RESEARCH ARTICLES

Nephrology nurse practitioner model of care for chronic kidney disease: Lessons learned and informing future healthcare delivery

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ABSTRACT

Background: Chronic kidney disease (CKD) affects more than 10% of the Australian adult population. It is a progressive disease that involves multiple physiological systems and is associated with several comorbid conditions, making it particularly burdensome on patients and the healthcare system. Alternative models of healthcare delivery are required to slow the progression to kidney failure.

Aim: To describe the characteristics, patient profiles, and health outcomes of patients with CKD attending a nephrology nurse practitioner-led clinic.

Design: Longitudinal health-service exploratory design.

Methods: Following ethics approval, data were extracted from a chronic kidney disease registry for all consenting patients who attended a nephrology nurse practitioner-led clinic. Data were analysed descriptively.

Results: Over the study period, 253 patients (122 male and 131 female) attended the clinic. The mean age was 70.27 ± 10.48 years, and at baseline most had either chronic kidney disease grade 3A (32.8%) or 3B (41.5%). For the majority of those who remained in the clinic, kidney function remained stable or slightly improved. A large proportion were within recommended target ranges for systolic (85.6%) and diastolic (98%) blood pressure although many had high BMI (mean 31.99 ± 6.47) and HbA1c (57.1%).

Conclusion: The nephrology nurse practitioner-led clinic demonstrated effectiveness in addressing CKD targets for patients and provides an opportunity to transform traditional primary and specialist healthcare delivery.

Keywords: Advanced practice nursing, CKD, nephrology, Nurse Practitioner, renal

What is already known about the topic?

- Early intervention in chronic kidney disease (CKD) can slow or halt the progression of the disease, reducing long-term burden and healthcare costs.
- An integrated model of care including primary and specialist providers is considered optimal for the early detection and treatment of CKD.
- An integrated nephrology nurse practitioner model is an emerging model of care for CKD patients. However, studies investigating the cost-effectiveness, efficacy, and characteristics of this model compared to specialist or primary care in Australia are lacking.

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What this paper adds:

- This paper describes the characteristics and outcomes of a nephrology nurse practitioner-led outpatient clinic embedded within a multidisciplinary model of care.
- The majority of patients who remained in nephrology nurse practitioner care maintained recommended CKD targets.
- The findings provide evidence that nephrology nurse practitioners are able to manage patients with less advanced CKD grades who have comorbid conditions and other health risk-factors.

INTRODUCTION

Chronic diseases are persisting conditions requiring long-term healthcare. They affect people of all age groups and account for at least 75% of all global deaths.[1] Chronic kidney disease (CKD) has seen an increase in mortality of 41.5% from 1990 to 2017.[2] In Australia, one in three adults are at risk of developing CKD and more than 10% already have CKD.[3] This disease is predominantly due to diabetes, hypertension, and cardiovascular disease in an ageing population; >44% of Australians over 75 years old have CKD.[4] In addition, First Nations people are 20 times more likely to develop CKD than non-Aboriginal or Torres Strait Islander people.[3,5] CKD is graded (G) on the level of estimated glomerular filtration rate (eGFR) from G1 (evidence of albuminuria from urinalysis) to G5 (kidney failure, previously termed end-stage kidney disease). Most cases of CKD are G3 where there is significant irreversible but manageable damage to kidney function.[6] CKD G3A and G3B are often asymptomatic and frequently underdiagnosed.[7]

Early intervention in CKD is required to slow or halt progression to kidney failure, and an integrated approach to healthcare between primary and specialist providers is considered optimal for the early detection and treatment of CKD.[8] Current clinical guidelines recommend early identification and regular management to reduce cardiovascular risk and to slow the progression of CKD.[9,10] If CKD is detected early and managed appropriately, then the otherwise inevitable deterioration in kidney function can be reduced by 50% and, in some cases, reversed. Management of CKD is directed towards multiple clinical targets, such as using Angiotensin Converting Enzyme Inhibitors/Angiotensin Receptor Blockers (ACEi/ARB), achieving blood pressure (BP) targets, and controlling blood glucose levels as well as lifestyle modifications.[9,10]

In Australia, treatment by a specialty kidney care team is triggered at eGFR below 30ml/min/1.73m^2 (CKD G4).[11] However, CKD G3 is a critical period for care in terms of managing risk factors and slowing disease progression. Traditionally, general practitioners have been tasked with this role, although many people are referred to kidney care services. This is where a specialist nephrology nurse practitioner (NNP) role is used in either primary care or outpatient clinics. These nurses have extensive knowledge, experience, and qualifications in nephrology, and spend most of their time providing direct patient care.[12]

Internationally, the nurse practitioner role first began in America in the 1960s and has subsequently been adopted in numerous countries across the world.[13] Nurse practitioners are advanced practice nurses who typically have an expanded scope of practice, such as undertaking comprehensive health assessments, instigating diagnostic investigations, planning and implementing a complete episode of care (including prescribing medication) and, in some countries, conducting admission and discharge of patients.[14] Nurse practitioner-led services are found in hospital wards, outpatient departments, community healthcare centres, primary care (e.g. alongside general practitioners), as well as through private practice. These models of service delivery are seen as an alternative to medical practitioner services, particularly for managing chronic diseases.[15] Several studies evaluating nurse practitioner roles have found that they provide high-quality care, enhance patient satisfaction, and reduce hospital admissions and re-admission rates for people with chronic diseases.[15,16]

In Australia, a nurse practitioner must hold a Masters level qualification (typically a specialised Master of Nurse Practitioner 2-year degree) and endorsement to extend the traditional nursing scope of practice to that of an advanced level. One of the key differences between nurse practitioners in the United Kingdom is that nurse practitioners in Australia have title protection, meaning that all nurse practitioners are registered by the Australian Health Practitioner Regulation Agency rather than holding the title of a post.[17] The extended scope of practice afforded to nurse practitioners enables them to provide a complete episode of care, such as ordering and interpreting diagnostic investigations (e.g. pathology), making a diagnosis, referring patients to other health professionals (e.g. specialist medical practitioners), prescribing medications, admitting/discharging patients, and undertaking advanced clinical procedures such as intubation and central line insertions.[18,19] As of 2023, there were 2,656 nurse practitioners registered with the Nursing and Midwifery Board of Australia (NMBA) across a range of primary, secondary, and tertiary healthcare settings, including specialty services such as neonatal intensive care, emergency departments, mental health, and kidney care.[20]

In kidney care, NNPs provide care for people with early CKD (in primary care or hospital-based outpatient services) or kidney failure (either in dialysis units or providing conservative care for those people who opt not to have kidney replacement therapy). Across Queensland NNP-led CKD outpatient clinics have been established for over 10 years, and these clinics manage patients with CKD grades 2 to 5 (eGFR 12-85mls/min/1.73m^2). The role of the nurse practitioner is to undertake comprehensive clinical assessments of patients, order and interpret pathology results, and manage CKD targets (e.g., BP, glycaemia, cholesterol) through pharmacological (prescribing/titrating medication) and non-pharmacological (diet, smoking cessation, exercise, sleep) management. They also provide education, support patients (and their informal carers) to engage in self-management, as well as support them to make informed health-care related decisions.[18,21] An additional role is outreach from hospitals into primary care practices to educate general practitioners and practice nurses to ensure diagnosis and early intervention, and timely referral to a nephrologist.

When NNPs are used to manage patients with CKD G2-4, there is evidence of improved patient outcomes, increased uptake of lifestyle modifications, medication adherence, and better glycaemic and BP control.[22] A randomised control trial conducted in the Netherlands (MASTERPLAN) found that additional patient support provided by NNPs attenuated the decline of kidney function and improved renal outcomes (measured as death and progression to kidney failure).[23] These studies suggest that NNPs having active roles in a CKD multidisciplinary team within a primary care or hospital setting produce environments of efficient, high-quality care for patients with CKD. One reason for the positive outcomes seen in nurse practitioner services may be that a major focus is the provision of patient education and patient-centred care.[12] General practitioners and medical specialists have frequently been criticised for suboptimal outcomes. Previous research has shown general practitioners and specialists place significantly less value on information provision and person-centredness,[24-26] and often have a poor understanding of patients' health-related priorities.[27,28] There is also some evidence that costs to patients are lower when care is provided by a nurse practitioner compared to a specialist,[29] although cost-effectiveness evaluations of the model are lacking.

Despite evidence of the benefits of the inclusion of nurse practitioners into multidisciplinary care, the nurse practitioner workforce is underutilised and research into this model of care is scarce. The nurse practitioner workforce in Australia is irregularly distributed, dependent more on independent state and territory initiatives than on coordinated state or federal service planning.[30] Previous studies have cited a lack of organisational support, and a lack of understanding and awareness of the role, requiring nurse practitioners to actively promote and advocate for their positions.[31]

National Australian organisations such as the Australian Nursing and Midwifery Federation, the Australian College of Nurse Practitioners, and the Australian College of Nursing have long been lobbying for changes to the Medicare Benefits Schedule (MBS).[32] Increasing MBS item numbers would allow nurse practitioners to work to their full scope of practice. Changes to the MBS would improve the financial viability of employing NNPs in primary care where they could provide a significant benefit by working with general practitioners to access to and improve patient care and to increase early detection of CKD and slow its progression.[33] To add to the current body of knowledge around nurse practitioner models of care in Australia, the aim of this study was to describe the characteristics, patient profiles, and health outcomes of patients with CKD attending a NNP model of care.

METHODS

This study was an examination of health services and used a longitudinal design. The evaluation tracked all patients with CKD who attended a NNP-led clinic over a five-year period. This period was chosen due to consistency of the clinic's operation and quality of data. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines have been used for reporting.[34]

SETTING

The NNP clinic services one of the most culturally diverse populations in Queensland, Australia, where 22.7% of the local population is born overseas and 19.5% speak a language other than English at home.[35] The area has a growing population, high levels of social disadvantage, and an increased burden of chronic disease, especially obesity, diabetes, and cardiovascular disease. The Queensland Health clinic operates at multiple locations across the week from a large acute hospital outpatient clinic and as outreach to two community healthcare centres and a smaller district hospital (50 kms from the large hospital). These locations enabled the service to be closer to patient's homes. It is staffed by one NNP (employed by the acute hospital) who works independently conducting the outpatient clinics although has collaborative arrangements with a nephrologist. When the NNP is on leave, there is no backfill for the position, so the clinics are not scheduled at that time.

Patients are referred by general practitioners to the renal department of the large local hospital, and then triaged by nephrologists. Triage category 1 patients include the most serious cases, and must be seen within one month of referral, triage category 2 must be seen within three months, and triage category 3 must be seen within 12 months.[36] Patients triaged to category 3 enter the NNP-led outpatient clinic, where the NNP undertakes a comprehensive health assessment and makes a clinical diagnosis. An individualised care plan is developed to establish person-centred

behavioural goals and to focus on achieving CKD targets. Assessments include taking a medical and medications history, assessing CKD risk factors (blood pressure; smoking, diet, and other lifestyle factors; lipidaemia, proteinuria, and other biomarkers), and discussing appropriate lifestyle modification. These discussions are undertaken in a non-judgemental environment using motivational interview techniques, and engaging the patient on a regular basis, while assessing their readiness to change. Patients may then be referred by the NNP to a number of services, including the Quit smoking program, dietetics, psychology, social work, occupational therapy, exercise physiology, nephrology, or another nurse practitioner (e.g., diabetes nurse practitioner).

Patient education, coaching, and the promotion of self-management are in place to reinforce treatment adherence. Patients return to the NNP clinic every three to six months, depending on individual need. Patients are reviewed a nephrologist approximately once every one to two years to develop a relationship in case kidney function deteriorates and the patient requires kidney replacement therapy or requires more complex care. Patients are also encouraged to see their primary care provider between appointments. Clinic appointments vary from 45-90 minutes depending on the needs of the patient. Patients attend the NNP clinic until their eGFR remains stable for over 12 months, whereby they are discharged to a general practitioner. Should a patient's condition deteriorate (i.e., a reduction in eGFR > 5mLs/min/1.73m^2, progression from micro to macro albuminuria, or the development of another serious medical condition), they are referred back to the nephrologist for ongoing management.

PARTICIPANTS

Adults with an eGFR >25mls/min/1.73m^2 or those with an eGFR <25mls/min/1.73m^2 who had chosen a conservative pathway of care (i.e., not receiving dialysis) were referred to the NNP-led clinic. Those with rapidly deteriorating kidney function, acute kidney injury, or a kidney transplant were not eligible for this clinic.

DATA COLLECTION

Retrospective data was obtained from the Chronic Kidney Disease Queensland (CKD.QLD) registry for all patients who attended the NNP clinic, and who had consented to participate in the registry. This registry was established for the purpose of CKD surveillance across 11 public hospitals in Queensland.[37] Data obtained from the registry included: demographic data (age, gender, ethnicity), cause of kidney failure, comorbidities, eGFR, body mass index (BMI), BP, albumin-creatinine ratio (ACR), protein-creatinine ratio (PCR), HbA1C, low density lipoprotein, and cholesterol levels. Participants were included into the study as they entered the clinic (i.e., not all participants will be present for the entire study period as many entered at years 2 to 5).

DATA ANALYSIS

Quantitative, de-identified data contained within the CKD.QLD Registry dataset was imported into SPSS version 27 for analysis. Descriptive statistics and frequency distributions were generated to investigate patients' demographic and clinical characteristics. For analysis timepoints were established as: baseline (first recorded appointment); 1-year; 2-years; and 5-years from the first recorded appointment. CKD status was defined as progression (if eGFR decreased by >5mls/min/year), stable (if eGFR remained within +/-5 mls/min/year) and recovery (if eGFR increased by >5 mls/min/year).[37]

ETHICAL CONSIDERATIONS

The study obtained ethical approval from all necessary university and hospital Human Research Ethics Committees. Participants entered into the CKD.QLD registry had provided written informed consent for the use of their demographic and health information.

RESULTS

DEMOGRAPHIC CHARACTERISTICS

Over the evaluation period, 253 patients (122 male and 131 female) attended the NNP-led clinic for a mean of 1.69 years (SD = 1.69). Table 1 provides the demographic characteristics of patients on entry to the clinic. Patients' mean age was 70.27 ± 10.48 years. The clinic saw a range of patients with CKD G1 to G5, although most patients presented in CKD G3A (32.8%) or G3B (41.5%). The most common cause of CKD was renovascular disease (31.6%) or diabetes (22.9%). Patients had a mean of 4 ± 2.6 comorbid conditions with the most common comorbidities being hypertension (73.9%), dyslipidaemia (53.9%), heart disease (49.4%) and diabetes (48.9%).

CHRONIC KIDNEY DISEASE PROGRESSION

Due to patient numbers varying at each timepoint, eGFR results were collapsed into three time periods: from baseline to 1-year; 1 to 2 years follow-up; and 2 to 5 years follow-up. One year after entry, eGFR had improved by ≥5ml/min/1.72min2 in 24.4% of patients, remained stable in 53.6% of patients, or had deteriorated by ≤5ml/min/1.72min2 in 22% of patients (see Table 2). Over 5-years on average, kidney function remained stable as there was only a small average decrease in eGFR of -3.33mls/min/1.73m^2. No significant changes in risk factors, or deterioration (as measured by the pathology results) were seen during the time patients spent in the clinic.

TABLE 1: DEMOGRAPHIC INFORMATION ON ENROLMENT INTO THE STUDY (N = 253)

Item		N (%)	Median (IQR)
Gender	Male	122 (48.2)	
	Female	131 (51.8)	
Age	Range	33–94	72 (64.00–78.00)
CKD Grade	Grade 1	10 (4.0)	
	Grade 2	32 (12.6)	
	Grade 3A	83 (32.8)	
	Grade 3B	105 (41.5)	
	Grade 4	21 (8.3)	
	Grade 5	2 (0.8)	
Primary diagnosis	Renovascular	80 (31.6)	
	Diabetic nephropathy	58 (22.9)	
	Other	16 (6.3)	
	Glomerulonephritis	12 (4.7)	
	Unknown	8 (3.2)	
	Genetic renal disease	6 (2.4)	
	Missing	73 (28.9)	
Number of comorbidities	Range	0–11	4 (2.25–6.00)
Type of comorbidities	Other comorbidities	148 (58.5)	
	Hypertension	133 (52.6)	
	Dyslipidaemia	97 (38.3)	
	Heart disease	89 (35.2)	
	Diabetes	88 (34.8)	
	Unknown	73 (28.9)	
BMI	Range	18.3–58.3	31 (27.50–35.90)
Smoking status	Current smoker	31 (12.3)	
	Never smoked	102 (40.3)	
	Ex-smoker	104 (41.1)	
	Unknown	16 (6.3)	

Abbreviations: CKD, chronic kidney disease; BMI, body mass index.

TABLE 2: CHANGES IN KIDNEY FUNCTION (EGFR CHANGES +/- 5ML)

	Baseline to 1 year N = 168	1–2 year follow-up N = 118	2–5 year follow-up N = 40
Increase in eGFR (≥5mL/min/1.73m^2)	41 (24.4%)	22 (18.6%)	9 (22.5%)
Decrease in eGFR (≤5mL/ min/1.73m^2)	37 (22.0%)	38 (32.2%)	10 (25.0%)
No / small change	90 (53.6%)	58 (49.2%)	21 (52.5%)

Abbreviations: eGFR, estimated glomerular filtration rate.

To determine the factors that predict change in eGFR, binary logistic regression analysis was used. The eGFR results were collated into a binary outcome variable: deterioration (reduction in eGFR of ≥5mL/min/1.73m^2) or no deterioration (< 5mL/min/1.73m^2 change reduction or an increase in eGFR). Using demographic characteristics (age, gender, number of comorbidities) to predict change in eGFR, none of these characteristics were associated with whether eGFR deteriorated or not.

CLINICAL TARGETS

The results across the four timepoints for BP, BMI, smoking status, CKD grade, ACR, PCR, HbA1c, low density lipoprotein, and cholesterol are presented in supplementary table 1. Patients were predominantly overweight (30.0%) or obese (59.7%), having an average BMI of 32.14 kg/m^2. At 1-year after entry to the clinic, those within clinical targets were 60.5% of patients for systolic and 85.1% for diastolic (85.1%) BP, smoking (81.1%), ACR (44.1%), PCR (33.8%), low-density lipoprotein (64.4%), and cholesterol (41.9%). However, very few patients had normal HbA1c (14.2%) or BMI (4.3%). After attending the clinic for 2-years, the number of those achieving clinical targets was similar for systolic (54.1%) and diastolic (91%) BP, smoking (82.1%), ACR (38.5%), PCR (42.3%), and HbA1c (38.2%). Slight improvements were seen in BMI (11.1%), low-density lipoprotein (84%), and cholesterol (68%). After attending the clinic for 5-years, only a few of the same patients remained. Of these, a high proportion of patients remained within target ranges for systolic (58.5%) and diastolic (92.7%) BP, smoking (80.9%), and HbA1c (42.9%). However, many had deteriorated in terms of ACR (25.9%), PCR (26.1%), low-density lipoprotein (50.0%), and cholesterol (28.6%).

DISCUSSION

To provide an overview of a NNP-led model of care, we tracked a group of patients attending an outpatient clinic. Patients predominantly were in CKD G3A and G3B due to renovascular disease or diabetes. This group of patients were mostly overweight or obese, had several other chronic diseases and had well controlled BP although they had suboptimal HbA1c and proteinuria levels. This profile represents a common presentation of patients from socio-economic areas, and who are challenging for primary care practices, requiring specialist kidney care. Regular management by an advanced practice nurse with expertise in nephrology can slow progression to advanced CKD grades. Those patients who had remained for two or more years had stable kidney function, remaining predominantly in G3A and G3B; reflecting that NNP was treating appropriate patients, with those deteriorating being referred to a nephrologist, and those who improved returning to their general practitioner. The focus of the NNP is on slowing progression of CKD, which in turn would delay the need to be managed by a nephrologist and also delay the need for burdensome kidney replacement therapies.

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The NNP was managing patients who were representative of the broader CKD patient population reported by Hoy et al.[37] These patients were in less advanced CKD grades, obese, and had high rates of albuminuria or proteinuria. Our findings, along with other studies of NNPs in the Netherlands and Canada, provide an understanding of the benefits of NNPs in managing patients with CKD.[38-40] While research comparing the trajectory of patients in NNP clinics to those in primary care or specialist nephrology care is just emerging,[40] further research is needed, particularly in under-served populations such as those in rural and remote areas of Australia. With the increase in primary care funding for nurse practitioners by the Australian Federal Government, evaluation of these roles chronic disease management is also needed.

Few studies have examined nephrologist's practice in achieving clinical targets, and in those studies were found inconsistent results regarding disease progression, morbidity, and mortality. For example, a similar sample in a large-scale study investigating a nephrologist model of care found that, at 5-6 years follow-up, half of all patients had progressed to the next CKD grade, with rates of progression of approximately -4.5±0.3ml/min/1.73m^2/year.[41] Hoy and colleagues analysed all patients enrolled in the CKD.QLD registry (n = 7,060) reporting similar changes in eGFR over time, indicating that in Australia NNP-led clinics may be similarly effective as nephrologist clinics in delaying progression of CKD in less severe patients.[37] Moreover, James and colleagues in Canada did find that patients with early CKD grades had similar outcomes whether managed by a nurse practitioner or nephrologist.[40]

There is a wide agreement that blood pressure control in CKD reduces both cardiovascular risk and disease progression.[9,10] Patients remaining in this NNP clinic maintained BP targets, despite the age of patients, comorbidity status, and BMI of those attending the clinic while minimising harm (e.g. falls due to low BP). A large recent study in Canada also found similar findings.[40] Given the complex nature of this cohort, a key aspect of effective NNP care may be the ability to individualise treatment and consider the risk: benefit ratio in patients rather than simply aiming for blood pressure targets. For instance, avoiding falls risk or complex medication regimens to increase adherence.

In other chronic diseases, cost-benefit analyses have found that nurse practitioner models of care were around 12% less expensive than general practitioner care for a similar volume of service.[30] As CKD is increasing globally, alternative non-medical models of care are required to manage those people in earlier stages of disease, to reduce the risk of progression to kidney failure, and meet the burden on healthcare services.[23,42] The results of our evaluation suggest that in Australia, nurse practitioners may be an ideal way to meet this burden by providing both clinically effective and cost-effective care.

LIMITATIONS

Health service evaluations do have limitations, and the major limitation was the inability to determine why patients left the service which as due to limited funding to undertake this evaluation. Understanding how many were discharged due to improvement or deterioration would greatly enhance our understanding of the benefits of NNP-led clinics. This evaluation reports on only one clinic and was only able to report on data captured by the CKD.QLD registry, which limits the generalisability of these findings. Other factors such as medication adherence were not collected and could have also impacted findings. Nevertheless, few studies report on CKD clinical targets, particularly for those patients being managed primarily by a NNP. Further research is required to better explore the impacts of differing CKD models of care provision and the mediating influences of patient health status, health literacy, and other patient and social factors.

When patients are specifically selected (i.e. triaged) for low risk of CKD progression, NNP-led clinics are more likely to be the most appropriate for this group of patients. These nurses provide a valuable contribution to a multidisciplinary team, working collaboratively with general practitioners, nephrologists, practice nurses and allied healthcare providers. It is important for primary and specialist healthcare services to undertake routine audits to benchmark achievement of CKD targets against national and international standards. Regular patient satisfaction surveys would also be beneficial to substantiate the care that patients with CKD receive.

CONCLUSION

We have reported on patients with moderate CKD being managed by a NNP with limited nephrologist involvement. While the current evaluation cannot draw conclusions as to the healthcare outcomes of patients who left the clinic, it does indicate that nurse practitioners are able to manage patients with less advanced CKD grades who have comorbid conditions and other health risk-factors. These nurses are educated and have developed higher levels of skills and abilities in treatment, pathology interpretation, medication management, patient education, and other factors that impact on disease progression. Further evaluation and reporting of innovative, non-traditional models of CKD healthcare are needed. Additional cross-sectional and cohort studies that compare the treatment provision, health outcomes, and CKD progression of patients attending different service models is necessary to adequately evaluate the benefits and cost-effectiveness of NNP-led models of care.

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