *Contrib Nephrol* 2012; 178: 68-73.
12. Lew SQ, Sikka N. Are patients prepared to use telemedicine in home peritoneal dialysis programs? *Perit Dial Int* 2013; 33(6): 714-715.
13. Juergensen E, Wuerth D, Finkelstein SH, Juergensen PH, Bekui A, Finkelstein FO. Hemodialysis and peritoneal dialysis: patients assessment of their satisfaction with therapy and the impact of the therapy on their lives. *Clin J Am Soc Nephrol* 2006; 1(6): 1191-1196.
14. Kirchgessner J, Perera-Chang M, Klinkner G, Soley I, Marcelli D, Arkossy O, Stopper A, Kimmel PL. Satisfaction with care in peritoneal dialysis patients. *Kidney Int* 2006; 70(7): 1325-1331.
15. Rubin HR, Fink NE, Plantinga LC, Sadler JH, Klinger AS, Powe NR. Patient ratings of dialysis care with peritoneal dialysis vs hemodialysis. *JAMA* 2004; 291(6): 697-703.