

IMPROVING THE QUALITY OF A PERITONEAL DIALYSIS SERVICE: LEARNING FROM EXPERIENCE

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SUMMARY

Background: Different trends in peritoneal dialysis (PD) utilisation are observed all over the world. The primary aim of all of these dialysis programmes is to provide a quality service to the patients, which depends in part in careful planning of the structure and organisation of the dialysis unit.

Aim: The aim of this paper is to review the available literature on the development and evaluation of PD programmes and to provide recommendations about how to start a new PD unit.

Findings: The essentials of a quality PD service are pre-dialysis education and timely start on dialysis, adequate training for the physicians and nurses, full support from complementary disciplines, effective programme size and continuous quality improvement strategies. Those working in PD should make maximum use of limited resources to improve their dialysis programme penetration as well as clinical outcomes.

KEY WORDS Clinical standard • Outcome • Peritoneal dialysis • Quality

INTRODUCTION

Peritoneal dialysis (PD) is an accepted modality for renal replacement therapy (RRT) for end stage renal disease worldwide (Yang *et al.* 2011). Still there are differing trends in PD utilisation in various parts of the world (Finkelstein *et al.* 2011). PD has grown in some countries due to governmental policies such as in Hong Kong and Thailand, whereas it has been driven by the lack of haemodialysis facilities in some African countries (Finkelstein *et al.* 2011). In addition, there is a decline in patient recruitment for PD in the developed

world (Castledine *et al.* 2011), and as an example, in Canada, 20% of people on RRT are on PD (Perl *et al.* 2012).

Important elements when initiating a PD programme are adequate chronic kidney disease education programmes, adequate physician and nursing training in basic principles of PD, an adequate size of facility and support staff including physicians (nephrologists and surgeons), nurses, dieticians and social workers (Schaubel *et al.* 2001; Huisman *et al.* 2002). The PD unit should develop its own unique continuous quality improvement (QI) programme to monitor the outcomes and hence modify the treatment strategies accordingly (Finkelstein *et al.* 2011; Finkelstein 2006).

The initial step in establishing a good quality PD service requires the shared responsibilities of the medical director and PD nurse manager (Luongo & Prowant 2009). Each should recognise their responsibilities for the quality of the programme and should define a position statement at the very beginning (Bower 2006).

PLANNING AND DEVELOPING A PD UNIT

PHYSICAL REQUIREMENTS OF A PD UNIT

Providing the physical environment and necessary equipment of a PD service should be the next step (Diaz-Buxo *et al.* 2006). The PD centre should be at a suitable location with a back-up of haemodialysis beds since haemodialysis back-up might be required for temporary and/or permanent leavers from PD (Finkelstein 2006). The physical requirements of a PD service can be summarised as a waiting area, a training room large enough

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to host the patient, the trainer and the family members, an outpatient room, staff offices, conference room, restrooms for the patients and staff, storage area for PD fluids and equipment, clean and dirty utility rooms and a secure area for all the patient records (Luongo & Prowant 2009). The characteristics of the physical environment of a PD service have been defined by laws in some countries. For example in Turkey, a PD unit must have a 15 m² reception area, at least one 9 m² training room, a 12 m² clinic and exchange room, at least two restrooms for the patients and a supply storage room in order to be recognised by the Ministry of Health authorities as a qualified PD service (Resmi Gazete 2010).

During the planning sessions, focus should be on the safety of the patients and staff as well. Hence, the unit and the hallways should be large enough to accommodate any wheelchair and/or stretchers. In order to decrease the incidence of infections, the unit must be decorated and painted accordingly (Luongo & Prowant 2009).

The equipment needed in the unit can be varied including the furniture and the sinks. For example, the Turkish Ministry of Health authorities have defined minimum equipment to be present in the PD unit as a portable defibrillator, a patient scale, an emergency kit and aspiration and oxygen units (Resmi Gazete 2010). A dialysis cyclor as well as devices to heat the solutions should be available in the PD unit in order to both teach and treat the patients (Luongo & Prowant 2009).

Another concern for PD units is the capability of providing home training and/or regular home visits which are required by regulations in some countries to their patients (Bernardini *et al.* 2006a; Resmi Gazete 2010). There will be a continuous need for drivers or nurses who can drive, well maintained cars and time for home visits during working hours (Levy *et al.* 2009). However, in the near future the need for virtual home visits may decrease as the utilisation of telecare (video contact) with patients on home dialysis increases (Riemann & Thie 2012).

THE STAFF OF A PD UNIT

The success of a PD service is dependent on the commitment and efforts of all members of the PD healthcare team (Heaf 2006; Leung 2009). The team should include core members and a peripheral group of specialty consultants (Holley *et al.* 1990). The core team should include a nephrologist, registered PD nurse, access surgeon, dietician and social worker (Blake 2006;

Holley *et al.* 1990; Luongo & Prowant 2009). Among the consultants, infectious disease and diabetology specialists as well as a psychologist/psychiatrist are the most critical members of the healthcare providers of a PD programme (Luongo & Prowant 2009).

POLICY DEVELOPMENT FOR A PD UNIT

Each PD service should define their policy and procedures at the start (Leung 2009). For many years both the International Society for Peritoneal Dialysis (ISPD) and other societies including the national organisations have provided evidence-based practice guidelines. The policies and the procedures of a new unit should be based on these evidence-related guidelines and should be revised annually if needed according to new evidence and regulations (Luongo & Prowant 2009). Reviewing clinical outcomes and current standards of care is crucial for continuous QI (Leung 2009).

Areas that present particular problems should receive more attention. For example in China (Yang *et al.* 2011) the PD programme included a standard protocol for catheter insertion by the nephrologists; a well-planned patient training as well as retraining programme in order to endorse patients' self-management and independence; a routine follow-up strategy and a continuous QI programme. In some countries catheter insertion can be performed only by the surgeons or by both nephrologists and surgeons who acknowledge the importance of catheter placement in the technical survival of patients on PD (Dombros *et al.* 2005).

EDUCATION POLICIES IN PD UNITS

Offering PD to an increased number of suitable patients should be the aim of a unit as soon as the structural procedures have been completed. It is established that in some countries most of the patients reaching end stage renal disease have little knowledge about their disease (Mehrotra *et al.* 2005; Finkelstein *et al.* 2011). It has been suggested that this lack of information could be due to late referral to the nephrologist or nephrology unit; however other studies have shown that even the knowledge of those patients seen by a nephrologist regarding chronic kidney disease and renal replacement therapies is limited (Mehrotra *et al.* 2005; Finkelstein *et al.* 2011).

It is clear that there are challenges related to adult education. *Nosology* which was suggested by Ballerini and Paris (2006), could be defined as the science of teaching adults affected by

chronic disease. The educator should be someone deeply involved in renal care that knows and understands the characteristic conflicts and dynamics that arise in patients who have kidney disease and possess adequate communication skills to deal with him or her (Ballerini & Paris 2006). In addition, the educator should plan an education programme according to the patient's learning style (Thomas 2009).

Pre-dialysis education programmes are currently carried out in many countries and studies have confirmed that patient-centred education can both delay the start of dialysis and decrease the mortality rate as well as facilitating appropriate modality selection (Ravani *et al.* 2003; Wu *et al.* 2009).

A specific education programme for PD is vital (Kong *et al.* 2003). The Nursing Liaison Committee of the ISPD had reviewed current standards of care for PD training throughout the world through a survey of nurses and they later performed a literature review and published recommendations for a patient training programme (Bernardini *et al.* 2006a, 2006b). The guideline/recommendations of ISPD provide detailed information about who should be a PD trainer, the role of the physician, what should be taught, where should the training occur, what should be the duration of training, how the patient should be taught, retraining and home visits (Bernardini *et al.* 2006a).

A study from Taiwan described how every new patient on PD received individual training from a qualified PD nurse provided in the week following catheter implantation (Chen *et al.* 2008). Our own experience also demonstrates the importance of patient education and related retraining and home visits (Kazancioglu *et al.* 2008b; Ozturk *et al.* 2009). We aimed to examine how patients continue with the training and practice taught in our unit and then correlate these data with the incidence of peritonitis (Kazancioglu *et al.* 2008a). In this study, home visits were paid to 32 patients and a form including questions about 'knowledge and skill' was filled in for each patient. Meaningful correlations were detected between the 'knowledge and skill' score as well as the environmental score with the rate of peritonitis (Kazancioglu *et al.* 2008b). Fifteen patients participated in the second analysis and received two visits post-training. During the visits, a questionnaire was completed, and the answers were analysed. Consecutive home visits revealed that as the time on PD increased, knowledge and practice regarding infections and medication increased. Thus,

this study also confirmed the importance of home visits in detecting the weakest point of PD practice (Ozturk *et al.* 2009).

As the population is getting older, many older patients will have to learn PD and this may seem an overwhelming task (Thomas 2009). Such patients might be slow to learn and have the risk of short-term memory loss; therefore individualised training programmes are vital (Povlsen & Lomholdt 2009).

TRAINING ENVIRONMENT

It is often not easy for adults to adapt to new therapies leading to changes in lifestyle (Ballerini & Paris 2006). Trying to educate patients in hospital/clinical settings may be tiresome and not effective since education in that setting requires a special environment (Bernardini *et al.* 2006a). The training room needs a door for privacy and should be quiet. There should be no other activities conducted in the room while a patient is in training and ideally the room should be equipped as a home (e.g. comfortable chairs) not as a hospital. One study has shown improved outcomes for patients taught in their home compared with training at the hospital (Castro *et al.* 2002). For older patients especially, training and visits at home would make them feel more comfortable partly because there is no need for transportation to the hospital (Riemann 2011). Since patient-centred training is an essential component of a successful PD unit, the establishment infrastructure for training in-centre or at the patient's homes should be considered.

TRAINING PHYSICIANS AND NURSES

Physician and nurse training are as crucial as patient training to a successful PD service (Finkelstein *et al.* 2011). As PD is a home-based therapy and patients visit the PD unit less than once-monthly for routine follow-up care, this provides limited access to junior nurses and doctors (Finkelstein *et al.* 2011). In order to overcome this problem, suggestions have been proposed such as online curriculum for PD or short PD training courses targeting nephrology specialists (Berns 2010). The Turkish Society of Nephrology Peritoneal Dialysis working group has been organising PD academies including lectures and practical sessions such as catheter insertion, since 2007 (www.tsn.org.tr).

The nursing staff of a unit provides critical contact with the patients including their initial education in order to provide safe and effective treatment at home (Finkelstein *et al.* 2011). The nurses also have to function as the interface between the

patient, physician and the PD unit (Finkelstein *et al.* 2011). The best performance of PD nurses can be achieved when there is one nurse for every 25–30 patients on PD (Finkelstein 2006). The number of patients that can be cared by a single nurse of course depends on the age and comorbidity of the patients and it should be reviewed regularly. Moreover, this ratio is dependent on the responsibilities of the nurses, such as patient and nurse educations, home visits, care of the patients on the ward and running nurse-led clinics.

As expected variations exist in training of nurses as the nurses acquire their knowledge from formal educational courses, continuing education, review of the education literature and from senior colleagues (Bernardini *et al.* 2006a, 2006b). The Ministry of Health in Turkey requires education of PD nurses to be performed at registered PD units qualified to give education. The programme is three months long and at the end of the course the participants take a written and oral examination to qualify as a certified PD nurse (Resmi Gazete 2010).

QUALITY IMPROVEMENT IN A PD UNIT

The quality of a PD service is determined by its centre's size and experience (Afolalu *et al.* 2009; Piraino *et al.* 2009; Plantinga *et al.* 2009). Huisman *et al.* (2002) found that having less than 20 PD patients in a centre or having a small fraction of patients on continuous ambulatory peritoneal dialysis (CAPD), carry an increased risk of technique failure. Similarly, it was demonstrated that in Canada, as the cumulative number of PD patients treated increased, covariate-adjusted mortality significantly decreased (Schaubel *et al.* 2001). In Hong Kong, most of the dialysis centres take care of around 300 patients on PD which depend on the availability of special medical expertise in the practice of PD, dedicated staff, well-designed patient training programmes and integrated back-up facilities (Li & Szeto 2008). Moreover, the Hong Kong successful model of PD can be summarised as utilisation rate, patient factors, patient and technique survival, peritonitis rate, quality of life, reimbursement policy and a 'PD first' principle (Li & Chow 2003).

The success of a PD service programme depends on many factors that are interlinked and inseparable from one another (Moraes *et al.* 2009; Nayak *et al.* 2012). Nayak (2007) has defined a dozen key points for a successful programme including patient selection, personnel management, product selection, PD prescription and pharmacotherapy, protein calorie intake, patient on line support, peritonitis, exit-site infection and other

complication, preservation or renal function, physiotherapy and rehabilitation, purse management of patients, post-graduation fellowship and academic activities.

Each PD service should initiate a continuous QI programme (Cerviño *et al.* 2009; Qamar *et al.* 2009). A QI programme will provide data collection, evaluation and outcome management for the PD healthcare team (Golper 1995). PD-related infections, catheter survival, patient and technical survivals should be monitored (Luongo & Prowant 2009). The goal should be at the target levels suggested by international and/or local guidelines. The QI domains can be broadened to patient satisfaction of the PD treatment; health-related quality of life, adequacy of PD, anaemia management and calcium and phosphorus control (Burkart *et al.* 2006b).

INFECTION CONTROL

PD units should undertake regular audit of their peritonitis and exit-site infection rates, including causative organisms, treatments and outcomes. They should enter into active dialogue with their microbiology department and infection control team to develop optimal local treatment and prevention protocols (Bender *et al.* 2006; Li *et al.* 2010). Very low rates of peritonitis can be achieved by introducing innovations such as double bag systems, spike assisted devices, antibiotic prophylaxis during the implantation of the PD catheter and afterwards for nasal carriage of *S. aureus* (Figueiredo *et al.* 2010). The choice of antibiotic during the implantation is advised to be based upon local guidelines, with consideration given to efficacy and risks of selection of resistant organisms (Figueiredo *et al.* 2010). *S. aureus* nasal and/or exit-site carriage is accepted as a risk factor for both peritonitis and exit-site infections (Lobbedez *et al.* 2004). The efficacy of mupirocin ointment in treating *S. aureus* carriage has been well documented; therefore use of mupirocin for prophylaxis should be implemented (Tacconelli *et al.* 2003).

In addition, protocols including proper catheter placement, careful training of patients with periodic retraining, particularly after episodes of infection and/or at each home or clinic visit, thorough hand washing with complete drying, and aggressive treatment of exit-site infection can significantly reduce PD-related infections (Bender *et al.* 2006; Brown *et al.* 2007). As peritonitis episodes decrease, the clinical outcomes improve as demonstrated by The Aus/NZ Registry (Brown *et al.* 2007).

PSYCHOSOCIAL AND DIETARY ASSESSMENTS

As previously mentioned the PD unit needs to operate with a team approach in order to achieve success (Leung 2009). Psychosocial assessment and timely interventions are crucial for patients on PD, since depression and anxiety and caregiver stress can negatively affect the clinical outcomes of patients (Wuerth *et al.* 2007). For example, depression has been associated with increased rate of peritonitis, which is still a major cause of technique failure in PD (Troidle *et al.* 2003). As a result, US regulations mandate the use of health-related quality of life measures regularly (Finkelstein *et al.* 2011).

Dietary advice for patients on PD is also crucial especially for the management of sodium and fluid intake. Blood pressure, lipid and weight measures are components of the QI domains established by NKF/KDOQI Clinical Practice Guidelines and Clinical Practice Recommendations 2006 Updates, so a dietician is a critical member of the PD team (Burkart *et al.* 2006b). Careful dietary instructions about protein and phosphorus intake should be documented for every patient on a regular basis (Heng & Cano 2010).

METABOLIC MANAGEMENT

Patients with CKD are at a heightened risk of developing cardiovascular disease, with contributions from both traditional and non-traditional cardiovascular risk factors (Wang 2007). Among those non-traditional factors are chronic inflammation, deranged calcium–phosphorus metabolism, extracellular volume overload, anaemia, increased oxidative stress, hyperparathyroidism, hyperhomocysteinaemia and sympathetic overactivity (Longenecker *et al.* 2002).

In addition, the high glucose load associated with PD may lead to insulin resistance and to the development of an atherogenic lipid profile. The presence of glucose degradation products in conventional PD solutions leads to the local formation of advanced glycation end products (Krediet & Balafa 2010). For metabolic control, plasma bicarbonate should be maintained within the normal range, which can be achieved by the adjustment of dialysis dose and/or dialysate buffer concentration (Szeto *et al.* 2003).

Central obesity and associated metabolic complications, notably increased atherogenicity of lipid profiles and insulin resistance, can be reduced by avoiding excessive glucose prescription (Davies *et al.* 2003). A reduction in the glucose exposure

associated with conventional PD fluids can be achieved by introducing amino acid based or icodextrin solutions to the patients' prescriptions (Prichard 2006).

PRESCRIPTION MANAGEMENT

Adequate dialysis can only be provided if dialysis adequacy is measured. The peritoneal membrane function should be measured within the first two weeks of starting PD therapy and at regular intervals thereafter, particularly after infections (Levy *et al.* 2009). The results of the peritoneal membrane test can then be used to ensure an individualised approach to dialysis prescription, for example, using APD for patients with higher transport membranes and/or lifestyle requirements and CAPD for those patients with lower transport membranes or who request CAPD for lifestyle reasons.

The initial regimen's variables are exchange volume, number and timing of exchanges, ultrafiltration requirements, residual renal function and size of the patient (Levy *et al.* 2009). A standard daily CAPD prescription can be 4 × 2 l exchanges, three during the day and one overnight depending on the patient size (Blake *et al.* 2011). Once the residual renal function declines the prescription needs to be modified to reach the adequacy targets set by guidelines (Blake *et al.* 2011). The recent Canadian, UK Renal Association and K/DOQI guidelines have included trial evidence from ADEMEX and EAPOS trials and set a target of $K_t/V > 1.7$ and $C_{\text{crea}} > 50$ l/week/1.73 m² (Paniagua *et al.* 2002; Brown *et al.* 2003; Burkart *et al.* 2006a; Woodrow & Davies 2010; Blake *et al.* 2011).

The repeated measurements should be performed at six-month intervals (Levy *et al.* 2009). More frequent measurements of adequacy are needed whenever changes are made to PD prescription and there is a significant rise in plasma creatinine or patient becomes symptomatically uremic (Levy *et al.* 2009). Membrane transport status should be repeated at least annually after the initial determination unless a change in PD modality or an infection occurs (Levy *et al.* 2009).

DISCUSSION

A 'PD First' initiative can be presented as a strategy for increasing the number of patients using PD in that facility; however the clinical and lifestyle benefits should not be underestimated. Better survival on PD compared to HD during first two years of dialysis treatment is one of the compelling reasons to start patients on PD (Dalal *et al.* 2011). Residual renal function is

associated with a reduction in blood pressure and left ventricular hypertrophy, increased sodium removal and improved fluid status, lower serum beta 2-microglobulin, phosphate and uric acid levels, higher serum haemoglobin and bicarbonate levels, better nutritional status, a more favourable lipid profile and decreased circulating inflammatory markers (Marrón *et al.* 2008). This highlights the usefulness of strategies oriented to preserve both RRF and the long-term viability of the peritoneal membrane. Hence by initiating a 'PD First' strategy, the patient's residual renal function will be preserved alongside the potential vascular access for use later in their lifetime (Dalal *et al.* 2011). Lower cost of therapy, convenience of home therapy, a flexible schedule and increased freedom from the patient's perspective are other reasons to offer PD as the first choice modality (Dalal *et al.* 2011).

One challenge for PD units is the provision of assisted PD programmes for specific cohorts of patients. This will include patients who start dialysis in an unplanned way but commence directly onto PD and require assistance at home until they have had time to make a choice about their permanent form of dialysis and/or their training sessions are planned (Povlsen 2009).

The PD staff should have a plan for helping new patients who are feeling uncertain or worried about performing their dialysis unassisted and require support in the early days. These include frail or physically disabled patients who require assistance to lift heavy PD solution bags and equipment as well as older patients with cognitive problems who find the process of performing their own dialysis challenging (Povlsen & Ivarsen 2005; Kooman *et al.* 2012). Those with decreased physical and mental activity as well as impaired hearing and vision could benefit from assisted APD requiring two daily visits from the home-care nurse (Povlsen & Lomholdt 2009).

IMPLICATIONS FOR PRACTICE

Important elements when initiating a PD programme are adequate chronic kidney disease predialysis education programmes, adequate physician and nursing training in basic principles of PD, an adequate size of facility and support staff

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including physicians (nephrologists and surgeons), nurses, dieticians and social workers.

Each PD service should define their policy and procedures at the very beginning in a manual. Reviewing clinical outcomes and current standard of care is crucial for continuous QI.

An education programme for patients starting PD, based on ISPD recommendations, should be fulfilled for a better PD service. After the initial training, the patients should be retrained at regular intervals and/or after infection episodes.

A programme of assisted care should be included in the PD centre's aims as the population is getting older.

Each PD service should initiate and develop a continuous QI programme. PD-related infections, catheter survival, patient and technical survivals should be monitored. The goal should be at the target levels suggested by international and/or local guidelines. PD units should undertake regular audit of their peritonitis and exit-site infection rates, including causative organism, treatment and outcomes. Treatment adequacy measurements should be performed at six-month intervals.

CONCLUSION

Each PD programme needs to identify its special circumstances, deficiencies and strong points, and then to strategise accordingly. Ultimately, 'teamwork' is the key for a successful outcome, with the patient being central to all endeavours. The PD nurse is the mediator and acts as an advocate to the patient and their family. A belief and a passion for PD by the nurses and physicians are the fountainhead and cornerstone on which to build a quality PD programme.

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CONFLICT OF INTEREST

No conflict of interest has been declared by the author.

AUTHOR CONTRIBUTIONS

RK researched and wrote the paper.

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