The renal system and associated disorders

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Abstract:

Disorders of the renal system, including kidneys and urinary tract, are increasingly recognized as a public health concern, accounting for 830.000 deaths worldwide. Patients are often co-morbid with many presenting with other diseases. Healthcare professionals require good knowledge of the renal system and associated disorders to create holistic care plans to meet individual patients' needs.

Introduction

Disorders of the renal system, including kidneys and urinary tract, are estimated to account for 830.000 deaths worldwide and are the 12th cause of death among all deaths (Jager et al., 2019). Renal disorders comprehend a range of diseases with different etiologies, trajectory, functional severity, and treatment options, ranging from minor changes in renal function to more serious conditions including acute kidney injury, or if present long-term, chronic kidney disease. These patients also tend to present with other co-morbidities such as hypertension, diabetes, and cardiovascular disease. These are also predictors for the occurrence of acute kidney injury, further aggravating prognosis and mortality outcomes. When not managed, renal diseases can progress to a final stage as end-stage renal disease (ESRD) whereby kidney function is needed to be substituted by renal replacement therapy (RRT), hemodialysis, peritoneal dialysis or, when patients fit the selective criteria, transplantation. Patients are more likely to die from co-morbidities, such as cardiovascular causes, than reach ESRD with dialysis intervention, illustrating

the complexity of these cohort of patients and the need to manage co-morbidities to allow better renal function (Jankowski et al., 2021). Considering the adverse impact of renal disease on public health, awareness of the severity and risks of these conditions is important for nursing practice. Nursing care for this co-morbid cohort of patients is challenging as patients can deteriorate quickly. Understanding the different classifications, interventions and the ability to create tailored care plans, is essential to deliver patient centered care, aiming to improve health-related outcomes.

The Renal System – an overview

The renal system plays an important role in homeostasis and its function is to filter approximately 200 litres of fluid each day, allowing excretion of toxins and metabolic waste whilst keeping essential substances in the blood, supporting electrolyte balance. It is composed of the kidneys, ureters, bladder, and urethra (**see figure 1**). The kidney's main function is to regulate the volume and composition of extracellular fluid, removing waste and extra fluid from the body, assisting control of blood pressure, amongst other function as depicted in **Table 1.**

Fluid homeostasis
Excretion of urea and creatinine (nitrogenous waste)
Electrolyte homeostasis (potassium and sodium)
Secretion of renin (control blood pressure)
Production of red blood cells (Erythropoiesis)
Acid-base balance
Synthesis of vitamin D
Detoxification
Gluconeogenesis (generation of glucose from certain non-carbohydrate carbon substrates)

Table 1: Functions of the kidney

Figure 1: Editor, please draw a picture of the renal system

The two kidneys are found at the back of the abdomen on the posterior wall (retroperitoneal), usually 5 – 6cm wide and 3-4 cm thick. The outer border of the kidneys is convex, and the inner border is known as the hilum. The outer capsule of the kidney is called the renal capsule, which protects the kidney from damage (Ashelford, Raynsford, and Taylor, 2019). It is here that renal arteries, renal veins, nerves, and ureters enter and leave the kidneys (Nagalingam, XXX). The kidneys have a rich blood supply from the aorta via the renal artery with approximately 1200ml of blood flowing through each kidney each minute. Nephrons are situated within the medulla; their main function is to produce urine which is drained into the tiny ducts.

Urine formation

There are three main processes involved in the formation of urine as depicted in **figure 2.**

Figure 2 Editor, please draw a picture of the micturition system

The sensory nerve fibers signal the brain to trigger the process to expel the urine, which is known as micturition, with healthy adults holding an average of 500 to 600 mls of urine before voiding (Vaugh and Grant 2018). Urine concentration is controlled by the hypothalamus and the posterior pituitary gland and when an increase in blood osmolality (increased concentration of blood particles), anti-diuretic hormones are released causing water reabsorption in the kidneys and more concentrated urine. Characteristics of urine change according to a wide range of factors such as fluid or nutrient intake, age, body mass index, exposure to exercise, and environmental temperature.

Measuring normal kidney function

Laboratory tests

Monitoring and establishing kidney function through biomarkers allow to define the parameter of structural, chemical, or physiological change that suggests the presence,

severity or progress of a disease (Wasung et al., 2015). Kidney function is usually measured through creatinine levels in the blood (SCr), blood urea nitrogen (BUN). Glomerular filtration rate (GFR) is not a biomarker but an estimation of the clearance of filtrate in the glomerulus **(table 3)**. Evidence suggests these biomarkers are not powerful in detecting the early stages of renal disease as kidney injury starts with biological and molecular changes, evolving into cellular damage at a later stage when these would be able to be measured in the blood.

Creatinine	End product of protein metabolism and muscles, directly affected by muscle mass. The more muscle, the higher the creatinine level. Normal creatinine levels in adults are 59-104umol/L for males and 45-84 umol/L in females.
Blood Urea Nitrogen	Measures the nitrogen component of urea in the blood, it drops as eGFR drops and can be affected by other factors than renal disease such as malnutrition, sepsis, heart failure, hypovolemia (Seki et al., 2019).
eGFR	Calculation through a formula using serum creatinine, age, gender and body mass index. Generally, normal GFR is above 90 ml/min/1.73m^2

(Table 3 – Renal function biomarkers)

Urine Tests

Urine output remains a powerful early “biomarker” of kidney injury as to successfully excrete body wastes, an adult must produce around 1ml/kg or 0.5 mls/kg/hr of urine body in relation to their body weight (Waugh and Grant, 2018). Changes in urine characteristics and output can also inform objective history taking and management plans, as it can suggest renal disease. Urinalysis is performed in two parts. The first, usually done in a quick manner when abnormalities are suspected, consists of dipping a reagent strip noting color changes in each section of the strip (**figure 3**).

Figure 3 Editor please draw a picture of reagent strip

Specific gravity indicates the concentrating ability of the kidneys, with low values suggesting urine dilution through excessive diuresis. On the other hand, presence of protein in urine (proteinuria) is likely to be a consequence of damage to the glomeruli, often linked to chronic kidney disease (**see table 4, composition and characteristics of normal urine**). The albumin-creatine ratio (ACR) test is a common test used to inform diagnosis as the relation between albuminuria (presence of albumin in urine) and GFR informs risk for kidney disease progression, morbidity, and mortality (**see table 5**) (Seidu, Barrett and Khunti. 2020). The next step for urologic diagnosis is often timed urine collection whereby collection may vary from 2 to 24 hours, informing how the kidneys excrete and conserve various solutes.

Components of Urine	**Normal Adult values (usually measured in 24h collection specimen)**	**Should not have**
pH	4.5 – 8.0	ketones
Sodium	27-287mEq/ L /24hr	nitrites
Potassium	25-123 mEq/L / 24 hrs	blood
Urea	165 – 583 mmol/L / 24hrs	glucose
Creatinine	500-2000 mg/day	protein
Uric acid	1.4 - 4.5 mmol/24h	leukocytes
Phosphorus	0.9-1.3 g/ 24h	
Calcium	100-250 mg/ 24hrs	
Chloride	110-250 mEq/L / 24 hrs	
Ammonia		
Water (96%)		

Table 6 – Urine composition (Waugh et al., 2018)

				Albuminuria categories		
				A1	**A2**	**A3**
				Normal to mildly increased	Moderately increased	Severely increased
				<30 mg/g <3 mg/mmol	30-299 mg/g 3-29 mg/mmol	≥300 mg/g ≥30 mg/mmol
GFR Stages	**G1**	Normal or high	≥90			
	G2	Mildly decreased	60-90			
	G3a	Mildly to moderately decreased	45-59			
	G3b	Moderately to severely decreased	30-44			
	G4	Severely decreased	15-29			
	G5	Kidney failure	<15			

Key to Figure:
Colors: Represents the risk for progression, morbidity and mortality by color from best to worst.
Green: Low Risk (if no other markers of kidney disease, no CKD)
Yellow: Moderately Increased Risk
Orange: High Risk
Red: Very High Risk
Deep Red: Highest Risk

Table 5: ACR Values

Adapted from KDIGO (2012) (can it be redrawn?)

Kidney biopsy

Might be required to investigate damage caused to the kidneys and aid diagnosis. A small piece of the kidney is taken away during the procedure for analysing under a microscope (Cooper and Gosnell 2019).

Disorders and causes of renal system diseases

Kidney disease resulting in end-stage has many potential causes and disorders associated, with it and prevalence varies by country, ethnicity, gender and age. The following are some of the most seen in practice.

Cystitis			
Description	**Physical Examination and history taking**	**Investigations**	**Interventions**
Inflammation of the bladder Bacteria (E. coli) enters the bladder through the urethra	Frequency • Urgency • Pyuria • Dysuria • Hematuria • Nocturia • Abdominal pain or discomfort Urinary incontinence	Midstream urine Flexible cystoscopy if required to detect abnormalities Urine cytology to rule out renal cancer	• Antibiotics • Health education • Advise patient to increase fluid intake unless contraindicated

Renal Calculi			
Description	**Physical Examination and history taking**	**Investigations**	**Interventions**
Stones in the urinary tract	Early stages are asymptomatic Colicky pain, haematuria, nausea and vomiting if stones are in the ureters Dull pain in the suprapubic region after voiding urine	Urine analysis to detect UTI and haematuria • Abdominal Xray (identify urine obstruction) • Intravenous pyelogram (shows	Dietary modification if a result of excessive intake of calcium, protein, oxalates (Chocolate, rhubarb, nuts) or vitamin D • Encourage fluids -2.5-3L per day • Patient education to recognize signs of UTI

		position of stone) • Bloods – Full blood count, urea and electrolyte • Cystoscopy (Endoscopy of the urinary bladder via the urethra)	• Lifestyles changes to include regular exercise to prevent urinary stasis • Advice regarding medication adherence • Patient information to reduce anxiety • Pain management

Acute pyelonephritis			
Description	**Physical Examination and history taking**	**Investigations**	**Interventions**
Infection of the upper urinary tract involving both parenchyma and kidney pelvis. Usually starts as a lower urinary tract infection progressing upwards to the kidneys. Patients who are pregnant, have indwelling catheters, diabetes, genitourinary tract abnormalities or immunosuppression are at increased risk of	Information regarding symptom onset: these develop within hours or over the course of a day. In children's symptoms can be absent. - Flank pain - Nausea or vomiting - Dysuria & Hematuria especially in women - Sudden onset of fever - Suprapubic tenderness	Comprehensive history and physical assessment, including any pre-medical history of UTI and kidney stones Urinalysis to confirm diagnosis. Pyuria most common finding. Urine culture to identify micro-organism to inform antibiotic decision.	Outpatient or inpatient management depending on co-morbidities and risk of deterioration. Inpatient management usually required for elderly, immunocompromised, poorly controlled diabetes, renal transplant. <u>Pharmacological:</u> Empiric antibiotics based on urine culture (oral or IV) depending on setting

complications (NICE, 2019)		Full blood count – raised white blood cells indicate infection. Renal markers (creatinine and urea) to access repercussion in kidney function Imaging: abdominal / pelvic CT with contrast for unwell septic patients. Ultrasound to reveal any renal abnormalities.	Analgesia (oral or IV) Antipyretics IV anti-emetics and fluids if de-hydration due to nausea and vomiting <u>Non-Pharmacological:</u> Encourage increase oral intake Personal hygiene education especially in women Education towards voiding urine before and after sexual intercourse Educate to monitor for signs or urosepsis, signs and symptoms of urinary tract infections (UTI)

Acute Kidney injury (AKI) Replaced outdated terms such as acute renal failure or acute renal insufficiency. Currently KDIGO (2012) provides recommendations and definitions for AKI.			
Description	**Physical Examination and history taking**	**Investigations**	**Interventions**

Abrupt deterioration (within 48 hours) in marked by increased serum creatinine (from baseline) with or without reduction in diuresis (KDIGO, 2012). Causes can be classified in: <u>Prerenal</u>: Due to reduced kidney perfusion often because of hypovolemia, decreased cardiac output (Mercado et al., 2012) <u>Intrarenal:</u> Damage to the kidney parenchyma (where waste excretion takes place) and nephrons usually due to nephrotoxic drugs or nephritis (Mercado et al., 2019)	Assessment of volume status (pulse, blood pressure including any postural changes, capillary refill time, jugular venous pressure, skin turgor) Peripheral oedema, chest auscultation and weight history inform fluid status. Any abrupt changes in weight might suggest hyper or hypovolemia. Skin rashes can indicate systemic ilness Assess urine output and if inpatient review and monitor fluid charts considering the different stages of AKI (**see box 2**) Medication history can inform potential underlying causes (nephrotoxic such as	- Urinalysis (including album: creatinine ratio level) - Full blood count (excluding underlying infection and /or anemia) - Renal profile bloods, including urea, creatinine, eGFR. - Imaging studies might inform if obstruction (post-renal causes) is present. - Postvoid residual urine > 100 mls can suggest postrenal AKI (Mahboob et al., 2012)	Generally, requires inpatient admission unless clear reversible cause identified. <u>Pharmacological</u> (KDIGO, 2012 and Brochard, 2010): - Stop any nephrotoxic drugs (for example metformin should be avoided) and adjustment of medications to renal dosages when applicable. Involve and liaise with [pharmacists and prescribers - Ensure volume status which might require intravenous fluid (e.g normal saline) - Maintain arterial blood pressure > 65 mmHg which might require vasopressors if hypotension present <u>Non-pharmacological</u> (KDIGO, 2012 and NICE, 2021):

Postrenal: Inadequate urine drainage along the ureters, bladder and urethra, commonly secondar to stones or prostate enlargement (Peate, 2021).	NSAIDs, ACE inhibitors or some antibiotics)		- Avoid and monitor closely electrolyte imbalances (hyperkalemia, hyponatremia, hypermagnesemia) - Avoid and monitor hyperglycemia closely - Avoid radiocontrast procedures (such as angiography, CTCA) - Patient education towards adequate hydration, regular follow-up and renal function monitoring, when to seek medical advice and how to avoid UTIs Psychosocial assessment and support. This should encompass psychological and social support (often this is the first time a patient may have come into contact with specialist healthcare professionals who can provide support).

AKI stages	Serum creatinine changes	Urine output changes
1	>1.5 – 1.9 x the baseline	<05 mL/kg/hr for 6 hours

2	>2-2.9 x baseline	<0.5mL/kg/hr for 12 hours
3	>3 x baseline	<0.3mL/kg/hr for 24 hours or anuria (no urine production) for > 12 hours

Box 2: Stages of AKI (KDIGO, 2012)

Chronic Kidney injury (CKD)

Chronic Kidney disease is recognized as a global public health problem, with an estimated global prevalence of 13.4% (KDIGO, 2012), representing a total cost to the NHS of around £1.4 billion according to the quality and outcomes framework guidance for 2021/22.

Description	**Physical Examination and history taking**	**Investigations**	**Interventions**
Persistent abnormality in the kidney structure or function for more than 3 months (KDIGO, 2012). Defined by GFR < 60 mL/min/1.73 m^2, albuminuria of at least 30mg / 24hours. Classified in stages from 1 to 5 depending on GFR and	Determine duration of kidney disease and if GFR < 60 for less than 3 months AKI on CKD is possible and tests should be repeated (KDIGO, 2013). Review and evaluate volume status. Hypovolemia suggests overdiuresis, hypervolemia often	Renal function bloods (serum creatinine and GFR). FBC to identify extent of anemia Urine ACR and analysis for specific gravity. Urine culture (test for UTI)	<u>Pharmacological:</u> - Avoid nephrotoxins (ACEi, ARB, NSAIDs and herbal remedies) - Drug dosing is frequently required on medications such as antibiotics, oral anticoagulants, hypoglycaemic agents, among others (Chan et al., 2019)

albuminuria (**see table 5**)	linked to liver, heart failure or nephrotic syndrome (Chan et al., 2019) Usually identified through routine renal profile bloods, although less commonly patients present with (Chen et al., 2019): - Lethargy, fatigue - Headache - Breathlessness - Peripheral oedema - Proteinuria, hematuria, nocturia - “Foamy urine” (sign of albuminuria) - Oliguria - Anuria - Symptoms of anemia - Poor appetite, nausea, or vomiting, - Weight Loss - Pruritus (itchy skin)	Renal biopsy when advanced cases of CKD Renal ultrasound (to determine obstruction or aetiology).	<u>Non-Pharmacological</u> (Think Kidneys, 2022): Referral to specialist teams for regular follow up (nephrology) Promote healthy lifestyle (low salt diet, low potassium diet, regular exercise, avoidance of nephrotoxic medications such as NSAIDs, low alcohol) Check for signs of infection, pyrexia, tachycardia, inflammation and wound site if having peritoneal dialysis Encouragement and empowerments towards self-care (such as signs and symptoms of worsening renal function, monitor fluid intake and output) Address co-morbidities such as hypertension, anemia, low calcium or phosphate and diabetes.

			Offer Psychosocial interventions

eGFR (ml/min/1.73^2)	Terms	Stages
>90	Normal or high	1
60-89	Mildly decreased	2
45-59	Mildly to moderately decreased	3
15-29	Severely decreased	4
<15	Kidney Failure / End Stage	5

Table 6: Stages of renal failure (KDIGO, 2013)

Table 3: Renal system disorders. Adapted from Peate (2021)

Case study

Presenting Complaint: Nile presented to GP surgery for annual routine renal function review and following assessment, eGFR result is 65 ml/min/1.73^2 m and albumin creatinine ratio of 5 mg/mmol. eGFR result has not changed from his result in the past 2 years.

Social History: Nile is a widowed 70-year-old gentleman, who lives alone in a sheltered accommodation, smoking 20 cigarettes a day. He drinks 2 cans of beer a day to help with daily boredom when his friends are not available to meet. His mobility is mildly reduced, mobilizing with support of a stick and “furniture walking” around the house.

Pre-Medical history:

- Chronic Hypertension, managed with losartan 25 mg once day
- Chronic kidney disease diagnosed a year ago.
- Type 2 diabetes mellitus, controlled by gliclazide 30 mg once daily.
- Recent urinary tract infections (3 in the last 6 months)

Subjective & Objective Assessment:

- Recent onset of nocturia in the past few days. Report urine had a “foul” smell last week.
- Peripheral and bilateral ankle oedema, worse during the day.
- Weight gain of 2 kgs in the past 2 days, above his known “dry” and usual weight.

Care Plan

The nurse involved in Nile’s case recognizes the complexity of his needs, requiring involvement including psychosocial practitioners, dieticians, pharmacists, social workers, nephrologists, and specialist nurses to provide holistic care. Ultimately this will lead to better health-related outcomes, such as lower hospitalization rates, CKD progression and mortality (Collister et al., 2019).

Causes for CKD, in this case, are multi-factorial, including chronic hypertension, type 2 diabetes mellitus and lifestyle behaviours (such as sedentarism from low mobility and alcohol consumption). Hypertension is one of the main risk factors contributing to the development of CKD, whilst type 2 diabetes remains the most common (Peng et al., 2019). Fears related to future consequences and disease trajectory are commonly described by renal patients and patients’ own illness perceptions should be addressed regularly during routine follow-up (Clarke *et al*., 2016).

The following clinical care plan focuses on interventions that preserve renal function, and prevent adverse effects of comorbidities, however at the cost of requiring several behavioural changes in Nile’s daily routine. Effective self-management requires active patient participation, however, the degree of willingness to engage with these strategies can vary (Donald et al., 2018). The emotional burden associated with therapeutic goals and lifestyle changes is known to lead to non-concordance with self-management strategies (Welch et al., 2015).

Self-Management empowerment	**Address mental wellbeing and psychosocial implications** • Assess Nile's perspectives towards his illness, using open-ended questions such as "How do you fell about your symptoms and how well do you feel you understand your condition"? (Clarke et al., 2016) • Assess Nile's willingness to change lifestyle and adhere to self-management intervention, advocating a patient-centred approach (Donald et al., 2018) • Assess Nile's mental health and well-being routinely, using validated assessment tools such as Patient Health Questionnaire-4 (PHQ4) and distress thermometer • Involve any wider family or friends with Nile's consent providing practical and emotional support. Investigate if there is any available support for chronic patients in local areas and clinical commission groups (Havas et al., 2015) • Set realistic and specific goals in Nile's self-management care plan, offering positive reinforcement and help with establishing a routine by using reminders (for example through dosette box, and phone alarms) (Havas et al., 2015) **Promoting healthy behaviours** • Encourage Nile to stop smoking and reduce alcohol intake by choosing initially lower alcohol drinks (beer under 4% ABV) or swapping to no-alcohol alternatives,

	delaying disease trajectory (NHS, 2021). If in agreement, offer Nile referral to local community for further support. • Encourage Nile to set a “booze budget”, allocating specific money to spend on alcohol weekly. Work together with Nile to overcome boredom, looking for other activities such, a new hobby or DIY strategies (NHS, 2021). • Nutritional health: encourage low potassium and sodium-based diet with less than 3g/ day of salt to halter CKD trajectory and prevent hypertension (NIH, 2014). Assess Nile’s ability to cook at home and if help is needed, refer to social services or community support with meals. • Promote engagement with weight monitoring. Weight loss is effective in reduce blood pressure and proteinuria, slowing CKD progression for overweight patients, but in Nile’s case he is not overweight, positively reinforcing this (Pugh et al., 2020). Monitor Nile’s weight at each follow-up, observing whether weight fluctuates due to fluid overload (2-3 kgs increase in 2-3 days) or if it reduces progressively, suggestive of disease progression and malnutrition. Evaluate if other symptoms such as nausea, vomiting or reduced appetite could have led to lower calory consumption and therefore loss of weight. • Suggest that Nile raises his feet when resting to decrease peripheral ankle oedema • Refer to local low-function rehabilitation exercises in the community as available, exercise results in higher functional levels amongst CKD patients (Peng et al., 2019)

	• Refer to physiotherapy or occupational services community services for home assessment and rehabilitation if possible, promoting independence. **Recognition of early warning signs** • Educate Nile towards signs and symptoms suggestive of worsening renal function and when to activate resources in the community, providing safety net. Provide numbers and emails for his specialist renal team and GP surgery.
Manage co-morbidities	**Blood Pressure Management** • Aim for blood pressure < 140/90 mmHg, Losartan, being a angiotensin II receptor antagonist has both cardio and renal protective properties (Pugh et al., 2020) • Alert Nile towards common side effects of medication, and differences between these and what are specific to the disease, such as dizziness, fatigue, postural low blood pressure, risk of falls (Gebreychannes *et al.,* 2019) **Diabetes Management** • Refer Nile to specialist diabetic nurse for tailored HBA1c monitoring and management. HBA1c reflects an average of 90 days blood glucose and in CKD should be done every 3-6 months (Triozzi et al., 2021). • Caloric and exercise strategies can improve glycemic control. Protein intake of 0.8g/kg body weight/day is recommended for non-dialysis dependent patients (Triozzi et al., 2021) • Sodium–glucose cotransporter 2 inhibitors (SGLT2i), such as empagliflozin, should be considered as

	associated with slowing CKD progression and reduction in mortality (Zabetian et al, 2014)
Weight gain and peripheral oedema management	• Refer Nile to continence team due to nocturia • Refer Nile to physio team for high risk of falls secondary to low mobility. • Educate towards avoiding caffeinated hot drinks during the evening reducing fluid intake at this stage. • Encourage Nile to maintain a record of his daily weights until baseline weight is established (known as dry weight), providing nurse with accurate and relevant information on his fluid status, avoiding excessive diuresis and hypovolemia. • Ensure patient is known to nephrology team for specialized follow-up and up-to-date investigations • Pre and post void bladder scan might be necessary to rule out urinary retention • Low dose diuretic (thiazide such as Bendroflumethiazide) might be necessary to prevent further fluid overload. Volume overload is seen in 50% of CKD patients, offering antihypertensive and cardioprotective effects (Zamboli et al., 2011).
Polypharmacy / Medication regimes	• Medication reconciliation (compare the patients medication orders to all medication the patient has been prescribed. Include name, dosage, frequency) must be done on a regular basis by independent prescribers (either GP, specialist nurses or pharmacists) to ensure nephrotoxic agents are avoided and patients are avoiding over the counter therapies (Collister et al., 2019). • Promote concordance to medication prescribed such as Losartan and oral glycemic control medications. Review

	blood pressure and blood sugars / HBA1c and titrate accordingly

Conclusion

Renal biomarkers are essential to guide management plans, prognosis, and disease trajectory. However good history taking and physical assessment remain essential to differentiate between the wide range of renal disorders. Serum creatinine and GFR are often used and requested in bloods across clinical practice, therefore nurses must have an understanding of what these results mean and how to plan care accordingly.

Acute kidney injury and chronic kidney disease are public health problems. Care plans require an integrated and multidisciplinary team approach. Interventions should focus equally on both physical health and mental well-being. The emotional burden associated with demanding lifestyle changes has been well described in qualitative studies focusing on renal patients. Empowerment towards self-management, and addressing co-morbidities, is essential not only to reduce mortality and morbidity but also to achieve better patient-directed outcomes such as quality of life and satisfaction with care. Adequate follow-up requires a patient-centred approach, with careful considerations needed for the development of tailored and achievable care plans. Active participation is required from both patients and professionals, as patient's needs, and perceptions of illness change throughout renal disease trajectory.

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