

Chronic Kidney Disease - A Case Study

Hannah Oldfield

Faculty of Education, Health and Community
School of Nursing and Allied Health
Liverpool John Moores University

Abstract

An exploration of chronic kidney disease (CKD) focusing on a patient's experience on admission to a nephrology ward. Causes of the disease include hypertension, diabetes and acute kidney injury, and progression could be slowed by medication to reduce blood pressure and glucose levels, along with dietary and lifestyle changes. As the average wait for a kidney transplant is around 3 years, finding a donor match is becoming increasingly difficult. Patients have several different treatment options, the most common being haemodialysis and peritoneal dialysis, both with advantages and issues. Complications of the disease include respiratory problems and fluid overload, with possible interventions being fluid monitoring and restrictions on fluid intake. Effects of the disease on the everyday life of patients include the need for regular invasive dialysis treatment, the necessary behavioural changes surrounding fluid intake and diet, and debilitating symptoms such as nausea and respiratory difficulty.

Keywords

Chronic Kidney Disease; Renal Failure; Dialysis; Nurse.

Please cite this article as:

Oldfield, H. (2016) Chronic Kidney Disease - A Case Study *Links to Health and Social Care*
Vol 1 (2), pp. 18-33



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 Licence](https://creativecommons.org/licenses/by-nc-nd/4.0/). As an open access journal, articles are free to use, with proper attribution, in educational and other non-commercial settings.

This article will focus on a patient who was admitted onto a nephrology ward in a local NHS hospital. Treating patients with a variety of kidney conditions, including acute kidney injury (AKI) and chronic kidney disease (CKD), this ward specialised in peritoneal dialysis. It was adjacent to a haemodialysis unit utilised regularly by the patients. A definition of CKD will be given along with its possible causes, some of the complications associated with the disease, the treatments available to the patient and how these treatments can impact on the patient's life. In accordance with the Nursing and Midwifery Council (NMC) Code of Conduct (2015), no names, places and dates will be disclosed. Therefore, the patient in this study will be called Mrs Smith. Mrs Smith gave verbal consent for her condition and care process to be discussed.

Mrs Smith is a 56-year-old woman who presented to the ward with stage 5 CKD. She had found her current treatment plan challenging due to her experiencing unpleasant side effects including dizziness and nausea. As a result of stopping this treatment plan, her clinical symptoms of CKD progressed and she began to suffer with vomiting and breathlessness. She was fully mobile and self-caring. She suffered with hypertension and had a history of alcohol misuse. She currently lived alone in the local area. She had two sisters who supported her when possible, but no other immediate family to take part in her care. She received no professional care in the community, aside from her regular dialysis treatment.

Mrs Smith's advanced CKD involved a significant decline in her kidney function. The human body has two kidneys, which perform a variety of complex functions

(Aschenbrenner and Venable 2009). They maintain a balance of fluid, pH and electrolytes within the blood, stimulate red blood cell production by the release of erythropoietin, assist in the production of vitamin D and regulate blood pressure via the renin-angiotensin-aldosterone system (Martini, Nath and Bartholomew 2015). CKD has five stages that increase in severity, with stage 1 being the most minimally impaired kidney function, and stage 5 being the most severely impaired kidney function (Smeltzer et al. 2010).

The level to which the kidneys perform these complex functions is typically measured by the Glomerular Filtration Rate (GFR), the rate at which blood is filtered by the kidneys and waste products removed. The National Institute for Health and Care Excellence (NICE) (2014) states that a GFR of below $60\text{ml}/\text{min}/1.73\text{m}^2$ can indicate kidney damage. CKD is classified as any kidney damage present for more than 3 months (Himmelfarb and Sayegh 2010). The first two stages of CKD require other indicators of kidney damage aside from a low GFR in order to be diagnosed, including pathological abnormalities of the kidney or the presence of common indicators such as high levels of protein in the urine, known as proteinuria (Daugirdas, Blake and Ing 2007).

According to the National Kidney Foundation (2016a), the normal GFR is 90 or above, although this decreases slightly with age. Mrs. Smith had suffered with increasing impaired kidney function for several years, and at the time of admission had a GFR of $6\text{ml}/\text{min}/1.73\text{m}^2$, which would indicate that she had stage five CKD, or kidney failure, classified by a GFR or below $15\text{ml}/\text{min}/1.73\text{m}^2$ (NICE 2014), and is insufficient to sustain

health (Lewis 2012). Consequently, a patient with kidney failure would need to undergo dialysis to compensate for this lost kidney function.

GFR can be determined when a chemical marker, which is known to be filtered exclusively by the glomerulus, is inserted intravenously, and its levels in the blood are measured after a specific time. However, this method is expensive and time consuming and so is not often used for clinical diagnosis (Lewis 2012). Alternatively, the creatinine levels in the urine can be measured over 24 hours. Creatinine is filtered by the glomerulus, and so gives a good estimate of kidney function and GFR (Reilly and Perazella 2014).

NICE (2014) suggest that people at risk of developing CKD, for example those with hypertension, diabetes, AKI or cardiovascular disease, should undergo screening for the disease. Mrs Smith's hypertension was the reason for her initial screening and subsequent diagnosis of CKD. From tests such as measuring creatinine levels, the GFR can be estimated and consequently, stages of CKD can be further investigated (Daugirdas 2011). Levels of urea and electrolytes can also be measured via a blood test; high amounts would indicate impaired kidney function as the blood is not being filtered efficiently (Davidson 2005). These tests are repeated regularly to monitor the patient's kidney function, alerting staff of any deterioration and allowing for early intervention, such as hypertension medication or diet changes. (Mahon, Jenkins and Burnapp 2013).

The nurse's role when performing these tests is of high importance. They should be able to recognise abnormal results, both visually and through the use of testing equipment such as test strips (Brooker and Waugh 2013). The nurse should be

appropriately trained as it is essential that any abnormal findings are reported, and that results are recorded and reported accurately in order to reach a correct diagnosis (Altman 2010). Despite her already low level of kidney function, Mrs Smith underwent these tests on admission to the ward to determine her kidney function at that time, so that treatment could begin accordingly.

Kidney disease is often caused by other underlying health issues that put pressure on the kidneys' ability to function (Peate, Wild and Nair 2014). These include diabetes, as excessive glucose levels in the blood can damage the glomerulus, as well as hypertension, acute kidney injury, glomerulonephritis and polycystic kidney disease (Lerma and Nissenson 2012). Mrs. Smith had a long history of hypertension, meaning that blood entered the nephrons at a high pressure, causing damage (Kaplan 2010). Although hypertension plays an important role in causing kidney damage, the exact manner in which it causes damage is debated (Peixoto and Bakris 2015).

In addition, CKD also affects one of the kidneys' main functions, the regulation of blood pressure. In healthy kidneys, a raised blood pressure is needed to push the blood through the nephrons to complete the filtration process (Boore, Cook and Shepherd 2016). To achieve this higher pressure, the kidneys release renin which converts into angiotensin and aldosterone in order to cause vasoconstriction and sodium retention, thus causing pressure to rise to a suitable level for filtration (Martini, Nath and Bartholomew 2015). However, if the blood pressure is already high, as it was in Mrs. Smith's case, this function becomes detrimental to the kidneys as a further increase in pressure would cause the flow of blood through the nephrons to become too forceful and cause irreparable damage (Mancia, Grassi and Kjeldsen 2014).

It is important for the nurse to have good observational skills in order to notice patterns of deterioration or improvement (Bullock, Clark and Rycroft-Malone 2012). Mrs Smith's blood pressure was closely monitored to ensure her prescribed dose of ramipril was effective in reducing it and therefore avoiding further damage to her kidneys due to hypertension.

The progression from hypertension to CKD is known as hypertensive nephrosclerosis and is cited as the second leading cause of CKD after diabetes (Kaplan 2010). Mrs. Smith's history of prolonged alcohol misuse could be a factor that caused her hypertension; although the initial cause of chronic hypertension is often unknown, it can be affected by lifestyle choices including diet, exercise and alcohol consumption (Sherwood 2015).

As kidney function declines, levels of sodium can be affected. This can lead to the kidneys releasing an excessive amount of renin, causing angiotensin and aldosterone to continue to raise blood pressure (Lewis 2012). Mrs Smith presented with hypertension prior to her diagnosis of CKD, so it was assumed by medical staff to be a cause and not a consequence of her decline in kidney function. When looking after patients with CKD and hypertension, the nurse should offer advice on lifestyle changes such as a low sodium diet and regular exercise in order to help improve the condition alongside any medical interventions. This would help the patient manage their condition when discharged from hospital, as increased autonomy is known to improve patient's confidence and independence (Peate, Wild and Nair 2014).

Mrs Smith's CKD had progressed to end stage kidney failure; she did not realise she was suffering from the disease until its later stages. A decline in kidney function is

initially asymptomatic, and often clinical manifestations only occur later in the disease (Himmelfarb, and Sayegh 2010). Mrs Smith was experiencing nausea, vomiting, and loss of appetite as a result of her end stage CKD, and this is common among patients with such extreme kidney failure (Cash and Glass 2016). The exact cause of these symptoms remains the subject of debate; however, it is thought to be linked with the kidneys' inability to control the body's acid-base balance (Lew and Radhakrishnan 2015).

Mrs Smith was prescribed cyclizine, an anti-emetic, to reduce her nausea and vomiting. To counter her loss of appetite, Mrs. Smith was also prescribed dietary supplements in the form of a milkshake twice daily, as she rarely ate meals and often vomited after eating. This became problematic, as like many CKD patients, Mrs. Smith was on a fluid restriction due to her reduced kidney function (Ignatavicius and Workman 2016). The liquid diet supplement was detrimental to this as she often requested several additional drinks and therefore struggled to remain within the restriction.

It is important that the nurse explains to the patient the rationale for the fluid restriction, including any complications non-compliance may lead to, including fluid retention and respiratory difficulty. Advice on how to choose low sodium foods, including how to read food labels to find sodium levels, can be very useful to encourage autonomy and compliance after discharge (Peate, Wild and Nair 2014). This explanation helped Mrs Smith to understand her condition and to become more aware of her fluid intake. This was also beneficial to her discharge; she stated she would attempt to continue monitoring her fluid intake and diet content at home, as she was aware of the risks of non-compliance.

Fluid restrictions are common in patients with advanced CKD. Due to reduced kidney function, fluids are not removed as efficiently from the body and can quickly lead to fluid overload if intake is not controlled. Fluid overload causes patients to become oedematous, meaning they appear to have swollen limbs and faces due to the increase in fluid in their bodies, in severe cases making it difficult for them to move. To alleviate some of these symptoms, Mrs Smith was prescribed furosemide, a diuretic, to reduce fluid retention, alongside her fluid restriction.

Lewis (2012) explains that although fluid restrictions are an effective intervention to prevent such overload, they should not be implemented to the extent that the patient's thirst becomes intrusive, and recommends that at least a litre a day should be allowed. Fluid restriction can be beneficial, as fluid overload can cause serious issues such as respiratory problems, causing patients to become breathless (Goldstein and Morrison 2013). Mrs. Smith, like many patients on a restriction, struggled to adhere to it. This was because unexpected items contribute to fluid intake, such as soups, milk used for cereal and liquid diet supplements. It is important for the nurse to keep a fluid balance chart for patients with CKD to ensure they do not exceed their fluid restriction, yet remain hydrated throughout the day.

To assist with Mrs Smith's control of her fluid intake, doctors and pharmacists worked together to prescribe tablets for Mrs. Smith as opposed to liquid or intravenous medications to prevent these from contributing to her fluid intake. Mrs Smith had requested her Cylcizine be given intravenously as she had difficulty swallowing tablets when nauseous. She also preferred her Paracetamol to be in liquid form. After discussion with the doctor, and the nurse having explained the benefits of a reduced

fluid intake, she agreed that she would try both medications in tablet form.

Mrs Smith was often breathless performing the smallest physical action, such as transferring from chair to bed. The nurse could refer Mrs Smith to members of the multi-disciplinary team (MDT) in order to relieve some of these symptoms. A physiotherapist could help with her movement issues, alongside an occupational therapist who could suggest home adjustments including bathroom rails and a stair lift to make transferring easier.

The nurse should also make a dietician referral to help Mrs Smith adjust her diet; choosing low sodium foods and advice on ways to reduce fluid intake (Peate, Wild and Nair 2014). Alongside this, the nurse should provide frequent skin oral hygiene care such as mouthwashes and rinses to prevent the patient's mouth and lips becoming dry and uncomfortable (Bullock, Clark and Rycroft-Malone 2012).

Mrs Smith was admitted to the ward due to issues with her CKD treatment. Unfortunately, due to the irreversible damage to the kidneys at stage five CKD, Mrs. Smith had two options for treatment; dialysis or kidney transplant (Smeltzer et al. 2010). The average wait for a deceased donor kidney in the United Kingdom is currently around 3 years (Chandak and Callaghan 2016). As the transplant list is extensive and the chances of finding a matching donor are small, Mrs. Smith commenced dialysis while she waited for a suitable donor.

There are two types of dialysis; haemodialysis (HD) and peritoneal dialysis (PD). HD consists of the blood being removed from the body and filtered across a dialysis membrane in a machine which removes all the excess fluids and solutes, for example urea and creatinine, in the same way a fully functioning kidney would (Levy, Morgan

and Brown 2009). The blood is then returned to the body. This has many advantages, including control over blood flow into the machine and low infection rates (Lewis and Noble 2013). Should a fistula not yet have been surgically created, blood can be removed through a femoral or neck line. This is ideal in an emergency situation where a patient needs immediate dialysis without time to have a fistula created or repaired (Danielson, Deutsch and White 2010). Patients normally have HD about three times weekly, but this can vary according to patient needs (Turner, Goldsmith and Lumiere 2016).

A disadvantage of HD is that because a machine is needed to filter the blood, the patient would have to travel to hospital or to another health centre to undergo the session (Levy, Morgan and Brown 2009). On admission to the ward, Mrs Smith refused any sessions of HD, explaining that she found it extremely difficult to tolerate, causing dizziness, anxiety and nausea. This is known as 'osmotic disequilibrium syndrome' and has been known to occur in numerous HD patients (Thomas 2004). The nurse emphasised the importance of treatment and the benefits Mrs Smith would experience, such as improved breathing and movement. However, it is not uncommon for patients to consider discontinuing treatment, and patients should be given the opportunity to talk to a specialist nurse and have their ultimate decision respected (Smeltzer et al. 2010).

After finding HD intolerable, Mrs Smith initially wanted to cease dialysis altogether. A decision such as this could have had a major impact on her already diminished kidney function (Patel and Holley 2015). In the absence of a transplant, dialysis was Mrs Smith's only option to live with such severe loss of kidney function. Without any form of dialysis, she would likely experience an accumulation of uremic toxins, excess fluid and

metabolic acidosis, ultimately leading to death (Goldstein and Morrison 2013).

Following several meetings with the multi-disciplinary team, including a specialist renal nurse, during which these concerns were explained to Mrs Smith, she agreed to have PD. PD involves surgically inserting a cannula into the patient's abdominal cavity. Large bags of fluid called dialysate are pushed in and out of this cannula regularly, and serve to filter the blood using the peritoneal lining as a membrane (The National Kidney Foundation 2016b). Fluid and solutes are removed from the blood into the dialysate via osmosis and diffusion across the membrane. There are two types of PD, continuous ambulatory peritoneal dialysis (CAPD), and automated peritoneal dialysis (APD). APD occurs overnight by an automated cyclor. CAPD, which Mrs Smith opted to try, typically involves four bags of fluid being inserted and drained through the cannula daily, each lasting approximately four to six hours (Daugirdas, Blake and Ing2007).

An advantage of PD is that the patient does not need to travel to a dialysis unit to undergo treatment. They can begin and end the sessions themselves, even whilst travelling or at work, whereas access to a haemodialysis unit would need to be arranged should a HD patient go on holiday, which usually incurs a cost (Levy, Morgan and Brown 2009). Bags of fluid are delivered to an address of the patient's choice regularly.

A common issue for CKD patients due to their altered diet and fluid intake is constipation. The increased pressure in the bowel can cause the PD cannula to flip into an inappropriate position and be insufficient for dialysis sessions (Lee 2011). This would require a small surgical procedure to correct, and could mean the patient misses one or more vital dialysis sessions whilst this is rectified. As a result, PD patients are

prescribed to take regular laxatives, such as lactulose. Another disadvantage of PD is the increased risk of peritonitis, due to a foreign body inserted into the peritoneum; however, this risk can be reduced by effective hygiene techniques and patient education (Levy, Morgan and Brown 2009).

Upon discharge Mrs Smith seemed content with her PD sessions, having been educated by a specialist nurse on how to initiate, maintain and complete sessions independently. She was assessed by an occupational therapist to ensure she was able to complete sessions at home, and her sisters had also been given PD education, so they were aware of how to assist Mrs Smith should she require it. She was given her medication to take home, and instructed how and when to take it. A community nurse referral was made to ensure Mrs Smith was coping well during her first weeks of PD at home. She was also given information on clinic appointments to attend regularly to ensure her PD was working efficiently (Rosner and Ronco 2012). She had not reported any negative side effects of PD, unlike those that she suffered during her initial HD sessions. In 2015, the average wait for an adult kidney transplant in the UK was 2-3 years (NHS Organ Donation 2016). Unless a suitable donor is found, Mrs Smith will require PD for the rest of her life, as a consequence of the irreversible nature of CKD.

Being involved in the care of Mrs Smith and subsequently exploring the disease and its treatment in this article has allowed me to expand my knowledge of CKD, its associated conditions, and the different treatment options available to patients. The need for individual patient care became clear to me when I was looking after Mrs Smith. I have become more familiar with the two main types of dialysis used to treat CKD, and would feel more confident explaining the advantages and disadvantages of each to

prospective patients.

This experience also introduced me to the difficulty in obtaining suitable organ donors for those suffering with chronic, life changing conditions, and how a lack of available donors can mean a patient spends the rest of their life undergoing invasive and sometimes uncomfortable treatment. This can have a negative impact on their everyday living including employment, education and even holiday opportunities. Finally, I have come to realise through this experience the importance of the kidneys and the renal system as a whole, and the impact even a minor reduction in function can have on someone's life.

Following this experience, I would consider a career in specialist renal nursing. Renal nurses must have a high level of knowledge surrounding the renal system and dialysis treatments, but also of the psychological effects a chronic renal condition can have (Bonner and Douglas 2014). They must understand the impact waiting for a transplant and undergoing regular invasive treatment can have, and how a patient may be uncomfortable with or not understand treatment options. It is important that they are able to alleviate fears and suggest ways in which patients can minimise the effect of their condition and treatment on their daily life. Renal nurses must provide support for patients whilst also encouraging autonomy and independence.

References

- Altman, G. (2010) *Fundamental and advanced nursing skills*. 3rd ed. New York: Delmar.
- Aschenbrenner, D. and Venable, S. (2009) *Drug therapy in nursing*. 3rd ed. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
- Brooker, C. and Waugh, A. (2013) *Foundations of nursing practice*. 2nd ed. Edinburgh: Mosby/Elsevier.
- Bonner, A. and Douglas, B. (2014) Chronic Kidney Disease. In: Chang, E. and Johnson, A., (eds.) *Chronic illness and disability*. 2nd ed. Sydney: Elsevier, pp.424-444.
- Boore, J., Cook, N. and Shepherd, A. (2016) *Essentials of Anatomy and Physiology for Nursing Practice*. London: Sage.
- Bullock, I., Clark, J. and Rycroft-Malone, J. (2012) *Adult nursing practice*. Oxford: Oxford University Press.
- Cash, J. and Glass, C. (2016) *Adult-gerontology practice guidelines*. New York: Springer Publishing.
- Chandak, P. and Callaghan, C. (2016) Organ Donation. In: Wyatt, M., Reed, M. and Thomas W. (eds.) *Oxford Textbook of Fundamentals of Surgery*, Oxford: Oxford University Press, pp.761-766.
- Danielson, M., Deutsch, L. and White, G. (2010) Central Venous Cannulation for Haemodialysis Access. In: Wilson, S. (ed.) *Vascular Access: Principles and Practice*, Philadelphia: Lippincott Williams & Wilkins, pp.120-138.
- Daugirdas, J. (2011) *Handbook of chronic kidney disease management*. Philadelphia: Wolters Kluwer/Lippincott Williams & Wilkins Health.
- Daugirdas, J., Blake, P. and Ing, T. (2007) *Handbook of dialysis*. Philadelphia: Lippincott Williams & Wilkins.
- Davidson, A. (2005) *Oxford Textbook of Clinical Nephropathy*. 3rd ed. Oxford: Oxford University Press.
- Goldstein, N. and Morrison, R. (2013) *Evidence-based practice of palliative medicine*. Philadelphia: Saunders.
- Himmelfarb, J. and Sayegh, M. (2010) *Chronic kidney disease, dialysis, and transplantation*. Philadelphia: Elsevier.
- Ignatavicius, D. and Workman, L. (2016) *Medical-surgical nursing*. St. Louis: Elsevier.

Kaplan, N. (2010) *Kaplan's Clinical Hypertension*. 10th ed. Philadelphia: Lippincott Williams & Wilkins.

Lee, A (2011) Constipation in patients on peritoneal dialysis: a literature review. *Renal Society of Australasia Journal*, 7(3), pp.122-129.

Lerma, E. and Nissenson, A. (2012) *Nephrology secrets*. 3rd ed. Philadelphia: Elsevier.

Levy, J., Morgan, J. and Brown, E. (2009) *Oxford Handbook of Dialysis*. Oxford: Oxford University Press.

Lew, S. and Radhakrishnan, J. (2015) Chronic Kidney Disease and Gastrointestinal Disorders. In: Kimmel, P. and Rosenberg, M. (eds.) *Chronic Renal Disease*, London: Elsevier, pp.298-309.

Lewis, D. (2012) *Understanding Chronic Kidney Disease*. Keswick: M & K Publishing Ltd.

Lewis, R. and Noble, H. (2013) *Kidney disease management*. Chichester: Wiley-Blackwell.

Mahon, A., Jenkins, K. and Burnapp, L. (2013) *Oxford Handbook of Renal Nursing*. Oxford: Oxford University Press.

Mancia, G., Grassi, G. and Kjeldsen, S. (2014) *Manual of Hypertension of the European Society of Hypertension*. 2nd ed. London: CRC Press.

Martini, F. Nath, J. and Bartholomew, E. (2015) *Fundamentals of Anatomy and Physiology*. 10th ed. Essex: Pearson Education.

National Kidney Foundation. (2016a) *Glomerular Filtration Rate (GFR)*. [online] Available at: <https://www.kidney.org/atoz/content/gfr> [Accessed 23 September 2016].

National Kidney Foundation. (2016b) *Peritoneal Dialysis: What You Need to Know*. [online] Available at: <https://www.kidney.org/atoz/content/peritoneal> [Accessed 5 May 2016].

NHS Organ Donation. (2016) *NHS Blood and Transplant reveals nearly 49,000 people in the UK have had to wait for a transplant in the last decade*. [online] Available at: <https://www.organdonation.nhs.uk/news-and-campaigns/news/nhs-blood-and-transplant-reveals-nearly-49-000-people-in-the-uk-have-had-to-wait-for-a-transplant-in-the-last-decade/> [Accessed 23 Sep. 2016].

NICE (2014) *Chronic kidney disease*. [online] Available at: <https://www.nice.org.uk/guidance/cg182/chapter/About-this-guideline> [Accessed 1 May 2016].

Nursing and Midwifery Council (NMC) (2015) *The Code: professional standards of practice and behaviour for nurses and midwives*. London: NMC.

Patel, S. and Holley, J. (2015) Chronic Kidney Disease in the Elderly. In: Kimmel, P. and Rosenberg, M. (eds.) *Chronic Renal Disease*, London: Elsevier, pp.843-853.

Peate, I., Wild, K. and Nair, M. (2014) *Nursing Practice: Knowledge and Care*. Hoboken N.J.: Wiley Blackwell.

Peixoto, A. and Bakris, G. (2015) Approach to the Patient with Hypertensive Nephrosclerosis. In: Kimmel, P. and Rosenberg, M. (eds.) *Chronic Renal Disease* London: Elsevier, pp.455-469.

Reilly, R. and Perazella, M. (2014) *Nephrology in 30 days*. 2nd ed. New York: McGraw-Hill Education.

Rosner, M. and Ronco, C. (2012) Remote Monitoring for Continuous Peritoneal Dialysis. In: Ronco, C., Rosner M. and Crepaldi, C. (eds.) *Peritoneal Dialysis*, Basel: Karger, pp.68-73.

Sherwood, L. (2015) *Human physiology*. 9th ed. Boston: Cengage Learning.

Smeltzer, S., Bare, B., Hinkle, J. and Cheever, K. (2010) Management of Patients with Renal Disorders. In: Smeltzer, S., Bare, B., Hinkle, J. and Cheever, K. (eds.) *Brunner and Suddarth's Textbook of Medical Surgical Nursing*. Philadelphia: Lippincott Williams & Wilkins, pp.1311-1357.

Thomas, N. (2004) *Advanced renal care*. Oxford: Blackwell

Turner, N., Goldsmith, D. and Lameire, N. (2016) *Oxford textbook of clinical nephrology*. 4th ed. Oxford: Oxford University Press.