PD IN THE DEVELOPING WORLD

PERITONEAL DIALYSIS IN CAPE TOWN, SOUTH AFRICA

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♦ **Background:** Chronic kidney disease is a major public health problem in sub-Saharan Africa (SSA), which encompasses 70% of the least-developed countries in the world. Most people in SSA have no access to any form of renal replacement therapy (RRT). Given its ease of performance and patient independence, peritoneal dialysis (PD) should be an ideal form of RRT in SSA, but several complex and interdependent factors make PD a difficult option in SSA. The present review describes the practice of PD in SSA, with emphasis on Cape Town, South Africa.

♦ **Methods and Results:** After a review of the recent PubMed literature on RRT in SSA and an appraisal of nephrology practice in South Africa, factors that make the provision of RRT (especially PD) a challenge in SSA include the low number of qualified health care workers, socio-demographic issues (poor housing, electricity, and water supplies), and the cost of PD fluids in the region. Although South Africa has the largest PD population in all of SSA, the growth of PD in South Africa is specifically impeded by the system of RRT rationing, which favors HD; the methods of funding for dialysis and for remuneration of doctors in private practice; and many other socio-economic factors. The peritonitis rate remains relatively high, and it is a significant contributor to morbidity in PD patients in Cape Town.

♦ **Conclusions:** In many parts of SSA, PD could be the main dialysis modality. However, African governments must start taking responsibility for their people by providing adequate funds for renal replacement programs. Attempts to produce PD fluids locally and to train and educate health care workers will greatly improve the use of PD as a RRT option in SSA.

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“Chronic kidney disease (CKD) is becoming a significant public health problem” has been the start to many journal articles. Nowhere is that statement truer than in the developing countries of the world, especially those in sub-Saharan Africa (SSA), where the level of poverty and underdevelopment is very high. Approximately 70% of the least-developed countries of the world are in SSA, where half the population lives on less than US\$1 per day, and where annual per-capita expenditure on health ranges from US\$9 to US\$158, compared with more than US\$2000 in developed countries.

Although the prevalences of CKD and end-stage renal disease (ESRD) continue to increase globally, the impact is more severe in developing countries (1,2), where two health burdens collide (Table 1):

- the increasing prevalence of non-communicable diseases, and
- established epidemics of infectious diseases such as HIV/AIDS, tuberculosis, and malaria.

Much of the limited health care funding in these resource-constrained countries is therefore channeled to combat ravaging epidemics of communicable disease.

Hypertension is common and affects about 25% of the adult population in South Africa; it also accounts for approximately 21% of the patients on renal replacement therapy (3). Prevalence of hypertension as a cause of CKD in other SSA countries is reported to range

between 25% and 48% (4–8). Primary and secondary glomerular diseases also commonly occur in SSA, and for various reasons—such as late presentation of patients, inadequate tools to make a diagnosis, and inadequate treatment—premature ESRD may result (9). Recently, HIV-associated nephropathy was reported from our center in South Africa to have increased by 25.7% over a 10-year period (10). Diabetes mellitus is reported to affect 9.4 million people in Africa, with the reported prevalence of diabetic nephropathy being estimated at 6%–16% in SSA (11). However, because of poor reporting and lack of renal registries across SSA, data on the incidence and prevalence of other diseases causing CKD or leading to ESRD are not readily available, despite the perceived burden of disease.

TABLE 1
Estimated Burden of Disease in Africa Relative to the Rest of the World, 1999^a

Variable	Africa	Rest of world	Total
Total burden of disease (DALYs)	373 360	1 064 794	1 438 156
Communicable (%)	73.7	32.1	42.8
Non-communicable (%)	17.1	52.4	43.3
Injuries (%)	9.2	15.5	13.9

DALYs = disability-adjusted life years.

^a From *The World Health Report 2000—Health Systems: Improving Performance* (1).

Peritoneal dialysis (PD) gained worldwide acceptance as a renal replacement therapy because of ease of performance and patient independence from frequent hospital visits. The use of PD varies worldwide, with the highest prevalences of use being reported for Mexico and Hong Kong (70.5% and 81.3% of all dialysis patients respectively) and with prevalences of 19.3%, 23%, 12%, and 5.3% being reported for the United Kingdom, the Netherlands, France, and Germany respectively (12). The high cost of treatment for the various RRT modalities—hemodialysis (HD), PD, and transplantation—means that they are either completely unavailable or available only to a very few patients in SSA (Tables 2 and 3) (11).

The purpose of the present review is principally the description of the practice of PD as a modality of RRT in Cape Town, South Africa. However, constraints associated with the use of PD in South Africa, as well as in other African countries, are highlighted.

CHALLENGES TO RENAL REPLACEMENT IN SOUTH AFRICA AND SSA

Workforce: One of the main constraints to renal replacement in SSA is the low number of qualified health care workers—nephrologists, trained renal nurses, social workers, and technologists—in the region (Figure 1 and Table 2). Among the important factors leading to this shortage are insufficient training opportunities and the so-called brain-drain syndrome. Although two thirds of SSA countries have just one medical school, 11 have no medical school at all, and in those countries with a

TABLE 2
Distribution of Nephrologists and Renal Replacement Therapy (RRT) in a Few African Countries^a

Country	Nephrologists		HD (n)	HD (pmp)	Patients by RRT modality CAPD		CAPD fraction ^b (%)
	(n)	(pmp)			(n)	(pmp)	
Egypt	500	6.5	33 000	421	45	0.3	0.14
Morocco	135	4.5	4 800	162	30	1	0.62
Tunisia	70	7	6 500	650	200	20	3.0
Nigeria	100	0.7	1 000	8	0	—	0
Ghana	2	0.1	35	2	0	—	0
Senegal	2	0.2	50	4.2	26	1	34.2
Sudan	25	0.7	1 610	46	111	3	6.5
Kenya	15	0.5	260	7.5	30	3.7	10.3
Rwanda	1	—	0	—	30	3.7	100.0
South Africa ^c	80	1.8	3 360	75	1 449	32.2	28.7

HD = hemodialysis; CAPD = continuous ambulatory peritoneal dialysis; pmp = per million population.

^a Adapted from Naicker (11), with permission from Dustri-Verlag, publishers of *Clinical Nephrology*.

^b Prevalence of peritoneal dialysis expressed as a percentage of the total dialysis population.

^c Data for South Africa is more recent (2009).

TABLE 3
Adult Renal Transplantation (Public and Private
Sectors) in Centers Across South Africa,
2007 – 2009

Center and year	Cadaveric donation	Living donor	
		Related	Unrelated
Cape Town			
2007	51	33	10
2008	43	51	9
2009	65	56	15
Johannesburg			
2007	55 ^a	15	4
2008	33 ^b	8	5
2009	44 ^c	19	3
Pretoria			
2007	21	—	2
2008	13	7	4
2009	17	7	4
KwaZulu-Natal			
2007	7	2	7
2008	11	3	14
2009	12	14	3
Bloemfontein			
2007	—	—	—
2008	14	1	—
2009	4	—	3
TOTAL			
2007	134	50	23
2008	114	70	32
2009	142	96	28

^a Includes 10 cases of simultaneous kidney and pancreas transplantation.

^b Includes 3 cases of simultaneous kidney and pancreas transplantation.

^c Includes 11 cases of simultaneous kidney and pancreas transplantation.

medical school where doctors are regularly trained, many of the doctors eventually leave for better opportunities in developed countries (14). The absence or continual departures of these skilled workers prolongs the under-development of the practice of PD. Although the number of nephrologists per million population (pmp) in South Africa is low, it is higher than in many other countries in SSA.

Socio-demographic Factors: Many parts of SSA still have inadequate social amenities such as electricity, proper housing, and running water. Socio-demographic factors play a significant role in the use and outcomes of PD in SSA, and patient survival on PD has been shown to correlate with such factors. In one study from Cape

Figure 1 — Distribution of health workers by level of health expenditure and burden of disease, World Health Organization regions (13). Reproduced with permission.

Town, the rate of peritonitis was significantly associated with a high occupancy-to-bedroom ratio, absence of electricity, informal housing, number of years of education, and black race. On multivariate analysis, poor social circumstances ($p < 0.05$), but not race, was a determining factor (15). In South Africa, where a rationing system is applied in selecting patients for dialysis, poor socio-demographic factors (race excluded) will bar a patient from dialysis or hinder the use of PD if the patient is accepted (16).

Cost of Dialysis—PD Fluid As King: The annual per-patient cost for PD is less than that for HD (17,18). In the United States in 2007, Medicare spent \$19,560 less per annum for each PD patient than for each HD patient (19). In South Africa, the annual per-patient cost for PD is about 50% of that for HD, without taking into account the number of HD dialyzer reuses. However, PD costs less than HD only if the fluids are manufactured and distributed locally. In many SSA countries where PD is practiced, there is an absolute dependence on imported PD fluids because those fluids cannot be produced locally. In Sudan, supplies for PD are shipped from Europe or the Middle East to Port Sudan and are then transported more than 1000 km for distribution (20). This process adds substantially to the cost of PD and may lead to inadequate dialysis or dialysis failure if fluids do not reach the patient in good time. South Africa is the most developed economy in SSA, and PD fluids are locally manufactured. Compared with imported PD fluids, the locally produced fluids in South Africa cost about US\$1200 less per patient per annum. That differential is reflected in the number of patients accommodated in the PD program in South Africa relative to other SSA countries (Table 2).

Doctor- and Patient-Related Factors: Despite the huge costs associated with HD, fewer patients are placed on PD than on HD, a situation that is often a result of patients not wanting the “inconvenience” associated with PD procedures at home, the “damage” caused to their body image by having a tube protruding from the abdomen, and a wish to “be looked after” because they are ill. Despite the education programs conducted within each unit, some patients have a low understanding of PD and ESRD treatment, which affects compliance with treatment. Compliance in PD patients who lack insight is particularly low, given that in most cases they are unsupervised at home. Patient factors such as these discourage doctors and reduce reliance on PD as a modality of RRT in South Africa. Furthermore, a number of interviewed nephrologists and nurses felt that the frequent occurrence of peritonitis in noncompliant patients makes PD too labor-intensive.

PD IN CAPE TOWN, SOUTH AFRICA

In 2007, the overall prevalence of patients on dialysis in Africa was estimated to be 74 pmp compared with a global average of 250 pmp. At that same time, the HD prevalence in Africa was 71.6 pmp (global HD prevalence: 223 pmp), and the PD prevalence in Africa was 2.2 pmp (global prevalence: 27 pmp) (21). The prevalence of dialysis (HD and PD) in South Africa is still much lower than might be expected based on gross domestic product, even though South Africa is one of the relatively rich countries in SSA and has one of the largest dialysis programs in the African continent (Table 2).

Cape Town and other large cities in South Africa (Johannesburg, Durban, Pretoria, and Port Elizabeth) are very different from other cities in SSA, where basic infrastructure (housing, water supply, electricity, and good roads) is often lacking. Although the availability of PD in South Africa varies from one province to another, it is available and concentrated mainly around those named big cities. In addition, of the 1449 patients on PD in South Africa, 52.5% receive treatment from public-sector providers; and although the choice of dialysis modality is not restricted in the private sector, the opportunity for income is greater when doctors treat patients with HD, leading to higher numbers of HD patients in the private sector.

If PD is the modality of RRT chosen (by the patient in the private sector, or for the patient in the public sector), most recipients will be trained on continuous ambulatory PD (CAPD). Only a few are trained on automated PD (APD) because of the limited availability and high cost of APD machines. Only employed patients whose work environments are not conducive to PD fluid exchanges

are trained for APD at our center (12% of our PD patients are on APD). That fraction is low in comparison with many European countries, where 30% – 60% of PD patients are on APD. Although the European best practice guideline recommends patient preference, with the need to avoid increased intraperitoneal pressure and an inability to obtain adequate ultrafiltration and solute clearances as reasons for using APD, we are often guided by the cost and availability of APD devices (22,23).

PD or HD—Whose Choice Is It Anyway? Because of the rationing system in place for RRT in state hospitals in South Africa, the choice of dialysis modality is made for the patient principally by health care providers. The decision is taken according to set criteria and is based on socio-economic factors (that is, type of housing, degree of social support, and employment status, among others; see Table 4). Paradoxically, fewer patients are chosen to start on PD because fewer PD than HD spaces are available. That imbalance is a consequence of total dialysis station restriction (because of cost constraints) and a preference for HD because of socio-economic conditions, although it would be cheaper to expand the PD pool, thereby expanding the overall dialysis program.

Funding for Dialysis and Remuneration for Doctors: South Africa is one of the few countries in SSA in which the government offers to pay for dialysis care for patients. For that reason, a larger number of patients are on dialysis in South Africa relative to other SSA countries (Table 2). Patients with a limited income, or those who are unemployed, receive treatment from public hospitals, which are funded by the government. Working-class patients and those able to afford medical insurance (medical aid) receive treatment from private hospitals. However, unlike the situation in many Western countries, government support for dialysis in South Africa is limited, and the limitations have led to a system of dialysis rationing that uses certain criteria (Table 4) to determine the most suitable patients to be accepted for dialysis (16). In our center in Cape Town, we are permitted only 130 dialysis patients at any time (85 on HD and 45 on PD). As patients from this pool undergo transplantation, space is opened for other incident ESRD patients to be accepted for dialysis. If, however, the program is full, patients with ESRD needing dialysis cannot be accepted.

Medical aid companies pay the complete costs of dialysis in the private sector in South Africa, but only those few patients who are able to pay for medical aid are offered dialysis in private clinics. Space for dialysis in the private sector is therefore unlimited; anyone who can pay is accommodated.

TABLE 4
Renal Assessment Tool for Renal Replacement Therapy Rationing in the Western Cape, South Africa

Category 1 ^a	Category 2 ^b	Category 3 ^c
Age < 50 years	Age 50–60 years	Age > 60 years
Body mass index < 30 kg/m ²	Body mass index 30–35 kg/m ²	Body mass index > 35 kg/m ²
Gainfully employed	Hypertension with target organ damage	Transplantation contraindicated or associated with unacceptable risk
HIV-negative	Diabetes mellitus	HIV infection other than as described in category 2
HBsAg-negative	Smoking	Active substance abuse
South African citizen	HBsAg- or HCV-positive (no cirrhosis)	HBeAg-positive or cirrhosis
	HIV-positive	Diabetes mellitus plus age > 50 years
	(CD4>200, undetectable viral load, on HAART)	Active uncontrollable malignancy with short life expectancy
	Late presentation needing urgent dialysis	Non-South African citizen
	Comorbid disease (for example, stable IHD)	Advanced irreversible progressive vital organ disease (cardiac, cerebrovascular, liver, lung, unresponsive infection)
	Previous renal graft	Mental illness resulting in diminished capacity to take responsibility for actions
	Poor home circumstances	Habitual non-adherence with medical treatment
	Convicted criminal in serious offence	
	Not gainfully employed	
	Poor social network or support	
	No proximity to dialysis unit	

HIV = human immunodeficiency virus; HBsAg = hepatitis B surface antigen; HCV = hepatitis C virus; HAART = highly active antiretroviral therapy; HBeAg = hepatitis B e-antigen; IHD = ischemic heart disease.

^a Patients in this category must be accepted.

^b Patients in this category will be accepted depending on availability of space in the program and the number of factors in this category.

^c Patients with any category 3 factor are excluded.

Peritonitis: Peritonitis is a major threat to PD worldwide and remains a serious complication and a major cause of mortality and technique failure on PD. The prevalence and causes of peritonitis vary depending on the region and the time period. In a study conducted in Cape Town in the early 1990s, the peritonitis rate was high (2.4 – 4.9 episodes per patient-year), especially in patients classified within the lowest socio-economic strata (15). In 2010, the peritonitis rate at the same center in Cape Town, although much improved, remained unacceptably high at 1.7 episodes per patient-year. The currently reported rate is slightly higher than, but similar to, rates reported from Cape Town in 2002 by Rayner *et al.* (24). Currently, gram-positive organisms are responsible for most episodes of peritonitis (50%); culture-negative peritonitis and fungal peritonitis occur in 15.4% and 3.8% of patients respectively. We believe that the absence of a permanent clinical coordinator (registered nurse) for our PD clinic (because of staff shortages) and the lack of regular home visits are important contributors

to the high rates of peritonitis observed in our center. Home visits are a particularly vital aspect of PD care. They have been shown to improve patient mobility and mental health, to increase patient longevity and technique survival, to improve compliance, and to reduce rates of peritonitis (25,26). Efforts are currently underway to re-institute home visits at our center.

Increased Risk of Transmission of Viruses: In many SSA countries, the burden of renal disease attributable to viruses (HIV, hepatitis C) is high (9). Other than costs and lack of resources, the increased risk of transmission of such viruses to health care workers and other patients during dialysis could mean that many infected patients with ESRD are denied the opportunity for treatment. Before 2009, when the criteria in Cape Town for patient acceptance to RRT was revised, all HIV-positive patients were automatically refused chronic RRT (Table 4). Recently, stable HIV-positive patients on antiretroviral therapy with a CD4 cell count above 200/mm³ and a viral

load below detectable limits are accepted for dialysis as category 2 patients, provided that they meet other acceptance criteria (Table 4). Although Abraham *et al.* in India (27) have correctly suggested that the use of PD is associated with reduced transmission of viruses, PD is usually not offered in Cape Town to patients positive for hepatitis B and HIV because of the fear of poor handling of PD effluent (waste disposal) and, therefore, of an increased risk of transmission of the viruses to family members or neighbors. Seroconversion for these blood-borne viruses is extremely uncommon in all dialysis patients in Cape Town because patients are frequently tested and regularly vaccinated. There are no data from SSA on the rate of seroconversion in dialysis patients.

Quality-of-Life Issues: Several studies have compared health-related quality of life (HRQOL) in HD and PD patients, with inconsistent results. However, many such studies have reported that HRQOL is higher in PD patients than HD patients. We recently showed, using the Kidney Disease Quality of Life–Short Form (KDQOL-SF) questionnaire, that HRQOL is low but not significantly different between HD and PD patients at our center (28). We also reported that certain factors—such as use of erythropoiesis-stimulating agents, blood pressure (systolic and diastolic), and serum ferritin levels—influence HRQOL in our PD patients. The HRQOL of PD patients can therefore be increased by adequate control and treatment of those observed clinical factors. Better quality of life in PD patients will reduce morbidity and make PD an attractive RRT option in many parts of SSA.

CONCLUSIONS AND RECOMMENDATIONS FOR PD TREATMENT IN SSA

Africans must start to find practical solutions to their own problems rather than incessantly expect foreign aid—after all, this is the 21st century! Although there is poverty and a massive burden of disease in Africa, many African governments must start taking responsibility for their own people by providing funds for renal replacement programs and by initiating a dialogue with the private sector on how to sustain such programs. Also, given that the cost of PD fluids is a strong determinant of the public PD population in SSA, efforts to manufacture PD fluids should be increased in many other SSA countries. Local manufacturing will reduce the cost of RRT in many countries and make PD an available modality where only HD currently exists. The International Society of Nephrology (ISN) and the International Society for Peritoneal Dialysis, which both have a track record of success in training nephrologists and nurses in SSA to deliver PD,

have to continue their educational support. The ISN's Global Outreach and Sister Renal Care programs in SSA are particularly laudable in their continuation of training and support for renal centers across SSA. The ISN's programs can be further advanced and easily achieved by working in conjunction with the African Association of Nephrology and the various national nephrology societies in SSA.

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DISCLOSURES

The authors have no financial conflicts of interest to declare.

REFERENCES

1. World Health Organization (WHO). *The World Health Report 2000—Health Systems: Improving Performance*. Geneva, Switzerland: WHO; 2000.
2. Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. *Lancet* 2009; 374:934–47.
3. Naicker S. End-stage renal disease in sub-Saharan and South Africa. *Kidney Int Suppl* 2003; (83):s119–22.
4. Arogundade FA, Sanusi AA, Akinsola A. Epidemiology of chronic renal failure in Nigeria: is there a change in trend? (Abstract). *Nephrology (Carlton)* 2005; 10(Suppl 1):A56.
5. Matekole M, Affram K, Lee SJ, Howie AJ, Michael J, Adu D. Hypertension and end-stage renal failure in tropical Africa. *J Hum Hypertens* 1993; 7:443–6.
6. Abboud OL, Osman EM, Musa AR. The aetiology of chronic renal failure in adult Sudanese patients. *Ann Trop Med Parasitol* 1989; 83:411–14.
7. Diouf B, Ka EF, Niang A, Diouf ML, Mbengue M, Diop TM. Etiologies of chronic renal insufficiency in a adult internal medicine service in Dakar (French). *Dakar Med* 2000; 45:62–5.
8. Du-Toit E, Pascoe M, MacGregor K, Thompson PD, eds. *Combined Report on Maintenance Dialysis and Transplantation in the Republic of South Africa*. Cape Town, South Africa: Observatory; 1994.
9. Okpechi IG, Rayner BL, Swanepoel CR. Nephrotic syndrome in adult black South Africans: HIV-associated nephropathy as the main culprit. *J Natl Med Assoc* 2010; 102:1193–7.
10. Okpechi I, Swanepoel C, Duffield M, Mahala B, Wearne N, Alagbe S, *et al.* Patterns of renal disease in Cape Town South Africa: a 10-year review of a single-centre renal biopsy database. *Nephrol Dial Transplant* 2011; 26:1853–61.

11. Naicker S. Burden of end-stage renal disease in sub-Saharan Africa. *Clin Nephrol* 2010; 74(Supp 1):S13–16.
12. Lameire N, Van Biesen W. Epidemiology of peritoneal dialysis: a story of believers and nonbelievers. *Nat Rev Nephrol* 2010; 6:75–82.
13. World Health Organization (WHO). *Working Together for Health. The World Health Report 2006*. Geneva, Switzerland: WHO; 2006.
14. Anyangwe SC, Mtonga C. Inequities in the global health workforce: the greatest impediment to health in sub-Saharan Africa. *Int J Environ Res Public Health* 2007; 4:93–100.
15. Zent R, Myers JE, Donald D, Rayner BL. Continuous ambulatory peritoneal dialysis: an option in the developing world? *Perit Dial Int* 1994; 14:48–51.
16. Moosa MR, Kidd M. The dangers of rationing dialysis treatment: the dilemma facing a developing country. *Kidney Int* 2006; 70:1107–14.
17. Jager KJ, Korevaar JC, Dekker FW, Krediet RT, Boeschoten EW on behalf of the Netherlands Cooperative Study on the Adequacy of Dialysis (NECOSAD) Study Group. The effect of contraindications and patient preference on dialysis modality selection in ESRD patients in the Netherlands. *Am J Kidney Dis* 2004; 43:891–9.
18. Berger A, Edelsberg J, Inglese GW, Bhattacharyya SK, Oster G. Cost comparison of peritoneal dialysis versus hemodialysis in end-stage renal disease. *Am J Manag Care* 2009; 15:509–18.
19. United States Department of Health and Human Services, Public Health Service, National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases, US Renal Data System (USRDS). *2009 Annual Data Report*. 2 vols. Bethesda, MD: USRDS; 2009.
20. Finkelstein FO, Abdallah TB, Pecoits-Filho R. Peritoneal dialysis in the developing world: lessons from the Sudan. *Perit Dial Int* 2007; 27:529–30.
21. Abu-Aisha H, Elamin S. Peritoneal dialysis in Africa. *Perit Dial Int* 2010; 30:23–8.
22. Dombros N, Dratwa M, Feriani M, Gokal R, Heimbürger O, Krediet R, *et al.* European best practice guidelines for peritoneal dialysis. 6. Automated peritoneal dialysis. *Nephrol Dial Transplant* 2005; 20(Supp 9):ix21–3.
23. European Renal Association (ERA) and European Dialysis and Transplant Association (EDTA) Registry. *ERA-EDTA Registry Annual Report 2006*. Amsterdam: Academic Medical Center, Department of Medical Informatics; 2008. [Available online at: <http://www.era-edta-reg.org/files/annualreports/pdf/AnnRep2006.pdf>; accessed 29 April 2011]
24. Rayner B, Hollander M, Willett C. Adequacy of peritoneal dialysis and nutritional status in patients on continuous ambulatory peritoneal dialysis (CAPD). *S Afr Med J* 2002; 92:887–9.
25. Bernardini J, Piraino B. Compliance in CAPD and CCPD patients as measured by supply inventories during home visits. *Am J Kidney Dis* 1998; 31:101–7.
26. Nayak KS, Sinoj KA, Subhramanyam SV, Mary B, Rao NV. Our experience of home visits in city and rural areas. *Perit Dial Int* 2007; 27(Suppl 2):S27–31.
27. Abraham G, Padma G, Mathew M, Shroff S. How to set up a peritoneal dialysis program: Indian experience. *Perit Dial Int* 1999; 19(Suppl 2):S184–6.
28. Okpechi IG, Nthite T, Swanepoel CR. Health-related quality of life in haemodialysis and peritoneal dialysis patients in Cape Town South Africa. *Saudi J Kidney Dis Transpl* 2012;;(In press).