

USING A MULTIDISCIPLINARY TRAINING PROGRAM TO REDUCE PERITONITIS IN PERITONEAL DIALYSIS PATIENTS

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◆ **Objectives:** The present study evaluated the tool used to assess patients' skills and the impact on peritonitis rates of a new multidisciplinary peritoneal dialysis (PD) education program (PDEP).

◆ **Methods:** After the University Hospital Ethics Committee approved the study, the educational and clinical records of PD patients were retrospectively analyzed in two phases. In phase I, an Objective Structured Assessment (OSA) was used during August 2008 to evaluate the practical skills of 25 patients with adequate Kt/V and no mental disabilities who had been on PD for more than 1 month. Test results were correlated with the prior year's peritonitis rate. In phase II, the new PDEP, consisting of individual lessons, a retraining schedule, and group meetings, was introduced starting 1 September 2008. Age, sex, years of education, time on PD, number of training sessions, and peritonitis episodes were recorded. Statistical analyses used t-tests, chi-square tests, and Poisson distributions; a *p* value of less than 0.05 was considered significant.

◆ **Results:** In phase I, 25 patients [16 men, 9 women; mean age: 54 ± 15 years (range: 22 – 84 years); mean time on PD: 35 ± 30 months (range: 1 – 107 months)] were studied. The OSA results correlated with peritonitis rates: patients who passed the test had experienced significantly lower peritonitis rates during the prior year (*p* < 0.05). In phase II, after the new PDEP was introduced, overall peritonitis rates significantly declined (to 0.28 episodes/patient-year from 0.55 episodes/patient-year, *p* < 0.05); the *Staphylococcus* peritonitis rate also declined (to 0.09 episodes/patient-year from 0.24 episodes/patient-year, *p* < 0.05).

◆ **Conclusions:** The OSA is a reliable tool for assessing patients' skills, and it correlates with peritonitis rates. The multidisciplinary PDEP significantly improved outcomes by further lowering peritonitis rates.

KEY WORDS: Objective structured assessment; therapeutic education; peritonitis rate.

Peritonitis is a major complication and the main cause of peritoneal dialysis (PD) failure, severely affecting patient morbidity and mortality. Despite regularly updated guidelines from the International Society for Peritoneal Dialysis (ISPD) on PD-related infections and their prevention and treatment (1–3), peritonitis continues to be a worrisome problem throughout the world (4–8).

Patient training is recognized to be very important in preventing this complication (9–11). The impact of patients' knowledge about their illness on outcome is well known in diabetes and other chronic conditions (12,13). Education programs with a theoretical basis, using cognitive framing and motivational interviewing principles, are associated with improved outcomes (14–20). A multidisciplinary approach with a precise schedule—"therapeutic education" (11)—has become an important therapeutic tool (21,22). The ISPD guidelines (10) assert that a new PD education program (PDEP) may be evaluated by observing changes in peritonitis rates, but the value of individual evaluation at the end of a training period is still controversial (11). Chen *et al.* (23) found no correlation between post-training test scores and peritonitis rates. Russo *et al.* (24) proposed a theoretical questionnaire and a practical evaluation of patient performance using the Nurse Score Card as a checklist.

In an effort to lower the peritonitis incidence, we decided to change our PD training and retraining program and also our evaluation tool. We used questionnaires during training and a practical evaluation tool similar to the Objective Structured Clinical Assessment, first introduced by Harden *et al.* in the evaluation of medical students in 1975 (25) and today widely used for that purpose.

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In the present study, we evaluated the tool used to assess patients' skills and the impact on peritonitis rates of a new multidisciplinary PDEP.

METHODS

This retrospective analysis reviewed the educational and clinical records of patients on chronic PD at a Uruguayan PD center. The study was approved by the University Hospital Ethics Committee.

PHASE I

The center's database was used, preserving confidentiality. Regular surveillance and treatment of *Staphylococcus aureus* nasal carriers and antibiotic prophylaxis for

exit-site infections has been routine since 2002; staff members made no changes to those measures. In August 2008, 25 patients with adequate weekly Kt/V (≥ 1.8) and without mental disabilities who had been on PD for at least 1 month were studied after they gave informed consent. Age, sex, time on PD, years of formal education, and peritonitis episodes (date and causative microorganisms) were recorded, and prior-year peritonitis rates were calculated.

A new tool for evaluating the patients' skills was introduced in August 2008: PD bag exchange methods and troubleshooting questions were evaluated using an Objective Structured Assessment (OSA) based on the Objective Structured Clinical Assessment. The OSA consists of 6 "stations" (Table 1) and 15 "key" steps scored at 10 points (5%) each, so that if any key step is incorrectly

TABLE 1
Content of the Objective Structured Assessment

Objective structured assessment—first part (a complete bag exchange performed with a PD simulation apron)	Yes	No	Score
Station 1:			
Prepare the room and environment (close window and door, turn off fan, no pets, good lighting)			10
Wash hands vigorously with water and soap (1°)			5
Clean table surface			1
Check bag indemnity, expiration date, concentration, volume and warm it			10
Place gathered supplies on a clean surface, check 2 mini-cap exp date			2
Expose PD catheter out of clothes and ensure the twist white clamp of the transfer set is closed			1
Put facial mask on			10
Wash hands vigorously with water and soap (2°)			5
Go to the room and close door without touching anything with hands			1
Open the twin bag external package properly			2
Check bag condition and indemnity			4
Hang the warmed bag on a hook and the drainage bag low			1
Put blue clamps properly			1
Wash hands and arms up to elbows (3°)			10
Open the tap			
Pull up sleeves to elbow level			
Take off watch and jewels			
Wet hands and put on soap			
Wash hands vigorously, produce a lot of foam			
Rinse hands and arms up to elbows			
Wash carefully fingers, nails, and wrists			
Wash with water without rubbing with fingers up			
Dry with a paper towel			
Dry from fingers to elbows			
Turn off the tap with the paper towel			
Place a paper towel under the transfer set to protect clothes			1
Hold the twin bag connector on one hand (properly hand position)			2
Hold the transfer set on the other (proper hand and finger position)			2
Remove pull ring from bag connector			2
Remove used mini-cap from transfer set			2
Attach the bag connector to the transfer set with secure movements			10

TABLE 1 (cont'd)

Objective structured assessment—first part (a complete bag exchange performed with a PD simulation apron)	Yes	No	Score
Flush lines before drain			10
Put blue clamps on lines			
Break green seal on fill line			
Open clamps to allow fluid to move into drain bag for 5 s			
Clamp the fill line with a blue clamp			2
Hold light blue area on transfer set and twist white clamp open			1
Drain until drain line is cold, after movements and enough drained vol			1
Close transfer set clamp			1
Clamp the drain line with a blue clamp			1
Open twist clamp on transfer set to fill			1
Fill until fill bag is empty			1
Close white twist clamp on transfer set			1
Clamp the fill line with second blue clamp			1
Ensure hands were cleaned during the exchange			10
Ensure facial mask is on			10
Wash hands vigorously with water and soap or use antiseptic sanitizer			2
Open new mini-cap package			10
Disconnect bag connector from transfer set and place new mini-cap on end of transfer set			10
Place catheter inside clothes properly fixed			1
Check drain bag to assess clarity or fibrin			1
Weigh drain bag			1
Registered weight			1
Discard effluent in toilet and used supplies properly			1
Wash hands and clamps			1
Objective structured assessment—second part (troubleshooting—also performed with a PD simulation apron; the patient is asked to describe or perform the activities they would do in the situations described)	Yes	No	Score
Station 2: If you touched accidentally the Luer-lock blue connector (with your clean hand and/or any other object) at the beginning of the bag exchange (during the connection)			10
Check transfer set twist white clamp and lines are properly clamped.			
Open a new sterile minicap package.			
Attach the Mini cap to the catheter luer-lock properly.			
Discard the prepared bag.			
Call the PD Centre and go immediately there to change the transfer-set.			
Station 3: If you touched accidentally the Luer-lock blue connector (with your clean hand and/or any other object) at the end of the bag exchange (during the disconnection)			10
Use same check list as station 2.			
Station 4: If during the bag exchange you observed that any of the bags had a leakage			10
Stop the exchange: close transfer set and cap off with a new mini-cap.			
Call the PD centre and go immediately there with the bags properly closed.			
Station 5: If you observed a cloudy effluent			10
Complete the drainage and the exchange (same checklist as station 1).			
Call and go immediately to the centre with the cloudy bag properly closed.			
Station 6: Look at the photos (minor exit-site infection). Describe your behavior if your exit site would look as in the photographs			10
Call and go immediately to the centre.			

Each step or station has been assigned a value according to its importance. If the step is perfectly performed, the Yes column is checked, and the value is added to the total score. Otherwise, the No column is checked, and no point is added. If the final score is 95% or less (that is 190 or fewer points), the person must be retrained.

performed or answered, the final score is 95% or less. Patient and partners on training who were completing the OSA were unaware of PD nurse observation so as to preserve self-confidence and reduce stress. An "acceptable" score was more than 95% correct answers. After an unacceptable score, retraining would begin, and testing would be repeated until a perfect score was achieved.

PHASE II

The main goal of the PDEP was to lower peritonitis rates. From 1 September 2008 to 31 December 2010, 31 new patients (at least 1 month on treatment) were admitted and trained using a new multidisciplinary PDEP according to ISPD recommendations (10,11). Sex, age, years of formal education, number of training sessions, time on PD during the study period, peritonitis episodes, and causative micro-organisms were recorded, and peritonitis rates were calculated according to ISPD guidelines (13). For patients incapable of performing the bag exchange (because of blindness, motor disabilities, or OSA failure), a partner was designated by the patient. In those cases ($n = 7$), the partner was trained, and the partner's educational data were recorded for the study.

The new PDEP consists of individual ("one-on-one") lessons delivered in a comfortable setting and providing printed material and troubleshooting information and practice of PD exchanges using a PD apron. Beginning with the second session and throughout the course, a brief oral questionnaire about the material taught in the previous session is administered; wrong answers are reviewed, with repetition of the entire session if necessary. The number of sessions, their duration, and the materials used are adapted to the personalities and cultural backgrounds of the patients and partners, and sessions continue until participants answer the pre-session questionnaires and complete the OSA perfectly. Only after participants pass the OSA are they authorized to perform PD independently at home.

The 8 lessons of the new PDEP (Table 2) are delivered in a minimum of 5 sessions, each session being about 2 hours long. Training is usually provided at the outpatient clinic before catheter placement, but if the patient needs to begin PD urgently, it is provided during hospitalization. The PD nurse, nutritionist, and nephrologist actively participate. In special circumstances, a psychologist or social worker also participates. The PD nurse visits the homes and work spaces of the patients; if environmental conditions are inadequate, the social worker helps to improve them (as usual).

TABLE 2
Lessons in the New Peritoneal Dialysis
Education Program

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- 1 Chronic kidney disease and renal replacement therapy modalities
 - 2 Peritoneal cavity and membrane; diffusion and ultrafiltration
 - 3 Concepts of clean and sterile; hand washing (five steps, World Health Organization)
 - 4 Peritoneal solutions (dextrose and icodextrin) and supplies; bag exchange
 - 5 Peritoneal dialysis adequacy and schedule: CAPD, NIDP, CCDP
 - 6 Troubleshooting: problems, solutions
 - 7 Nutrition and diet
 - 8 Chronic kidney disease complications and pharmacologic treatment
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CAPD = continuous ambulatory peritoneal dialysis; NIDP = nightly intermittent peritoneal dialysis; CCDP = continuous cycling peritoneal dialysis.

At the end of the standard training, participants' skills are evaluated using the OSA as previously described, and if the OSA score does not reach 95%, training is restarted with an in-depth review of the "failing" items. After 2 more sessions, a new OSA is performed until a perfect score was achieved. The PD nurse also goes to patients' homes the day they first begin bag exchanges. In addition, patients twice annually attend a retraining session, and at each monthly visit, exit-site care and safe bag exchange procedures are reinforced. Twice yearly, a workshop is held to discuss diet, physical exercise, and general well-being, with the whole team and the patients exchanging ideas. At each workshop, the "safe bag exchange in different environments" topic is discussed. If needed, motivational interviewing principles (express empathy, develop discrepancy, avoid argumentation, roll with resistance, and support self-efficacy) are used by the care team to help patients make lifestyle changes and to take better care of themselves (16).

STATISTICAL ANALYSIS

Results are given as means with standard deviations and medians with ranges. Differences between the groups in age, years of formal education, and number of training sessions were evaluated using the Student t-test. Differences in the prevalence of older patients were evaluated using the chi-square test. Poisson distributions were used to assess differences in peritonitis rates between the groups. The level of significance was set at $p < 0.05$.

RESULTS

PHASE I

Of the 25 patients on PD at August 2008 [16 men, 9 women; mean age: 54 ± 15 years (range: 22 – 84 years); mean time on PD: 35 ± 30 months (range: 1 – 107 months)], 22 obtained an acceptable score on the OSA, and 3 had an unacceptable score. Results correlated with the prior year's peritonitis rate. Those who passed the OSA had lower overall, *S. aureus*, and coagulase-negative *Staphylococcus* (CNS) peritonitis rates in the preceding year (overall: 0.24 episodes/patient-year; CNS: 0.1 episodes/patient-year) than did those who failed the OSA (overall and CNS: 0.67 episodes/patient-year; Poisson $p < 0.05$).

PHASE II

The 3 patients who did not achieve acceptable scores on the OSA were retrained until their scores were acceptable. Patients who started on PD from 1 September 2008 to 31 December 2010 [31 patients: 15 men, 16 women; mean age: 55 ± 16 years (range: 20 – 80 years)] were trained using the new PDEP and were evaluated using the OSA. Only 1 patient who did not achieve an acceptable score on the OSA after 20 sessions was advised to find a partner to perform the exchange. That partner's age, years of formal education, and performance were considered in the present study.

The mean number of sessions required to achieve the objective was 8 (range: 5 – 18). After the initial standard training, 19 participants achieved an acceptable score [group I: 14 patients, 5 partners; mean sessions: 6 (range: 5 – 8)]; 12 participants (group II: 10 patients, 2 partners) needed more sessions because their scores on the OSA were unacceptable after the 8 initial sessions. The group II patients and partners received a mean of 13 sessions (range: 10 – 18 sessions). Compared with group I, group II included more participants older than 65 years of age ($\chi^2 p < 0.05$). Mean age was significantly lower in group I (46 ± 11 years) than in group II (70 ± 11 years, t-test $p < 0.05$), and years of formal education were significantly greater in group I (12.3 ± 3.9 years) than in group II (9.1 ± 3.3 years).

During the next 2 years, peritonitis rates were not different between the groups (overall rate—group I: 0.29 episodes/patient-year; group II: 0.1 episodes/patient-year; CNS rate—group I: 0.14 episodes/patient-year; group II: 0.1 episodes/patient-year; $p =$ nonsignificant). The 7 patients who had a partner to perform the bag exchange did not experience any

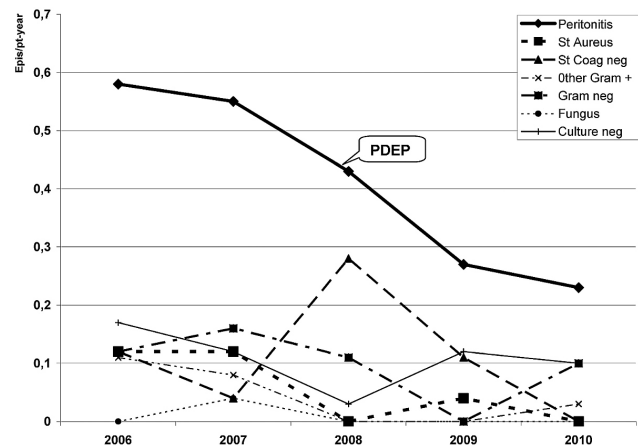


Figure 1 — Infections before and after implementation of the new peritoneal dialysis education program (PDEP), 1 September 2008.

peritonitis episodes during the study period; the other 24 patients experienced peritonitis episodes (overall and individual micro-organisms) that were recorded and analyzed in two 2-year periods: before the PDEP (from 1 September 2006 to 31 August 2008) and after the PDEP (1 September 2008 to 31 August 2010). Peritonitis rates declined significantly to 1 episode in 43 patient-months (0.28 episodes/patient-year) after the PDEP, from 1 episode in 22 patient-months (0.55 episodes/patient-year) before the PDEP ($p < 0.05$). Rates of *S. aureus* and CNS peritonitis also significantly declined to 1 episode in 128 patient-months (0.09 episodes/patient-year) after the PDEP from 1 episode in 51 patient-months (0.24 episodes/patient-year) before the PDEP ($p < 0.05$). The *S. aureus* peritonitis rate declined to 0.02 episodes/patient-year from 0.04 episodes/patient-year before the PDEP, and the CNS peritonitis rate declined to 0.07 episodes/patient-year after the PDEP from 0.20 episodes/patient-year before the PDEP ($p < 0.05$). Annual overall peritonitis rates at the PD center declined to 0.23 episodes/patient-year in 2010 from 0.58 episodes/patient-year in 2007; CNS peritonitis rates declined accordingly (Figure 1).

DISCUSSION

PATIENT TRAINING

The training of PD patients is extremely important and may affect technique success and clinical outcomes (23). Therapeutic education has been considered a key factor in PD outcomes (23,24,26). Ballerini and Paris (20) recommend that the nephrology team acquire a new professional biopsychosocial educational model: a patient may "know" procedures and self-care practices, but may

not be “motivated” enough to make the lifestyle changes necessary to achieve them. Therefore, our new PDEP used “motivational interviewing principles” (16), and patients were supported by a psychologist if necessary.

Nurse training experience must also be taken into account (11,26–28). Elderly patients need more time to learn, but may achieve the same or better results (29). We observed that elderly patients (>65 years of age) needed more training sessions to achieve the necessary skills to perform home PD, but they eventually achieved similarly good results. We therefore emphasize the importance of personalized training that considers individual circumstances and that supports self-efficacy (helping to increase the patients’ perception of their capability to cope with difficulties and to succeed).

PATIENT KNOWLEDGE EVALUATION

Chen *et al.* (23) did not find a correlation between results on a post-training test and peritonitis rates, but demonstrated a correlation with years of formal education, suggesting that previous education prepared the patients to answer written questions but not necessarily to perform the needed manual skills. Kazancioglu (30) found a correlation between outcome and home-visit skills evaluation and environment.

We decided to use two evaluation tools suggested by Russo and colleagues (24): a cognitive evaluation of the patients’ understanding and a practical evaluation of the patients’ skills. We used those tools during training, with the immediate reinforcement of additional training sessions as necessary. The OSA evaluates only practical skills (bag exchange and troubleshooting behavior), a method that was inspired by the Objective Structured Clinical Assessment proposed by Harden *et al.* (25).

Our finding that participants who obtained an acceptable score on their first OSA had had a lower peritonitis rate in the preceding year than did participants whose first OSA score was unacceptable ($p < 0.05$) validates the OSA as a measure. The method has the advantage that skills are assessed using a predefined marking system in a “checklist” (31), helping the observer to pay attention to every single detail. However, final validation of the OSA requires further study in a different population.

In an international survey on training, Bernardini *et al.* (11) did not find any correlation between length of training and outcome. On the basis of our results, we believe that length of training depends mostly on individual patient characteristics. Training must be personalized, and results must be seen in the unique biopsychosocial circumstances of each participant.

PD THERAPEUTIC EDUCATION: IMPACT ON OUTCOMES

Our PDEP is based on cognitive philosophy and psychological theories of learning that focus on patient empowerment and autonomy motivation to improve communication and facilitate behavioral change (16,22). Peritonitis rates have been used in the quality evaluation of PD programs (32–34). In Uruguay, a national registry of PD infections (active since 2004) demonstrated that the main causative micro-organism is methicillin-resistant CNS; the national overall peritonitis rate is 0.5 episodes/patient-year (35). In the present study, the overall peritonitis rate showed significant improvement in the 2 years after the PDEP began compared with the 2 years before, declining to 0.28 episodes/patient-year from 0.55 episodes/patient-year. A constant decline in the overall and CNS peritonitis rates was observed between 2008 and 2010 (Figure 1).

We consider that our results represent a positive evaluation of the new PDEP. We hope that this education program, which can be summarized as “training until a perfect OSA test is achieved by a highly motivated person,” can be easily reproduced by other PD teams. As long as the educational approach described here is introduced, with motivational interviewing and the OSA test, our results should be replicable in other facilities.

CONCLUSIONS

The OSA is a reliable tool to assess technical skills (PD bag exchange and troubleshooting), and our new PDEP significantly lowered peritonitis rates, especially those attributed to CNS infection.

DISCLOSURES

The authors have no financial conflicts of interest to declare.

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