

# The challenges in preventing infection in peritoneal dialysis: a nurse's viewpoint

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## Abstract

The success of a peritoneal dialysis (PD) program depends on a multitude of factors, and prevention of infection is one then. Despite advances in connectology, peritonitis is still the Achilles' heel of PD. The aim of this paper is to review the role of the nurse in preventing infection in PD.

## Keywords

Nursing, prevention and control, peritoneal dialysis.

## Introduction

The role of nursing in peritoneal dialysis (PD) ensures the prevention of peritonitis and exit site infections by developing sound policies and procedures and effective patient education (Prowant, 1996). However, the successful and effective management of PD requires a multidisciplinary approach with a comprehensive education and training programme and appropriate support systems (Finkelstein, 2006). Nurses are also responsible for maintaining peritonitis data, as well as directing or participating in quality improvement activities. The aim of this paper is to review the role of the nurse in preventing infection in PD, focusing on the major risk factors. These risk factors are divided into three major categories: catheter, patient and programme management.

## Catheter-related risk factors

Catheter type, surgical team experience and pre- and postoperative care may influence outcomes. To date, there is no definitive study demonstrating that any catheter type has been proven to be better than another, although evidence is that surgically placed, double-cuff, straight catheters display better survival rates than coiled catheters (Hagen, Lafranca, Izermans, & Dor, 2014; Stylianou & Daphnis, 2014). Importantly, a key to successful chronic peritoneal dialysis is permanent and safe access, and a trusting partnership between the renal patient and renal health care professional (Flanigan & Gokal, 2005). Internationally this has manifested in an increase in the nurse's role coordinating PD catheter insertion under local anaesthesia, ensuring patients have a prompt and safe access in place and having the same practitioner from assessment to discharge (Bowes, 2010).

Infection prevention can be categorised into preoperative, postoperative and chronic care. Preoperative care starts as soon as the patient has decided on PD, with training to be done before or after catheter implantation. Training patients before or after 10 days of catheter implantation has a significant impact on peritonitis rates, as compared to training patients within 10 days immediately after catheter implantation. (Figueiredo *et al.*, 2014). Other preoperative aspects involve prophylactic antibiotics, bowel preparation, laxative use, and exit-site (ES) location determination, preferably downward facing (Bender, Bernardini, & Piraino, 2006; Cho & Johnson, 2014; A. Figueiredo *et al.*, 2010; Piraino, Bernardini, & Bender, 2008; Piraino *et al.*, 2011; Segal & Messana, 2013). Nurses, surgeons and patients should work together to decide the best ES, evaluating patients in the supine and seated positions: avoiding waistline, skin folds and scars, and also giving consideration to the choices and sleep pattern of the patient (Piraino *et al.*, 2011).

Immediate postoperative care involves dressing and catheter immobilisation; chronic ES care involves the use of *Staphylococcus aureus* prophylaxis and daily care of the catheter. One of the most important preventive care measures in post-catheter insertion is the immobilisation or anchoring of the catheter to promote healing and reduce trauma (Bender, Bernardini, & Piraino, 2006; Bernardini, & Bender, 2008). Dressing changes should be avoided in the first week. However, if these are needed, for a soaked or contaminated dressing, only the PD nurses using aseptic technique and a non-irritating cleansing agent should perform this. The dressing should be kept dry and changed only once a week, during the early healing phase,

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except if bleeding, infection or wetness is suspected, using a non-irritating agent (Dombros *et al.*, 2005). There is, however, no evidence to verify that a particular dressing or cleansing agent is superior (Bender *et al.*, 2006; Cho & Johnson, 2014; Piraino *et al.*, 2008; Segal & Messina, 2013). Chronic care of the ES should begin once healing is complete, usually two or more weeks. An international survey showed that gauze was used most frequently for postoperative dressings (75% of adult and 65% paediatric centres), followed by semipermeable dressings (16% adult and 30% paediatric centers) and occlusive dressings (8% adult and 4% paediatric centers). Although the type of dressings used varied by location and differed in paediatric and adult programmes, these differences were not significant (Prowant, Warady, & Nolph, 1993).

Spanish research involving a randomised controlled clinical trial with 60 patients compared ES care using saline and povidone-iodine versus polyhexanide, finding a reduction in peritonitis rates with 1 episode/37 patient-months for the povidone-iodine group in comparison to 1 episode/102 patient-months for the polyhexanide group (Nunez-Moral *et al.*, 2014). Of promise was a small study using sodium hypochlorite (Alcavis 50) to scrub the transfer set connection before and after a PD system connect/disconnect (Clere, 2014; Funes, 2009). Evidence exists to support the use of topical antibiotics either at the catheter ES, intranasal, or both; however, the use of topical antibiotic ointments should be avoided for a polyurethane catheter ES (Piraino *et al.*, 2011; Tacconelli *et al.*, 2003; Xu, Tu, & Xu, 2010). Studies have shown that topic mupirocin ES application is more effective than its intranasal use in reducing *S. aureus* peritonitis (Tacconelli *et al.*, 2003; Xu, Tu, & Xu, 2010). As an alternative to mupirocin, gentamicin cream has also been effective in preventing *S. aureus* infection; despite not been available in many countries, it has show its effectiveness (Bernardini *et al.*, 2005). Johnson *et al.*, comparing the daily application of Medhoney gel at the ES and intranasal mupirocin once a month, have shown that the infection rates and peritonitis were no different between the groups, although the Medhoney group presented more skin irritations and were more likely to withdraw from the study (Johnson *et al.*, 2014). Clearly, nurses should be involved at the start of patient decision making, being aware of catheter types and new technology, participate in development and implementation of protocols and then to assure patient safety through the first phase of treatment.

### Patient-related factors

Patients should be allowed to choose the preferred dialysis modality based upon a timely and complete pre-dialysis education. Motivating patients to be involvement in the decision-making process improves compliance (Bernardini, 2004; Bernardini, Price, & Figueiredo, 2006; Figueiredo, Santos, & Creutzberg, 2005). One of the major recommendations of the ISPD guidelines for patient training is the using adult learning techniques (Bernardini, Price, & Figueiredo, 2006). A survey of PD nurses demonstrated that only 31% of respondents had

a formal background in adult education (Bernardini, Price, Figueiredo, Riemann, & Leung, 2006). To achieve such goals, dialysis nurses should have some adult learning knowledge to be able to prepare well-designed training and educational programmes using both active and passive methods (Hall *et al.*, 2004; Knowles, 2009).

Adult learning requires the identification of the type of learner, in this case the patient or care partner, and the capacity to plan the training. The key to teaching adults is to provide new information that is relevant and usable within a relatively short period of time. There are several instruments assessing type of learning; the traditional model will classify adults as having a visual, aural, read/write and kinaesthetic style of learning. It is important to understand that learning requires changes in behaviour, habits, knowledge and attitudes; the patients' background and previous experience will have an impact on the process of learning (Knowles, 2009). Knowledge of different styles of learning will help the professional to prepare better training to meet the difference in learning styles (Almeida, 2010). It is important to make the distinction between education and learning. Education should result in changes in knowledge and skills, and the educator is the agent who presents stimuli and reinforcement, while learning is the act or process by which behavioural change are acquired (Knowles, 2009).

In an attempt to individualise PD training, nurses should be aware of barriers to self-care, such as decreased vision, hearing, manual dexterity, mobility, strength, language barriers, dementia or poor memory amongst other possibilities (Oliver *et al.*, 2010). Chow and Bennett have developed a tool for pre-training assessment that aims to identify the candidates' existing and potential health-related conditions that would undesirably affect the success of the home dialysis training. The use of such a tool will help nurses plan for a more suitable and individualised training (Chow & Bennett, 2001).

Nurses are responsible for the bulk of PD training. While there are no studies evaluating the education or abilities of the trainer, nurses may be more likely to possess the qualities required (Bernardini, Price, & Figueiredo, 2006). Coles and Uttley have state in a previous International Society for Peritoneal Dialysis (ISPD) recommendation that a six- to eight-week orientation in PD and assignment to a mentor who observes the nurse performing patient education would be ideal (Coles & Uttley, 1994). Nonetheless, there is conflicting information regarding the experience of PD nurses in the occurrence of peritonitis. Yang *et al.* (2012) showed that patients trained by nurses with advanced experience in general medicine prior to working with PD was associated with a lower risk for first-episode gram-positive peritonitis, but was not significantly correlated with all-cause peritonitis risk. In contrast, Chow *et al.* (2007) observed a negative association between the length of time in practice of the trainer and peritonitis incidence.

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There remains no consensus about how long the training time should be or the ideal timing or locale of training, making it difficult to define recommendations of particular standards of patient training that would ensure best PD outcome (Bernardini, Price, & Figueiredo, 2006). Data from the Brazilian Peritoneal Dialysis Multicenter Study (BRAZPD), analysing more than 2000 patients, suggests that training patients for at least 15 hours gives a better outcome. The incidence of peritonitis was higher in patients with up to 15 hours of training (0.32/year at risk or 1 episode/38 patient-month) than for patients trained for more than 15 hours (0.26/year at risk or 1 episode/46 patient-month). The method of training was the standard of care of each unit. In general, training methods in Brazil are based on didactic material provided by industry, with verbal instructions on how to perform exchange safely and how to recognise contamination or infection. (Figueiredo *et al.*, 2014).

The autonomy encouraged for PD patients may lead patients to modify their therapy or to be non-adherent with treatment (Hollis *et al.*, 2006). Younger, employed, smokers and diabetic patients are more likely to be non-compliant or to make modifications, such as: decrease the number of exchanges per day; adjust fill volume; choose a dry day; and reduce time on APD (Blake *et al.*, 2000; Hollis *et al.*, 2006; Kutner, 2001). Patient non-compliance with the treatment is known to be a reality and is a well-discussed topic among health care professionals; however, its identification is not always obvious (Bernardini & Piraino, 1998) and there is a lack of understanding as to how to manage and improve this situation (Griva *et al.*, 2014; Leggat, 2005; Nevins, 2005).

A correlation exists between infection and the amount of time patients were late for training appointments (Chow, Szeto, Leung *et al.*, 2007). Two studies conducted in different countries demonstrated that at least 70% of PD patients were compliant in performing 90% of bag exchanges when an inventory was carried out, either during home visits or via a telephone call (Bernardini & Piraino, 1998; Figueiredo *et al.*, 2005). A further investigation aimed to analyse patient compliance and retraining needs through an assessment of patient knowledge using a questionnaire and home visits, revealing important aspects of non-compliance. Only 66% of the questions were answered correctly, with women performing better than men. Some 25% of patients were partially compliant with their drug therapy, 23% were non-compliant with exchange protocol procedures, 29% of patients needed reinforcement of knowledge and ability to correctly perform exchange, and a significant association was found between compliance and incidence of peritonitis. The authors concluded nearly half the patients needed retraining (Russo *et al.*, 2006). A more recent publication demonstrated similar results, with 67% of patients showing an average compliance with the procedures for performing a CAPD exchange (Mawar, Gupta, & Mahajan, 2012).

Retraining patients is a recommendation from the ISPD, although it is not clear when this should be done after initial

training so further research is needed. Clear recommendation exists for patients who are returning to PD from hospitalisation, infection or changes in mobility or dexterity. This retraining should include dialysis exchange procedures, hand hygiene, recognition of signs and symptoms of peritonitis or education on contamination and exit-site care (Bernardini, Price, & Figueiredo, 2006; Piraino *et al.*, 2011).

There is no recipe on how we can improve treatment adherence, Kutner has suggested that patient education, continuous supervision, support and encouragement and formal treatment of depression and anxiety can help patients to deal with such a complex treatment (Kutner, 2001).

Non-modifiable risk factors for PD infections include race, indigenous racial origin, diabetes, chronic lung disease, poor residual kidney function and extremes of age; Nessim, Bargman, Austin, Nisenbaum, & Jassal, 2009; Piraino *et al.*, 2011) Modifiable risk factors such as obesity, smoking, hypokalemia, hypoalbuminaemia, depression, constipation, vitamin D deficiency, transfer from haemodialysis (HD) to PD, immunosuppression therapy and diverticulitis have been considered modifiable risk factors for peritonitis; Piraino *et al.*, 2011) can be addressed somewhat by the PD nurse.

### Programme management

The success of a PD programme depends on a multitude of factors, with each programme needing to identify its special context, deficiencies and qualities, and strategise accordingly. Safe, effective and ethical nursing requires sufficient staffing numbers and an appropriate use and mix of competent nurses available for patient care; the effectiveness of methods for determining nurse staffing is unknown for chronic kidney disease patients, either HD or PD. Most formulae to determine the nurse-patient ratio are based in general nursing and hospitalised patients and not for chronic self-care outpatients. Bernardini has suggested that a time-orientated score system be used to grade PD nurses activities (Bernardini, 2009). Whilst the roles and responsibilities of nurses differ across health systems and between countries, there is a large variation in the nurse-to-patient ratio around the world (1:15–200 or more); on the other hand, there is common agreement amongst all, particularly patients and public, that nurses must be properly educated and trained, meaning a postgraduation course or having an experienced mentor (Coles & Urtley, 1994; Finkelstein, 2006). The success of a PD programme is dependent upon having specialised nurses with appropriate skills in assessing and training patients for PD, adequate treatment monitoring, and having sufficient resources to provide continued care in the community (Finkelstein, 2006).

As workloads increase, the number of distractions and interruptions tend to increase, and each interruption is associated with a 12% increase in procedure failure and clinical errors by nurses (Wolfe, 2011). Studies examining adequacy of staffing have found an association between high patient-to-

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nurse ratios and several adverse outcomes (Petrosillo *et al.*, 2001; Saxena & Panhotra, 2004; Shimokura, Weber, Miller, Wurtzel, & Alter, 2006). It has been established that understaffing can decrease hand washing (HW) frequency and duration among HD nurses; associated with increased workload (Petrosillo *et al.*, 2001; Saxena & Panhotra, 2004; Shimokura *et al.*, 2006). The same can be expected to happen with PD nurses and patients.

Excellent hand hygiene (HH) is most important for the safety of all patients (Piraino *et al.*, 2011). The World Health Organization (WHO) recommends five moments for HH for health care professionals; in PD it should be done before any examination of the patient's exit-site by the patient, family members, or health care team members (Boyce & Pittet, 2002; Piraino *et al.*, 2011). The WHO advocates that HH should be performed by washing with non-antimicrobial or antimicrobial soap and water or 60–80% alcohol gel (Pittet, Allegranzi, Boyce, & Experts, 2009). A systematic review has demonstrated that non-compliance with HH guidelines is a universal problem and calls for action (Erasmus *et al.*, 2010). Despite the WHO recommendations, there is still a large variation in instructions given to patients, as little is known regarding aspects of HH for PD patients. The 2005 ISPD Guidelines state that antibacterial soap and water are recommended in many centres, while the 2010 ISPD Guidelines do not suggest any specific method for HH in detail (Piraino, 2005; Firanek & Guest, 2011; Li *et al.*, 2010). Some studies investigating HH with PD patients have found that rubbing hands with an alcohol gel is more efficient than either HW with a non-antimicrobial soap or the combination of HW plus alcohol gel rub (Figueiredo, de Siqueira, Poli-de-Figueiredo, & d'Avila, 2013; Siqueira, Figueiredo, Poli de Figueiredo, & d'Avila, 2012).

Since the introduction of PD, the bag-exchange procedure has been performed often with patients and/or nurses wearing disposable face masks. Interestingly, there is no evidence to support wearing masks to prevent infection. In many countries, such as the USA, China, Spain and most of Central and South America, its use is mandatory during bag exchange, recommended by the manufacturers. There are only two studies evaluating the role of the face mask in PD patients and no differences in the incidence of peritonitis were found, whether patients used face masks or not (Figueiredo, Poli de Figueiredo, & d'Avila, 2000, 2001). The 2011 ISPD position statement on reducing the risks of PD states that face masks are optional, in agreement with an international diversity for this practice (Piraino *et al.*, 2011). A Cochrane review on disposable face masks for the prevention of wound infection in clean surgery suggests there is no difference in infection outcome between wearing and not wearing masks (Lipp & Edwards, 2005).

Research assessing the impact of the bag-exchange procedure on risk infection concluded that not wearing a face mask and cap were independent risk factors for peritonitis (Dong & Chen, 2010). This study design did not specifically aim to compare the use, or not, of face masks and all patients had received previous

instruction to use them. It was found that more than half the subjects washed their hands improperly, whilst 11.5% of patients did not wear a face mask and cap as trained, demonstrating non-compliance. Furthermore, no significant difference was observed in the incidence of peritonitis when comparing those 15.4% of patients failing to fully cover the nose or hair, assuming that correct face mask use should cover the nose. Another study concluded that the most commonly compromised step in performing a bag exchange was not wearing a face mask (68%) and the least common was not washing hands (25%); however, it should be pointed out that among the episodes of peritonitis there were three caused by *S. aureus* and coagulase-negative *Staphylococcus*, both skin microorganisms associated with touch contamination (Mawar *et al.*, 2012).

Home visits by nurses is a recommendation of ISPD, but again no evidence exists on its value in preventing infections. A study about home visits stated that all patients should have at least an initial home visit, and further visits if needed, and no difference was found between routine and needed visits (Ponferrada *et al.*, 1993). The compliance with this recommendation has some barriers as we are not clear about frequency that they should be done, staffing numbers and economics to perform it and intrusiveness felt for some patients (Farina, 2001). Phone call monitoring has been used to reduce morbidity in heart failure patients with similar results in PD patients, and home telehealth has been proven to contribute to improved health outcomes and cost of care in high-risk dialysis patients (Aliti, 2007; Domingues, Clausell, Aliti, Dominguez, & Rabelo, 2011; Minatodani & Berman, 2013; Nayak, Karopadi, Antony, Sreepada, & Nayak, 2012).

### Conclusion

In summary, infection can cause significant morbidity and PD nurses play an important role in preventing its occurrence. Special attention to details, catheter implantation, patients' risk factors and management of a PD programme emphasising protocol adherence, staff training, and patient selection and training may minimise infection risk and improve outcomes. The focus on patient safety must be of ultimate importance to nurses.

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