THE CORRELATION BETWEEN DEPRESSION AND ADEQUACY IN CHRONIC HAEMODIALYSIS PATIENTS IN SOUTH AFRICA

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A dissertation

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Declaration of Independent work

I, Bongani Miya, identity number _____________ and student number __________, do hereby declare that this research project submitted to the Central University of Technology, Free State for the Master of Health in Clinical Technology, is my own independent work, and complies with the Code of Academic Integrity, as well as other relevant policies, procedures, rules and regulations of the Central University of Technology, Free State, and has not been submitted before to any institution by myself of any other person in fulfilment of the requirements for the attainment of any qualification.

Signature of student Date 04 February 2026

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Abstract

Introduction

Chronic Kidney Disease (CKD) is a global public health concern, contributing to a wide range of social, physical, psychological and economic burdens. CKD is one of the most prevalent non-communicable diseases worldwide. Survival rates for CKD patients remain poor, with annual mortality exceeding 10%, and five-to-ten-year survival at approximately 50%.

Methods

This prospective analytic study was conducted across five in-centre haemodialysis centres located in the Free State and Northern Cape provinces of South Africa. The study included 78 adults aged 18 to 65 years, all diagnosed with CKD and undergoing in-centre haemodialysis. Depression levels were assessed using the Beck Depression Inventory (BDI) questionnaire, while clinical pathology markers (urea and creatinine) were evaluated using blood samples. Online dialysis adequacy was determined by recording the calculated Kt/V on the dialysis machines. Data were collected over three months, with Kt/V values measured during each session. Descriptive statistics were analyzed using frequencies, percentages, and averages. Shapiro-Wilk tests were applied to determine p-values, with a significance threshold of 0.05. Spearman Correlation Coefficients were used to assess relationships between variables.

Results

The median BDI total score was 17, with an interquartile range of 13 to 22, and a maximum score of 50. The overall median Kt/V value was 1.04. A significant correlation was observed between BDI total scores and the overall average Kt/V value, with a p-value of 0.0231. However, no significant relationship was identified between BDI total scores and overall creatinine or urea levels.

Conclusion

The findings confirm that achieving minimum Kt/V targets is associated with improved morbidity and mortality outcomes for haemodialysis patients. This study highlights the potential of psychosocial interventions to alleviate depression symptoms. It is strongly recommended to raise awareness of the psychological well-being of CKD patients

Keywords

Kidney disease, end-stage kidney disease, mental health, depression, dialysis adequacy, OCM, haemodialysis, compliance

Chapter 1
Introduction

1.1 Background

The global incidence of chronic kidney disease (CKD) is rising, necessitating the development of healthcare programs to create policies and infrastructure that address the growing number of individuals living with kidney-related conditions (Borg *et al.*, 2023). The World Health Organization (WHO, 2024) projects that by 2040, CKD will rank fifth in prevalence among chronic diseases. According to the Global Burden of Disease Study (GBD, 2015), CKD accounted for 1.2 million deaths in 2017, rising from being the 17th leading cause of death in 1990 to being the 12th leading cause of death in 2017 (Ying *et al.*, 2023). By 2019, CKD was reported to be responsible for 74% of deaths globally (Molaoa *et al.*, 2021). Since then, CKD has emerged as one of the world's most widespread non-communicable chronic diseases (NCDs) (Borg *et al.*, 2023), affecting approximately nine percent of the global population, with its impact steadily increasing. Over the past three decades, the global prevalence of CKD has increased by 29.3%, making it a significant public health concern (Hariparshad *et al.*, 2023). Additionally, survival rates for CKD are poor, with an annual mortality rate exceeding 10% and a five-year survival rate of approximately 50% (Borg *et al.*, 2023). Despite being associated with adverse clinical and economic outcomes, awareness of CKD remains low (Kampmann *et al.*, 2023). In turn, CKD disproportionately affects the poor, vulnerable, and marginalized citizens of the world. Populations with limited resources, poor healthcare access, and low health literacy are at the highest risk of developing CKD and its complications (Meremo *et al.*, 2023; Rayner *et al.*, 2023). Globally, the CKD patient population is estimated to be twice the size of the diabetic population and over twenty times larger than the population affected by HIV/AIDS (Hariparshad *et al.*, 2023).

Chronic kidney disease is defined as kidney structure or function abnormalities persisting for at least three months, with significant health implications (KDIGO, 2024). These abnormalities include abnormal albuminuria levels or an estimated glomerular filtration rate (eGFR) below 60 ml/min/1.73 m^2 (Liu *et al.*, 2024).

In Africa, CKD affects about 10% of the population (Mbeje and Mtshali, 2019), with South Africa reporting a prevalence of 10.7% (Hariparshad *et al.*, 2023). Chronic kidney disease has led to increased rates of illness, death, and years lived with disability, with sub-Saharan Africa particularly impacted (Ebrahim *et al*., 2022). The vast majority of South African individuals with chronic kidney disease undergoing dialysis at public healthcare facilities are said to be in constant fear of dying. This is because these public institutions are forced to make life and death decisions. Their reliance on dialysis and the uncertainty surrounding their survival without renal replacement therapy contribute to their anxiety about many facets of their lives (Mbeje and Mtshali, 2019).

In South Africa alone, CKD-related mortality rates have increased by 67% (Hariparshad *et al*., 2023). As per the annual report of the South African Renal Registry for 2022, the total count of patients undergoing Kidney Replacement Therapy (KRT) as of 31 December 2022 was nine thousand three hundred forty-two (9,342). However, its prevalence is driven by the rise in non-communicable diseases such as obesity, hypertension, and diabetes, as well as communicable diseases like HIV. Limited renal registries and insufficient healthcare resources result in delayed diagnosis and progression to chronic kidney failure (Mbeje, 2022).

Treatment for CKD involves three primary renal replacement therapies:

i. Haemodialysis (HD): Blood is filtered using a machine to remove toxins and excess fluid (Halili *et al*., 2021).

ii. Peritoneal dialysis (PD): Blood is filtered using the lining of the abdomen, known as the peritoneum (NKF, 2024).

iii. Kidney transplant: A donor kidney replaces the failed kidney (Kalantar-Zadeh, 2021).

Haemodialysis frequently leads to physical restrictions, including an inability to carry or lift heavy objects due to fistula or graft access. Patients may experience significant pain from inadequate needle cannulation of the fistula or graft, as well as discomfort from episodes of intradialytic complications. Additionally, long dialysis sessions can result in fatigue, and psychological challenges such as depression and anxiety may also arise (Burdelis and Cruz, 2023; Shirazian *et al*., 2017). Depression affects about 39% of dialysis patients and is an independent risk factor for mortality (Zhu *et al*., 2023). However, evidence on the relationship between depression and clinical outcomes in CKD remain limited (Jemali *et al*., 2023). This study seeks to investigate the correlation between haemodialysis adequacy and depression scores among CKD patients in South Africa.

Fewer patients on dialysis choose PD as their renal replacement therapy (RRT). This is because PD's effective management requires a lot of self-care, and patients on PD are more likely to experience issues like volume overload and peritonitis compared to those on haemodialysis (Yoshida and Tsuruya, 2021). According to Lubitz and Woo, (2024), there exist both absolute and relative contraindications to peritoneal dialysis that result in a reduced number of patients undergoing this treatment. The contraindications are outlined as follows:

<u>Absolute contraindications</u>:

- Loss of peritoneal function or intra-abdominal adhesions that limit the dialysate flow
- Those who have physical or mental disabilities in the absence of assistance
- Patients with irreparable mechanical defects that can prevent PD, such as surgically irreparable hernia, omphalocele, gastroschisis, diaphragmatic hernia, and bladder exstrophy.

<u>Relative contraindications</u>:

- Fresh intra-abdominal foreign bodies (four-month wait after abdominal vascular prostheses, recent ventricular-peritoneal shunt).
- Peritoneal leaks.
- Body size limitations.
- Intolerance to PD volumes necessary to achieve an adequate PD dose.
- Active inflammatory or ischemic bowel disease.
- Abdominal wall or skin infection.
- Morbid obesity (in short individuals).
- Severe malnutrition.
- Frequent episodes of diverticulitis.

On the other hand, kidney transplant patients are expected to take medications and have frequent monitoring to minimize the chance of organ rejection. This must continue for their entire lifetime. The medications can have significant side effects, including an increased risk of severe infections, diabetes, and some cancers (Berns, 2023).

In 2010, 2.6 million people were receiving renal replacement therapies, and this figure is expected to reach 5.4 million by 2030 (Francis *et al*., 2024). Additionally, dialysis, being a time-consuming therapy, has been found to cause psychological distress, including heightened depression and anxiety (Mosleh *et al*., 2020). Depression is one of the most frequently reported psychiatric disorders among CKD patients, affecting around one-quarter of those with the condition. Meta-analyses have shown that depression is an independent risk factor for all-cause mortality in patients undergoing maintenance dialysis (Zhu *et al*., 2023). However, evidence on the relationship between depression and clinical outcomes in earlier stages of CKD remains limited (Jemali *et al*., 2023). Depressive symptoms are estimated to affect 39% of patients on dialysis and 25% of kidney transplant recipients (Cogley *et al*., 2023). The study conducted by Hernandez *et al*. (2024) discovered a significantly adverse effect of depression on adults with CKD. Yang *et al*. (2024) suggest that psychosocial interventions are promising for improving psychological well-being in adults with CKD. Psychosocial interventions may reduce depression and improve the quality of life in these patients. It is, therefore, against this premise that this study explored the correlation between depression and haemodialysis adequacy in chronic kidney patients in South Africa.

1.2 Problem statement

Chronic Kidney Disease is a significant global public health concern, affecting over 850 million people worldwide and resulting in severe social, physical, economic, and psychological consequences (Eckardt *et al*., 2023). Among the factors contributing to increased morbidity and mortality in CKD patients, depression has been identified as critical. Depression is an independent predictor of poor clinical outcomes, associated with lower quality of life, increased hospitalizations and higher mortality rates (Chen *et al*., 2010; Paul *et al*., 2019). In 2021, the estimated national prevalence of depression in South Africa varied between 14.7% and 38.8% (Shezi *et al.*, 2024). This significant prevalence has resulted in depressive disorders being linked to adverse outcomes. The prevalence of depression among dialysis patients is three to four times higher than in the general population and two to three times higher than in patients with other chronic diseases. Despite these alarming statistics, research investigating the correlation between mental health, specifically depression, and dialysis adequacy among CKD patients remains limited, particularly in South Africa. Existing data on this topic primarily focuses on sub-Saharan Africa as a whole (Alshelleh *et al.*, 2023). Additionally, socioeconomic challenges exacerbate mental health issues in CKD patients. Many people undergoing dialysis are unemployed, making it difficult to adhere to recommended lifestyles, such as maintaining proper diet, medication, and dialysis schedules, all of which exacerbate mental health outcomes (Quinones and Hammad, 2020). Dialysis adequacy is one of the important issues in patients undergoing haemodialysis and has been considered to affect survival in maintenance HD patients (Aghsaeifard, 2022). On the other hand, it is suggested that the presence of psychiatric disorders increases the morbidity and mortality in maintenance HD patients. The quality of life with end-stage kidney disease on maintenance haemodialysis depends upon consistent and efficient removal of uremic toxins (Pahari and Kumar, 2023). While maintenance haemodialysis serves as the main therapy for patients with end-stage kidney disease, it is also associated with a high prevalence of psychological problems such as depression and anxiety (Mosleh *et al.*, 2020). This study addresses the existing gap in knowledge by exploring the correlation between depression and dialysis adequacy in South African CKD patients.

1.2.1. Research question

The research question in this study is: What is the relationship between haemodialysis adequacy and depression?

1.2.2 Aim of the study

The aim of this study was to investigate the correlation between depression and chronic haemodialysis adequacy in chronic kidney disease patients from selected centres in Free State and Northern Cape provinces.

1.2.3 Objectives of the study

The study has the following objectives:

i) To determine the association between haemodialysis adequacy and depressive symptoms using daily and average monthly Kt/V values.

ii) To determine depression levels in participants undergoing chronic haemodialysis using the Beck Depression Inventory (BDI)

iii) To report the prevalence of depression among chronic haemodialysis patients

iv) To correlate dialysis adequacy results with BDI scores

1.3 Chapter outline

- Chapter 1: Introduction

This chapter introduces the study, including its background, objectives, and problem statement.

- Chapter 2: Literature review

The second chapter provides a comprehensive review of existing literature on CKD, depression, and dialysis adequacy.

- Chapter 3: Research methodology

This chapter details the research design, study population, participation selection, instruments used for data collection, measures implemented to ensure the study’s validity and credibility, as well as the ethical considerations addressed.

- Chapter 4: Results and discussion

This chapter presents and analyses the findings of the study.

- Chapter 5: Conclusion and recommendations

The last chapter summarizes the study's findings and provides recommendations for future research and practice.

Chapter 2
Literature review

2.1 Introduction

Chronic kidney disease is a widespread non-communicable condition that increasingly represents a significant global health issue (Kose and Mohamed, 2024). There is limited evidence indicating that CKD could be linked to social and psychological difficulties, including depression, anxiety, and reduced quality of life. The dual burden of communicable and non-communicable diseases, along with limited access to nephrology services, makes CKD a common occurrence in low- to middle-income countries; in Africa, genetic predispositions further intensify this trend (Hariparshad *et al*., 2023). In South Africa, individuals may face an increased risk of CKD due to a combination of genetic and environmental factors, including hypertension, diabetes, HIV infection and unhealthy lifestyle practices (Fabian *et al*., 2022).

2.2 Kidney disease

The kidneys play a crucial role in filtering waste products and excess fluids from the blood, maintaining a balance of electrolytes, and regulating blood pressure (NKF, 2024). When the kidneys fail to function properly, the body becomes overwhelmed with toxins, developing kidney diseases, which are life-threatening situations that, if not treated promptly, could lead to death (Kalantar-Zadeh *et al*., 2021). There are five types of kidney diseases. Firstly, acute prerenal kidney disease is characterized by insufficient blood flow to the kidneys. Without enough blood flow, the kidneys cannot filter toxins from the blood. This type of kidney failure can usually be cured once the cause of the decreased blood flow is addressed (Turgut *et al*., 2023). Secondly, acute intrinsic kidney disease can result from direct trauma to the kidneys, such as physical injury or an accident. Other causes include toxin overload and ischemia, a lack of oxygen to the kidneys, which may be caused by severe bleeding, shock, obstruction of the renal blood vessels, glomerulonephritis, and an inflammation of the kidney's small blood vessels (Hugh *et al*., 2020). Thirdly, chronic prerenal kidney disease occurs when there is not enough blood flowing to the kidneys for an extended period; the kidneys begin to shrink and lose the ability to function (Manzoor and Bhatt, 2023). The forth type, chronic intrinsic kidney disease, occurs when there is long-term damage to the kidneys due to intrinsic kidney disease. Intrinsic kidney disease develops from direct trauma to the kidneys, such as severe bleeding or a lack of oxygen (Vaidya *et al*., 2024). Lastly, the fifth type is known as chronic post-renal kidney disease, a long-term blockage of the urinary tract that prevents urination. This causes pressure and eventual kidney damage. As the disease progresses to requiring dialysis, patients start experiencing multiple losses, including their kidney function (Hugh *et al*., 2020).

2.2.1 Chronic kidney disease

Chronic kidney disease is a clinical syndrome resulting from the permanent changes in the function and structure of the kidneys (KDIGO, 2024). It is characterized by irreversibility and slow and progressive development. This condition carries a higher risk of complications and mortality, especially related to cardiovascular disease (Kalantar-Zadeh *et al.*, 2021). Chronic kidney disease is classified into five stages based on the level of glomerular filtration rate (GFR). A GFR below 15 ml/min/1.72m^2 often necessitates dialysis or kidney transplantation to sustain life (Hariparshad *et al*., 2023). Table 2.1 presents the classification of CKD stages.

Table 2.1 The classification of kidney failure into the five stages (Kalantar-Zadeh, 2021)

Stages	Classification	GFR (ml/min/1.73 m^2)
1	Kidney damage with a normal or increased GFR	>90
2	Kidney damage with a mild decrease in GFR	60-89
3	Kidney damage with a moderate decrease in GFR	30-59
4	Kidney damage with a severe decrease in GFR	15-29
5	End stage kidney disease	<15

Symptoms and progression

Symptoms associated with CKD include nausea, vomiting, loss of appetite, fatigue, weakness, sleep disturbance and oliguria (NKF, 2023). These symptoms result from progressive uraemia, anaemia, volume overload, electrolyte disturbances, mineral and bone disorders; if left untreated, CKD can ultimately lead to death

(Kalantar-Zadeh *et al*., 2021). The trajectory of kidney function loss differs by disease etiology, exposure to risk factors such as hypertension, diabetes mellitus, and nephrotoxic agents, and the implementation of interventions such as pharmacological therapy and lifestyle modification; however, progression to kidney failure generally unfolds over months to decades (Hugh *et al*., 2021). Social adjustment and psychological adaptation remain major challenges among patients with CKD receiving haemodialysis treatment (Adejumo *et al.*, 2023).

Complications of CKD include salt and fluid imbalance, hypertension, hyperphosphatemia, anaemia and cardiovascular disease (NKF, 2023). Progressive CKD is linked to several complications with higher prevalence and intensity at lower levels of kidney function (Alkhaqani, 2022). According to Khan (2022), anaemia is a common complication in CKD and a predictor of mortality, cardiovascular disease-related hospitalizations, and end-stage kidney disease (ESKD). Badura *et al*., (2024) further elaborate that the primary cause of anaemia in CKD is the inadequate production of erythropoietin by the kidneys to support erythropoiesis, which results in decreased red blood cell production.

Cardiovascular disease is another prevalent complication, with the risk of mortality increasing two to three times in CKD stages 3 and 4, respectively. The relationship between CKD and cardiovascular disease is complex and bidirectional, as shared risk factors such as hypertension and diabetes contribute to the development of both conditions. In addition, CKD promotes cardiovascular pathology through mechanisms including fluid overload, uraemia, chronic inflammation, and vascular calcification, while cardiovascular disease can accelerate kidney damage by reducing renal perfusion and worsening haemodynamic stress, thereby increasing the incidence and progression of both conditions (Warrens *et al*., 2022).

Epidemiology

Chronic Kidney Disease is a global public health concern, leading to adverse outcomes such as ESKD, cardiovascular disease, and even premature death (Peer *et al*., 2020). The incidence, prevalence, mortality and disability-adjusted life years (DALYs) of CKD have increased significantly over the past 30 years, largely due to population growth and aging (Guo *et al*., 2025). As many as nine out of ten individuals with CKD in resource-poor settings with weak primary care infrastructure are unaware that they have this condition and therefore do not seek treatment (Francis *et al*., 2024).

Its prevalence has significantly increased over the last two to three decades. According to a study carried out in the United States by Kovesdy (2022), CKD is more common in females than in males. The age-adjusted prevalence of CKD stages 1 to 4 from 2015 to 2016 was determined to be 14.9% for females, while it was 12.3% for males.

The underlying reasons for this disparity may be partly explained by biological differences, such as hormonal influences and lower muscle mass affecting kidney function estimates, as well as differences in health-seeking behavior and survival, with females more likely to live longer and thus reach stages where CKD is detected (Hodlmoser *et al*., 2020). Additionally, the increased prevalence of CKD in women stands in contrast to experimental findings that suggest oestrogen may have protective effects, while testosterone could potentially have a harmful impact on non-diabetic CKD. There are notable regional disparities in the prevalence of CKD, with a substantial majority of individuals affected residing in low- and middle-income countries, which represent around 78% of all cases. The prevalence is particularly elevated in Southeast Asia, Central and South America, as well as the Middle East and North Africa, whereas it is comparatively lower in high-income regions of Asia and Europe. In areas with high social development indices (SDI), factors such as elevated body mass index (BMI), dietary risks, and insufficient physical activity play a more significant role. Conversely, in regions with low SDI, environmental hazards like air pollution and water contamination are more pronounced (Guo *et al*., 2025).

In 2017, there were 697.5 million recorded cases of CKD worldwide. Africa has a CKD prevalence of about 10%, with South Africa having a prevalence of 14.3% (Mbeje and Mtshali, 2019; Rayner *et al*., 2023). According to Brennan (2024), the significant prevalence in South Africa can be mainly linked to the increasing rates of non-communicable diseases like diabetes and hypertension, which are further complicated by the substantial burden of HIV and tuberculosis. In 2022, adult obesity prevalence in sub-Saharan Africa was estimated at 12.1%, with higher rates observed among women (17%) than men (7%); South Africa reported a particularly high prevalence of 30.8% (WHO, 2024). Obesity not only worsens critical risk factors for chronic kidney disease, including hypertension and diabetes, but also serves as an independent risk factor for both the onset and advancement of CKD. As many as one in three people with diabetes and one in five with hypertension in high- income countries have CKD, which has led to the suggestion that focusing on the control of diabetes and cardiovascular disease will alleviate the growing burden of CKD (Francis *et al*., 2024).

Hirst *et al*., (2021) indicated that individuals with CKD who also have multimorbidity face a heightened risk of requiring dialysis, experience higher mortality rates, and incur greater healthcare expenses compared to those without comorbid conditions. Additionally, a larger proportion of CKD patients are living with three or more comorbidities than those who do not have CKD (Guo *et al*., 2025). According to Ko et al., (2024), hypertension, diabetes, older age, and the presence of multiple comorbid conditions were significant risk factors for the development of CKD. Other contributing risk factors for CKD include diabetes, kidney obstructions, excessive use of pain medications, allergic reactions to antibiotics, inflammation, a family history of kidney disease, premature birth, age, and trauma or accidents (Francis *et al*., 2024).

A recent survey of 36 sub-Saharan African nephrologists found that dialysis prevalence rates ranged from 0 per million (in two countries) to fewer than 10 per million (in 14 countries). In North Africa, prevalence rates ranged from 300 per million (in three countries) to 734 per million (in four countries), with Taiwan reporting over 3000 per million (Ashu *et al*., 2022). Statistics from the Global Burden of Disease 2021 indicate that chronic kidney disease accounted for 1.5 million deaths in 2021. This condition has seen a significant increase in its ranking among the leading causes of age-standardized mortality, moving from 18th place in 1990 to 11th place in 2021 (Guo *et al*., 2025).

Figure 2.1 below, derived from the 2021 annual report of the South African Renal Registry illustrates the number of patients and prevalence of CKD rates categorized by province and healthcare sector. The denominators used for calculating prevalence are sourced from the mid-term estimates provided by Stats SA and the annual report of the Council for Medical Schemes. Medical aid beneficiaries who were not classified by province were distributed among the provinces in proportion to the number of beneficiaries in each area. According to Figure 2.1, CKD prevalence was greatest in the Eastern Cape, followed by KwaZulu-Natal in the private sector, with the Western Cape showing the highest numbers in the public sector (Davids *et al*., 2023). The study by Davids *et al*., (2023) further highlights important differences in health system capacity and access between the private and public sectors across South Africa. As illustrated in Figure 2.1, the Western Cape recorded the highest proportion of CKD patients in the public sector, a finding that was likely attributable to the province's comparatively well-developed healthcare infrastructure. The province had a higher concentration of nephrology specialists, dialysis units, and tertiary referral hospitals, thereby facilitating early detection of CKD, ongoing disease monitoring, and timely referral to specialized renal services (Davids *et al*., 2023).

Similarly, the Free State province demonstrated relatively higher public-sector CKD figures, which may have reflected better availability of renal services and more effective integration of CKD care within the public healthcare system. In contrast, provinces such as the Eastern Cape display lower public-sector CKD numbers, which are unlikely to represent a lower true disease burden. Rather, these figures may reflect limited access to renal services, shortages of specialized healthcare professionals, and constrained diagnostic capacity, resulting in under-diagnosis and delayed referral of patients with CKD (Davids *et al*., 2024; Mtingi-Nkonzombi *et al*., 2023).

Consequently, lower public-sector prevalence in some provinces should be interpreted with caution, as it more likely indicates systemic barriers to care rather than genuine epidemiological differences. Provinces with better-resourced health systems are more capable of identifying, managing, and retaining patients within renal care programmes, thereby reporting higher CKD prevalence within the public sector (Hariparshad *et al*., 2023). Socioeconomic disparities further compound provincial differences. Provinces with higher levels of poverty, unemployment, and lower educational attainment are associated with increased exposure to CKD risk factors, including poorly controlled hypertension, diabetes mellitus, and HIV infection. These risk factors are disproportionately prevalent in rural and historically disadvantaged regions, yet screening and preventive services remain limited. As a result, CKD is often diagnosed at advanced stages, particularly in provinces with weaker primary healthcare systems.

Rural populations are disproportionately affected by limited access to healthcare facilities, longer travel distances to specialized renal services, and persistent shortages of trained healthcare professionals. Evidence from South Africa and the broader sub-Saharan African context suggests that CKD prevalence in rural areas may be comparable to, or in some cases higher than, that reported in urban settings; however, levels of disease awareness, screening, and timely diagnosis are markedly lower in rural communities (Kaze *et al*., 2018). In contrast, urban provinces and metropolitan regions benefit from stronger health system infrastructure, including improved diagnostic capacity, more frequent laboratory investigations, and well-established referral pathways. These systemic advantages contribute to higher reported CKD prevalence and greater access to treatment services in urban areas, reflecting improved detection rather than a true excess disease burden (Davids *et al*., 2023; George *et al*., 2019).

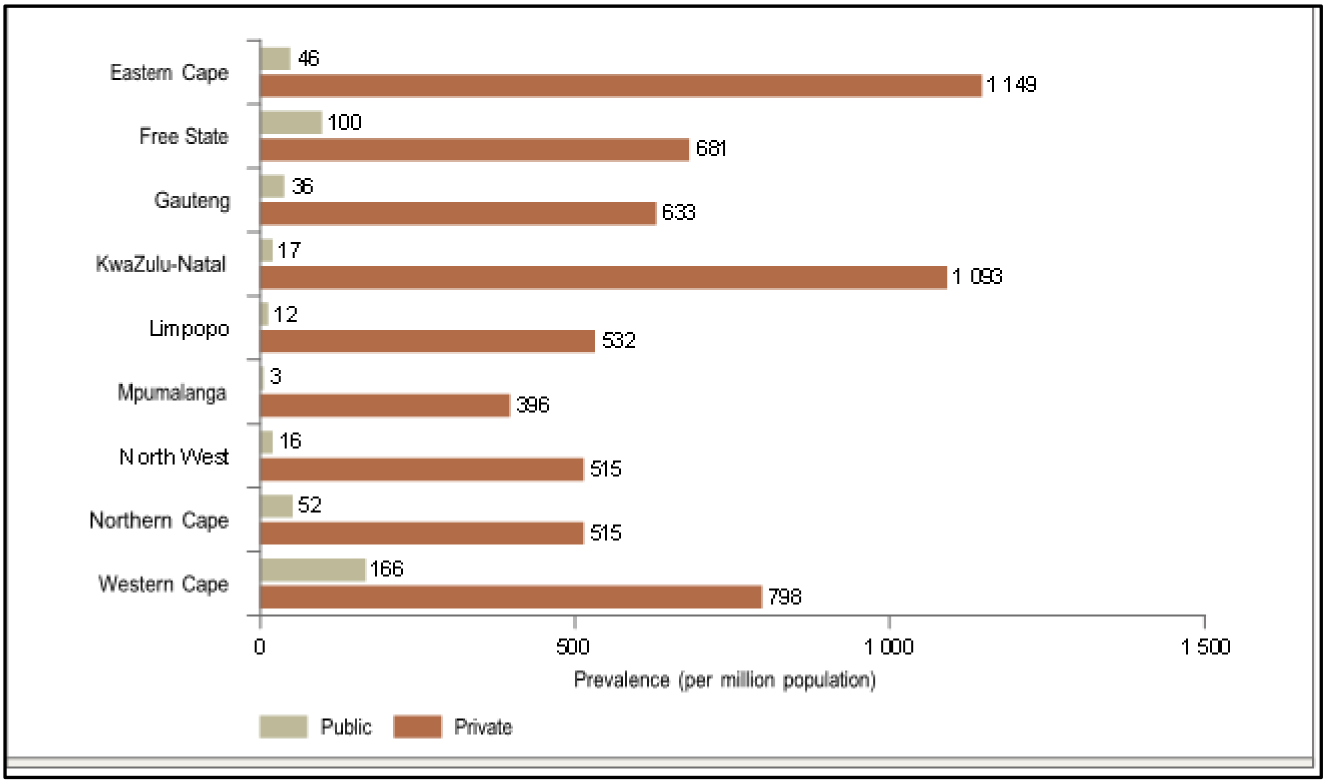

Figure 2.1 Prevalence of kidney replacement therapy for CKD by province and sector (Davids et al., 2023)

Figure 2.2 illustrate that the number of South African medical scheme members registered with CKD increased more than fourfold between 2008 and 2022, rising from 1747 members in 2008 to 8 113 members in 2022. According to the medical aid scheme (2023), this reflects a 4.6-fold increase in incidence (absolute number of members with CKD) over the 15 years under consideration, and a 3.25-fold increase in prevalence (the proportion of all members who have CKD at a specific point in time), from 77 per 100 000 person years to 251 per 100 000 person years.

The decision to use single medical aid insurance as the reference source was informed by the need to demonstrate longitudinal trends in CKD diagnoses over time. Analysis of data from this medical aid revealed a consistent and significant year-on-year increase in the number of beneficiaries diagnosed with CKD, highlighting the growing burden of the disease. The medical aid insurance was selected specifically because it routinely publishes comprehensive and longitudinal epidemiological statistics on publicly accessible platforms. This level of transparency allows for reliable trend analysis and reproducibility of findings, in contrast to other medical aid schemes, which rarely make such data publicly available. Consequently, the use of one medical aid scheme was a pragmatic and methodologically justified approach, enabling robust analysis while acknowledging limitations related to generalizability.

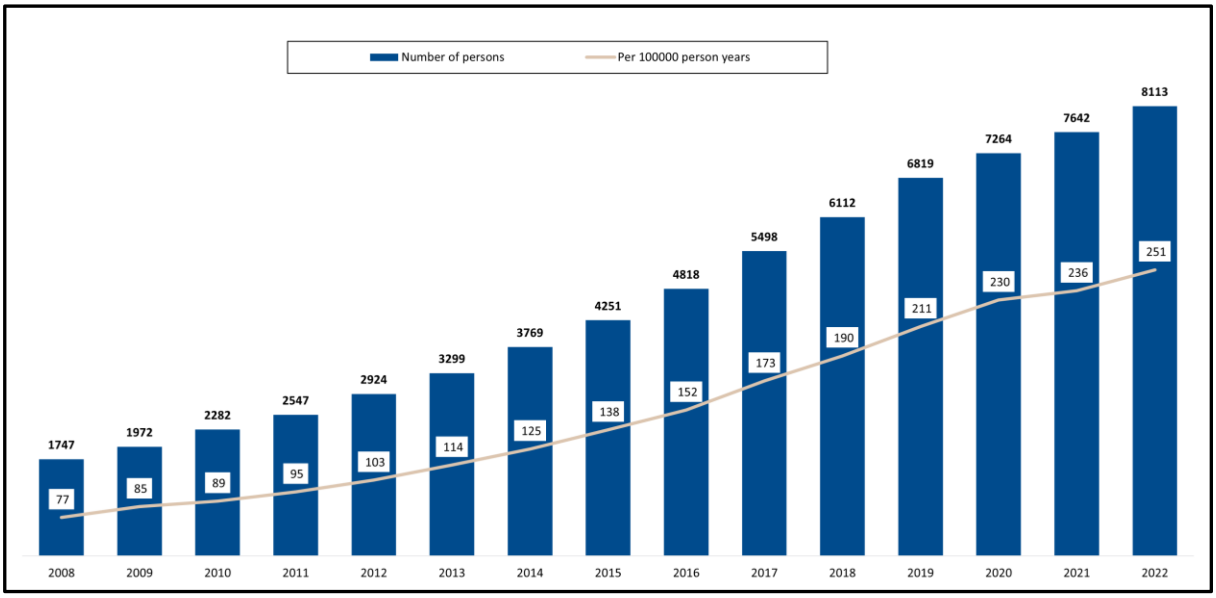

Figure 2.2 Number of Discovery Health Medical Scheme members registered for CKD (Discovery, 2023)

2.2.2 Treatment options

There are two alternative treatment options for chronic kidney disease. While this study concentrates exclusively on haemodialysis, the other two modalities are kidney transplantation and peritoneal dialysis (Halili *et al*., 2021). This focus is attributed to the concerns associated with these two treatment methods. While kidney transplantation is widely regarded as the optimal treatment choice for CKD owing to its superior survival advantages over extended dialysis therapy, the issue of kidney transplant rejection persists as a critical factor impacting the long-term survival of grafts (Alasfar *et al*., 2023). Acquiring a kidney transplant is a challenging process, as it necessitates waiting for a compatible donated kidney. The waiting list for patients in need of a kidney is extensive, with children and young individuals typically receiving priority when a suitable kidney becomes available. An optimal solution is to find a family member who is willing to donate a kidney. However, it is important to note that the transplantation procedure involves surgery, which carries the risk of various complications. According to Berns (2023), following kidney transplant surgery, the patient will need to take medication and undergo regular check-ups to reduce the likelihood of organ rejection; this regimen must persist throughout their entire life. The medications may come with considerable side effects, such as an increased risk of serious infections, diabetes, and certain types of cancer (Agrawal *et al*., 2022).

Although kidney transplantation services are available currently in both private and public facilities, the availability of graft donors as well as financial constraints greatly limit the number of patients able to access this service (Lida *et al*., 2020).

Peritoneal dialysis is a renal replacement therapy with benefits including being a home modality, leading to a better quality of life and autonomy, continuous therapy, decreased vascular complications, as well as fewer interruptions in therapy (Sokwala *et al*., 2022). Compared to HD, PD has more flexibility, fewer restrictions, lower risk of infection, better preservation of residual kidney function and is associated with lower healthcare costs than HD. However, more than 35% of patients drop out of PD and transfer to HD (Sun *et al*., 2024). The primary complications associated with PD infection consist of peritonitis, catheter exit site infection, and subcutaneous tunnel infection. Among these, peritonitis stands out as the most frequently encountered complication in individuals receiving PD (Sokwala *et al*., 2022).

Additionally, diabetes serves as an independent risk factor for mortality in patients suffering from peritonitis (Hu *et al*., 2024). Furthermore, the disadvantages of peritoneal dialysis include an increased risk of hernia from the pressure of the fluid inside the abdominal cavity (Berns, 2023). Additionally, issues related to space, pet management, mechanical failures, and power outages are also reported to be barriers associated with peritoneal dialysis treatment (Sokwala *et al*., 2022). Patients who have larger prescribed fluid volumes tend to perceive the "space occupied by PD supplies" as a significant disadvantage (Eroglu *et al*., 2022). Peritoneal dialysis supplies must remain sealed and stored in a temperature-controlled environment, away from direct sunlight. Additionally, patients must ensure that pets do not access the storage area. The automated peritoneal dialysis (APD) machine is susceptible to breakdowns, which can disrupt treatment. In South Africa, recurrent electricity supply disruptions pose a significant challenge to the delivery of dialysis. Unexpected power outages during treatment may result in incomplete dialysis sessions, reduced treatment adequacy, and heightened risks to patients' safety, underscoring the vulnerability of dialysis services to a broader infrastructural instability (Makoni, 2023).

2.2.3 Financial implications of CKD

Over 80% of the South African population depends on state healthcare services, as only a minority possess medical insurance (Makhele *et al*., 2019). A study conducted in South Africa by Mtingi-Nkonzombi *et al*., (2023) revealed that merely 14.8% of the nation's population possesses health insurance that grants access to the private sector, where the provision of kidney replacement therapy (KRT) is legally mandated. Consequently, the majority (85.2%) of South Africans depend on the public healthcare system, which offers limited access to rationed KRT for individuals with ESKD. Furthermore, the study indicates that in South Africa, the selection process for KRT is determined by the suitability for kidney transplantation, with guidelines designed to ensure equitable access to the procedure. However, various regions have implemented local adaptations of this rationing policy, reflecting the constraints of local resources and the uneven access to healthcare. In 2020, the SA Renal Registry (SARR) reported that the prevalence rate for KRT provision was 729 per million population (pmp) in the private sector, in contrast to 44 pmp in the public sector, which is a decline from the 70 pmp recorded in 1994.

Chronic kidney disease imposes significant financial burdens on the healthcare system worldwide (Nam-Ng *et al*., 2023). In developed countries, up to 6% of the annual healthcare budget is allocated to dialysis patients with ESKD (Makhele et al., 2019). In South Africa, limited kidney transplant rates compel many patients to rely on prolonged dialysis, often financed out-of-pocket (Matlala *et al*., 2019). Several barriers contribute to the low treatment rates for CKD in Sub-Saharan Africa, including inadequate dialysis infrastructure, a lack of reimbursement or government subsidies for dialysis programs, and a severe shortage of trained nephrology personnel (Ashu *et al*., 2022).

Despite the pressing need, only 4.5% of the world's dialysis population resides in Africa, a figure far below the estimated population requiring dialysis in developing countries (Makhele *et al*., 2019). Public healthcare systems in these regions face resource constraints such as drug shortages, limited facilities, insufficient human resources, and equipment deficits, all exacerbated by high patient loads (Japiong *et al*., 2023). In South Africa's private medical sector, patients are more likely to be managed with automated HD, while those in the public sector typically receive PD due to the limited treatment centres (Matlala and Meyer, 2019).

Access to KRT is disproportionately low in low- and middle-income countries, with only 32% of patients in low-income and 45% in lower-middle-income countries receiving treatment. In Africa, fewer than 16% of those requiring KRT receive it due to high costs and limited access (Thsehla *et al*., 2025). For context, CKD treatment in the United

States accounts for 2–3% of annual healthcare spending, averaging $14,399 per month, even though this population represents less than 0.03% of the total population (Yeo *et al*., 2023). A study by Thsehla *et al*., (2025) found that PD was more cost-effective than HD in South Africa, with a willingness-to-pay threshold of R38 500. Their budget impact analysis demonstrates that increasing the use of PD could save the government billions of Rands over five years. Assuming patients remain on their initial dialysis modality, the analysis indicated an incremental cost-effectiveness ratio of R5 096 154 per quality-adjusted life year over the same period.

Regional variations

African nations face unique ethical and financial difficulties in managing patients with or at risk of ESKD (Ashu *et al*., 2022). In sub-Saharan Africa, inadequate dialysis infrastructure, lack of subsidies, and a shortage of nephrology personnel hinder treatment access (Ashu *et al*., 2022). According to Crosby *et al*., (2020), the heavy financial burden of dialysis, encompassing both medical and non-medical costs-leads 59% of patients in sub-Saharan Africa to discontinue dialysis even when it is medically indicated. To manage costs and increase capacity, countries like Kenya and Malawi have reduced dialysis frequency, limiting access for many patients. In these regions, patients, rather than the state, are responsible for paying their transportation and medication costs. Jardine and Davids (2020) highlight that access to well-resourced private healthcare is contingent upon the ability to afford services, typically through medical insurance.

In South Africa, CKD treatment is included under “prescribed minimum benefits” that all registered medical insurance schemes must provide (Davids *et al*., 2022). However, public healthcare systems remain underfunded and under-resourced, with dialysis services available primarily on a sliding scale based on income. Indigent patients may access public healthcare dialysis centres for free (Wearne *et al*., 2019). While acute kidney injury treatment is fully covered by the state, the same does not apply to CKD. In Nigeria, there is no state coverage for dialysis, leaving only a wealthy minority able to afford haemodialysis in urban centres, where it remains prohibitively expensive (Okoye and Mamven, 2022).

Cost analysis

The financial cost of haemodialysis varies significantly across regions and presents substantial challenges for healthcare systems and patients. A 2019 study reported that the annual haemodialysis costs in South Africa ranged from R180 213 00 to R215 374 00 per patient, excluding prescribed medication and hospitalization costs (Malatji *et al*., 2019). The Discovery Medical Scheme (2019) places annual dialysis costs even higher, at R250 000 00 per patient. With limited subsidized healthcare, many patients finance dialysis out-of-pocket, rendering it unaffordable for a large portion of the population (Robertson *et al*., 2023).

Patients in rural areas requiring a kidney transplant face additional transportation and accommodation costs when travelling to centralized transplantation centres, which are often borne by the patients themselves (Malatji *et al*., 2019). Similarly, in sub-Saharan Africa, high dialysis costs strain national budgets. For instance, the estimated cost of providing haemodialysis is $1-7 billion in Kenya, $3-5 billion in Nigeria, and $450 million in Senegal, representing 15–55% of total domestic governmental health expenditure (Crosby *et al*., 2020). In Ghana, Tannor *et al*., (2023) report that the average annual cost of HD for patients requiring three sessions per week is US$8 408 4, while two sessions per week cost US$5 605 6. In Nigeria, where the minimum wage is N30 000 (US$72), the average cost of a single HD session is N40 000 (US$96), with costs rising even higher in private facilities. Additionally, A tunnel catheter costs N80 000 (US$192), a temporary central catheter N25 000 (US$60), a femoral catheter N10 000 (US$24), and AVF surgery costs N150 000–N300 000 (US$316–US$722) (Okoye and Mamven, 2022).

These financial challenges exacerbate the hardships faced by CKD patients, many of whom also experience reduced productivity and income loss. Such burdens increase the risk of depression among CKD patients, further complicating their treatment and quality of life (Jemali *et al*., 2023). Ultimately, the financial hardships not only impair quality of life but also increase mortality risk among this vulnerable population (Moalosi *et al*., 2023).

Table 2.2 below presents a detailed cost breakdown of variable costs, including one-off costs for fistula access for HD. Other variable costs that contributed to total costs included ultrasound for PD but not for HD (PD: US$68 84).

Table 2.2 Variable costs of haemodialysis per year per patient (Makhele et al., 2019)

Variable	Estimated price in dollar (US$)	Cost for access (US$)	Total cost (US$)
Monthly lab tests (U and E, Hb, Ca, Alb, Phosphate	2 470 52	284 49	2755 01
Concentrate acid	914 19	0 0	914 9
Concentrate bicarbonate	914 19	0 0	914 9
Disinfectant acid	568 23	0 0	568 23
Disinfectant bleach	568.23	0.0	568 23
Circuit bloodlines	517 68	0 0	517 68
Dialyzer	300	0 0	300
Anticoagulation Heparin - 5000 units	115 43	0 0	115 43
CVC double lumen	317 90	0 0	317 90
Wound dressing pack	89 77	0 0	89 77
Cannulating needles	60 14	0 42	60 52
Connecting syringes	40 75	0 0	40 75
PPE cloves	104 86	0 78	105 64
Cleaning alcohol swabs	10 24	0 0	10 24
PD ultrasound	0 0	68 84	68 84
PPE mask	11 79	0 0	11 79
Laundromat	200 per 7 Kg	0 0	200
Infusion set	5 80	0 0	5 80

2.3 Dialysis adequacy

Dialysis adequacy refers to the maintenance of a patient's overall health, mental state, and biochemical balance, which collectively enhance the quality of life and reduce morbidity and mortality rates among those undergoing dialysis (Karaaslan and Pembegul, 2023). It is a critical factor in the management of CKD patients, as it has been linked to both mortality and morbidity. The measurement of dialysis dose is essential for the management of CKD patients on maintenance haemodialysis. As described earlier, haemodialysis is a treatment modality that utilizes a machine (Figure 3) to cleanse the blood through an artificial kidney, removing toxins and excess fluid (NKF, 2021).

During haemodialysis, blood is processed through a device known as a dialyzer, often referred to as an 'artificial kidney.' At the commencement of a haemodialysis session, a dialysis nurse or technologist inserts two needles into the patient's arm. Before needle insertion, aseptic cleaning is performed to ensure hygiene. Each needle is connected to a blood line that links to the dialysis machine. This machine circulates blood through the dialyzer and subsequently returns it to the patient. Throughout the procedure, the dialysis machine monitors blood pressure and regulates the rate at which blood flows through the dialyzer. Blood enters the dialyzer at one end and is directed into numerous thin, hollow fibres. As the blood traverses these fibres, dialysis solution flows in the opposite direction along the exterior of the fibres, allowing waste products to transfer from the blood into the dialysis solution. The purified blood remains within the hollow fibres and is then returned to the patient's body (KDIGO, 2024).

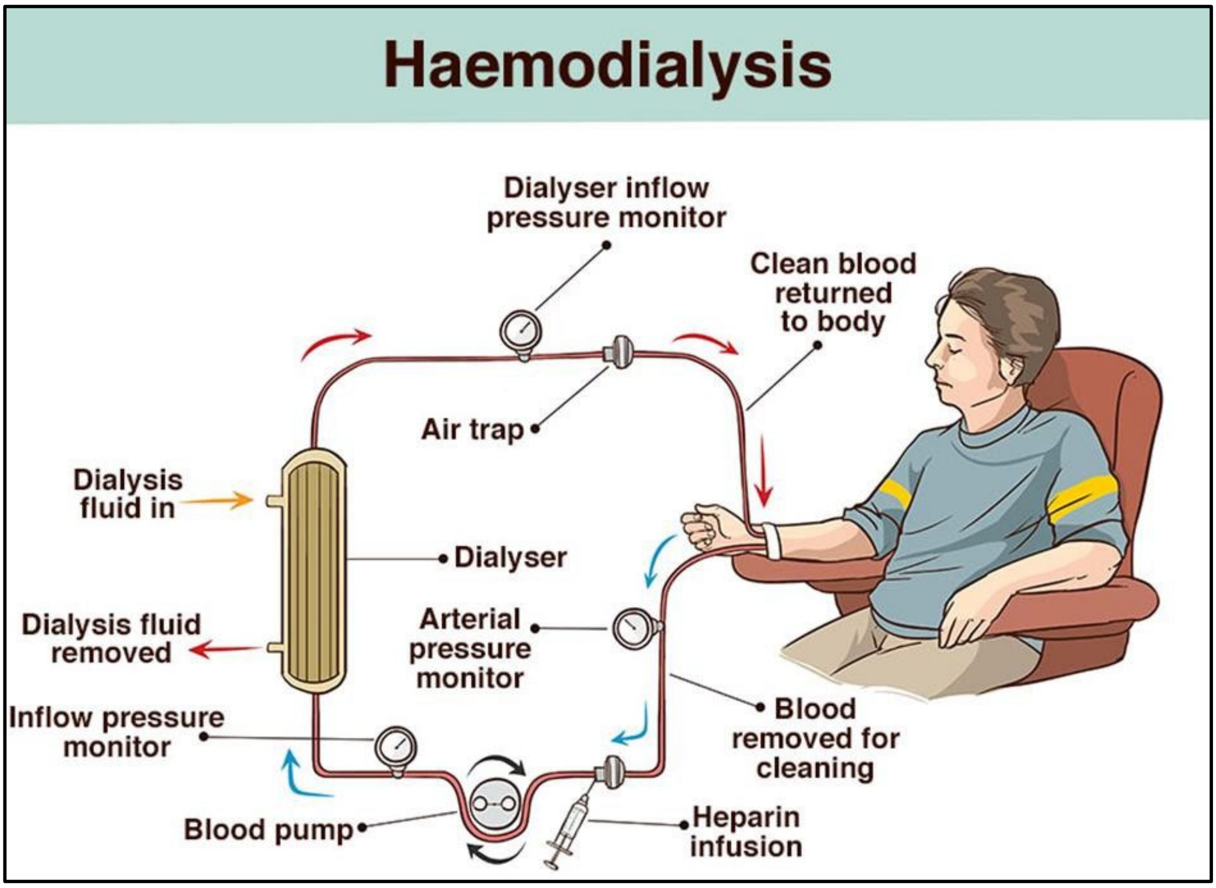

Figure 2.3 Haemodialysis treatment (Healthdirect, 2023)

Dialysis adequacy is indicated by a clear filter, longer dialysis duration and the volume of urea removed. In patients undergoing haemodialysis, a Kt/V less than 1.4 is associated with higher mortality rates (NKF, 2023). A study by Aghsaeifard *et al*. (2022) found that 41.4% of patients were hospitalized for cardiac and renal issues, including dialysis failure. However, no significant correlation was found between dialysis adequacy and the number of hospitalization (p= 0.295). Similar results were obtained when evaluating the relationship between dialysis adequacy and vascular access. Nevertheless, a significant correlation was observed between dialysis adequacy and mortality (p= 0.001).

The adequacy of dialysis is determined by its ability to efficiently remove toxins and waste from the blood, directly impacting the patient's well-being (Japiong *et al*., 203). The NKF-KDOQI guidelines (2023) commonly use the Kt/V and urea reduction rate as indicators of dialysis adequacy. The variables in the formula are as follows:

- **K**: Urea clearance of the dialyzer, measured in millilitres per minute, which depends on dialyzer size, blood flow rate, and dialysate flow (Churchill and Patri, 2021).
- **Td**: The time (in minutes) of the dialysis session, typically ranging from three to four hours (180–240 minutes) (Churchill and Patri, 2021).
- **V**: The patient's urea distribution volume, measured in litres, which corresponds to approximately 50% of body weight, though it can be more accurately estimated using formulas that include parameters such as gender, age, height, and weight (Churchill and Patri, 2021).

The single pool (spKt/V) is calculated by multiplying the urea clearance by the duration and adjusting for the volume of urea distribution. Research suggests that achieving a Kt/V of 1.4 and a URR greater than 65% can improve the outcomes for dialysis patients (Halili *et al*., 2021). On the other hand, a Kt/V less than 1.4 is associated with higher mortality rates (NKF, 2023). Current recommendations for dialysis adequacy target spKt/V of 1.4 per session, with a minimum delivered spKt/V of 1.2 for patients undergoing dialysis three times a week. The spKt/V is inversely related to body size, meaning larger patients tend to have lower spKt/V values due to the normalization for urea distribution volume. Therefore, patients with higher body mass index are more likely to have lower spKt/V values (Halili *et al*., 2021).

Two methods of calculating Kt/V are commonly used: the Daugirdas formula and online clearance monitoring (OCM). The Daugirdas formula incorporates the normalized protein catabolic rate (nPCR) to emphasize the significance of nutrition in assessing dialysis effectiveness. However, nPCR is no longer considered a reliable measure of nutritional adequacy in relation to dialysis efficacy, as it can be influenced by factors such as inflammation, liver dysfunction, fluid overload, and protein losses through urine or dialysate. Furthermore, its association with mortality is weakened when accounting for malnutrition and inflammation. Additionally, nPCR does not distinguish between proteins from dietary sources and those derived from the body's own breakdown (Torreggiani *et al*., 2021).

This study focused solely on OCM-based Kt/V calculations. OCM offers a non-invasive method to measure Kt/V, eliminating the need for blood sampling. The OCM evaluates changes in conductivity between the dialysate entering and exiting the dialyzer by using two distinct dialysate electrolyte concentration monitors (Mateen *et al*., 2022). The integration into modern haemodialysis machines, the OCM system not only measures the total dialysis dose delivered during a session but also monitors the clearance process throughout, providing real-time feedback for online adjustments (Canaud *et al*., 2024). This capability enables prompt dose modification, ensuring consistent delivery of the required dialysis dose.

While the OCM is regarded as the preferred and dependable method for calculating Kt/V, it is important to acknowledge certain limitations. The efficiency of dialysis may be underestimated when employing OCM, as it is restricted to urea clearance. This method does not consider the clearance of other toxins, particularly those with larger molecular weights, which could be significant for the overall adequacy of dialysis. Furthermore, inaccuracies in value estimation can impact the Kt/V calculation. Another limitation involves the recirculation of blood, which can also influence the results. Additionally, incorrect pathology results can affect the OCM calculation (Tayebi-Khosroshahi *et al*., 2022).

The primary goal of dialysis is to adequately remove uremic solutes and excess fluid from the body to preserve health and quality of life. More specific objectives include managing uremic symptoms, maintaining stable electrolyte levels, preventing nutritional decline, and achieving the best possible long-term survival rates (Ai-Rubaia *et al*., 2022). Although dialysis can prevent death, it does not cure kidney disease or replace the kidneys' endocrine or metabolic functions. Several factors can influence the adequacy of dialysis, including mechanical issues, problems with dialysis components, and patients' non-compliance, particularly in those suffering from depression (Kilonzo *et al*., 2023). Other factors having an impact on dialysis adequacy, as calculated by Kt/V, include treatment duration, blood flow rate, session interruptions caused by hypotension or clotting, access functionality issues (e.g. stenosis and recirculation), needle size and placement and dialyzer characteristics. Proper blood sampling is also critical (AlSahow *et al*., 2021). Many long-term dialysis patients still experience anorexia due to insufficient dialysis, retention of uremic toxins, other illnesses, chronic systemic inflammation, or depression (Ye *et al*., 2022). Dialysis adequacy is one of the most important modifiable factors affecting survival in CKD patients (Hong and Lee, 2019).

Patients with CKD who miss more than 25% of their monthly haemodialysis treatments are considered to be non-compliant (Dalal *et al*., 2022). Dialysis treatment significantly disrupts daily routines, work, living arrangements, relationships, and social roles, leading to financial strain and job-related challenges. The frequent pain from repeated needle insertions is a common issue among these patients, often resulting in depression and a diminished quality of life. Over one-fifth of haemodialysis patients have reported that this pain is unbearable (Eslampour *et al*., 2022). Additionally, medical conditions such as electrolyte imbalances, anaemia, kidney bone disease, and high blood pressure, resulting from inadequate dialysis, can also contribute to mental health issues, including depression and anxiety (Halili *et al*., 2021). Cardiovascular disease and inadequate dialysis are currently the leading causes of illness and death in haemodialysis patients (Aghsaeifard *et al*., 2022). Non-compliant patients with mental health challenges are at a higher risk of discontinuing treatment, being re-admitted to the hospital, experiencing prolonged hospital stays, and having a lower survival rate. Non-compliance can also result in death due to the accumulation of fluids and waste products in the body (Jemali *et al*., 2023).

Pathology tests

Creatinine is the anhydride and excretory form of creatine. Creatine is a tripeptide composed of glycine, arginine, and methionine. Urea and creatinine are substances generated from arginine, an amino acid found in the liver (urea cycle) and also in the kidney, where it is mainly eliminated through glomerular filtration. In stage five of CKD, serum creatinine levels exceed 5.0 mg/dl in men and surpass 4.0 mg/dl in women. Creatinine is not reabsorbed and is excreted from the body; however, approximately 40–50% of urea is reabsorbed in the tubules, where it is linked to reabsorption of sodium and water (Aruna and Shabana, 2019).

As noted by Avila *et al*., (2025), serum creatinine concentration serves as the primary clinical indicator for evaluating the glomerular filtration rate (GFR). The extensive application of this indicator is attributed to the correlation between its concentration and the accurate measurement of GFR through the clearance of substances, such as inulin. Additionally, the authors mention that various factors can influence creatinine levels. Certain elements may elevate creatinine levels, including a diet high in protein, creatine supplementation, muscle mass, and specific medications. In contrast, factors that may lower creatinine concentrations include degradation by intestinal microbiota, advanced age, and nutritional deficiencies. In renal failure, serum urea and creatinine levels usually rise proportionally with a progressive decline in renal function. Serum urea levels can be further increased by excess protein intake, hypovolaemia, heart failure, gastrointestinal bleeding and catabolism. Increases in serum urea out of proportion to serum creatinine result in an elevated urea-to-creatinine ratio and reflect a critical condition (Brookes and Power, 2022).

Liu *et al*., (2021) suggest that various environmental and other factors, including geographical changes, climate variations, gender, age, dietary habits, and physical health, influence blood urea nitrogen (BUN) levels. As individuals age, a difference in protein turnover based on sex becomes evident. Furthermore, it has been proposed that older females exhibit a higher rate of protein synthesis than their male counterparts, despite having a lower muscle mass. These observations imply that serum BUN levels may fluctuate with age. Nevertheless, the serum BUN values between males and females vary, even within the same age group.

In the study carried out by Ullah *et al*., (2023), which evaluated serum urea and creatinine levels among diabetic patients, it was noted that renal function indicators exhibited significant alterations in this population. Both serum urea and creatinine levels deviated from the normal range in the presence of hyperglycemia. Consequently, it was concluded that serum urea and creatinine serve as dependable, straightforward and cost-effective parameters for monitoring renal impairment in diabetic patients with poor glycaemic control.

2.4 The psychological impact of CKD

Mental health is a state of well-being in which an individual realizes their abilities, can cope with the normal stresses of life, works productively and contributes to their community (Guerra *et al.*, 2021). Mental health is influenced by multiple social, psychological, and biological factors, and it can fluctuate over time. Mental health issues in adults, particularly in low- and middle-income countries, are an increasingly significant public health concern. According to Cogley *et al.*, (2022), current evidence indicates that individuals with severe mental illness, such as psychosis, tend to die 15–20 years earlier than those without such illnesses.

For CKD patients with mental disorders, the risk of death ranges from 11% to 66%, and the risk of hospitalization can reach up to 90%, compared to CKD patients without common mental disorders (Gela *et al.*, 2024). Psychological distress, depression, and anxiety have a negative impact on the quality of life and well-being of individuals. Distress is defined as a multifaceted emotional experience involving psychological (cognitive, behavioural, and emotional), social, and/or spiritual nature (El-Majzoub *et al.*, 2019).

Factors such as changes in body image, physical symptoms, functional limitations, social, and mental challenges can significantly affect the quality of life of CKD patients (Palmer *et al.*, 2013). Psychiatric disorders in CKD patients can result in functional impairment, suicidal ideation, sleep disturbances, compromised immune function and poor nutritional status, all of which contribute to increased morbidity and mortality (Guerra *et al.*, 2021). From the moment of diagnosis, CKD patients are confronted with profound life changes, requiring strong emotional coping skills. These changes include adapting to the diagnosis, adjusting future perspectives, managing physical symptoms, and addressing social implications (Cardol *et al.*, 2023).

As noted by Palmer *et al.*, (2013), individuals with chronic illnesses experience a significant burden of physical symptoms, reduced quality of life, and functional limitations, all of which may increase their susceptibility to depression. Furthermore, many patients with advanced CKD (stage 5) undergoing dialysis report high levels of psychological distress and highlight the enhancement of psychosocial factors related to their condition as one of their key research priorities. Patients with CKD are considered especially vulnerable to emotional issues due to the chronic stress associated with the disease (Jemali *et al*., 2023). Chronic kidney disease requires complex and expensive treatments such as dialysis or transplantation, both of which have a substantial impact on the patient's life (Li *et al*., 2023). Dialysis patients frequently experience emotional and mental health challenges that complicate disease management.

These challenges might include low self-esteem, stress, despair, and worry (Li *et al*., 2023). Haemodialysis therapy is a particularly stressful process, and its burden affects patients' daily lives. Regular treatment in the hospital, along with recovery periods, affects physical functioning and contributes to negative emotions associated with the progression of the disease, as well as the development of depression and anxiety (Guerra *et al*., 2021). The figure below (Figure 2.4) by Rhee *et al*., (2022) illustrates that individuals affected by CKD experience significant physical, psychological, and life-related consequences.

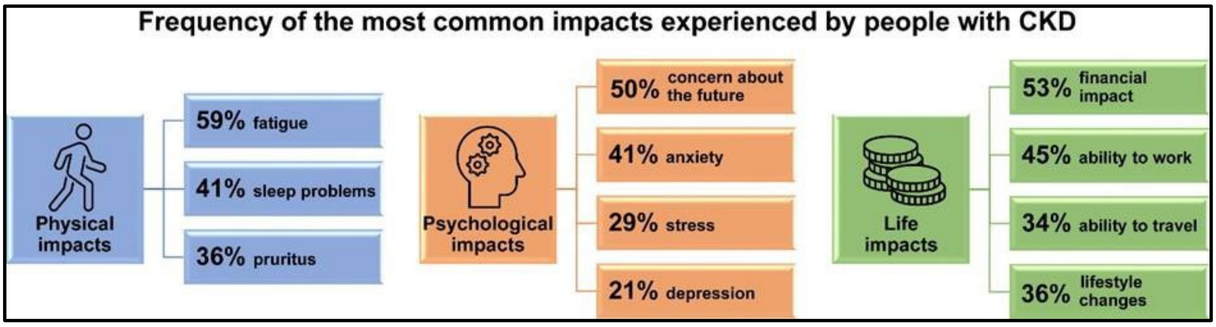

Figure 2.4 Frequency of the most common impacts experienced by people with CKD (Rhee et al., 2022)

2.4.1 Physical impacts

A total of 59% of CKD patients reported experiencing fatigue, 41% encountered sleep disturbances, and 36% suffered from pruritus. Mallamaci *et al*., (2020) identified CKD as a public health issue, noting that despite the importance of physical activity in preventing and managing chronic diseases, exercise is seldom prescribed for CKD patients. A study by Lambert *et al*. (2022) further emphasizes that insufficient physical activity and exercise among dialysis patients are associated with a reduced quality of life, impaired physical functioning, increased bodily pain, higher hospitalization rates, and lower overall survival. Although maintaining physical activity is crucial for dialysis patients, numerous barriers, physiological, physical, psychological, or structural, limit their ability to engage in regular exercise.

Fatigue is among the most frequently reported symptoms of CKD, affecting 60 – 97% of patients on long-term renal replacement therapy and up to 84% of those with stage 5 CKD (Ramadan *et al*., 2023). Fatigue is characterized as a profound and subjective sense of tiredness that persists even at rest, accompanied by exhaustion during physical activities, reduced energy levels, diminished endurance, and decreased vitality (Debnath *et al*., 2021). This debilitating condition can disrupt daily activities and social interactions, significantly affecting patients' quality of life (Debnath *et al*., 2021). Fatigue in haemodialysis patients is associated with poor quality of life and lower survival rate due to reduced physical and psychological activity (Prastiwi *et al*., 2021). Factors contributing to CKD-related fatigue include decreased albumin levels, anaemia, restless legs syndrome, and obstructive sleep apnoea. Moreover, fatigue has been independently linked to the progression of ESKD (Ho *et al*., 2022). Artom *et al*., (2014) identified additional contributors to fatigue in CKD patients, including clinical, biochemical, and psychological elements. Clinically, fatigue levels are often the highest immediately following a dialysis session and the lowest during the interdialytic period. Two patterns of dialysis-related fatigue have been observed (1) intradialytic fatigue (IDF), which arises during or immediately before a dialysis session, and (2) post-dialysis fatigue (PDF), which develops after dialysis and can persist for hours (Bossola *et al*., 2023). Post-dialysis fatigue is influenced by factors such as osmotic disequilibrium, ultrafiltration, diffusion processes, and elevated tumour necrosis factor levels (Debnath *et al*., 2021).

Approximately 25% of dialysis patients recover from fatigue within minutes of completing a dialysis session, while one-third recover upon reaching home. However, nearly 25% require an entire night to return to their baseline energy levels (Artom *et al*., 2014). Dialysis patients often adjust their daily activities to accommodate post-dialysis fatigue, with some requiring over three hours of rest following treatment (Jesmi *et al*., 2022). Biochemically, anaemia is a prevalent issue among CKD patients due to impaired erythropoietin production, which reduces red blood cell synthesis (Badura *et al*., 2024). Erythropoietin is a hematopoietic growth factor essential for red-blood cell production. Its deficiency leads to reduced haemoglobin levels, causing symptoms such as fatigue, weakness, pallor, and changes in heart rate, all stemming from a decreased oxygen supply (Portoles *et al*., 2021). Anaemia exacerbates fatigue and impairs patients' ability to perform daily activities. Psychosocial factors also play a significant role in CKD-related fatigue. These include depression, anxiety, social isolation, reduced social support, and poor health-related quality of life (Artom *et al*.,2014). Depression, in particular, is strongly associated with fatigue, manifesting as persistent lethargy and reduced energy. Chronic inflammation is another key contributor, with inflammatory cytokines directly affecting the central nervous system, pituitary gland, hypothalamus, and adrenal glands, as well as indirectly disrupting sleep and mental health (Ballesio, 2023).

Sleep disorders frequently co-occur with cardiovascular disease, psychiatric conditions, and impaired social functioning, further complicating CKD management. Insufficient sleep adversely affects cardiovascular, endocrine, metabolic, and inflammatory systems, exacerbating CKD symptoms. Between 50% and 75% of patients with kidney failure report insomnia, with 8–36% of pre-dialysis patients experiencing similar issues (Tan *et al*., 2022).

Obstructive sleep apnoea (OSA) is another common issue linked to increased cardiovascular morbidity and mortality (Gunta *et al*., 2022). OSA prevalence has risen with obesity rates and is associated with arterial hypertension, heart failure, and CKD progression. Renal failure can exacerbate OSA through mechanisms such as fluid retention and uremic toxin accumulation (Tu *et al*., 2019).

Pruritus, a persistent skin sensation that triggers scratching, is another distressing complication of CKD, affecting both dialysis and pre-dialysis patients. Its prevalence increases with advancing CKD stages and is associated with poor quality of life and sleep disturbances (Molina *et al*., 2023). Pruritus is attributed to the accumulation of pruritogenic substances like calcium, phosphorus, and uremic toxins, which are inadequately removed during dialysis. Severe pruritus has a significant impact on social, familial, and professional interactions, often causing heightened anxiety (Santoro *et al*., 2024). Studies have also found correlations between pruritus severity and increased mortality rates, underscoring its clinical significance (Molina *et al*., 2023). The regression analysis conducted by Daraghmeh *et al*., (2022) revealed that pruritus severity is associated with factors such as residency, lifestyle, and comorbidities, emphasizing the need for personalized care.

2.4.2 Psychological impacts

Rhee *et al*., (2022) indicated that 50% of patients with CKD are deeply concerned about their future. These concerns revolve around their health, family dynamics and everyday life (Frandsen *et al*., 2020; Seery and Buchanan, 2022). Chronic kidney disease not only affects patients but also has a significant impact on their family members, leading to lifestyle changes and shifts in family dynamics. Families often serve as a vital support system for patients sharing in the burden of the disease (Frandsen *et al*., 2020).

Patients diagnosed with CKD frequently experience profound feelings of fear and hopelessness due to the unpredictable nature of the disease, which varies greatly from one individual to another. This uncertainty makes it challenging for patients to make long-term plans, and prognostic uncertainty remains a recurring theme throughout the different stages of CKD. Many patients express a desire for greater clarity regarding their future (Milders *et al*., 2024).

Anxiety, defined as a persistent feeling of worry, nervousness, or unease, is often associated with financial crises, domestic challenges, healthcare issues, and uncertainty about the future. While occasional anxiety can be appropriate, chronic anxiety may signal an anxiety disorder (Mosleh *et al*., 2020). Among CKD patients, the prevalence of anxiety ranges from 12-52%, depending on the assessment methods and study demographics. High anxiety rates are particularly evident in dialysis patients and are attributed to chronic illness-related stress, fear of complications, lifestyle limitations, and uncertainty about future health outcomes. Anxiety can exacerbate healthcare usage, reduce quality of life, and increase mortality rates. Specific complications tied to anxiety include infections (especially those related to access points), cardiovascular events, and hospital admissions (Kimmel and Cukor, 2019).

2.4.3 Life impacts

Rhee *et al*., (2022) highlight that another critical life domain affected by CKD is employment, with only 45% of patients working. Chronic illnesses often lead to lower employment rates, reduced working hours, and a diminished quality of life in comparison to the general population. Chronic kidney disease patients face multiple daily restrictions, including physical symptoms, decreased work capacity, psychological stress and environmental obstacles, such as long waiting periods for nephrology services and frequent hospital visits (Choi *et al*., 2024).

Reduced kidney function severely impairs employment capacity and changes in professional roles. For CKD patients, engaging in paid employment holds significant value, as it enhances quality of life, instils a sense of self-worth, and provides financial stability (Alma *et al*., 2023). The study conducted by Bay *et al*., (2024) found that patients with higher education levels (81% of tertiary educated participants) were more likely to be employed. This suggests that education is a strong predictor of employment among CKD patients, as higher education often leads to less physically demanding jobs and more flexible working hours, unlike the roles typically available to less educated individuals.

For patients with end-stage kidney disease, starting dialysis often results in job loss or reduced working hours. Employment challenges include limited job opportunities due to socioeconomic status, persistent fatigue, CKD-related symptoms, depression, social isolation, transportation difficulties (e.g. dialysis schedules requiring two to three sessions weekly), and the need for frequent peritoneal dialysis exchanges. Moreover, fears of losing disability or medical assistance benefits upon gaining employment, combined with employer perceptions of unreliability, further complicate employment prospects (Hallab and Wish, 2018).

Unemployment among CKD patients can result in decreased self-esteem, heightened anxiety, depression, and a lower overall quality of life. It also imposes financial strain on both the patients and their families. Regional disparities in employment rates are influenced by social support systems, socioeconomic factors, and the proportion of patients undergoing haemodialysis versus peritoneal dialysis (Ogieuhi *et al*., 2025).

The quality of life of working versus nonworking end-stage kidney failure patients was assessed using the SF-36 questionnaire in a study by Bodessova *et al*., (2024). The study results showed that working patients in their first year of haemodialysis experienced better quality of life compared to nonworking patients. The mean physical health scores were slightly lower (36.28) than the mean mental health scores (43.33) for all participants.

Another area of concern for CKD patients is travel, with only 34% able to travel. haemodialysis patients face significant obstacles to travel, including limited access to alternative dialysis centres, insufficient travel information, health-related concerns, financial constraints, and anxiety about unfamiliar dialysis services. These barriers significantly reduce the number of dialysis patients who can enjoy holidays can take vacations, despite travel being considered a means of enhancing quality of life (Yamadera, 2014).

Travel poses unique challenges for CKD patients, particularly those living in rural areas. Geographic barriers often result in delayed referrals to kidney specialists and poorer health outcomes. These patients frequently undertake lengthy journeys for haemodialysis treatment or medical consultations, exacerbating socioeconomic disadvantages (Robertson *et al*., 2023). Additionally, CKD patients who travel are at risk of health complications, such as diarrhea, which can be life-threatening due to compromised immune function and pre-existing malnutrition. Severe dehydration resulting from such illnesses can lead to cardiovascular events, posing a significant risk to this population (Guo *et al*., 2011).

While haemodialysis sustains life, it cannot fully replicate kidney function. As a result, CKD patients endure long-term physical, social, and psychological challenges. Families, too, bear a considerable burden, experiencing emotional, marital, social, and financial difficulties while trying to provide the complex care required. This strain often leads to feelings of disempowerment among family members (Alkhaqani, 2022; Jardim *et al*., 2023).

A study conducted by Mbeje (2022) examined the factors influencing the quality of life for patients with end-stage renal disease undergoing dialysis in KwaZulu-Natal, South Africa. The findings revealed a significant demand for renal replacement therapy in the country, with most patients suffering from chronic kidney disease reporting a diminished quality of life. Additionally, it was found that educating and informing healthcare professionals about the physical, social, psychological, and economic factors that affect patients' quality of life, will enable them to implement appropriate interventions through the existing renal multidisciplinary health teams. Furthermore, the author advocates for policymakers to promote the decentralization of renal services to other provincial hospitals, which would enhance collaboration, facilitate knowledge sharing, and establish funding mechanisms to support mutual assistance.

2.4.4 Depression

Depression is classified as a mood disorder and is often characterized by feelings of sadness, loss, or anger that interfere with daily activities. It is associated with a diminished quality of life and increased mortality (Mosleh *et al*., 2020). Depression significantly contributes to the global burden of disease and is a major cause of disability worldwide. In 2010, it was identified as the leading cause of years lived with disability globally, with 17.9 million years lost to mental health problems in 2015 (Sankoh *et al*., 2018). Approximately 280 million individuals worldwide are affected by depression (Bahall *et al*., 2023). According to Edwards *et al*., (2023), depression and anxiety rank first and sixth, respectively, in terms of global disability burden. These conditions also exacerbate outcomes in other chronic diseases, such as cardiovascular events in patients with coronary heart disease or kidney disease.

In addition to contributing to the burden of suicide and heart disease, depression is associated with a higher likelihood of self-harm rather than harm to others in individuals with severe mental health issues (Onuh *et al*., 2021). Depressed individuals are 20 times more likely to die by suicide and are more vulnerable to violence, assault and other crimes compared to those without depression (Onuh *et al*., 2021; Ritchie and Roser, 2018). These consequences not only affect individuals but also disrupt family structures, communities and societal development.

Despite depression being a global public health concern, its prevalence varies across different populations. For instance, pregnant and postpartum women are more likely to experience clinical depression compared to the general population (Endomba *et al*., 2021). In the United States, one in five adults reported having been diagnosed with depression by a healthcare provider in 2020. Depression was more prevalent among women, younger adults, and those with lower education levels (Goodwin *et al*., 2022).

The WHO (2017) predicted that by 2020, depression would rank second in terms of global disease burden and would remain a priority condition under the WHO's Mental Health Gap Action Programme. In 2018, depression ranked third in global disease burden, with predictions placing it first by 2030 (Cui *et al*., 2024). However, an important barrier to effective depression care remains inaccurate assessment, as depressed individuals are often misdiagnosed.

Chronic diseases are closely associated with depression due to long-term physical dysfunction, pain, and reduced quality of life, which contribute to feelings of powerlessness and self-worth denial (Ma *et al*., 2021). Depression is a known predictor of adverse clinical outcomes, including increased healthcare utilization and negative health events (Crump *et al*., 2022). For example, the prolonged course of chronic illnesses such as CKD or cardiovascular disease, coupled with complications, physical decline, and financial strain, leads to increased depressive symptoms, particularly in older adults (Zhang *et al*., 2018). Persistent pain in such patients often results in irritability and restlessness, contributing further to anxiety and depression (Ma *et al*., 2021).

Depression and anxiety are the most common psychiatric complications in CKD patients (Mosleh *et al*., 2020). A bidirectional association between inflammation and depression has been identified in patients with chronic illnesses, with cerebrovascular conditions further exacerbating depression in CKD patients (Kim *et al*., 2022). Depression is three to four times more prevalent in CKD and ESKD patients compared to the general population and occurs at higher rates than in individuals with other chronic illnesses, such as diabetes (12%–18%), coronary artery disease (15%–23%), and chronic obstructive pulmonary disease (around 25%) (Sharapov, 2022). In CKD patients, depression prevalence can reach up to 73%, most commonly in the moderate-to-severe range. Women and patients between the third and ninth years of therapy are disproportionately affected (Lefrere *et al*., 2025).

2.4.5 Recent studies on the prevalence of depression

Ngema and Ramalepa., (2025) conducted a scoping review on depression among African dialysis patients, reporting prevalence rates to be 32.4% to 80%, varying by country and demographic factors. Regular depression assessments are recommended for newly initiated dialysis patients to enable early intervention. Similarly, Zahran *et al*., (2024) found that longer dialysis duration and higher ultrafiltration volumes were associated with depression in haemodialysis patients in Egypt. In South Africa, Shezi *et al*., (2024) highlighted the protective effect of proximity to public green spaces on depressive symptoms, especially among women, middle-aged individuals, and those with higher education. Table 2.3 below provides a summary of recent research assessing the prevalence and consequences of depression in CKD. For instance, a study conducted by Alkabuti *et al*., (2024), utilizing the PHQ-0 questionnaire, revealed that 63% of the 204 participants were experiencing depression. Additionally, another study by Osunbor *et al*. (2024) reported a prevalence rate of 22.4% concerning the outcomes associated with uraemia, based on a sample of 205 participants diagnosed with CKD.

Table 2.3 Studies evaluating the prevalence and outcomes of depression in CKD: systematic review.

Authors	Sample size	Tools used	Depression prevalence	Outcomes
Osunbor *et al*. (2024)	205	Hamilton Depression rating scale	22.4%	Uraemia. Implications on job security, productivity, and relationships
Solomon *et al*. (2025)	224	PHQ questionnaire	63%	High mortality
Mal *et al*. (2024)	113	Beck Depression Inventory (BDI-II) questionnaire	74.3%	Cerebrovascular or ischemic heart disease
AlShammari *et al*. (2024)	158	Anxiety and Depression Scale (HADS)	26.6%	Higher anxiety levels. Deterioration of quality of life
Gela *et al*. (2024)	424	Self-Reporting Questionnaire-Falk Institute (SRQ-F)	40.8%	Increased risk of mortality. Poor quality of life
Akpan *et al*. (2025)	54	anxiety and depression scale (HADS)	64.8%	Loss of confidence and self-esteem.
Singh *et al*. (2024)	72	1. Hospital Anxiety and Depression Scale (HADS) 2. General Health Questionnaire-12 (GHQ-12) 3. Addenbrooke's Cognitive Examination-III (ACE-III) 4. Alcohol Use Disorders Identification Test (AUDIT-Scale)	32.3%	Substantial burden of psychiatric morbidity and cognitive dysfunction.

Collectively, these studies indicate that mental health disorders are highly prevalent among patients with chronic kidney disease and are associated with poorer quality of life and an increased risk of mortality. Common depressive symptoms include suicidal ideation, appetite changes, feelings of worthlessness or guilt, and excessive sleep (Bahall *et al*., 2023).

Psychosocial factors influencing depressive symptoms in CKD patients include reduced family support, advanced age, and low educational attainment. Clinical factors, such as disease severity and comorbidities, play critical roles as well (Bahall *et al*., 2023; Guenzani *et al*., 2019).

Depression has a negative impact on adherence to treatment, including fluid restriction, nutritional plans, and medication, resulting in worsened health outcomes such as acute kidney injury (AKI), CKD progression, and cardiovascular disease (Jemali *et al*., 2023). It also contributes to higher rates of hospitalization, increased mortality, and reduced work performance (Maarce *et al*., 2022; Paul *et al*., 2019). Furthermore, depression can strain familial relationships and reduce treatment compliance, compounding its adverse effects (Mosleh, 2020).

2.4.6 Management of depression

Alghamdi (2021) indicates that despite the increased prevalence of depression and associated adverse health outcomes, depression detection and treatment administration remain low. One issue that can be particularly challenging for clinicians is the use of antidepressant medications in the treatment of CKD. This is attributed mostly to the scarcity of large, controlled trials and the hesitancy of clinicians to offer treatment.

Depression can be addressed through both physical methods, such as medications and electroconvulsive therapy (ECT), as well as psychosocial interventions (Natale *et al*., 2019). According to Pearce *et al*., (2022), psychosocial interventions are defined as approaches that offer psychological, emotional, or social support without the use of pharmacological agents. These interventions may encompass counselling, social group support, cognitive-behavioural therapy (CBT), relaxation or visualization techniques, physical exercise, educational programs, or individual social support, including support via telephone.

The delivery, intensity, and methodology of these therapies may differ, along with the level of interaction with a therapist or support worker. Psychosocial interventions can aid in alleviating distressing symptoms, enhancing coping mechanisms, fostering social connections, providing strategies to tackle specific disease-related issues, and reducing anxiety and stress (Natale *et al*., 2019).

Currently, there is no standardized approach or uniform treatment protocol for psychotherapy. The intensity or method of therapy, as well as the degree of interaction with individual therapists or support personnel, can differ significantly. Psychosocial interventions may be particularly beneficial for patients with CKD, as they help to circumvent possible drug interactions and the negative side effects associated with antidepressant medications. It is important to note that depressive symptoms are linked to decreased adherence to treatment, diminished functional capacity, and increased hospitalization rates (Yang *et al*., 2024).

2.5 Beck's Depression Inventory

In dialysis centres, where access to psychiatric care is often restricted, diagnostic scales are routinely employed to screen for depression in patients with ESRD. Various screening instruments have been utilized, such as the Cognitive Depression Index (CDI), the Centre for Epidemiological Studies Depression Scale (CES-D), the Hospital Anxiety and Depression Scale-Depressive Subscale (HADS-D), the Geriatric Depression Scale 15 (GDS-15), and the Initial Depression Inventory-Maintenance Haemodialysis (ID-MHD) (27). Nevertheless, the most frequently utilized assessment tool has been the self-administered Beck Depression Inventory, in both its original (BDI) and revised (BDI-second edition, BDI-II) formats (Kubanek *et al*., 2024).

The Beck Depression Inventory (BDI) is a widely used self-report tool for screening and measuring the severity of depression (Hajduska-Der *et al*., 2022). The BDI comprises 21 questions assessing symptoms and attitudes related to depression, with each item rated on a scale from 0 to 3. Its versatility allows it to be administered in both clinical and non-clinical settings. Scores range from normal mood variations to extreme depression, providing a reliable measure for monitoring symptom progression and treatment efficacy (DuBois-Maahs, 2020; Hajduska-Der *et al*., 2022). Since its development in 1961, the BDI has been widely adopted worldwide for assessing depression not only in clinical patients but also in the general population (Hassan *et al*., 2022).

A study by Lee *et al*., (2017) evaluated the reliability, validity, and factor structure of the BDI in a non-clinical population of Korean adolescents. The study reported a high

Cronbach's alpha, comparable to results from Taiwanese and U.S. adolescent samples, confirms the BDI's internal consistency. The findings by Lee *et al*., (2017) demonstrated high internal consistency, good construct validity, and a stable factor structure of the BDI across diverse populations support its appropriateness as a reliable screening instrument for depressive symptoms in adult haemodialysis patients, where both cognitive-affective and somatic symptoms of depression are prevalent. Another study by Cho *et al*., (2021) examined the psychometric properties of the BDI in a homeless or precariously housed population, demonstrating its convergent and discriminant validity in this group. The BDI questionnaire was found to measure depressive symptoms effectively while distinguishing them from symptoms of schizophrenia and degenerative diseases. The tool also exhibited excellent reliability and sensitivity to changes in depressive symptoms, making it suitable for tracking within-subject changes over time.

Toledano-Toledano and Contreras-Valdez (2018) investigated the use of the BDI among family caregivers of children with chronic illnesses. The study found that depression was positively associated with anxiety, caregiver burden, and parental stress and negatively associated with quality of life and well-being. The findings demonstrated the BDI's validity, reliability, and cultural relevance in this population, revealing a two-factor structure comprising somatic-affective and cognitive components.

The BDI's wide applicability has been validated across different populations and cultural groups, with translations available in multiple languages. Studies in Taiwan (Yu and Yu, 2007) and Malaysia (Mukhtar and Oei, 2011) affirmed its effectiveness, while test-retest reliability scores ranging from 0.73 to 0.92 confirmed its consistency over time (Gebrie, 2018; Wang and Gorenstein, 2021). Studies conducted in countries including Japan, the United States, South Korea, Brazil, Iran, and South Africa have consistently utilized the BDI to assess depressive symptoms in haemodialysis and peritoneal dialysis populations, supporting its position as one of the most frequently used depression screening tools in renal research (Kondo *et al*., 2020). Its internal consistency remains high among psychiatric (alpha = 0.86) and non-psychiatric (alpha = 0.81) populations (Lu and McCabe, 2022), making it a valuable resource for clinicians and researchers.

In South Africa, Makhubela and Mashegoane (2016) assessed the factorial validity of the BDI-II in a diverse sample of 919 university students. The study identified a three-factor structure: Negative Attitude, Performance Difficulty, and Somatic Complaints. A hierarchical second-order analysis supported a general factor of depression encompassing these lower-order factors. The study further validated the instrument's convergent and discriminant validity through correlations with subscales from the Hopkins Symptom Checklist–25. Findings confirmed the BDI-II's reliability and validity for evaluating depressive symptoms over time among South African university students.

The BDI uses a straightforward scoring system:

- **1–10:** Considered normal.
- **11–16:** Mild mood disturbance.
- **17–20:** Borderline clinical depression.
- **21–30:** Moderate depression.
- **31–40:** Severe depression.
- **40+** Extreme depression.

Conclusion

In this chapter, we have provided a comprehensive overview of CKD, detailing its various stages, symptoms, and progression. We examined the epidemiology of CKD, beginning with a global perspective and narrowing down to the situation in South Africa, while also discussing the different treatment options available. Additionally, we elaborated on the concept of dialysis adequacy, particularly in relation to haemodialysis. The chapter also addressed the psychological effects of CKD, highlighting the most common challenges faced by patients, including physical, psychological, and lifestyle impacts. We placed particular emphasis on depression, discussing its prevalence and consequences for CKD patients. Lastly, we introduced the Beck Depression Inventory tool, explaining its functionality, result interpretation, and the tool's reliability and validity.

Chapter 3
Research design and methods

3.1 Introduction

This chapter outlines the research design, study location, population, data collection methods, and analytical procedures used to explore the correlation between depression and chronic haemodialysis adequacy in chronic kidney disease patients (CKD) in South Africa. A rigorous methodological approach was employed to ensure the reliability and validity of the findings.

The study was conducted at selected healthcare centres across the Free State and Northern Cape provinces of South Africa. Participants with stage 5 CKD undergoing haemodialysis were included based on specific inclusion and exclusion criteria (3.4.1). Data collection involved both objective measurements of dialysis adequacy, such as Kt/V calculations and blood tests, and subjective assessments of depression using the Beck Depression Inventory (BDI) questionnaire.

To achieve the study's objectives, clear protocols were followed for participant selection, data collection, and statistical analysis. The demographic and clinical information provided a comprehensive overview of participant characteristics, while the statistical methods, such as the Shapiro-Wilk and Chi-Square tests, are outlined in this chapter, facilitating a robust and reproducible assessment of the relationship between mental health and dialysis outcomes.

This chapter provides a detailed description of the procedures followed, ensuring transparency and reproducibility of the research process. The chapter describes the study design, including the criteria for participant selection, the sampling strategy, and recruitment procedures. It also provides a detailed account of the data collection process, outlining the instruments and tools used, how they were administered, and the measures implemented to ensure data accuracy and consistency. Furthermore, the chapter explains the procedures for data management and statistical analysis, including the specific tests used and the steps taken to ensure the validity and reliability of the results.

3.2 Study locations

The study employed a prospective analytical design and was conducted across multiple healthcare centres located in the Free State and Northern Cape provinces of the Republic of South Africa. These centres were selected to provide a representative sample of haemodialysis patients from diverse clinical settings, encompassing both urban and rural populations. The multicenter approach allowed for the collection of real-time data on dialysis adequacy and mental health outcomes, enhancing the generalizability of the findings within these regions. By including multiple centres, the study was also able to account for variations in clinical practices, patient demographics, and resource availability across different healthcare facilities. The facilities in the Free State province included National Renal Care (NRC) Pelonomi, NRC Universitas, NRC Bram Fischer, and NRC Kroonstad. In the Northern Cape province, the study site was NRC Kimberley. The study locations were selected based on their proximity and ease of access for the principal investigator during the data collection period, as the investigator's presence was required. Approval was obtained only from National Renal Care. Ethical Clearance for the study was obtained from the University of Free State HSREC committee and assigned ethical clearance number UFS-HSD2023/2414/3004.

3.3 Research design

The study employed a prospective analytic design to examine the correlation between depression levels and dialysis adequacy in patients with CKD. This design was chosen because it allows for the observation and analysis of relationships between variables over time, ensuring a robust understanding of the interplay between mental health and dialysis outcomes (AJE, 2022).

3.4 Data collection

3.4.1 Study population

Across the five haemodialysis centres, the total patient population comprised 120 individuals. The initial target was to recruit 100 individuals for the study. However, due to unforeseen challenges outlined in the limitations section in chapter five of this dissertation, the final sample size comprised 78 participants. In determining an appropriate sample size, the research team considered the total number of patients at each study site alongside the study's inclusion and exclusion criteria. Additionally, we consulted a biostatistician to confirm whether a sample size of 78 would be sufficient for statistical analysis, particularly in assessing the probability, significance, reliability, and validity of the results. Ahmed (2024) emphasizes that overly small samples may fail to produce conclusive results, whereas excessively large samples can be inefficient and offer limited additional value to the study's credibility. The application of inclusion and exclusion criteria ensured a homogeneous study group.

Inclusion criteria:

- Chronic haemodialysis patients aged 18 to 65 years.
- Participants undergoing day haemodialysis.
- Patients who provided informed consent.
- All genders

Exclusion criteria:

- Paediatric patients.
- Pregnant participants.
- Holiday patients.

3.4.2 Participant recruitment

Participants were recruited from the selected healthcare centres through collaboration with healthcare professionals and patient care teams. Recruitment strategies included direct engagement with potential participants and the distribution of study information sheets (Annexure A- Information document). The principal investigator, along with the nursing staff, physically distributed the information sheets to the participants at the hemodialysis centres. The principal investigator introduced the study's concept to all patients at each location, encouraging them to ask questions about the study. After addressing all inquiries to the satisfaction of the patients, the study team, in partnership with the nursing staff, identified patients who expressed interest in participating.

The inclusion and exclusion criteria were explained in detail to ensure clarity and understanding. Subsequently, potential participants were provided with an informed consent form and a study information sheet. After the consultation sessions concluded and participants expressed their satisfaction, they signed the consent form (Annexure B- Signed informed consent).

3.4.3 Sampling procedure

The study employed a convenience sampling method to select participants meeting the inclusion criteria. Convenience sampling is a non-probability sampling method where participants are selected based on their accessibility, availability, or willingness to participate in the study (Nikolopoulou, 2022). It is often used when the target population is difficult to reach or when time and resources are limited (Ahmed, 2024). In this study, convenience sampling was chosen because it allowed for the inclusion of chronic haemodialysis patients who were readily accessible at the selected healthcare centres and who met the specified inclusion criteria. While it is efficient and practical, one limitation is that it may not provide a fully representative sample, potentially affecting the generalizability of the study findings.

3.4.4 Data collection and instrumentation

Data collection was conducted over a three-month period (June 2024 to August 2024). Participants attended three haemodialysis sessions per week, resulting in a total of 12 sessions per month and 36 sessions over the study period.

Measurement of dialysis adequacy:

1. Kt/V calculations: Automatically computed by the haemodialysis machine during each session.

2. Blood tests: Blood samples were collected monthly from each participant to monitor dialysis adequacy and relevant biochemical parameters. Samples were obtained either on the first or last dialysis session of the month, depending on the patient's schedule, ensuring consistency in timing across participants. The collected blood was analyzed to assess clearance levels, including markers such as urea and creatinine, which are routinely used to evaluate dialysis effectiveness. Standardized procedures were followed for sample collection, handling, and laboratory analysis to minimize pre-analytical variability and ensure the accuracy and reliability of the results. This approach allowed for the ongoing monitoring of treatment outcomes and the assessment of correlations between biochemical markers and clinical parameters.

Depression assessment: Participants completed the Beck Depression Inventory (BDI) questionnaire at the start of the study. The questionnaire was administered once and analyzed in consultation with a qualified psychologist (Annexure C – Completed BDI). The confidentiality declaration was signed by a psychologist who is part of the research team.

3.4.4.1 Demographic data

The study included 78 chronic kidney disease patients who met the inclusion and exclusion criteria. Participants were recruited from five different centres: NRC

Pelonomi, NRC Universitas, NRC Bram Fischer and NRC Kroonstad in the Free State province, and NRC Kimberley in the Northern Cape province. Approval for the study was not granted by the Provincial Department of Health, as a staff member was conducting a similar study across provincial hospitals. In addition, private healthcare organizations indicated that approval processes for external researchers are often prolonged, as priority is given to internal staff members who are concurrently engaged in other research projects. Consequently, approval was obtained only from National Renal Care, and data were therefore collected at its centres in Free State and Northern Cape provinces. Participants were aged between 18 and 65 years. All tests and data collection were conducted at the respective haemodialysis centres.

3.4.4.2 Clinical data

Clinical data, including the underlying cause of chronic kidney disease, existing comorbidities, current medications, treatment complications, and duration of dialysis, were obtained from the participants' medical records. The National Renal Care gave permission for the study. The BDI questionnaire was completed by all 78 participants at the study's outset, with scores reflecting the level of depression.

3.5 Statistical data analysis

Descriptive statistics, including frequencies and percentages, were calculated for categorical data. Mean, standard deviation, median and percentiles were calculated for numerical data.

- The Shapiro-Wilk test was used to investigate numerical data that followed a normal distribution.
- The Chi-Square test was employed to compare proportions between BDI groups.
- The student t-test and analysis of the variance (ANOVA) were used to compare mean values, while the Mann-Whitney U-test and Kruskal-Wallis test were applied to compare median values
- Correlation analysis and logistic regression were conducted to explore the correlation between mental health and dialysis adequacy

A significance level (α) of 0.05 was used for all statistical analyses. These statistical methods were chosen to ensure a comprehensive analysis and address the study objectives effectively.

3.6 Validity, reliability, credibility and trustworthiness

The study ensured validity and reliability through:

- Rigorous application of inclusion and exclusion criteria.
- Standardized measurement tools, including the BDI and Kt/V calculations.
- Statistical methods to ensure the accuracy and reproducibility of results.

Credibility was enhanced through triangulation of data sources (objective data sources-Kt/V calculations and blood test results, and subjective data sources-assessment of participants' depression levels). Trustworthiness was maintained by adhering to ethical research practices and employing transparent methodologies.

3.7 Ethical considerations

Ethical considerations in research are a set of principles that guide one's research designs and practices. Scientists and researchers must always adhere to a certain code of conduct when collecting data from people (Bhandari, 2021). Additionally, they must behave and act morally (Arafat, 2024).

Ethical considerations were of the utmost importance in this study. Ethical clearance was obtained from the UFS HSREC (ethical clearance number: UFS-HSD2023/2414/3004). Participants received an information sheet detailing the study's objectives, expectations, duration, and investigator contact information. Informed consent was obtained, and participants were informed of their right to withdraw from the study at any time without facing negative consequences. National Renal Care gave permission for the study (Annexure I).

Pseudonymized data were used to protect participants' confidentiality. De-identification techniques, such as pseudonymisation and anonymization, play an important role in facilitating such secondary uses and disclosures of data (Hintze and El-Emam, 2018). In this study, data were securely stored in the university's digital storage system, with physical documents, including questionnaires and chronic dialysis sheets, locked in a safe. Portable devices used for data collection were encrypted, and hard copies containing identifiable information were securely stored and limited to authorized research team members. Participants received an information sheet detailing the study's objectives, expectations, duration, and investigator contact information. Informed consent was obtained, and participants were informed of their right to withdraw from the study at any time without facing negative consequences.

Conclusion

This chapter details the methodological framework employed to investigate the correlation between depression levels and dialysis adequacy in patients with chronic kidney disease. The integration of demographic and clinical data, objective measures of dialysis adequacy, and subjective assessments of depression provided a multidimensional perspective on the study population. By adhering to ethical research practices and employing robust statistical tools, the methodology ensures that the findings will be reliable, meaningful, and applicable to the clinical context.

The results derived from this methodological approach will contribute to a deeper understanding of the interplay between mental health and dialysis outcomes, thereby informing clinical practices and patient care strategies.

Chapter 4
Results and discussion

4.1 Introduction

The aim of this study was to investigate the correlation between depression and chronic haemodialysis adequacy in chronic kidney disease patients (CKD) from selected private centers in Free State and Northern Cape provinces. This chapter presents the findings in alignment with the study objectives.

The first objective of the study was to measure dialysis adequacy using daily average monthly Kt/V values. Dialysis adequacy was assessed through Kt/V calculations and analysis of blood test results (Annexure D) to evaluate clearance levels. Descriptive statistics, including frequencies and percentages, were used for categorical data analysis.

The second objective in the current study focused on assessing the depression levels of participants undergoing chronic haemodialysis. The Beck Depression Inventory (BDI) questionnaire (Annexure C - Completed BDI) was utilized to evaluate the severity of depression. Participants rated their agreement with 21 items on a four-point Likert scale, where scores ranged from 0 ("Never") to 3 ("Always"). Total scores were calculated by summing responses, and frequencies for each BDI item were analyzed.

The third objective of this study was to report the prevalence of depression among the participants. The BDI questionnaire was used to classify participants based on their scores according to the BDI scoring system. The categories ranged from "Considered no depression" (scores below 10) to "Extreme" (scores above 45). Assessments conducted before haemodialysis treatment were also considered in the evaluation of depression prevalence.

The final objective of this research study was to examine the correlation between dialysis adequacy and BDI scores. To achieve this objective, the statistical analysis was conducted using the Spearman Correlation Coefficients. This analysis included evaluations of sample size, probability assessments, and p-value tests for each variable. The variables related to dialysis adequacy included average Kt/V, urea, and creatinine levels, all measured over three months.

4.2 Results

4.21 Patient demographics

Among the total of 78 participants, forty-eight (48) were female and thirty (30) were male. The average age of the participants was forty-five (45) years. The study comprised both twenty-eight (28) unemployed and fifty (50) employed individuals. The principal investigator, together with the nursing staff, distributed the questionnaire and was available to answer any questions and provide clarity regarding the research or questionnaire. The same nursing staff were present during data collection to ensure that participants felt comfortable and confident in asking questions, as the principal investigator was unfamiliar to them. They also assisted by interpreting for participants who were shy or had language barriers. Additionally, the racial composition of the study included forty (40) African, fourteen(14) White, twenty (20) Coloured, and four (4) Indian participants. There were 10 participants who were non-ambulant and used wheelchairs, while 68 participants were ambulant.

4.2.2 Assessment of dialysis adequacy

4.2.2.1 Kt/V values

Dialysis adequacy was evaluated using average monthly Kt/V values, calculated from clinical data collected over the study period by the principal investigator alongside the nursing staff. The resulting average monthly Kt/V values and the overall Kt/V average values for three months are summarized and presented in Table 4 below. While each participant was expected to have 12 recorded values per month, some had fewer due to various circumstances, as discussed in the study limitations in the fifth chapter of this dissertation.

Table 4.1The Median test for overall Kt/V

Variable	N	Median	25th Pctl	75th Pctl	Minimum	Maximum
Month one Kt/V average	78	1.03	0.99	1.11	**0.68**	**1.24**
Month two Kt/V average	78	1.03	0.98	1.08	0.70	**1.76**
Month three Kt/V average	78	1.07	0.98	1.12	0.83	1.59
Overall Kt/V average	78	**1.04**	**1.00**	**1.10**	0.76	**1.34**

Bold-faceted values indicate significant value.
N - Sample number
Pctl - interquartile range percentile

The average Kt/V for the first and second months remained consistent, with a median of

1.03. However, the second month recorded a maximum Kt/V value of 1.76, compared to the first month's maximum of 1.24 and a minimum of 0.68. The overall median Kt/V value for the three months was 1.04, with a maximum Kt/V value of 1.34 and an interquartile range of 1.00 to 1.10, as shown in Table 4.1 above. A significant Shapiro-Wilk test p-value (< 0.0006) indicated that the Kt/V distribution deviated from normality, as can be seen in Table 4.2 below.

Table 4.2 Normality test for Kt/V average

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.935094	**Pr < W**	**0.0006**
Kolmogorov-Smirnov	D	0.086708	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.123954	Pr > W-Sq	0.0528
Anderson-Darling	A-Sq	1.068252	Pr > A-Sq	0.0082

Bold-faceted indicate significant values.
Pr - probability
W – test statistic

4.2.2.2 Blood tests

4.2.2.2.1 Urea levels

Blood samples for the study were collected concurrently with routine monthly blood tests prescribed by nephrologists. This approach was implemented to prevent unnecessary repeat testing and to minimize any additional financial burden on participants, with their informed consent. Clearance levels were assessed from the routinely collected blood samples monthly to further measure dialysis adequacy. The resulting urea clearance levels and the overall urea clearance average levels for a three-month period are summarized and presented in Table 4.3 below. Out of 78 participants, 75 underwent urea testing. Three participants missed the test because of issues with medical aid insurance.

Table 4.3 The Median test for overall urea

Variable	N	Median	25th Pctl	75th Pctl	Minimum	Maximum
Urea month one	75	19.40	16.20	22.40	5.20	40.00
Urea month two	75	20.50	16.50	23.20	5.20	**41.30**
Urea month three	75	19.70	16.50	22.40	5.20	39.20
Overall Urea	75	**20.13**	**16.77**	**22.40**	5.20	**39.73**

Bold-faceted indicate significant values.
N- Sample size
Pctl- interquartile range percentile

The median urea level for the three months was 20.13 mmol/L, with an interquartile range of 16.77 to 22.40. A maximum urea level of 41.30 mmol/L was recorded in the second month, surpassing the overall maximum of 39.73 mmol/L, as can be seen in Table 6 above. A significant Shapiro-Wilk test p-value (< 0.0053) confirmed non-normal distribution, as can be seen in Table 4.4 below.

Table 4.4 Normality test for overall urea (mmol/L)

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	**W**	0.950503	**Pr < W**	**0.0053**
Kolmogorov-Smirnov	D	0.113772	Pr > D	0.0174
Cramer-von Mises	W-Sq	0.189152	Pr > W-Sq	0.0073
Anderson-Darling	A-Sq	1.157216	Pr > A-Sq	<0.0050

Bold-faceted indicate significant values.
W – Test statistic
Pr - Probability

4.2.2.2.2 Creatinine levels

Additionally, creatinine clearance levels were assessed from the routinely collected blood samples monthly to further measure dialysis adequacy. The resulting creatinine clearance levels and the overall creatinine clearance average levels for a three-month period are summarized and presented in Table 4.5 below. Creatinine testing was completed by 76 participants. Three participants experienced issues with their medical aid insurance; for one participant, the insurance covered only the creatinine test, resulting in two participants lacking creatinine results.

Table 4.5 The mean test for overall creatinine (µmol/L).

Variable	N	Mean	Std Dev	Minimum	Maximum
Creatinine month one	76	**791.84**	301.15	239.00	**1504.00**
Creatinine month two	76	769.14	313.64	167.00	1491.00
Creatinine month three	76	773.91	315.97	**122.00**	**1448.00**
Overall creatinine	76	**778.30**	**300.20**	247.00	**1448.00**

Bold-faceted indicate significant values.
Std Dev- Standard deviation
N- Sample number

The initial month recorded the highest mean value of 791.84µmol/L, along with a peak maximum of 1504.00µmol/L, surpassing all subsequent months. The lowest creatinine level of 122.00µmol/L was noted in the third month. Additionally, the third month and the 'Overall creatinine' category both exhibited a maximum creatinine value of 1448.00µmol/L. The overall creatinine's mean was determined to be 778.30µmol/L, with a standard deviation of 300.20µmol/L. The Shapiro-Wilk test yielded a non-significant p-value of 0.0936, as presented in Table 4.6 below, indicating no significant deviation from normality.

Table 4.6 Normality test for overall creatinine (µmol/L).

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	W	0.972214	**Pr < W**	**0.0936**
Kolmogorov-Smirnov	D	0.090077	Pr > D	0.1294
Cramer-von Mises	W-Sq	0.097376	Pr > W-Sq	0.1230
Anderson-Darling	A-Sq	0.591315	Pr > A-Sq	0.1240

Bold-faceted indicate significant values.
W – Test statistic
Pr – Probability

4.2.3 Depression assessment

4.2.3.1 BDI scores

The Beck's depression inventory was used to assess depressive symptoms among haemodialysis patients because it is a widely validated and reliable self-report instrument for measuring the severity of depression in both clinical and non-clinical populations (Kubanek *et al*., 2024). The BDI questionnaire has been extensively applied in chronic illness populations, including patients with chronic kidney disease and those receiving haemodialysis, making it suitable for this study population. Importantly, the BDI captures cognitive, emotional, and somatic symptoms of depression, which are common among haemodialysis patients and may influence treatment adherence, including attendance at dialysis sessions and compliance with prescribed dialysis duration factors directly related to dialysis adequacy (Kt/V). Cronbach's alpha (α) of 0.886, confirming the reliability of the instrument (Kondo *et al.*, 2020).

In the current study, the severity of depression among CKD patients undergoing haemodialysis was evaluated using the BDI questionnaire presented in Table 4.7 below which was completed once by each participant and analyzed in consultation with a qualified psychologist. It was finalized at the onset of the study, comprising 21 questions along with a total score assessment.

Table 4.7 The median test for BDI total score

Analysis Variable : BDI total scores					
N	**Median**	**25th Pctl**	**75th Pctl**	**Minimum**	**Maximum**
78	17.00	13.00	22.00	1.00	50.00

N- Sample number
Pctl- interquartile range percentile

The median was 17.00, with an interquartile range of 13.00 to 22.00. Scores ranged from 1 to 50 as presented in Table 4.7 above, with a significant Shapiro-Wilk test p-value (< 0.0063) indicating non-normal distribution shown in Table 4.8 below.

Table 4.8 Normality test for BDI total score

Tests for Normality				
Test	**Statistic**		**p Value**	
Shapiro-Wilk	W	0.953429	**Pr < W**	**0.0063**
Kolmogorov-Smirnov	D	0.112789	Pr > D	0.0155
Cramer-von Mises	W-Sq	0.155059	Pr > W-Sq	0.0210
Anderson-Darling	A-Sq	0.907196	Pr > A-Sq	0.0210

Bold-faceted indicate significant values.
W – Test statistic
Pr - Probability

4.2.3.2 BDI categorization

Participants were categorized based on total BDI scores (Table 4.9), and the categories were composed as follows:

- 14 participants (17.95%) were classified as "No depression".
- 64 participants (82.04%) experienced varying levels of depression, distributed as follows:
  - Mild: 20 participants (25.64%)
  - Borderline: 20 participants (25.64%)
  - Moderate: 17 participants (21.79%)
  - Severe: 5 participants (6.41%)
  - Extreme: 2 participants (2.56%)

Table 4.9 The frequency procedure

BDI category	Frequency	Percent	Cumulative Frequency	Cumulative Percent
1: Considered normal/ no depression	14	17.95	14	17.95
2: Mild	20	25.64	34	43.59
3: Borderline	20	25.64	54	69.23
4: Moderate	17	21.79	71	91.03
5: Severe	5	6.41	76	97.44
6: Extreme	2	2.56	78	100.00

4.2.3.3 BDI item analysis

Detailed analysis of individual BDI items highlighted contributing factors to participants' depression levels. Key findings are presented below in Table 4.10:

- Sadness (Question 1): 51.28% disagreed with the statement, while 48.72% expressed varying degrees of agreement.
- Future Outlook (Question 2): Most participants (57.69%) strongly opposed the statement, indicating hopefulness about the future.
- Feelings of Failure (Question 3): A majority (67.95%) strongly disagreed, suggesting resilience among participants.
- Dissatisfaction (Question 4): A majority of 60.26% indicated partial agreement with the assertion of consistently feeling dissatisfied with everything, recognizing that they have

experienced a sense of dissatisfaction regarding all that occurs.

- Feelings of Guilt (Question 5): 58.97% strongly disagreed, indicating limited feelings of guilt.

- Feelings of Punishment (Question 6): A significant majority of 66.67% expressed strong disagreement with the notion of feeling punished, indicating instead that they experienced contrary emotions.

- Self-Hate (Question 7): A majority, comprising 65.38%, expressed total disagreement with the assertion of consistently feeling self-hatred, indicating that they do not experience such feelings.

- Self-Blame (Question 8): A majority of 47.44% expressed complete disagreement with the notion of consistently attributing all negative occurrences to oneself, indicating that they do not feel a sense of self-blame for every unfortunate event.

- Suicidal Thoughts (Question 9): 78.21% strongly disagreed, reflecting a low prevalence of suicidal ideation.

- Frequent Crying (Question 10): A majority representing 42.31%, strongly disagreed with the assertion concerning frequent crying

- Feelings of Irritation (Question 11): A majority, accounting for 42.31%, partially agreed with the statement regarding a constant feeling of irritation, indicating that they experience irritation at times.

- Loss of Interest (Question 12): A majority, specifically 42.31%, partially agreed with the statement regarding a loss of interest in others, while also expressing feelings that contradict this sentiment.

- Feeling of Indecisiveness (Question 13): 37.18% of the majority partially agree with the statement. The participants indicate that they occasionally find it challenging to make decisions.

- Feeling Ugly (Question 14): A significant 46.15% of the participants expressed disagreement with the statement, indicating that they do not perceive themselves as unattractive

- Feelings of Unfit (Question 15): 43.59% of participants agreed with the statement. The respondents agreed with the claim that they are incapable of performing any work.

• Sleeping Problems (Question 16): A total of 48.72% of participants expressed partial agreement with the statement. The participants reported experiencing occasional sleep issues, indicating that they are unable to sleep as they once did.

• Feelings of Tiredness (Question 17): A majority of participants, specifically 61.54%, expressed agreement with the statement. The participants reported occasionally experiencing significant fatigue that hinders their ability to engage in activities. They frequently request assistance from others to complete tasks.

• No Appetite (Question 18): A majority of participants, specifically 58.97%, expressed agreement with the statement regarding difficulties related to appetite. They reported a lack of enjoyment in the food they consume.

• Weight Loss (Question 19): 50% of the majority group expressed partial agreement with the statement regarding having lost some weight.

• Physical Problems (Question 20): A majority of 56.41% partially concurred with the statement expressing concern over their physical issues to the extent that it hinders their ability to focus on anything else.

• Low Libido (Question 21): A majority of 51.28% of participants partially concurred with the statement regarding a decline in interest in sexual activities. They reported engaging in sexual relations less frequently than they had in the past.

Table 4.10 BDI item analysis

BDI Questions	**Never**		**Sometimes**		**A lot**		**Always**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Q1. I am so sad and unhappy that I can't stand it	40	**51.28**	27	34.62	9	11.54	2	2.56
Q2. I feel the future is hopeless and that things cannot improve	45	**57.69**	22	28.21	7	8.97	4	5.13
Q3. I feel I am a complete failure as a person	53	**67.95**	18	23.08	6	7.69	1	1.28
Q4. I am dissatisfied or bored with everything	11	14.10	47	**60.26**	18	23.08	2	2.56
Q5. I feel guilty all the time	46	**58.97**	20	25.64	9	11.54	3	3.85
Q6. I feel I am being punished	52	**66.67**	16	20.51	4	5.13	6	7.69
Q7. I hate myself	51	**65.38**	21	26.92	3	3.85	3	3.85
Q8. I blame myself for everything bad that happens	37	**47.44**	28	35.90	8	10.26	5	6.41
Q9. I would kill myself if I had the chance	61	**78.21**	12	15.38	4	5.13	1	1.28
Q10. I cry all the time now	33	**42.31**	29	37.18	2	2.56	14	17.95
Q11. I feel irritated all the time	16	20.51	33	**42.31**	27	34.62	2	2.56

Q12. I have lost all of my interest in other people	23	29.49	33	**42.31**	22	28.21	0	0
Q13. I can't make decisions at all anymore	25	32.05	29	**37.18**	21	26.92	3	3.85
Q14. I believe that I look ugly	36	**46.15**	24	30.77	15	19.23	3	3.85
Q15. I can't do any work at all	10	12.82	30	38.46	34	**43.59**	4	5.13
Q16. I don't sleep as well as I used to	8	10.26	38	**48.72**	27	34.62	5	6.41
Q17. I am too tired to do anything	11	14.10	48	**61.54**	18	23.08	1	1.28
Q18. I have no appetite at all anymore	24	30.77	46	**58.97**	7	8.97	1	1.28
Q19. I have lost more than fifteen kgs	29	37.18	39	**50.00**	9	11.54	1	1.28
Q20. I am so worried about my physical problems that I cannot think of anything else	22	28.21	44	**56.41**	10	12.82	2	2.56
Q21. I have completely lost interest in sex	20	25.64	40	**51.28**	13	16.67	5	6.41

Bold-faceted indicate significant values
Freq – Frequency
% - percentage

4.2.4 Correlation analysis

The correlation between BDI and the other three variables namely overall urea, overall creatinine and overall Kt/V is reported in Table 4.11 below.

BDI total score and overall Kt/V average: A significant correlation is observed between the two variables Kt/V and BDI with r = -0.257 and p = 0.0231. Since r^2 = 0.0661 only 6.61% of the change in BDI score is due to the change in Overall Kt/V, where 93.39% of the change in BDI score is due to other factors.

The BDI and Overall urea: The analysis showed a non-significant correlation with p value = 0.779 and probability = -0.0329, while r^2= 0.0011. The BDI and Overall creatinine: A non-significant correlation was observed between the two-variable, p= 0.654 and r= 0.0522, while r^2= 0.0027.

Table 4.11 The correlation procedure

Spearman Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations	
	BDI total score
Overall Kt/V average	r = -0.25711 **p = 0.0231** n =78
Overall urea	r =-0.03293 **p = 0.7791** n = 75
Overall Creatinine	r = 0.05224 **p = 0.6541** n = 76

Bold-faceted indicate significant values
r = Spearman's correlation coefficient
p = p value
n = sample number

Correlation analysis between Kt/V results and BDI variables

The correlation analysis between the overall Kt/V and BDI total scores is reported in Table 4.12 below. The categories of mild mood disturbance and borderline clinical depression each comprised twenty (20) participants. Both the mild mood disturbance and moderate depression categories reached an identical maximum Kt/V value of 1.34, as well as the same median value of 1.03; however, their interquartile ranges are distinct. The interquartile range for mild mood disturbance spans from 0.99 to 1.11, whereas for moderate depression, it ranges from 1.00 to 1.07. The moderate depression category recorded the lowest minimum Kt/V value of 0.76. In contrast, the extreme depression category noted a maximum Kt/V value of 1.02, which is the lowest maximum value among all categories, with only two participants. The severe depression category exhibited the lowest median value.

Table 4.12 The correlation analysis: overall Kt/V average and BDI scores

Analysis Variable: Overall Kt/V average							
BDI Category	**N Obs**	**N**	**Median**	**25th Pctl**	**75th Pctl**	**Minimum**	**Maximum**
1: Considered normal/ no depression	14	14	1.09	1.03	1.11	0.97	1.18
2: Mild mood disturbance	20	20	1.03	0.99	1.11	0.97	1.34
3: Borderline clinical depression	20	20	1.05	1.02	1.10	0.94	1.20
4: Moderate depression	17	17	1.03	1.00	1.07	0.76	1.34
5: Severe depression	5	5	0.98	0.96	1.04	0.96	1.09
6: Extreme depression	2	2	0.99	0.96	1.02	0.96	1.02

Reliability analysis

The BDI demonstrated good internal consistency as shown in Table 4.13 below, with a Cronbach's alpha (α) of 0.886, confirming the reliability of the instrument

Table 4.13 The reliability test

Cronbach Coefficient Alpha	
Variables	**Alpha**
Raw	0.884455
Standardized	**0.886049**

Bold-faceted indicate significant values.

4.3 Discussion of results

Depression is the fourth leading cause of disability globally and is one of the most common psychological disorders among haemodialysis patients. Various factors, including emotional stress, treatment side effects, dietary restrictions, functional limitations, and economic status, contribute to depression in dialysis patients (Halili *et al*., 2021).

The aim of this study was to investigate the correlation between chronic haemodialysis patients' depression scores and dialysis adequacy. The primary objective was to measure the dialysis adequacy of participants by calculating their daily and average monthly Kt/V values. To achieve this, Kt/V values were recorded after each haemodialysis session, alongside any intradialytic complications during haemodialysis or interruptions, such as eating, or restroom breaks. The adequacy of dialysis was determined using the average monthly Kt/V values derived from clinical data collected during the study duration. The median “overall Kt/V average” value (Table 4.1) for the cohort was 1.04, indicating that all the participants are not within the minimum prescribed target range of more (>) than 1.2 based on spKt/V formula. When examining the data presented in Table 4.1, derived from the statistical analyses that solely concentrate on the average figures, it can be inferred that the participants do not achieve the prescribed Kt/V value of 1.4. However, this does not imply that every participant is incapable of attaining the Kt/V target of 1.4 or the minimum prescribed Kt/V dose of 1.2 or higher. A closer look at each haemodialysis session throughout the month (Annexure F – Raw Kt/V data) reveals that in every haemodialysis session, some participants did meet the target goal of Kt/V greater than 1.4 or the minimum required dose of Kt/V greater than 1.2. For example, in the first week (05 to 09 August 2024), 35 participants achieved the minimum required dose of more than 1.2, while only 14 reached the target of at least 1.4. In the second week (12 to 16 August 2024), 46 reached 1.2 or higher, while 12 achieved 1.4 or more. During the third week (19 to 23 August 2024), 39 met the minimum of 1.2 or above, while 16 reached 1.4 or more. In the fourth week (26 to 30 August 2024), 50 participants attained 1.2 or above, with 15 reaching 1.4 or more. All of this information pertains exclusively to the third month.

Current recommendations for dialysis adequacy target spKt/V of 1.4 per session (prescribed dose), with a minimum delivered spKt/V of 1.2 for patients undergoing dialysis three times a week (Halili *et al*., 2021). The findings, based on three months of data collection, revealed that participants achieved varying Kt/V values across dialysis sessions. Factors influencing the ability to attain adequate dialysis varied significantly. The use of inappropriate dialysis supplies, insufficient pump speed resulting from inadequate access cannulation or poor central venous catheter patency, excessive fluid retention, and non-adherence to medication or dialysis protocols are among the common factors that often lead to inadequate dialysis. The highest recorded (Table 4.1) "overall Kt/V average" was 1.34, and the lowest was 0.76, both below the recommended threshold. Although participants occasionally achieved or exceeded the target Kt/V of 1.4 during specific sessions, these occurrences were inconsistent and correlated with improved parameters such as better fluid management and enhanced blood flow.

Before each dialysis session, treatment parameters, including ultrafiltration goals and dry weight, were established based on individual dialysis prescriptions. These prescriptions varied for each participant, and factors such as ultrafiltration goals and dry weight impacted Kt/V values (Henning, 2007). Participants were assessed by nursing staff, with vital signs measured to establish treatment parameters. Despite this standard setup, the majority of participants failed to meet the recommended Kt/V target of 1.4. Participants who did not achieve adequate levels were predominantly male and had higher body weights. Although these participants required longer treatment durations, increased blood flow rates, and larger dialyzer surface areas, their dialysis parameters were similar to those of participants meeting adequacy targets. As indicated by Somji *et al*., (2020), dialysis adequacy is inversely related to the volume of urea distribution (V). Consequently, it is anticipated that patients with greater height will experience reduced dialysis adequacy, which may partially account for the observed differences, given that men typically have greater height than women. Furthermore, the elevated sodium levels found in males align with findings from our study, indicating a higher prevalence of excessive fluid retention in males.

Several factors not measured in the study can influence the Kt/V values. One factor was the setup of the dialysis machine, which required accurate input of parameters such as haematocrit, height, weight, and age. Errors in dialysis machine configuration affected Kt/V calculations. Furthermore, improper needling of arteriovenous fistulas (AVFs) or grafts (AVGs) led to reduced blood flow, necessitating lower pump speeds and consequently lower Kt/V values. Participants with central venous catheters (CVCs) faced additional challenges, including infections, kinks, and lumen port breakages, which disrupted blood flow and reduced dialysis adequacy.

Studies such as that by Schein and Cesar (2020) have shown that effective vascular access improves haemodialysis adequacy. For instance, AVFs and AVGs are associated with lower infection risks and reduced mortality rates compared to CVCs (Eynde *et al*., 2022). Needle size also influenced adequacy; smaller needles restricted blood flow, while larger needles increased the risk of vascular access rupture (Sikora *et al*., 2024). Low predialysis urea and residual renal function, as well as clotting within the circuit, posed additional challenges, leading to session interruptions and disposal of clotted blood, which had a negative impact on participants' haematocrit and haemoglobin levels. The dose of haemodialysis may be reduced in patients with significant residual kidney function. According to KDIGO (2024), residual kidney function needs to be monitored closely, and dialysis dose adjusted accordingly. However, residual renal function was not taken into account in our study.

Dialysis adequacy can be improved by adjusting treatment parameters such as session duration, blood flow rates, dialysate flow rates, and dialyzer size (Iman *et al*., 2024). For example, increasing the dialysate flow rate from 500 mL/min to 800 mL/min has been shown to enhance dialysis adequacy (Bohm *et al*., 2024). However, during this study, complications such as muscle cramps, intradialytic hypotension (IDH), and dialysis disequilibrium syndrome were reported. These complications often required session interruptions, further affecting Kt/V calculations.

Muscle cramps, reported in 5–20% of chronic haemodialysis patients, were linked to excessive ultrafiltration and skeletal muscle ischemia (Kot *et al*., 2024). Intradialytic hypotension, occurring in 5–30% cases, was associated with rapid fluid removal and antihypertensive medications (Cedeno *et al*., 2020). Dialysis disequilibrium syndrome, characterized by neurological symptoms, resulted from electrolyte imbalances during dialysis sessions (Mistry, 2019). These complications highlight the need for careful management to optimize treatment outcomes.

Comparative studies support these findings. For instance, Kilonzo *et al*., (2023) found a 36.7% prevalence of inadequate dialysis when assessed using Kt/V. They emphasized the importance of evaluating and documenting dialysis adequacy parameters using locally suitable equations. Kt/V is considered superior to URR as it accounts for ultrafiltration and urea generation during dialysis, whereas URR requires only pre- and post-dialysis blood urea nitrogen (BUN) levels (Ashby *et al*., 2019).

Our analysis included descriptive statistics for essential indicators of dialysis adequacy, such as urea and creatinine clearance. The mean value for 'overall urea' (Table 4.3) was recorded at 20.13 mmol/L, whereas 'overall creatinine' (Table 4.5) was noted at 778.30μmol/L, exceeding the KDIGO 2024 target ranges of 2.5 – 7.8 mmol/L for urea and 53 – 106 μmol/L for creatinine. These elevated values reflect the chronic kidney disease severity and the inadequacy of dialysis in the study population. participants. This aligns with Bahall *et al*., (2023), who reported a 62.1% prevalence of depression among CKD.

Now, as we examine the monthly blood results in Annexure G more closely, we see that in the third month (01 August 2024), just one (1) participant exhibited low pre-dialysis urea levels that conform to the recommended KDIGO 2024 guidelines. Additionally, there were seven (7) other participants with values below 15mmol/L, which are marginally outside the advised range. The remaining seventy (70) participants had significantly elevated pre-dialysis urea levels. Regarding creatinine, all participants displayed values that were above the acceptable range.

The results suggest various perspectives, including the participants' inadequate dietary habits and the accumulation of both variables resulting from chronic kidney disease. The BDI questionnaire revealed that participants reported experiencing appetite-related issues presented in Table 4.10 (question 18). Urea, a by-product of protein metabolism, is frequently utilized as an indicator of CKD severity and the adequacy of dialysis in clinical environments (Laville *et al*., 2023). It is the primary metabolite produced from dietary proteins and the turnover of tissue proteins. The impaired urinary excretion of urea due to CKD is the principal reason for the elevation of serum urea levels. Factors such as volume depletion from diuretics or a reduction in effective circulating volume caused by heart failure may also contribute to increased urea levels in our CKD patients (Vanholder *et al*., 2018). Throughout the progression of CKD, serum urea levels can easily rise to or surpass ten times the upper normal limit, particularly in cases of kidney failure (Laville *et al*., 2023).

This study, which recorded an overall urea median level of 20.13 mmol/L, aligns with the findings of Wang *et al*., (2019), who examined a cohort of 40 patients exclusively undergoing haemodialysis, suggesting a likely elevated long-term uremic burden. Wang *et al.* (2019) report a mean serum urea concentration exceeding 20 mmol/L, indicating that the differences observed between pre- and post-dialysis measurements were likely substantial. An additional study that yields comparable findings to our research is the cross-sectional study conducted by Dalimunthe *et al*. (2024), which involved 67 participants examining the relationship between skin moisture, serum urea levels, and the Dermatology Life Quality Index (DLQI) in patients with chronic kidney disease undergoing haemodialysis. The findings of their study revealed no significant correlation between serum urea levels and DLQI scores. Moreover, a negative correlation was noted, although the reason for this negative correlation was not clearly understood. The prevalence of haemodialysis inadequacy observed in our study closely aligns with the findings reported by Ndahayo *et al*., (2019) in Rwanda, where 38% of patients did not achieve the prescribed dose. Our analysis indicates that the elderly demographic faces a risk of inadequate haemodialysis that is more than double that of younger patients. Factors such as frailty and protein-energy malnutrition, which are prevalent among older individuals undergoing haemodialysis, are believed to hinder the clearance of dialysis urea and contribute to inadequate haemodialysis in this population (Somji *et al*., 2020). Furthermore, a study conducted by Burrowes *et al*., (2022), which examined the correlation between dietary protein and energy intake and comorbidities in older versus younger haemodialysis patients, suggests that older adults may benefit from more tailored treatment strategies to enhance outcomes.

The secondary aim of the study, which involved assessing depression through the Beck Depression Inventory (BDI), was conducted at the outset with the assistance of a team comprising a psychologist and healthcare professionals. Although the BDI tool is primarily a self-report questionnaire, a psychologist interview was conducted to validate the findings and ensure that all diagnostic criteria for mental disorders were satisfied. A median BDI score of 17 (Table 4.7) indicated that most participants were clinically depressed. This aligns with findings from Bahall *et al*., (2023), who report clinical depression rates of 62.1% among CKD patients. Although depression is a common disorder in these patients, it is frequently underdiagnosed and untreated during dialysis, which may be due to the similarity between the somatic symptoms of depression and those related to Uraemia (Kimmel, 2002). Depression in haemodialysis patients is influenced by factors such as socioeconomic status, employment challenges, dietary restrictions, and non-adherence to treatment protocols. Participants often reported inadequate psychological support following their CKD diagnosis, contributing to increased stress and depression.

Additionally, the study is closely aligned with the results of Zahran *et al*., (2024), which aimed to detect depression in patients undergoing regular haemodialysis. Their study revealed a significant proportion of patients with multiple comorbidities exhibiting signs of depression, highlighting the potential for overlapping emotional issues and the necessity for preventive and management strategies. They identified hypertension as the most prevalent condition, followed by diabetes and heart failure.

A noteworthy investigation conducted by Mosleh *et al*., (2020) revealed a significant disparity, indicating that males exhibited considerably higher BDI scores than females ($p = 0.022$), which aligns with the patterns observed in our study. Furthermore, a study conducted by Mal *et al*., (2024) corroborates our findings, indicating a significant prevalence of depression among patients undergoing haemodialysis. It is noteworthy that factors such as male gender, marital status, and current smoking were linked to an increased risk of depression within this demographic.

In the course of the study, several participants reported being diagnosed with multiple health conditions. They identified illnesses such as hypertension, diabetes mellitus, cardiovascular diseases, and some even felt at ease disclosing their HIV status. This aligns with the findings of Hawthorne *et al*., (2023), who identified a significant prevalence of multimorbidity among individuals with chronic kidney disease, encompassing both those in the early stages and those who have undergone transplantation. Their study highlighted a correlation between depressive symptoms and the progression to end-stage kidney disease, as well as an increased risk of developing comorbidities associated with heightened anxiety symptoms. Furthermore, a higher occurrence of mental health disorders was noted in the cohort of participants at stages 1 and 2 of the study.

The findings revealed a significant correlation between BDI scores and dialysis adequacy (Table 14). Participants with lower BDI scores achieved higher average Kt/V values compared to those with elevated scores. Despite these findings, the average Kt/V values for all groups remained below the recommended target of 1.4. Nonetheless, upon examining the performance of individuals by reviewing the session data in Annexure F, it becomes clear that some participants achieved the minimum required dose of 1.2 or more. In the first week of “month three”, 49% of participants met this minimum dosage requirement. In the Kt/V formula, if V is either underestimated or overestimated, the Kt/V calculation will be inaccurate. Minor inaccuracies in the volume estimation 'V' may have a limited impact on the Kt/V (Daugirdas) since it is utilized solely for a minor adjustment in the Daugirdas formula; however, these inaccuracies can lead to considerable errors in the assessment of dialysis dosage when utilizing OCM. Furthermore, machines frequently utilize formulas that consider sex, weight, and height, which might not be suitable for every body type when determining the prescribed dose.

This suggests that both physical and psychological factors have an impact on dialysis adequacy. Furthermore, non-adherence to treatment, medication, and dietary restrictions was identified as a contributor to inadequate dialysis and elevated urea and creatinine levels. Other factors include gender, age, marital status, BMI, dialysis adequacy and residual renal function, dialysis frequency, type of dialysis solution used, disease duration, and age at the start of dialysis.

The Kt/V formula is the most effective and commonly used index for prescribing the dialysis dose and evaluating the actual dose delivered. It is now widely acknowledged that an adequate delivery of HD dose, as indicated by Kt/V derived from urea reduction, is a vital factor influencing the clinical outcomes of patients undergoing chronic HD. This necessitates not only the prescription of an appropriate HD dose, but also the regular evaluation to ensure that the treatments administered are indeed adequate. It is important to highlight that Kt/V and protein catabolic rate (PCR) are two significant determinants of dialysis adequacy. Unfortunately, OCM cannot measure PCR. Furthermore, while Kt/V > 1.2 and PCR > 1.0 g/kg/d are essential, but there are not sufficient criteria for assessing dialysis adequacy (Tayebi-Khosroshahi *et al*., 2022).

The findings align with those of the study conducted by Xi *et al*., (2016), which involved 40 participants undergoing haemodialysis. Their study aimed to assess the prevalence of anxiety and depression among HD patients and to explore the relationship between these mental health conditions and both dialysis adequacy and nutritional status. The univariate logistic regression analysis revealed a significant inverse correlation between depression and albumin levels (P = 0.041, OR = 0.88 [95% CI = 0.78 to 0.99]) as well as Kt/V (P = 0.054, OR = 0.03 [95% CI = 0.01 to 1.07]).

Additionally, a study conducted by Noee *et al*., (2020) yielded results that align with our findings. This research involved 185 patients, revealing that the majority were male (n=101, 54.6%) with an average age of 55±1 years, while females (n=84, 45.4%) had a mean age of 59.8±0.85 years. Approximately 49.5% of the participants exhibited a urea reduction ratio of ≥0.65 and a Kt/V of ≥1.2. The adequacy of dialysis demonstrated a significant correlation with well-being, anxiety, and depression (P<0.001). The daily impact of haemodialysis and heightened treatment-related stressors can compound the therapeutic burden and contribute to the onset of depression (Xi *et al*., 2016).

A study conducted by Abdelmobdy *et al*., (2022) demonstrated a statistically significant correlation between the severity of the Beck Depression Inventory and access, with a p-value of 0.001. It was found that depression increases with the presence of a central venous catheter, and there is also a statistically significant correlation between BDI severity and interdialytic weight gain, again with a p-value of 0.001, indicating that depression escalates with increased interdialytic weight gain. Both CVC and interdialytic weight gain are identified as factors that influence the adequacy of dialysis.

A study conducted by Al Awwa *et al*., (2018) revealed a negative correlation between depressive symptoms and dialysis adequacy (Kt/V). Similarly, research by Hashemi *et al*., (2014) indicates an inverse relationship between dialysis adequacy and depression, suggesting that individuals with sufficient dialysis adequacy experience little to no depressive symptoms.

Conversely, the research carried out by Najafi *et al*., (2016) examined the two metrics of urea reduction and Kt/V, revealing that neither of these indicators has a significant correlation with the occurrence of depression and anxiety among patients. However, age significantly influences the levels of depression and anxiety in individuals undergoing haemodialysis treatment. Additionally, the study by Jeon *et al*., (2024) indicates that age affects Kt/V outcomes. Thus, it can be concluded that age, as a component of Kt/V parameters, is related to both dialysis adequacy and the prevalence of depression.

In conclusion, this study highlights the importance of achieving dialysis adequacy, as indicated by Kt/V, to improve quality of life and reduce depression among haemodialysis patients. Future research should explore the correlation between depression and treatment adherence, as well as the development of psychosocial interventions to support CKD patients. The findings emphasize the need for multidisciplinary approaches to optimize dialysis adequacy and address the psychological well-being of patients undergoing long-term haemodialysis.

Chapter 5
Conclusion and recommendations

5.1 Conclusion

Chronic kidney disease and dialysis have an impact on patients beyond the physical symptoms of the disease. The results in Table 4.11 indicated a significant correlation between the average Kt/V and the total BDI score. However, no significant correlation was found between the average urea level and the total BDI score or between the average creatinine level and the total BDI score. The *p*-values for average urea (0.779) and average creatinine (0.654) exceeded the 0.05 threshold. This suggests that other factors may influence these, making the results inconclusive. Possible factors may include dietary protein intake, renal residual function, fluid status, medication, duration of dialysis treatment and adherence to dialysis treatment protocol.

Conversely, the data revealed a significant relationship between the average Kt/V and the total BDI score, with a p-value of 0.02, leading to the rejection of the null hypothesis. This finding suggests that intensive haemodialysis, which entails significant lifestyle changes and expectations, has an impact on patients' mental health. The researcher strongly recommends increasing awareness of the psychological well-being of patients with CKD. Governments should prioritize increasing funding to support poorly diagnosed CKD patients who cannot afford private treatment. This study highlights the potential of psychosocial interventions, such as cognitive-behavioral therapy, exercise programs and counselling to alleviate depression symptoms and enhance patients’ quality of life. Incorporating depression screening into the assessment of all pre-dialysis CKD patients is essential. Nephrologists can advise on the appropriate referral of patients in the acute stage to mental health specialists. Additionally, achieving the target Kt/V rate not only improves the clinical outcomes of patients undergoing haemodialysis but may also positively influence their mental health by reducing treatment-related complications, enhancing overall well-being, and potentially alleviating psychological distress associated with inadequate dialysis.

5.2 Limitations

Although the study initially planned to recruit 100 participants, only 78 consented to participate. This shortfall resulted from hospital admissions and vacations during the data collection period. Another limitation was that three participants experienced medical insurance issues preventing them from undergoing blood tests for urea and creatinine.

However, this did not have an impact on the findings, as no significant correlation was observed between these markers and the BDI total score.

An additional limitation in this research was the inability to conduct the URR test, as this would have required participants to incur out-of-pocket expenses. Medical aid schemes have strict protocols regarding which tests are fully covered for patients, and any tests performed outside of this schedule must be paid for by the individual. Consequently, the research team opted to use the Kt/V tool, which is acknowledged as a dependable and precise method for evaluating the adequacy of dialysis. While OCM provides a convenient and non- invasive method for measuring Kt/V, it is essential to acknowledge its limitations, including the potential underestimation of dialysis efficiency and the possible impact of machine type and volume estimation techniques when interpreting the findings. All haemodialysis machines utilized are of the same brand and model; therefore, it is advisable to evaluate this online clearance monitoring (OCM) model on various brands of haemodialysis machines to ensure the reliability of the results. The use of small molecules and variability can also influence the outcomes. It serves as a single marker, whereas a comprehensive assessment should include clinical evaluations, patient-reported outcome measures (PROM), as well as middle and large molecules. A notable limitation of the study was the potential for errors arising from the use of incorrect haemodialysis consumables or the pre-setting of inaccurate machine parameters. Such mistakes could compromise the accuracy of Kt/V calculations, meaning some values might not precisely reflect dialysis adequacy. To mitigate this risk, staff prepared the dialysis machines while cross-checking each patient's prescription immediately before treatment, ensuring greater reliability of the recorded data. Dialysis doses should be individualized.

The study was geographically restricted to the Northern Cape and Free State provinces due to their proximity to the principal investigator and to avoid delays in data collection. This limitation may affect the generalizability of the findings.

5.3 Research recommendations

Individuals exhibiting signs of depression, as indicated by BDI scores, should be promptly referred to psychologists. Furthermore, all CKD patients should be educated on access care, dialysis complications and prevention, mental health, and the adequacy of dialysis. Special emphasis should be placed on patients demonstrating non-compliance with haemodialysis treatments, prescribed medications, and dietary recommendations.

Consistency in evaluating dialysis prescriptions is critical. Nursing staff and nephrologists should ensure regular monitoring and strict adherence to prescribed treatment protocols to optimize both clinical outcomes and patient well-being. For example, even patients with well-matured vascular access may experience reduced dialysis adequacy if small needles or low pump speeds are used, which can negatively impact Kt/V values and overall treatment effectiveness.

The principal investigator recommends that support group meetings be arranged for the family members of participants with CKD, focusing on educational topics throughout the sessions. Various professionals, including psychologists, financial advisors, dietitians, and nephrologists, can be invited to these meetings to provide lectures on how to assist individuals with CKD, as this condition not only impacts on the patients but also their families.

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Annexures

1. Annexure A - Information sheet
2. Annexure B - Signed informed consent
3. Annexure C – Completed BDI
4. Annexure D – Blood test results
5. Annexure E - Chronic haemodialysis charts
6. Annexure F – Raw Kt/V data (month three)
7. Annexure G – Raw data (Blood results)
8. Annexure H - HSREC Ethical Clearance
9. Annexure I – NRC approval letter

Annexure A

INFORMATION DOCUMENT

Study title: The correlation between depression and adequacy in chronic haemodialysis patients in South Africa

Greetings:

Introduction:

I, Miya Bongani is doing research on the correlation between depression and adequacy in chronic haemodialysis patients in South Africa. Research is just the process to learn the answer to a question. In this study we want to learn the correlation between the presence of depression and achieving adequate dialysis dose in chronic haemodialysis patients in Free State and Northern Cape.

Invitation to participate: We are asking/inviting you to participate in a research study.

What is involved in the study: The study will be prospective analytic study; data will be collected over three months. The study will involve participants in stage 5 of kidney failure undergoing dialysis, which includes chronic haemodialysis. The study will include participants attending dialysis sessions three days a week, each session lasting four hours. Consequently, each participant will undergo 12 sessions in a month, resulting in a total of 36 sessions over a three-month period. Participants will complete the Beck's depression inventory questionnaire only once at the initial stage of the study. The data that will be then collected in three months will be as follows:

- Kt/V value every dialysis session through dialysis machine.
- Haemoglobin once a month
- Urea once a month
- Creatinine once a month

Haemoglobin, Urea and Creatinine will be collected from the laboratory. Patients will not be expected to take another blood tests.

Risks of being involved in the study: Participants will not be subjected to any risk as the study is prospective. Psychologist will assist with the questionnaire.

Benefits of being in the study: Drafting of the standard operating procedure and guidelines for CKD patients with mental health.

Participation is voluntary, and refusal to participate will involve no penalty or loss of benefits to which the subject is otherwise entitled; the participants may discontinue participation at any time without penalty or loss of benefits to which the subject is otherwise entitled.

Reimbursements for "out of pocket" expenses. There will be no financial obligations for

participants, and they will not receive any reimbursement for their participation in the study.
Confidentiality: Efforts will be made to keep personal information confidential. Personal information may be disclosed if required by law. Organizations that may inspect and/or copy your research records for quality assurance and data analysis include groups such as the biostatistician, ethics committee for medical research and the medicines control council.

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Annexure B

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CONSENT TO PARTICIPATE IN RESEARCH

CONSENT TO PARTICIPATE IN RESEARCH

PROJECT TITLE: The relationship between chronic haemodialysis patients' depression scores and adequate haemodialysis

You have been asked to participate in a research study. You have been informed about the study by: Miya Bongani

Participant : You have been informed about any available compensation or medical treatment if injury occurs as a result of study-related procedures.

You may contact **Miya Bongani** at **0735392512** any time if you have questions about the research or if you are injured as a result of the research.

You may contact the Secretariat of the Ethics Committee of the Faculty of Health Sciences, UFS at telephone number (051) 4052812 if you have questions about your rights as a research subject.

Your participation in this research is voluntary, and you will not be penalized or lose benefits if you refuse to participate or decide to terminate participation.

It is also important to note that your attending doctor will be informed about the questionnaire results by Psychologist immediately after the analysis. Study results will also be shared with you and medical staff once completion of the study.

It is important to note that you as the participant will cover the costs should the mental health services be required. This will include consultations with mental health specialists and medications.

If you agree to participate, you will be given a signed copy of this document as well as the participant information sheet, which is a written summary of the research.

The research study, including the above information has been verbally described to me. I understand what my involvement in the study means and I voluntarily agree to participate.

05 June 2024

Signature of Participant Date

MATLI S.G

5 June 24

Signature of Witness Date

(Where applicable)

Signature of Translator Date

(Where applicable)

P26-MOH

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.
- 0 I do not feel sad.
- 1 I feel sad
- 2 I am sad all the time and I can't snap out of it.
- 3 I am so sad and unhappy that I can't stand it.

2.
- 0 I am not particularly discouraged about the future.
- 1 I feel discouraged about the future.
- 2 I feel I have nothing to look forward to.
- 3 I feel the future is hopeless and that things cannot improve.

3.
- 0 I do not feel like a failure.
- 1 I feel I have failed more than the average person.
- 2 As I look back on my life, all I can see is a lot of failures.
- 3 I feel I am a complete failure as a person.

4.
- 0 I get as much satisfaction out of things as I used to.
- 1 I don't enjoy things the way I used to.
- 2 I don't get real satisfaction out of anything anymore.
- 3 I am dissatisfied or bored with everything.

5.
- 0 I don't feel particularly guilty
- 1 I feel guilty a good part of the time.
- 2 I feel quite guilty most of the time.
- 3 I feel guilty all of the time.

6.
- 0 I don't feel I am being punished.
- 1 I feel I may be punished.
- 2 I expect to be punished.
- 3 I feel I am being punished.

7.
- 0 I don't feel disappointed in myself.
- 1 I am disappointed in myself.
- 2 I am disgusted with myself.
- 3 I hate myself.

8.
- 0 I don't feel I am any worse than anybody else.
- 1 I am critical of myself for my weaknesses or mistakes.
- 2 I blame myself all the time for my faults.
- 3 I blame myself for everything bad that happens.

9.
- 0 I don't have any thoughts of killing myself.
- 1 I have thoughts of killing myself, but I would not carry them out.
- 2 I would like to kill myself.
- 3 I would kill myself if I had the chance.

10.
- 0 I don't cry any more than usual.
- 1 I cry more now than I used to.
- 2 I cry all the time now.
- 3 I used to be able to cry, but now I can't cry even though I want to.

11.
0 I am no more irritated by things than I ever was.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time.

12.
0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions more than I used to.
3 I can't make decisions at all anymore.

14.
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly.

15.
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16.
0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.
0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18.
0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19.
0 I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.

20.

0	I am no more worried about my health than usual.
1	I am worried about physical problems like aches, pains, upset stomach, or constipation.
2	I am very worried about physical problems and it's hard to think of much else.
3	I am so worried about my physical problems that I cannot think of anything else.

21.

0	I have not noticed any recent change in my interest in sex.
1	I am less interested in sex than I used to be.
2	I have almost no interest in sex.
3	I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score 4	Levels of Depression
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
over 40	Extreme depression

http://www.med.navy.mil/sites/NMCP2/PatientServices/SleepClinicLab/Documents/Beck_Depression_Inventory.pdf

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Central University of Technology, Free State

(1)

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.
0 I do not feel sad.
1 I feel sad
2 I am sad all the time and I can't snap out of it.
3 I am so sad and unhappy that I can't stand it.

2.
0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel the future is hopeless and that things cannot improve.

3.
0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

4.
0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

5.
0 I don't feel particularly guilty
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6.
0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7.
0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8.
0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9.
0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10.
0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11.
0 I am no more irritated by things than I ever was.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time.

12.
0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions more than I used to.
3 I can't make decisions at all anymore.

14.
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly.

15.
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16.
0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.
0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18.
0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19.
0 I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.

20.
0 I am no more worried about my health than usual.
~~1~~ I am worried about physical problems like aches, pains, upset stomach, or constipation.
2 I am very worried about physical problems and it's hard to think of much else.
3 I am so worried about my physical problems that I cannot think of anything else.

21.
0 I have not noticed any recent change in my interest in sex.
1 I am less interested in sex than I used to be.
~~2~~ I have almost no interest in sex.
3 I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score 20	Levels of Depression
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
over 40	Extreme depression

http://www.med.navy.mil/sites/NMCP2/PatientServices/SleepClinicLab/Documents/Beck_Depression_Inventory.pdf

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Pg 1

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.

0 I do not feel sad.
1 I feel sad
2 I am sad all the time and I can't snap out of it.
3 I am so sad and unhappy that I can't stand it.

2.

0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel the future is hopeless and that things cannot improve.

3.

0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

4.

0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

5.

0 I don't feel particularly guilty
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6.

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7.

0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8.

0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9.

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10.

0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11.

0 I am no more irritated by things than I ever was.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time.

12.

0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.

0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions more than I used to.
3 I can't make decisions at all anymore.

14.

0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly.

15.

0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16.

0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.

0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18.

0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19.

0 I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.

Pg 2

20.

0	I am no more worried about my health than usual.
1	I am worried about physical problems like aches, pains, upset stomach, or constipation.
(2)	I am very worried about physical problems and it's hard to think of much else.
3	I am so worried about my physical problems that I cannot think of anything else.

21.

(0)	I have not noticed any recent change in my interest in sex.
1	I am less interested in sex than I used to be.
2	I have almost no interest in sex.
3	I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score 31	Levels of Depression
1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40 X	Severe depression
over 40	Extreme depression

http://www.med.navy.mil/sites/NMCP2/PatientServices/SleepClinicLab/Documents/Beck_Depression_Inventory.pdf

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PR- SEN

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.

0 I do not feel sad.
1 I feel sad
2 I am sad all the time and I can't snap out of it.
3 I am so sad and unhappy that I can't stand it.

2.

0 I am not particularly discouraged about the future.
1 I feel discouraged about the future.
2 I feel I have nothing to look forward to.
3 I feel the future is hopeless and that things cannot improve.

3.

0 I do not feel like a failure.
1 I feel I have failed more than the average person.
2 As I look back on my life, all I can see is a lot of failures.
3 I feel I am a complete failure as a person.

4.

0 I get as much satisfaction out of things as I used to.
1 I don't enjoy things the way I used to.
2 I don't get real satisfaction out of anything anymore.
3 I am dissatisfied or bored with everything.

5.

0 I don't feel particularly guilty
1 I feel guilty a good part of the time.
2 I feel quite guilty most of the time.
3 I feel guilty all of the time.

6.

0 I don't feel I am being punished.
1 I feel I may be punished.
2 I expect to be punished.
3 I feel I am being punished.

7.

0 I don't feel disappointed in myself.
1 I am disappointed in myself.
2 I am disgusted with myself.
3 I hate myself.

8.

0 I don't feel I am any worse than anybody else.
1 I am critical of myself for my weaknesses or mistakes.
2 I blame myself all the time for my faults.
3 I blame myself for everything bad that happens.

9.

0 I don't have any thoughts of killing myself.
1 I have thoughts of killing myself, but I would not carry them out.
2 I would like to kill myself.
3 I would kill myself if I had the chance.

10.

0 I don't cry any more than usual.
1 I cry more now than I used to.
2 I cry all the time now.
3 I used to be able to cry, but now I can't cry even though I want to.

11.
0 I am no more irritated by things than I ever was.
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time.
3 I feel irritated all the time.

12.
0 I have not lost interest in other people.
1 I am less interested in other people than I used to be.
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to.
2 I have greater difficulty in making decisions more than I used to.
3 I can't make decisions at all anymore.

14.
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive.
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly.

15.
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all.

16.
0 I can sleep as well as usual.
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep.

17.
0 I don't get more tired than usual.
1 I get tired more easily than I used to.
2 I get tired from doing almost anything.
3 I am too tired to do anything.

18.
0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be.
2 My appetite is much worse now.
3 I have no appetite at all anymore.

19.
0 I haven't lost much weight, if any, lately.
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.

20.
- 0 I am no more worried about my health than usual.
- (1) I am worried about physical problems like aches, pains, upset stomach, or constipation.
- 2 I am very worried about physical problems and it's hard to think of much else.
- 3 I am so worried about my physical problems that I cannot think of anything else.

21.
- 0 I have not noticed any recent change in my interest in sex.
- 1 I am less interested in sex than I used to be.
- 2 I have almost no interest in sex.
- (3) I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score ____44.____ Levels of Depression

1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
over 40	Extreme depression

http://www.med.navy.mil/sites/NMCP2/PatientServices/SleepClinicLab/Documents/Beck_Depression_Inventory.pdf

Central University of Technology, Free State

P35-Jam

Beck's Depression Inventory

This depression inventory can be self-scored. The scoring scale is at the end of the questionnaire.

1.
- 0 I do not feel sad.
- 1 I feel sad
- 2 I am sad all the time and I can't snap out of it.
- 3 I am so sad and unhappy that I can't stand it. ✓

3

2.
- 0 I am not particularly discouraged about the future.
- 1 I feel discouraged about the future.
- 2 I feel I have nothing to look forward to.
- 3 I feel the future is hopeless and that things cannot improve. ✓

3

3.
- 0 I do not feel like a failure.
- 1 I feel I have failed more than the average person.
- 2 As I look back on my life, all I can see is a lot of failures. ✓
- 3 I feel I am a complete failure as a person.

2

4.
- 0 I get as much satisfaction out of things as I used to.
- 1 I don't enjoy things the way I used to. ✓
- 2 I don't get real satisfaction out of anything anymore.
- 3 I am dissatisfied or bored with everything.

1

5.
- 0 I don't feel particularly guilty
- 1 I feel guilty a good part of the time.
- 2 I feel quite guilty most of the time.
- 3 I feel guilty all of the time. ✓

3

6.
- 0 I don't feel I am being punished.
- 1 I feel I may be punished.
- 2 I expect to be punished.
- 3 I feel I am being punished. ✓

3

7.
- 0 I don't feel disappointed in myself.
- 1 I am disappointed in myself.
- 2 I am disgusted with myself.
- 3 I hate myself. ✓

3

8.
- 0 I don't feel I am any worse than anybody else.
- 1 I am critical of myself for my weaknesses or mistakes.
- 2 I blame myself all the time for my faults.
- 3 I blame myself for everything bad that happens. ✓

3

9.
- 0 I don't have any thoughts of killing myself.
- 1 I have thoughts of killing myself, but I would not carry them out.
- 2 I would like to kill myself.
- 3 I would kill myself if I had the chance. ✓

3

10.
- 0 I don't cry any more than usual.
- 1 I cry more now than I used to.
- 2 I cry all the time now.
- 3 I used to be able to cry, but now I can't cry even though I want to. ✓

3

11.
0 I am no more irritated by things than I ever was. 2
1 I am slightly more irritated now than usual.
2 I am quite annoyed or irritated a good deal of the time. ✓
3 I feel irritated all the time.

12.
0 I have not lost interest in other people. 1
1 I am less interested in other people than I used to be. ✓
2 I have lost most of my interest in other people.
3 I have lost all of my interest in other people.

13.
0 I make decisions about as well as I ever could.
1 I put off making decisions more than I used to. 2
2 I have greater difficulty in making decisions more than I used to. ✓
3 I can't make decisions at all anymore.

14.
0 I don't feel that I look any worse than I used to.
1 I am worried that I am looking old or unattractive. 3
2 I feel there are permanent changes in my appearance that make me look unattractive
3 I believe that I look ugly. ✓ 3

15.
0 I can work about as well as before.
1 It takes an extra effort to get started at doing something.
2 I have to push myself very hard to do anything.
3 I can't do any work at all. ✓

16.
0 I can sleep as well as usual. 3
1 I don't sleep as well as I used to.
2 I wake up 1-2 hours earlier than usual and find it hard to get back to sleep.
3 I wake up several hours earlier than I used to and cannot get back to sleep. ✓

17.
0 I don't get more tired than usual.
1 I get tired more easily than I used to. 2
2 I get tired from doing almost anything. ✓
3 I am too tired to do anything.

18.
0 My appetite is no worse than usual.
1 My appetite is not as good as it used to be. 3
2 My appetite is much worse now.
3 I have no appetite at all anymore. ✓

19.
0 I haven't lost much weight, if any, lately. ✓ 0
1 I have lost more than five pounds.
2 I have lost more than ten pounds.
3 I have lost more than fifteen pounds.

20.

0 I am no more worried about my health than usual.

1 I am worried about physical problems like aches, pains, upset stomach, or constipation.

2 I am very worried about physical problems and it's hard to think of much else.

3 I am so worried about my physical problems that I cannot think of anything else. ✓ 3

21.

0 I have not noticed any recent change in my interest in sex.

1 I am less interested in sex than I used to be. ✓ 1

2 I have almost no interest in sex.

3 I have lost interest in sex completely.

INTERPRETING THE BECK DEPRESSION INVENTORY

Now that you have completed the questionnaire, add up the score for each of the twenty-one questions by counting the number to the right of each question you marked. The highest possible total for the whole test would be sixty-three. This would mean you circled number three on all twenty-one questions. Since the lowest possible score for each question is zero, the lowest possible score for the test would be zero. This would mean you circles zero on each question. You can evaluate your depression according to the Table below.

Total Score ___50___ Levels of Depression

1-10	These ups and downs are considered normal
11-16	Mild mood disturbance
17-20	Borderline clinical depression
21-30	Moderate depression
31-40	Severe depression
over 40	Extreme depression

50/63

http://www.med.navy.mil/sites/NMCP2/PatientServices/SleepClinicLab/Documents/Beck_Depression_Inventory.pdf

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Annexure D

Drs Du Buisson, Kramer, Swart, Bouwer Inc.
Registration number 2007/018337/21

Sample: E01 EDTA Haematology (1), E98 EDTA Plasma (...

Test	ABN	Result	Reference Range	Unit
HAEMATOLOGY				
Haemoglobin	L	10.3	13.6-17.6	g/dl
White Cell Count	L	3.81	4.31-12.39	10 9/L
Platelet Count		194	175-375	10 9/L
CHEMISTRY				
Sodium		142	136-145	mmol/l
Potassium		4.9	3.5-5.1	mmol/l
Total CO2	L	19	22-29	mmol/l
Creatinine				
Creatinine	*H	1132	64-104	umol/l
Estimated GFR (CKD-EPI)	*L	4	> 90	ml/min

Estimated glomerular filtration rate (ml/min/1.73m2) (CKD-EPI)
* Unreliable at the extremes of body size and age.
* Unreliable in acute renal failure.
* Chronic kidney disease should be classified using the combination of Cause, Glomerular filtration rate (GFR) category and Albuminuria category.

: GFR CATEGORIES in Chronic Kidney Disease (CKD) :

: Category : GFR : Terms :

Central University of Technology, Free State

Drs Du Buisson, Kramer, Swart, Bouwer
Registration number 2007/0183

Sample: E01 EDTA Haematology (1), S01 SST (1)

Test	ABN	Result	Reference Range	Unit
HAEMATOLOGY				
Haemoglobin	L	9.8	11.7-15.3	g/dl
CHEMISTRY				
Urea Pre-dialysis	#H	22.4	1.7-8.3	mmol/l
Previous Result: 11.5 on 07/02/24-1257				

For Consultation - Doctors only. Please call:

Drs Du Buisson, Kramer, Swart, Bouwer In
Registration number 2007/018337/

Test	ABN	Result	Reference Range	Unit
HAEMATOLOGY				
Haemoglobin	L	10.6	11.7-15.3	g/dl
CHEMISTRY				
Urea Pre-dialysis	H	23.2	1.7-8.3	mmol/l

For Consultation - Doctors only. Please call:

Drs Du Buisson, Kramer, Swart, Bou
Registration number 2007/0
PR05200

Test	ABN	Result	Reference Range	Unit
HAEMATOLOGY				
Haemoglobin	#	13.2	11.7-15.3	g/dl
Previous Result: 9.8 on 03/05/24-1126				
White Cell Count		8.44	4.71-13.20	10 9/L
Platelet Count		211	193-459	10 9/L
CHEMISTRY				
Sodium	L	133	136-145	mmol/l
Potassium		4.2	3.5-5.1	mmol/l
Total CO2	L	18	22-29	mmol/l
Creatinine				
Creatinine	H	403	49-90	umol/l
Estimated GFR (CKD-EPI)	*L	11	> 90	ml/min

Estimated glomerular filtration rate (ml/min/1.73m2) (CKD-EPI)
* Unreliable at the extremes of body size and age.
* Unreliable in acute renal failure.
* Chronic kidney disease should be classified using the combination of Cause, Glomerular filtration rate (GFR) category and Albuminuria category.

: GFR CATEGORIES in chronic kidney disease (CKD) :

: Category : GFR : Terms :

Central University of Technology, Free State

Annexure E

T HELPDESK LOG NUM

DATE					
PATIENT NAME					
ALLERGIES					
START OF CARE					
START OF DIALYSIS					
TEMPERATURE (PRE/POST)					
DRY WT			RE WT	1[illegible].5	
GAINED (PRE)		LOST (POST)		Kt/V	1.4/0.8

DIALYSIS DETAILS

QH/TIMES PER WEEK	4/3	Qd	600	CONCENTRATE	N.G
DIALYSER	Revaclear 400			UF	3L
HEPARIN LOADING DOSE	1000 I.U			HEPARIN MAINTENANCE	1000 I.U
TOTAL HEPARIN	3000 I.U				
MACHINE NAME / SERIAL NO:	SHANONAH			LOCATION NUMBER	5

EVENT	TIME	BP	PULSE	Qb	ARTERIAL P°	VENOUS P°	TMP	UF RATE	EPO/Iron Sticker (If administered)	HOURLY CHECKS- DDP SIGN
					—	—	—	—		Matlz S.S.G
PRE	07:30	167/99	81	—						
										Matlz S.S.G
INTRA	07:40	153/92	76	250	-94	107	7	0.80		Matlz S.S.G
	08:40	151/88	78	250	-101	110	11	0.79		Matlz S.S.G
	09:40	140/90	77	250	-97	119	18	0.63		Matlz S.S.G
	10:40	154/94	80	250	-105	123	21	0.55		
						—	—	—		Matlz S.S.G
POST	11:40	129/86	80	—	—					

SALINE BOLUS	Nil	BLOOD ADMINISTERED	Nil
CLOTTING	Clear	DISINFECTION	Heat

PRIMED BY: MATLZ SELLO GORDON	CONNECTED BY: MATLZ SELLO GORDON	DISCONNECTED BY: MATLZ SELLO GORDON
SIGNATURE: MATLZ S.S.G	SIGNATURE: MATLZ S.S.G	SIGNATURE: MATLZ S.S.G

SS ASSESSMENT	AVF/AVG	BRUIT/ THRILL	ANEURYSM	BRUISES	SWELLING	PAIN	REDNESS	SKIN CONDITION	SURROUNDING SKIN
	✓	✓	✗	✗	✗	✗	✗	Intact	Healthy
	PC/TC	A/V LUMEN PATENCY	CRUST	EXUDATE	SWELLING	TENDER / PAIN	REDNESS	DRESSING	A/V LOCKING VOL

Central University of Technology, Free State

IT HELPDESK LOG NU					
DATE					
PATIENT NAME					
ALLERGIES					
START OF CARE					
START OF DIALYSIS					
TEMPERATURE (PRE/POST)					
DRY WT		PREVIOUS WT		RE WT	56.3	POST WT
GAINED (PRE)		LOST (POST)		Kt/V	1.4/0.9

DIALYSIS DETAILS

QH/TIMES PER WEEK	4/3	Qd 600	CONCENTRATE	L.G
DIALYSER	Revaclear 450		UF	3.31
HEPARIN LOADING DOSE	1000i.u		HEPARIN MAINTENANCE	1000i.u
TOTAL HEPARIN	3000i.u			
MACHINE NAME / SERIAL NO:	TRACEY		LOCATION NUMBER	1

EVENT	TIME	BP	PULSE	Qb	ARTERIAL P°	VENOUS P°	TMP	UF RATE	EPO/Iron Sticker (If administered)	HOURLY CHECKS- D SIGN
				—	—	—	—	—		Matlu S
PRE	08:30	169/88	74							
INTRA	08:40	168/83	73	250	-110	92	0.62	4		Matlu S
	09:40	166/90	76	250	-119	74	0.74	11		Matlu S
	10:42	176/96	74	250	-127	83	0.59	18		Matlu S
	11:40	163/81	73	250	-130	101	0.93	21		Matlu S
						—	—	—		Matlu S
POST	12:40	186/93	76	—	—					

SALINE BOLUS	Nil	BLOOD ADMINISTERED	Nil
CLOTTING	Clear	DISINFECTION	Heat

PRIMED BY: Matlu Sello Gordon	CONNECTED BY: Matlu Sello Gordon	DISCONNECTED BY: Matlu Sello Gord
SIGNATURE: Matlu S.S.G	SIGNATURE: Matlu S.S.G	SIGNATURE: Matlu S.S.G

ACCESS ASSESSMENT	AVF/AVG	BRUIT/ THRILL	ANEURYSM	BRUISES	SWELLING	PAIN	REDNESS	SKIN CONDITION	SURROUNDING SKIN
	AVF	✓	x	x	x	x	x	Intact	Healthy
	PC/TC	A/V LUMEN PATENCY	CRUST	EXUDATE	SWELLING	TENDER / PAIN	REDNESS	DRESSING	A/V LOCKING VOL
	PIE	✓	✓	x	x	x	x	Intact	Heparin 1.9/1.9

UL / SHIFT LEADER NAME:	Matlu Sello Gordon	UL / SHIFT LEADER SIGNATURE:	Matlu S.S.G

Central University of Technology, Free State

IT HELPDESK LOG N							
DATE							
PATIENT NAME							
ALLERGIES							
START OF CARE							
START OF DIALYSIS							
TEMPERATURE (PRE/POST)							
DRY WT		PREVIOUS WT		PRE WT	70	POST WT	[illegible]
GAINED (PRE)		LOST (POST)		Kt/V	1.4/1.1		

DIALYSIS DETAILS

QH/TIMES PER WEEK	3/3	Qd	600	CONCENTRATE	STD
DIALYSER	Revaclear 400			UF	3L
HEPARIN LOADING DOSE	1000I.U			HEPARIN MAINTENANCE	1000I.U
TOTAL HEPARIN	3000I.U				
MACHINE NAME / SERIAL NO:	NEO			LOCATION NUMBER	3

EVENT	TIME	BP	PULSE	Qb	ARTERIAL P°	VENOUS P°	TMP	UF RATE	EPO/Iron Sticker (If administered)	HOURLY CHECKS- D SIGN
PRE	07:20	160/93	103	–	–	–	–	–	–	MATUZ S[illegible]
INTRA	07:30	169/90	97	280	-114	110	4	0.69		MATUZ S
	08:30	151/83	95	280	-119	130	13	0.72		MATUZ S
	09:30	163/83	95	280	-123	127	21	0.81		MATUZ S
										[illegible]
POST	10:30	164/84	105	–	–	–	–	–		MATUZ S

SALINE BOLUS	Nil	BLOOD ADMINISTERED	Nil
CLOTTING	Clear	DISINFECTION	Heat

PRIMED BY: MATUZ SELLO GORDON	CONNECTED BY: MATUZ SELLO GORDON	DISCONNECTED BY: MATUZ SELLO GORDON
SIGNATURE: MATUZ S.G[CT]	SIGNATURE: MATUZ S.G[CT]	SIGNATURE: MATUZ S.G[CT]

ACCESS ASSESSMENT	AVF/AVG	BRUIT/ THRILL	ANEURYSM	BRUISES	SWELLING	PAIN	REDNESS	SKIN CONDITION	SURROUNDING SKIN
	✓	✓	x	x	x	x	x	Intact	Healthy
	PC/TC	A/V LUMEN PATENCY	CRUST	EXUDATE	SWELLING	TENDER / PAIN	REDNESS	DRESSING	A/V LOCKING VOL
	P/C	✓	✓	x	x	x	x	Intact	Heparin 1.9/1.9

UL / SHIFT LEADER NAME: MATUZ SELLO GORDON | UL / SHIFT LEADER SIGNATURE: MATUZ S.G[illegible]

Central University of Technology, Free State

T HELPDESK LOG NU					
DATE					
PATIENT NAME					
ALLERGIES					
START OF CARE					
START OF DIALYSIS					
TEMPERATURE (PRE/POST)			(PRE/POST)		16
DRY WT		PREVIOUS WT		PRE WT 64	POST WT 61.4
GAINED (PRE)	+	LOST (POST)	–	Kt/V	1.4/0.9

DIALYSIS DETAILS

QH/TIMES PER WEEK	4/3	Qd	500	CONCENTRATE	L.G
DIALYSER	Revaclear 400			UF	4L
HEPARIN LOADING DOSE	1950I.U			HEPARIN MAINTENANCE	1000I.U
TOTAL HEPARIN	3000I.U			LOCATION NUMBER	6
MACHINE NAME / SERIAL NO:	GORDON				

EVENT	TIME	BP	PULSE	Qb	ARTERIAL P°	VENOUS P°	TMP	UF RATE	EPO/Iron Sticker (If administered)	HOURLY CHECKS- DDP SIGN
				–	–	–	–	–		MATLI S.G
PRE	06:00	156/97	72							
										MATLI S.G
INTRA	06:10	164/101	68	280	-106	94	8	0.84		MATLI S.G
	07:10	155/83	75	280	-111	83	11	1.03		MATLI S.G
	08:10	149/73	80	280	-123	101	13	0.94		MATLI S.G
	09:10	161/84	91	280	-134	97	01	0.83		
					–	–	–	–		MATLI S.G
POST	10:10	160/74	79	–						

SALINE BOLUS	Nil	BLOOD ADMINISTERED	Nil
CLOTTING	Clear	DISINFECTION	Heat

PRIMED BY: MATLI SELLO GORDON	CONNECTED BY: MATLI SELLO GORDON	DISCONNECTED BY: MATLI SELLO GORDON
SIGNATURE: MATLI S.G	SIGNATURE: MATLI S.G	SIGNATURE: MATLI S.G

ACCESS ASSESSMENT								
AVF/AVG	BRUIT/ THRILL	ANEURYSM	BRUISES	SWELLING	PAIN	REDNESS	SKIN CONDITION	SURROUNDING SKIN
PC/TC	A/V LUMEN PATENCY	CRUST	EXUDATE	SWELLING	TENDER / PAIN	REDNESS	DRESSING	A/V LOCKING VOL
PC	✓	✓	x	x	x	x	Intact	Heparin 1.9/1.9

UL / SHIFT LEADER NAME: MATLI SELLO GORDON	UL / SHIFT LEADER SIGNATURE: MATLI S.G

Annexure F

PT'S ID	Week one			Week two			Week three			Week four		
Surname	Tx 1	Tx 2	Tx 3	Tx 4	Tx 5	Tx 6	Tx 7	Tx 8	Tx 9	Tx 10	Tx 11	Tx 12
SEN-PL	1	1,1	1,2	1	0,9	1	0,9	1,4	1,3	1,1	1,2	1,2
JAM-BM	1,2	0,9	1	1,4	1,2	1	1,3	1,1	0,9	1,1	1,2	1
KAB-KR	0,9	1	1	0,9	0,8	0,9	1	1,1	0,7	0,9	0,9	1
LES-BM	1,3	1	1,1	1	1	1,2	1	0,9	0,9	0,8	0,9	0,9
TSU-PL	1	1,1	1,2	1,2	1	1,3	1	1,3	1,2	1,4	1,1	1,2
SEE-PL	1,1	0,9	1,4	1,4	1,2	1,3	1,1	1,2	1,4	1,1	1,2	1
MOI-PL	1,6	1,45	1,3	1,42	1,5	1,35	1,1	1,34	1,45	1,3	1,4	1.G
MAR-KM	0,9	0,9	1,4	1,2	0,9	1,2	1,4	0,9	0,9	1,3	1,4	1,2
THO-PL	1,1	1	1,1	1,2	1,1	0,9	1,1	1,23	1,2G	1,2	1,1	1
BRO-PL	0,9	1,1	0,9	1	1,1	0,8	1	1	0,6	1	1,35	0,9
SEE-KM	1,2	1,34	1	1,2	1,1	1,2	1,2	1,2	1,2	1,2	1,1	1,2
MUN-PL	1.1	0,6	0,6	0,6	1,1	0,8	1,1	1,2	1	1	0,7	0,9
TSH-KM	1,1	1,1	1	1,2	1,2	0,9	1,2	1,2	1,1	1,1	1,2	1,1
MOK-PL	1	0,8	1,1	1,2	1	0,8	0,7	1,2	1,2	1	0,9	1
TOL-PL	1,1	0,9	0,7	0,8	0,8	0,9	0,6	1,2	1,2	1	0,7	0,9
BAC-PL	1	1,1	1,1	1,2	1,1	0,9	1,2	0,8	0,9	1,1	1,2	1,2
KOK-PL	0,9	1,1	1,1	1	1,1	1,2	0,9	0,8	0,9	0,9	1	0,9
KHO-PL	1,2	1,2	1	1,2	0,9	0,9	0,9	1,1	1,2	0,9	1,1	0,8
KIR-UN	0,9	1,2	1	0,9	1	1,1	1,2	0,9	1	1,14	1,2	0,9
PEL-KR	1,2	1,2	1,1	1,2	1,2	1,2	1,1	1,1	1,1	1,2	1,2	0,9
JWA-PL	1	1,1	1,1	0,9	1	1,2	1,2	1,2	1,2	1,2	1,4	1,3
MAG-PL	1,3	1	1	1,1	1	1,1	1,2	1,1	1,4	1,3	1	1,5
JOU-PL	1	1,28	1,1	1,1	1,3	1,1	1,1	1,25	1,2	1,1	0,8	1,2
MOK-BM	1	0,9	1,27	1	0,9	1,1	1,31	1,1	1,1	1	1,34	0,9
MOR-UN	1,1	1	1,2	1,2	1,2	1,1	1,1	1,1	1,2	1,2	1,2	1,2
SMI-KM	1,4	0,9	1,2	1,2	1,1	1,2	1	1,1	1,4	1,4	0,9	1
MOC-KM	1,1	1,2	1,2	0,9	1,2	1,2	1,1	1,2	1,1	1	1,1	1,2
MOS-BM	1	1	0,9	0,9	1,2	0,8	1,34	1,25	1,1	0,9	1,2	1
LIP-PL	1,1	1,1	1,2	1,1	1,1	0,9	1,1	1,1	1,1	1	0,9	1
JEJ-PL	0,9	0,9	1,2	1,2	1,2	1,1	1,2	1,1	1,2	1,1	0,9	1,1
CHW-KM	1,1	1	1,2	1,2	1,2	1,1	1,1	1,1	1,2	1,2	1,2	1,2
NCU-KM	1,1	1	1	0,9	1,1	1	1,4	1,4	1,1	1	1,1	1
SEL-UN	1,1	1	1,1	0,9	0,8	0,9	1,1	1,2	1,2	1,1	0,9	0,9
ZAA-KM	1	1,1	0,9	1,1	1,4	1,2	0,9	1,4	0,7	0,9	0,9	1,2
MAM-UN	0,8	0,9	0,8	1	1,1	1	1	1	1	1,4	0,9	0,9
MAS-UN	1,2	0,9	0,9	0,9	1,4	0,9	1,4	1,4	1,2	1,4	0,9	1,1
LES-UN	1,1	1,4	1	1,37	1,4	1	1,1	1,1	0,9	1,3	1,2	1
SET-BM	1	1	0,8	1	0,9	1	0,9	1	1	0,9	1	1
LUS-UN	1,2	1,2	1,2	1,2	0,9	0,9	1	1,1	1,2	1,2	0,9	0,9

MOR-UN	1,4	1	1,2	1,4	1,4	1,4	1,4	1,4	1	1,4	1,3	1,35
VIS-KM	1,4	1,4	1,1	0,9	0,9	1	1	1,2	1	1,2	1,2	1,35
WAL-UN	1,1	1,2	0,9	1	0,8	0,9	1	1	0,9	0,9	0,9	1,3
MOR-PL	1,3	0,9	1	1,2	1	1,2	0,8	1,1	0,9	1,3	1,1	0,9
ERA-KM	1,2	1,2	1,1	1,2	1,2	1,2	1,1	1,1	1,1	1,2	1,2	0,9
MOL-PL	0,9	1,1	0,9	1,2	0,9	1,1	1,4	1,1	1,2	1,2	1,1	1,4
MKH-PL	1,1	1,2	0,9	1,1	1,2	1	1,3	1,1	1,39	1,2	1	1,2
PRE-PL	1,2	1	0,9	1	1,1	0,9	1	1,2	1	1,3	1	1,2
MOK-PL	1,1	1,2	0,9	1,1	1,2	1,2	1	0,9	1,1	1,2	0,9	1
MAT-UN	1,2	1	1	1,2	0,9	1	1,4	1,4	1,4	1,2	1,36	1,37
WES-PL	1,1	1,1	0,9	1,2	1,4	1,4	0,9	1,1	1	0,9	1	1
WEN-UN	1,2		1	1,2	1,1	1,2	1,2	1,2	1,2	1,2	1,1	1,2
SAM-UN	1,1	1,1	1	1,2	1,2	0,9	1,2	1,2	1,1	1,1	1,2	1,1
MOT-UN	1,1	1	0,9	1	0,7	1	0,9	1	0,8	1	0,7	1
BOO-KM	1,2	1,1	1,1	1,2	1,1	1,4	1,2	1,3	1,2	1,1	1,21	1,1
MOH-UN	0,9	1,1	1,1	0,9	1,1	0,9	0,8	0,9	0,9	0,7	0,7	0,9
MOL-PL	1	1	1,3	1,1	1,2	1,1	0,8	1	1,1	1,2	1,3	1
RAS-PL	0,7	0,7	0,9	0,7	0,9	0,8	1	0,7	0,8	1,1	1,8	0,9
NAR-PL	0,9	0,7	0,9	1,2	1	0,9	0,9	1	0,9	1,1	1,1	0,9
RAD-UN	1	1	0,7	1,1	0,8	0,7	1,1	1	0,9	1	0,9	1,1
PHA-PL	0,8	1,1	1	0,9	0,9	0,8	1	0,9	0,9	1,2G	1,34	1,3
SCH-KM	1	0,9	0,9	1,4	1,4	0,9	0,9	1,4	1,4	1,59	1,2G	1,4
SEB-KM	1,1	0,9	1	1	0,9	1	1,1	1,1	0,9	1	1,4	1,37
ZAH-UN	0,9	0,9	1	1,2	0,9	1,2	1	0,9	0,9	0,9	1,4	1,2
KGA-UN	1,2	1,3	1,1	1,2	1,1	1,2	1,26	1,2	1,2	1,34	1,1	1,23
MOR-KM	1,2	1,2	1,2	1,2	0,9	0,9	1	1,1	1,2	1,2	0,9	0,9
MOH-PL	1,4	0,9	1,2	1,1	1,3	1,1	1,1	1,4	1,1	1,1	1	1,2
VAW-PL	1,4	0,7	1,1	1,2	1,3	1,36	1	0,9	1,25	1,2	1,3	1,2
KUM-PL	0,9	1,1	0,9	1,1	1,1	1,3	1,1	1	1,2	0,9	1,1	1,3
WES-KR	1,4	1,4	1	1,2	1,1	1	0,8	1	1,2	1,4	1,1	1,4
MAN-PL	1,4	1,2	1,4	1,3	1,2	1,36	1,45	1,31	1,1	1,1	1,21	1
CHO-KM	1,2	0,9	1,3	0,9	1,4	0,9	1	1,4	1,2	1,4	1,1	1,1
MOL-KR	1,4	0,9	1,1	1,4	1,2	1,4	0,9	1,4	1	1,3G	1,28	1,4
JAN-KR	1,1	1,2	1,2	0,9	1,2	1,2	1,1	1,2	1,1	1	1,1	1,2
LEK-PL	1,2	1,1	1,1	1,1	1,4	1,2	1	1	1,1	1,2	1,1	1,2

Annexure G

	First month		Second Month		Third month	
Surname	Urea	Creatin	Urea	Creatin	Urea	Creatin
SEN-PL	19	1103	22	1101	19,2	889
JAM-BR	12,6	857	14,5	900	15,5	921
KAB-KR						
LES-BR	20,5	903	20,5	903	22,4	1132
TSU-PL	5,8	241	5,2	240	5,2	122
SEE-PL	32,3	1027	41,3	1127	24	1059
MOI-PL	28,2	1011	30,4	1343	35	1343
MAR-KM	30,8	675	28,6	672	31,7	680
THO-PL	16,2	436	11,8	410	12,6	410
BRO-PL	19,6	967	23,7	1170	19,3	921
SEE-KM	14	508	14	508	14	508
MUN-PL	19,3	239	20,7	250	16,9	214
TSH-KM	21,4	720	21	700	20,1	739
MOK-PL	18,3	817	16,7	714	18,3	814
TOL-PL	34,5	1238	27,9	932	26	1374
BAC-PL						
KOK-PL	19	766	39,6	807	19,7	766
KHO-PL	19,6	583	28,3	653	13	1010
KIR-UI	10,5	501	10,5	500	10,5	525
PEL-KR	22,3	812	22,3	800	22,3	820
JWA-PL	15,5	743	16	878	20,1	805
MAG-PL	15,6	486	24	519	20	444
JOU-PL	14,1	473	11,1	440	25,1	449
MOK-BR	19,8	509	19,9	609	19,1	700
MOR-UN	15,9	756	15,1	700	14,6	720
SMI-KM	14	746	20,1	845	23,2	403
MOC-KM	40	1448	40	1448	39,2	1448
MOS-BR	20,6	550	20,6	550	20,6	550
LIP-PL	17	936	12,1	222	11,9	413
JEJ-PL	17,3	1211	25,9	1132	17,3	1211
TSO-KR	21	949	20	909	21	959
CHW-KM	18,4	1205	29,1	1106	27,6	1006
NCU-KM	22,8	781	22,8	781	22,8	781
SEL-UN	24,2	1161	24,2	1161	24,2	1161
ZAA-KM	16,6	785	13,3	785	18,2	785
MAM-UN	23,1	895	23,1	895	23,1	895
MAS	14	821	13	851	11	801
LES-UI	18,4	871	12,4	800	20,4	731
MAL-KR	13,1	467	13,1	467	13,1	467
SET-BA	19,9	355	19,9	355	19,9	355

LUS-UN	16,8	1219	17,8	1079	15	1239
MOR-UN	15,0	766	15,9	746	14,9	756
VIS-KM	20,6	763	21,6	753	24,6	760
WAL-UN	20,6	902	20,6	110	20,6	1002
MOR-PL	14,3	668	26,3	574	14,3	668
ERA-KM	22,3	812	22,3	800	22,3	818
MOL-PL	18,6	867	20,9	691	20,9	691
MKH-PL	17	247	17	247	17	247
PRE-PL	19	1075	20	956	23	956
MOK-PL	22	617	19,4	167	16,9	762
MAT-UN	13,9	655	13,9	605	13,9	675
WES-PL	21,3	927	18,6	936	19,6	936
WEN-UN	21	543	21,8	500	21,3	600
SAM-UN	16,5	720	17	700	15	714
MOT-UN	22,1	754	20,1	748	22,5	764
BOO-KM		660		650		653
MOH-UN	14,8	1002	14,8	1102	14,8	1192
MOL-PL	25,1	1240	19,2	900	19	1008
RAS-PL	30,6	1504	23,6	1491	20	1334
NAR-PL	20,5	840	20,5	818	20,5	848
RAD-UN	19,1	867	19,4	700	20,1	700
PHA-PL	16	526	20	556	18,6	470
SCH-KM	19,4	469	19,8	467	19	485
SEB-KM	16,4	287	16,4	287	16,4	287
ZAH-UN	16,9	1044	16,9	1054	16,9	1064
KGA-UN	12,5	424	12,5	456	12,5	444
MOR-KM	33,5	1140	33,5	1240	33,5	1140
MOH-PL	11,5	326	18	403	11,5	326
VAW-PL	19,4	526	21,4	506	18,1	516
KUM-PL	23,4	1254	27,6	1254	28,9	1254
WES-KR	21,8	701	20,8	771	22,8	781
MAN-PL	23,4	788	20,1	731	18,8	837
CHO-KM	23,2	1013	23,2	1023	23,2	1033
MOL-KR	19,4	469	19,4	469	19,4	469
JAN-KR	19,4	1448	16,8	1400	17,8	1210
LEK-PL	26,6	353	23,2	376	26,6	353
MOK-KR	20	759	20,8	700	21,8	715
DUT-KR	21	510	20,4	540	21,4	500

Central University of Technology, Free State

ANNEXURE H

UNIVERSITY OF THE FREE STATE
UNIVERSITEIT VAN DIE VRYSTAAT
YUNIVESITHI YA FREISTATA

UFS·UV
HEALTH SCIENCES
GESONDHEIDSWETENSKAPPE

Health Sciences Research Ethics Committee

26-Apr-2024

Dear **Bongani Miya**

Ethics Clearance: **The relationship between chronic haemodialysis patients' depression scores and adequate haemodialysis**

Principal Investigator: **Bongani Miya**

Department: **Clinical Technology - CUT**

Submission Page

APPLICATION APPROVED

Please ensure that you read the whole document

With reference to your application for ethical clearance with the Faculty of Health Sciences, I am pleased to inform you on behalf of the Health Sciences Research Ethics Committee that you have been granted ethical clearance for your project.

Your ethical clearance number, to be used in all correspondence is:**UFS-HSD2023/2414/3004**

The ethical clearance number is valid for research conducted for one year from issuance. Should you require more time to complete this research, please apply for an extension.

We request that any changes that may take place during the course of your research project be submitted to the HSREC for approval to ensure we are kept up to date with your progress and any ethical implications that may arise. This includes any serious adverse events and/or termination of the study.

A progress report should be submitted within one year of approval, and annually for long term studies. A final report should be submitted at the completion of the study.

Research conducted in any Department of Health facility: Researchers are required to sign and return the HSREC approval letters to the provincial Department of Health where they applied. It is also a requirement for researchers to submit electronic copies of their final research findings, and/or make a presentation of their findings and recommendations at departmental research days when and where indicated.

The HSREC functions in compliance with, but not limited to, the following documents and guidelines: The SA National Health Act. No. 61 of 2003; Ethics in Health Research: Principles, Structures and Processes (2015); SA GCP(2020); Declaration of Helsinki; The Belmont Report; The US Office of Human Research Protections 45 CFR 461 (for non-exempt research with human participants conducted or supported by the US Department of Health and Human Services- (HHS), 21 CFR 50, 21 CFR 56; CIOMS; ICH-GCP-E6 Sections 1-4; International Council for Harmonisation (ICH) Harmonised Guideline, Integrated Addendum to ICH E6(R1), Guideline for Good Clinical Practice (GCP) E6(R2), 2016, SAHPRA Guidelines as well as Laws and Regulations with regard to the Control of Medicines, Constitution of the HSREC of the Faculty of Health Sciences.

The Principal Investigator (PI) bears final responsibility for the RIMS application. In the event of any misconduct or improper activities perpetuated by a third party, the PI will be held vicariously liable. The HSREC will bear no responsibility or liability for any actions of a PI and/or third party or breach of confidentiality caused by the PI and/or third party.

For any questions or concerns, please feel free to contact HSREC Administration: 051-4012650/9860 or email EthicsFHS@ufs.ac.za.

Thank you for submitting this proposal for ethical clearance and we wish you every success with your research.

Yours Sincerely

Dr. C. Armour (Barrett)
Chairperson: Health Sciences Research Ethics Committee

Health Sciences Research Ethics Committee
Office of the Dean: Health Sciences
T: +27 (0)51 401 2650/9860 | E: ethicsfhs@ufs.ac.za
IRB 00011992; REC 230408-011; IORG 0010096; FWA 00027947

ANNEXURE I

national
renal care™
Reg No.: 1995/006721/07

07 August 2023

Mr. Miya
Central University of Technology

Dear Mr. Miya

RE: PERMISSION TO CONDUCT RESEARCH IN THE WORKPLACE

This letter serves to confirm that the management of National Renal Care has granted you permission to conduct research in National Renal Care. Further, we undertake to abide by Central University of Technology's Research Committees Research Ethics policy and guidelines and to indemnify the institution and the researchers.

Please ensure that the National Renal Care research policy is signed and are complied with. Please read and initial each page of the attached policy and sign last page on space provided and return to Human Resources Department.

Should be provisions of the research policy not be complied with, this privilege may be withdrawn.

Kind Regards,

EDMUND JACOBS
HR EXECUTIVE