A study to scope structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with chronic kidney disease.

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PhD 2021

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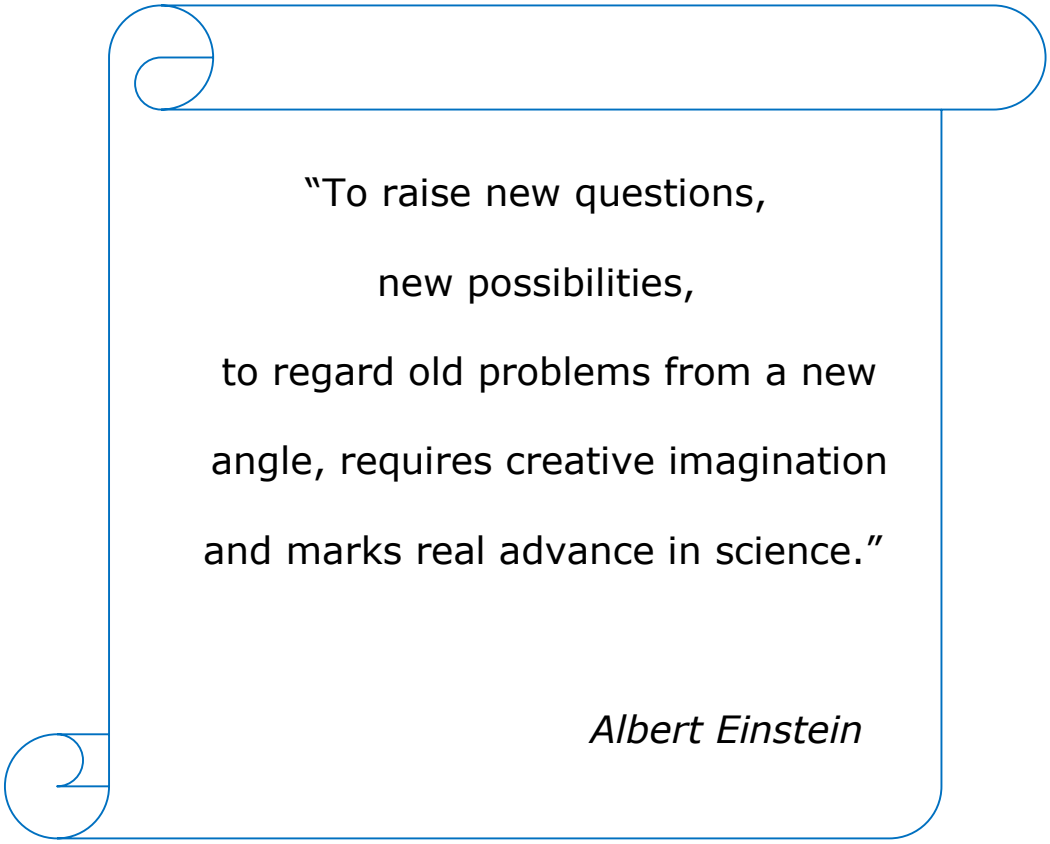
"To raise new questions,
new possibilities,
to regard old problems from a new
angle, requires creative imagination
and marks real advance in science."
Albert Einstein

Abstract

Chronic kidney disease (CKD) is a complex health related comorbidity with an enormous economic burden on any healthcare system globally. Clinical pharmacy services have potential to contribute significantly to the multidisciplinary team providing safe, effective and economic care for patients. However, published literature shows there is a lack of robust evidence for the role of clinical pharmacists in providing care to patients with CKD.

The overall aim of this doctoral research was to investigate the structures, processes and related outcomes of clinical pharmacy practice in the care of patients with CKD.

This doctoral research was undertaken under two stages. Stage 1 was a systematic review to appraise, synthesize and present the available evidence on the structures, processes and related outcomes of clinical pharmacy practice in the care of patients with CKD. While there is some evidence of positive impact on clinical, humanistic and economic outcomes, this evidence is generally of low quality and insufficient volume. While the existing evidence is in favour of pharmacists' involvement in the multidisciplinary team providing care to patients with CKD, more high-quality research is warranted.

A sequential explanatory design underpinned by the Consolidated Framework of Implementation Research CFIR was employed in Stage 2 of this doctoral research. It was executed in two phases of data generation. The findings from the first phase informed the subsequent phase.

In Phase 1, an online theoretically based cross-sectional survey was conducted on the behaviours and experiences of clinical pharmacists caring for patients with CKD. Seventy-one respondents completed the survey with a response rate of

50.0%. The majority of respondents provided general pharmaceutical care to dialysis and transplant patients, were confident in their abilities and tried new ways of working including independent prescribing. There was high level of agreement among the respondents in relation to CFIR items for clinical practice. Most respondents strongly agreed / agreed with CFIR items for prescribing practice yet 39.6% disagreed that they had sufficient cover for their prescribing duties when they are away. Many expressed that lack of resources was the main barrier to providing more advanced care. Further work is needed to explore these matters in more depth.

Phase 2 of stage 2 involved a semi-structured qualitative interview with clinical pharmacist prescribers' members of the UK Renal Pharmacy Group involved in the care of patients with CKD. Data saturation was confirmed after completing and analysing 14 interviews. The key findings of the interviews demonstrated positive views of prescribing practice for patients with CKD among the pharmacists. Underpinning the research with CFIR helped identify the key facilitators and barriers to the implementation of prescribing practice and facilitated identifying key areas for further developing the service.

Overall, this doctoral research produced original contribution to knowledge in the area of clinical pharmacy services in the care for patients with CKD in the UK and with emphasis of prescribing practice. The rigorous and robust findings from stage 2 of the research can help further develop pharmacy practice and prescribing practice in the care for patients with CKD. More research is needed to explore the potential to implement such practices in a wider context.

Key words: CFIR, CKD, clinical pharmacy, pharmacist, renal, UKRPG

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My hard work is dedicated to all those lovely people in my life and I am grateful to all of them, without their support this PhD would have remained a dream.

Outputs

Publications in peer-reviewed journals

1. AL RAIISI, F., Stewart D., Fernandez-Llimos F., Salgado T.M., Mohamed M.F., Cunningham S., 2017. The structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with CKD: a systematic review update protocol. [online]. York: PROSPERO. Available from: http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42017065258 [Accessed on 17/08/2017].

2. AL RAIISI, F., Stewart, D., Fernandez-Llimos, F., Salgado, T.M., Mohamed, M.F. and Cunningham, S., 2019. Clinical pharmacy practice in the care of Chronic Kidney Disease patients: a systematic review. International journal of clinical pharmacy, 41(3):630-666. doi: 10.1007/s11096-019-00816-4.

3. AL RAIISI, F., Stewart, D., Ashley, C., Fahmy, M., Alnaamani, H. and Cunningham, S., 2020. A theoretically based cross-sectional survey on the behaviors and experiences of clinical pharmacists caring for patients with chronic kidney disease. Research in Social and Administrative Pharmacy, 17(3):560-571. https://doi.org/10.1016/j.sapharm.2020.05.005.

Oral presentations

1. AL RAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Exploring structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD). Oral presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Journal Club, Aberdeen, UK, 25/10/17.

2. AL RAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD). Oral presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Postgraduate Research Symposium, Aberdeen, UK, 08/12/2017.

3. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. A pharmacist-based intervention to improve the care of patients with CKD. Oral presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Journal Club, Aberdeen, UK, 28/03/2018.

4. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Oral presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Postgraduate Research Day, Aberdeen, UK, 28/05/2018.

5. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2019. Implementation of Pharmaceutical Care Service: Renal Perspectives. Oral presentation at the 9th Pharmaceutical care conference, Muscat, Oman, 04/02/2019.

6. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. The structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD). Oral presentation for one of five winning posters at the 5th Qatar International Pharmacy Conference, Doha, Qatar, 7-9/02/2019.

7. ALRAIISI, F., Stewart, D., Ashley, C., Fahmy, M., Alnaamani, H. and Cunningham, S., 2019. A theoretically based cross-sectional survey on the behaviours and experiences of clinical pharmacists caring for patients with Chronic Kidney Disease. Oral presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Postgraduate Research Symposium, Aberdeen, UK, 19/06/2019.

Poster presentations

1. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review protocol. Poster presentation at

the Joanna Briggs Collaboration European Symposium, Robert Gordon University, Aberdeen, UK, 19/05/2017.

2. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Exploring structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD). Poster presentation at the UK Renal Pharmacy Group annual conference, Birmingham, UK, 29/09/2017.

3. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the Royal Pharmaceutical Society winter summit, Mary ward conference centre, London, UK, 05/12/2017.

4. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2017. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the NHS Grampian Research Conference, Suttie centre, Aberdeen, UK, 19/12/2017.

5. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the 23rd European Society of Hospital Pharmacy's Conference – hospital pharmacists – show us what you can do! – Gothenburg, Sweden, 21/03/2018.

6. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the Robert Gordon University School of Pharmacy and Life Sciences' Postgraduate Research Day, Aberdeen, UK, 28/05/2018.

7. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. Clinical pharmacy practice as part of the multidisciplinary care of patients with

Chronic Kidney Disease: A systematic review. Poster presentation at the International Pharmaceutical Federation Congress, Glasgow, UK, 02/09/2018.

8. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2018. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the UK Renal Pharmacy Group conference, Manchester, UK, 28-29/09/2018.

9. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2019. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the 9th Pharmaceutical care conference, Muscat, Oman, 4-6/02/2019.

10. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2019. The structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD). Poster presentation (one of five winning posters) at the 5th Qatar International Pharmacy Conference, Doha, Qatar, 7-9/02/2019.

11. ALRAIISI, F., Stewart, D., Ashley, C., Fahmy, M., Alnaamani, H. and Cunningham, S., 2019. A theoretically based cross-sectional survey on the behaviours and experiences of clinical pharmacists caring for patients with Chronic Kidney Disease. Poster presentation at the 24th European Society of Hospital Pharmacy's Conference, Barcelona, Spain, 27/03/2019.

12. ALRAIISI, F., Stewart, D., Fahmy, M. and Cunningham, S., 2019. Clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease: A systematic review. Poster presentation at the Health Services Research and Pharmacy Practice Conference, Birmingham, UK, 08/04/2019.

13. ALRAIISI, F., Stewart, D., Ashley, C., Fahmy, M., Alnaamani, H. and Cunningham, S., 2020. A theoretically based cross-sectional survey on the behaviours and experiences of clinical pharmacists caring for patients with

Chronic Kidney Disease. Poster presentation at the Health Services Research and Pharmacy Practice Conference, Cardiff, UK, 16/04/2020.

Further publication of Chapter 5 manuscript is in progress.

Foreword

This doctoral thesis describes work undertaken to fulfil the requirement of my PhD research exploring the structures, process and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with CKD.

Before starting my PhD journey, I was working as a newly appointed academic staff at the Oman Pharmacy College. Prior to this, I had worked as a renal pharmacist for 15 years in a tertiary care hospital in Oman (The Royal Hospital). My background as a renal pharmacist kindled my passion for clinical pharmacy practice for patients with renal disease and to incorporate my experience in clinical practice into education to enable the develop students clinically from the start of their pharmacy education and so facilitate the development of the next generation of clinical pharmacists. My primary aim for pursuing a PhD is to be a competent academic practitioner and to gain the skills to be able to transfer the knowledge in the best way to my students.

Through this I know I will enhance my research skills and satisfy my curiosity to advance knowledge, to stretch myself and explore my abilities. Another reason for my passion for pursuing a doctoral degree is to be able to make an original contribution to my study field.

Since I started my PhD at the Robert Gordon University, I have learned a lot of research related knowledge and skills. This has included a strong grounding in research methodology encompassing; research paradigms, philosophies, research theories and different methods for research. I understand the importance of this to designing and executing a robust research programme. I have attended a wide range of courses and training sessions throughout the four years of my PhD journey. These training sessions have developed my skills as a

researcher and equipped me with wide range of tools to use while undertaking high-quality research. I have attended courses related to conducting systematic reviews, managing references, qualitative research, as well as courses relevant to my wider development as an academic including those related to teaching and demonstrating.

I am very privileged to be supervised by such a great team of experienced supervisors for my PhD. Prof. Scott Cunningham, my principal supervisor, has been a great strength and support throughout these four years journey to undertake my PhD. Prof. Derek Stewart my second supervisor, who had to move to Qatar University to take a new post, has continued to offer dedicated support to me to the end of my journey.

My supervisors also encourage me to take a lot of demonstrating roles and so involvement in the teaching of the MPharm undergraduate students. This has helped me develop other skills beyond my research to enhance my academic skills. I have also delivered some research-based modules to MSc students and also delivered pharmaceutical care in renal patients to a cohort of MSc students. The area of clinical pharmacy practice for renal patients was and will be always my passion and was my primary driver to conduct this research to show the importance of this practice.

Towards the end of my PhD journey I am sure I will continue developing my skills though conducting more research and maybe consider undertaking a post-doctoral position.

I am confident that the findings of this doctoral research will have great impact on the advancement of clinical pharmacy practice for in renal medicine with

particular focus on the advancement of prescribing practice for patients with CKD in the UK and maybe extended to Oman.

This doctoral research was undertaken by employing a mixed-method approach and followed two stages; stage 1 was a systematic review and stage 2 was in two phases for generating data with phase 1 using a quantitative survey approach and phase 2 using a qualitative semi-structured interview approach. The doctoral research is reported in six chapters as explained below:

Chapter one: This chapter introduces the thesis with all relevant background of Chronic Kidney Disease and clinical pharmacy practice. The chapter also briefly provide information about the UK Renal Pharmacy group, nonmedical prescribing and Donabedian's Framework for healthcare quality in terms of structure, process and outcome. The Chapter also defines the overall research aim and specific objectives.

Chapter two: This chapter focuses on the research paradigms, philosophies, methodologies and methods in general and with the rationale of following specific methodologies for this doctoral research. The chapter also provide details about different types of reviews and the use of theoretical frameworks with specific justification for this programme. Towards the end of the chapter details about rigour and robustness as well as reflexivity as described.

Chapter three: This chapter reports an original systematic review of clinical pharmacy practice in the care of Chronic Kidney Disease patients. The systematic review was initiated by developing a protocol and registered in the PROSPERO database with registration number CRD42017065258. The results of the review reported that there is some evidence that shows positive contributions of

pharmacists' involvement in the multidisciplinary team to provide care to patients with CKD and more high-quality research in this topic is warranted.

Chapter four: First phase of the second stage is a quantitative survey underpinned with a theoretical framework (Consolidated Framework of Implementation Research) CFIR. The survey targeted clinical pharmacist caring for patients with CKD and members of the UK renal pharmacy group to report the characteristics of models of clinical pharmacy practice in the care for patients with CKD. It also reported the positive and negative experiences on the development and implementation of these models.

Chapter five: The second phase of the second stage is a qualitative semi-structured interview with pharmacist prescribing for patients with CKD and took part in the previous stage (survey). This phase aimed to explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease (CKD) in the UK.

Chapter six: The final chapter of this doctoral thesis is an overall summary of key findings for each stage with highlights on the strengths and limitations of the research programme. The chapter also describes the originality of the work and the impact of the research in a wider context. The chapter also list some potential future research ideas as a follow-up from this doctoral research programme. Since my doctoral research programme was funded from the Omani government, my plan is to return to Oman after the completion of my doctoral programme with plans to continue further research in the area of my interest in collaboration with Robert Gordon University.

Abbreviations

µg/L	Microgram Per Litre
µmol/L	Micromole Per Litre
AB	Abstract
ACEi	Angiotensin Converting Enzyme Inhibitor
ACR	Albumin to Creatinine Ratio
ADE	Adverse Drug Effect
AHPs	Allied Health Professionals
AKI	Acute Kidney Injury
ARB	Angiotensin Receptor Blocker
AT	Antonella Tonna
BP	Blood Pressure
BP	Brian Porteous
BRA	British Renal Association
BSc	Bachelor of Science
CA	Caroline Ashely
CC	Collaborative Care
CD	Clare Depasquale
CFIR	Consolidated Framework for Implementation Research
CI	Confidence Interval
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CKD	Chronic Kidney Disease
CM	Clare Morlidge
CP	Clinical Pharmacy
CPD	Continuing Professional Development
CrCl	Creatinine Clearance
CRD	The Centre for Reviews and Dissemination
CRRT	Continuous Renal Replacement Therapy
CVD	Cardiovascular Disease
CVVH	Continuous Veno-Venous Hemofiltration
DG	Dawn Gordon
DRPs	Drug Therapy Problems
DS	Derek Stewart
ECHO	Economic, Clinical, and Humanistic Outcomes
eGFR	Estimated Glomerular Filtration Rate
EPO	Erythropoietin
ESA	Erythropoiesis Stimulating Agent
ESRD	End Stage Renal Disease
FBC	Full Blood Count
FY1	Year 1 Foundation Doctor
g/dl	Gram Per Decilitre
GFR	Glomerular Filtration Rate
GP	General Practitioner
GPhC	General Pharmaceutical Council
Hb	Haemoglobin
HbA1c	Glycated Haemoglobin
HD	Haemodialysis
HR	High Risk
HRQoL	Health Related Quality of Life
HTN	Hypertension

ICU	Intensive Care Unit
ID	Ina Donat
IPA	International Pharmaceutical Abstracts
iPTH	Intact Parathyroid Hormone
JBI	Joanna Briggs Institute
JISC	Joint Information Systems Committee
KDIGO	Kidney Disease Improving Global Outcomes
KGS	Katie Gibson Smith
KM	Katie MacLure
L	Litre
LK	Laura Karim
LOS	Length of Stay
LR	Low Risk
m^2	Square Meter
MDRD	Modification of Diet in Renal Disease
MDT	Multidisciplinary Team
MeSH	Medical Subject Headings
MH	Mesh Heading
Min	Minute
mL	Millilitre
MM	Moira Marson
MMAT	Mixed-Methods Appraisal Tool
mmHg	Millimetre of Mercury
mmoL	Millimole Per Litre
MPharm	Master of Pharmacy
MR	Moderate Risk
MRC	The Medical Research Council
MSc	Master of Science
MTM	Medication Therapy Management
NDD	Non-Dialysis Dependent
NES	NHS Education for Scotland
NHS	National Health Services
NICPLD	The Northern Ireland Centre for Pharmacy Learning and Development
NKF	National Kidney Foundation
NMP	Nonmedical Prescribing/Prescriber
NPT	Normalisation Process Theory
PC	Pharmaceutical Care
PhD	Doctor of Philosophy
Pmp	Per Million Population
PRISMA	Preferred Reporting Items for Systematic Review and Meta-Analysis
PRISMA-P	Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols
PTH	Parathyroid Hormone
QALY	Quality-Adjusted Life Year
QOF	Quality and Outcomes Framework
QUERI	Quality Enhancement Research Initiative
RCT	Randomised Controlled Trial
RGU	Robert Gordon University
RPS	Royal Pharmaceutical Society
RPSGB	Royal Pharmaceutical Society of Great Britain

RRT	Renal Replacement Therapy
SC	Scott Cunningham
SD	Standard Deviation
SPSS	Statistical Package for The Social Sciences
TDF	Theoretical Domains Framework
TI	Title
TJ	Tesnime Jebara
TM	Trudi McIntosh
TRPs	Therapy Related Problems
Tx	Transplantation
UC	Usual Care
UK	United Kingdom
UKRI	United Kingdom Research aAnd Innovation
UKRPG	United Kingdom Renal Pharmacy Group
USD	United States Dollar
VHR	Very High Risk
WHO	World Health Organisation

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Chapter 1: Introduction.

1. Introduction to the chapter

The aim of this doctoral research was to scope structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease. This introduction provides a brief background of CKD and highlights some important aspects of the disease complications, management options and the role of the pharmacist in managing CKD patients in a multidisciplinary care. The Chapter also provides an overview of clinical pharmacy practice in the care of patients with CKD including pharmacist prescribing practice and models of such practice. Towards the end the chapter focuses on Donabedian's Framework for healthcare quality focusing on the structure, process and outcomes of a care provision (Donabedian 1990). Finally, the chapter ends with the research aim and objectives of each phase of this doctoral research.

1.1. Chronic kidney disease

1.1.1. Chronic Kidney Disease definition

Chronic Kidney Disease (CKD) is defined by many international organisations as a progressive loss of kidney function over a period of time varying from weeks to months. The Kidney Diseases Improving Global Outcomes (KDIGO) group comprehensively defines CKD as abnormalities in either the structure or the function of the kidney which is present for more than three months, with health concerns requiring an intervention (KDIGO 2013). The National Kidney Foundation (NKF) defines kidney damage by any one of the following findings:

a) Pathological abnormalities in the kidney

b) Persistent proteinuria

c) Urine abnormalities, such as renal haematuria

d) Structural abnormalities (imaging)

e) eGFR <60 mL/min/1.73 m^2 on two occasions separated by ≥90 days and that is not associated with a transient, reversible condition such as volume depletion (NKF 2012). Table 1.1 summarises the definition and categorisation of CKD in accordance with KDIGO guidance.

1.1.2. Classification and Staging of Chronic Kidney Disease

Table 1.1: Summary of the definition and categorisation of CKD by KDIGO 2012. Adapted from KDIGO guidelines 2012.

CKD classification and Staging **Green: Low risk (LR)** **Yellow: Moderate risk (MR)** **Orange: High risk (HR)** **Red: Very high risk (VHR)**				Kidney damage stage Urine albumin/creatinine ratio Description and range		
				A1	**A2**	**A3**
				Normal to mild increase <30mg/g	Moderate increase 30-300mg/g	Severe increase >300mg/g
Kidney function stages GFR (ml/min/1.73m²) Description and stages	G1	Normal or high	≥90	**LR**	**MR**	**HR**
	G2	Mild decrease	60-89	**LR**	**MR**	**HR**
	G3a	Mild to moderate decrease	45-59	**MR**	**HR**	**VHR**
	G3b	Moderate to severe decrease	30-44	**HR**	**VHR**	**VHR**
	G4	Severe decrease	15-29	**VHR**	**VHR**	**VHR**
	G5	Kidney failure	<15	**VHR**	**VHR**	**VHR**

The Kidney Disease Outcomes Quality Initiative (KDOQI) defines CKD as all individuals with Glomerular Filtration Rate (GFR) <60 mL/min/1.73 m^2 for ≥ 3 months, irrespective of the presence or absence of kidney damage. The justification for including patients with (GFR) <60 mL/min/1.73 m^2 is that as kidney function declines to this level, there is a loss of 50% of the normal function of the kidneys, resulting in the patient being at risk of developing major complications (Stevens 2008). Table 1.2 shows the stages of CKD in accordance with KDOQI guidance.

Table 1.2: Stages of CKD according to KDOQI guidelines. Adapted from KDOQI 2012.		
Stage	**Description**	**GFR (ml/min/1.73 m^2)**
1	Kidney damage with normal or ↑ GFR	≥ 90
2	Kidney damage with mild ↓ GFR	60-89
3	Moderate ↓ GFR	30-59
4	Severe ↓ GFR	15-29
5	Kidney failure	< 15 (require replacement therapy)

Both guidelines are very similar and interchangeable concerning defining or classifying CKD.

1.1.3. Aetiology of Chronic Kidney Disease

The aetiology of CKD and resultant kidney damage can be classified in three main ways: pre-renal, renal and post-renal. Pre-renal CKD may be caused due to conditions like hypovolaemia arising from major bleeding episode, or stenosis in the renal arteries, which may lead to hypoperfusion leading to renal ischaemia and so resulting in CKD (Ashley and Morlidge 2008). Whereas, in renal CKD the most irreversible damages occur within the kidney due to causes such as diabetes, hypertension, vasculitis, nephritis and polycystic kidney disease. Causes of CKD in the post-renal classification are most commonly associated with the disruption of the urine flow, which might be due to an obstruction in the bladder, ureteric stones or fibrosis, leading to increased pressure within the kidneys and damage to the nephrons (Ashley and Morlidge 2008). Classification of CKD is illustrated in Figure 1.1 below.

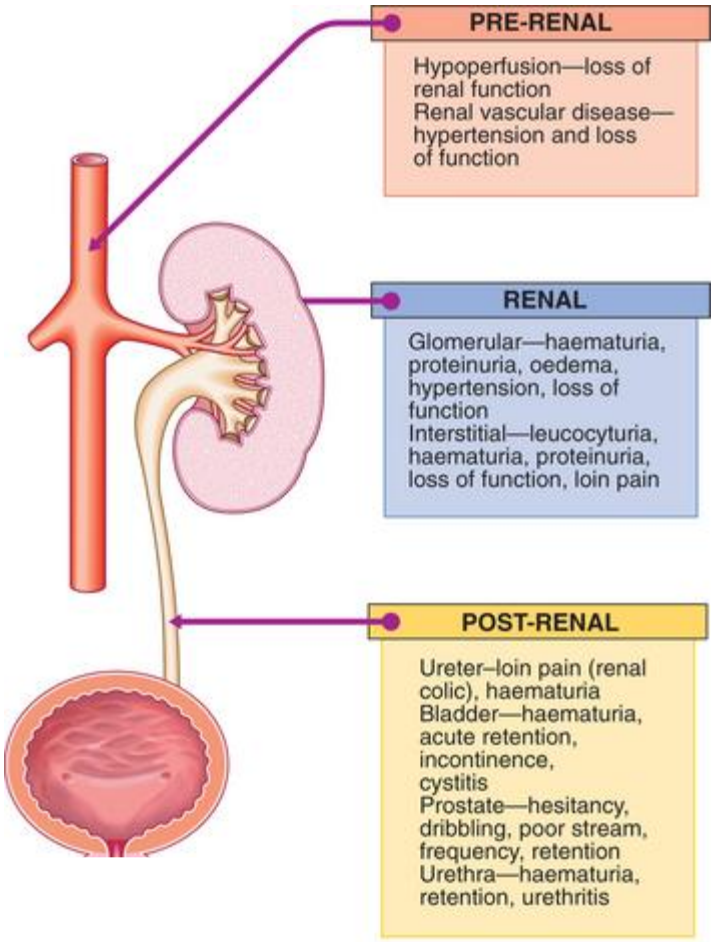

Figure 1.1: Causes of CKD (Ralston 2018)

1.1.4. Epidemiology of Chronic Kidney Disease

A systematic review published in 2016 focused on the global prevalence of CKD and reported that CKD prevalence in stages 1-5 was 13·4% and 10·6% in stages 3-5 (Hill 2016).

The prevalence of CKD (stage 3-5) in Quality and Outcomes Framework (QOF) reports for England in 2016-17 was 4.1% in adults, compared to 3.19% in Scotland. The UK Renal Registry report data for the UK notes that the incidence rate in the UK increased from 120 per million population (pmp) in 2015 to 121 pmp in 2017 (ScotPHO 2017).

1.1.5. Comorbidity and mortality

Comorbidities associated with CKD result in higher rates of mortality. Most common comorbidities associated with CKD are diabetes and hypertension as shown in Figure 1.2 below. Patients with CKD are also at increased risk of developing cardiovascular diseases (CVD). It is evident that more patients with CKD die as a result of associated CVD related conditions than the progression of their CKD (Allan 2003). Mortality is inversely related to the stage of CKD as shown in Figure 1.3.

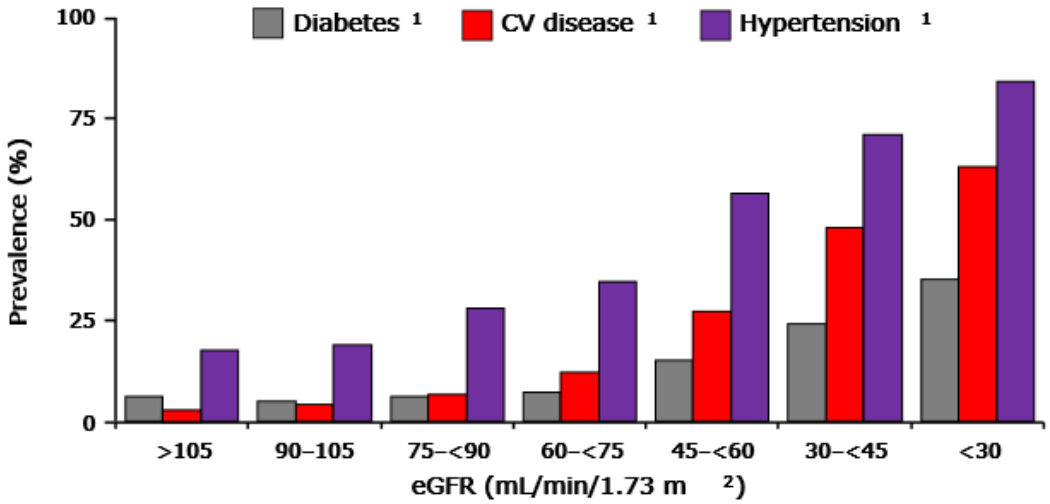

Figure 1.2: Common comorbidities observed in patients with CKD (USRDS 2008).

Footnote (Y=axis shows the prevalence of the comorbidities in patients with CKD)

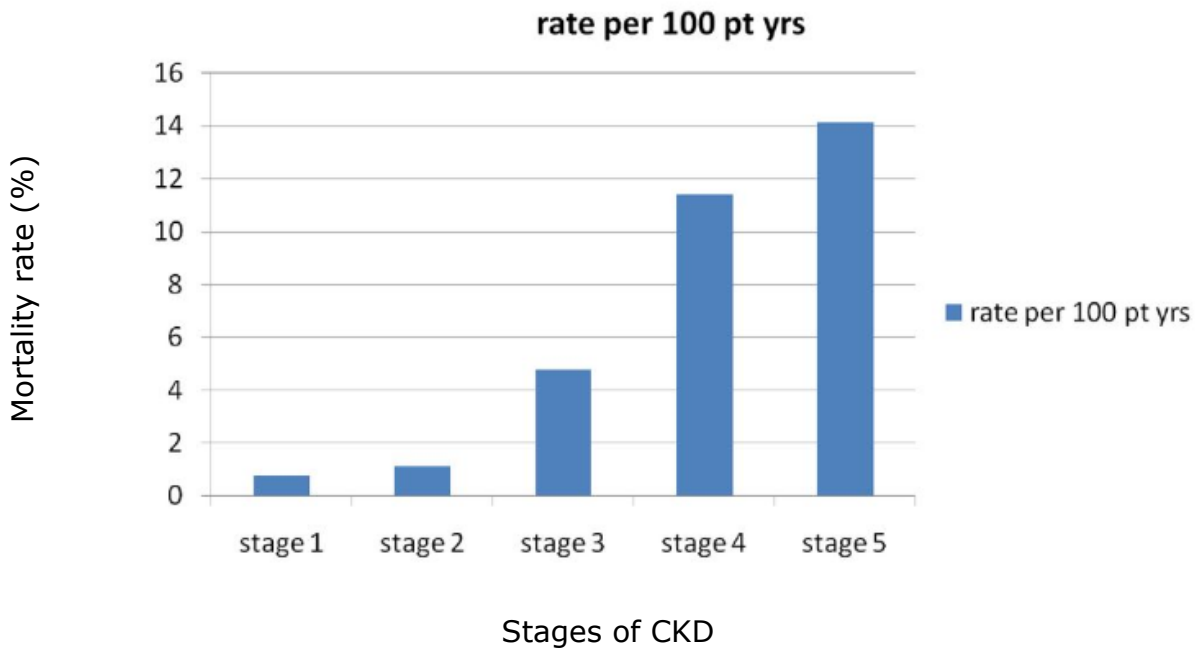

Figure 1.3: All-cause mortality by stage of CKD (NKF 2012).

1.1.6. Clinical manifestations and complications

CKD patients experience various types of symptoms ranging from direct symptoms such as uraemia to other symptoms including electrolyte disturbance, hypertension, pruritis, anaemia and mineral bone disease (Arnold 2016).

A) Electrolyte imbalance

One of the major roles of the kidney is to maintain fluid and electrolyte balance, hence, any deterioration in the kidney functions leads to electrolyte imbalance such as: hypo or hyperkalaemia, hypo or hyperphosphataemia, hyper or hypocalcaemia, and bicarbonate deficiency (Chambers 1987)

B) Mineral and Bone Disorder (MBD)

Patients with CKD suffer from imbalance in hormone levels because the kidneys lose the ability to balance the mineral levels in the body causing imbalance in hormones and electrolytes such as calcium and phosphate (Dhondup and Qian 2017). As the kidney function declines, phosphate filtrations decline leading to

raised phosphate levels which subsequently leads to a reduction in the calcium levels (Moe 2006). On the other hand, deficiency of active vitamin D results in reduced calcium absorption leading to low plasma calcium levels (Cheng 2016). The combined effect of hypocalcaemia, hyperphosphataemia and reduced vitamin D level leads to increased stimulation of parathyroid hormone secretion, which will stimulate calcium release from the bones causing renal bone diseases and fractures (Dhondup and Qian 2017).

C) Anaemia

Anaemia is one of the common consequences on CKD. It arises since patients suffer reduced production of erythropoietin from the damaged kidneys leading to reduction in red blood cell stimulation by the bone marrow. Not only that, patients with CKD also lose blood during the dialysis sessions and as a consequence they lose iron and folic acid (NICE 2015).

D) Hypertension

Chronic kidney disease and high blood pressure are associated together with an interlinked pathophysiological states. Up to 90% of patients with CKD might suffer from hypertension due to various causes. Uncontrolled hypertension could be a primary cause of CKD. On the other hand, patients with CKD have the tendency for sodium and fluid retention which could lead to hypertension as a CKD complication. This is due to volume expansions and rise in the systematic vascular resistance (Botdorf 2011).

E) Other Complications of Chronic Kidney Disease

Other symptoms include: pruritis due to raised phosphate levels, restless leg syndrome as a result of iron deficiency in CKD, nausea due to accumulation of toxins like urea in the circulation, oedema due to sodium and fluid retention, and

stress ulceration. Patients with CKD are at further risk of developing cardiovascular disease (CVD), which is a major cause of death in this group of patients (Weiner 2004).

1.1.7. Chronic Kidney Disease Monitoring

Patients with CKD undergo a series of blood and urine tests to either detect or diagnose kidney diseases or monitor kidney function and treatment responses. Usually patients with CKD are not diagnosed based on a single test, in fact, they need to be subjected to multiple tests and at different occasions to confirm a diagnosis. More information of these tests is provided below.

A) Biochemistry tests

The most common biochemistry tests performed for patients with CKD are shown in Table 1.3.

Table 1.3: Biochemistry tests for patients with CKD

Test	Reference ranges (may vary across units)
Creatinine	50 – 120 µmol/L
Urea	3 – 6.5 mmol/L
Potassium	3.5 – 5 mmol/L
Sodium	135 – 145 mmol/L
Calcium	2.2 – 2.55 mmol/L
Phosphate	0.8 – 1.6 mmol/L
Magnesium	0.8 – 1 mmol/L
Albumin	40 g/L
Bicarbonate	20 – 30 mmol/L
Glucose	Fasting 3.3 – 6.7 mmol/L Non-fasting <10 mmol/L
Ferritin	Male: 24 – 300 µg/L Female: 15 – 300 µg/L
Total iron-binding capacity	45 – 70 µmol/L
Serum iron	12 – 30 µmol/L

Abnormalities in biochemistry tests are highly associated with CKD however, the level of derangement depends on factors such as the stage of CKD, patients' characteristics, comorbidities and lifestyle (Gowda 2010).

B) Haematological tests

Haematological tests for patients with CKD are commonly performed as standard tests to identify any abnormalities and to diagnose CKD related anaemia. Table 1.4 illustrates the most common haematological tests for patients with CKD (George 2018). Haematological parameters are commonly deranged in patients with CKD leading to complications like anaemia. However, derangements depend on the stage of kidney impairment (Babitt 2012).

Table 1.4: Haematological tests for patients with CKD.

Test	Reference ranges (may vary across units)
Haemoglobin	Male: 13.5 – 18 g/dl Female: 12 – 16 g/dl
White blood cell count	3.5 – 11 X 10^9/L
Red blood cell count	Male: 4.5 – 6.5 X 10^{12}/L Female: 4.4 – 6 X 10^{12}/L
Platelets	150 – 400 X 10^9/L
Prothrombin time	11 – 13.5 seconds
Activated prothrombin time	28 – 34 seconds

C) Urine tests

Urine tests are the simplest non-invasive tests to perform for patients with CKD. Such tests include urinalysis dipsticks to identify proteins, blood traces, sugar and infection in the urine. There are some more specific urine tests for patients with CKD, such as 24-hour urine collection to assess the urine volume in 24 hours to identify the renal function. Urine microscopy is also a test performed for patients with CKD to examine the urine for presence of blood cells, crystals or bacteria under the microscope (Baumgarten and Gehr 2011).

D) Kidney biopsy

Usually kidney biopsy is performed to identify the underlying cause of CKD. The biopsy can also help identify the disease advancement over a period of time (Dhaun 2014).

E) Immunological tests

Some more specific tests such as the immunological investigations are used to identify the presence of any autoimmune antibodies in the blood or urine to diagnose any immunological disease related to the kidney (Winearls 2015).

F) Radiological examinations

These tests are used to guide the size and locations of the kidney as well as looking for any structural damage in the kidney or blockages of any renal vessels. Imaging techniques such as ultrasounds, computed tomography, magnetic resonance imaging and x-rays are the most widely used for patients with CKD (Moghazi 2005).

G) Kidney function measurements

The Glomerular Filtration Rate GFR can be measured through some invasive tests or estimated by calculations using serum creatinine levels.

The most common equations used to estimate the GFR in adults are the Cockcroft and Gault equation and the Modified Diet in Renal Disease (MDRD) equation (Baumgarten 2011).

1.1.8. Economic burden of Chronic Kidney Disease

CKD is considered one of the high cost conditions globally with huge economic burden on any healthcare provider. Renal replacement therapies are considered significantly costly treatment modalities yet cost-effective therapeutic options. A

study published in 2018 estimated the health-related quality of life burden of CKD per million of the population with diabetes to rise from £7.08 billion to £11.4 billion between 2012 and 2025 in the UK (Nguyen 2018).

1.1.9. Management of Chronic Kidney Disease

The first ever attempt to treat a patient diagnosed with early stages of CKD is to prevent the progression of the disease where a renal replacement therapy (RRT) would be required. RRT is usually required when almost 85% or more of kidney function is lost (Obrador 2002).

The currently available treatment options for CKD patients using RRT are either one of the dialysis modalities such as haemodialysis, peritoneal dialysis or a gold standard treatment option such as kidney transplantation. The latter is recognised as the preferred approach for CKD treatment, from both clinical and economic perspectives (Winkelmayer 2002).

Most of the patients with CKD suffer from co-morbid conditions requiring medical interventions (Kovesdy 2012). Usually, these patients have polypharmacy, which on its own is a risk for a further insult to the kidneys. The role of the pharmacist therefore, through contributions to the better management of medications, is crucial for delaying the progression of CKD, and so for improving the quality of the care provided to this group of patients (Joy 2005).

1.2. Clinical pharmacy

Clinical pharmacy has advanced since it was first introduced in 1960s with many emerging definitions, which placed the patient at the centre of the practice (Rotta 2015, Dreischulte 2016). Many new models of care and frameworks of practice such as pharmaceutical care, medication therapy management and comprehensive medication management have evolved in subsequent years

(McBane 2015, Dreischulte 2016). Given that clinical pharmacy is perhaps the most widely accepted broad generic term, it will be adopted in this work.

1.2.1. History of clinical pharmacy

From a historical perspective is evident that clinical pharmacy practice has developed significantly since its inception. From drug-supply oriented profession to providing high level advanced patient centred care in addition to many other roles. In 1990 Hepler and Strand suggested that pharmacists take more proactive roles in providing patient centred care by preventing, identifying and resolving drug therapy related problems for better patient outcomes (Hepler and Strand 1990). Later the concept of pharmaceutical care was developed and was defined as the pharmacist's contribution to patient care to ensure optimisation of medication therapy in order to improve health outcomes (Dreischulte 2016).
In the UK, clinical pharmacy was evolved from 'ward pharmacy' in early 60s and the role has expanded since then to a more independent well recognised clinical role (Cotter 1995).

1.2.2. Clinical pharmacy services in the United Kingdom

Pharmacy practice and clinical pharmacy in the UK has developed over the last two decades. The UK government and health authorities constantly promote that interventions delivered by pharmacists and their teams are safe and of a high quality (Root 2017). The NHS England and NHS Improvement and Health Education England have been leading a visionary approach to medicines optimisation that requires the right knowledge and skills for pharmacy professionals. To achieve success for such initiatives, pharmacists will need to develop to meet the highest standards of professionalism and be equipped with more clinically oriented training and education (Health Education England 2019).

Pharmacy practice and education in the UK is guided by the RPS advanced pharmacy framework along with other NHS and governmental policies related to pharmacy profession (Royal Pharmaceutical Society 2013). Expansion of pharmacy services in the UK has led to ever more innovative services being initiated in a variety of healthcare settings. This has included; medicines information, therapeutic drug monitoring services, patient education and counselling, medicines reconciliation, medication review, pharmacist led chronic disease management clinics and implementation of models of pharmacist independent prescribing practice delivered within the pharmacist's scope of competency (Tonna 2007).

Clinical pharmacy services were initially offered in hospital settings and developed at later stage into providing services in community setting and involved providing seamless care. There are several models of care practised by pharmacists, this is evident in a range of settings including the GP practices. Some of these models include:

- Practice based pharmacist: practise within the GP practice team and provide direction and guidance on evidence-based medicines (NHS England and NHS Improvement 2019).
- Primary care pharmacists: practice in a primary care facility and support through prescribing and analysing service development related to medicines management (NHS England and NHS Improvement 2019).
- Community pharmacists: practice within a community pharmacy and provide crucial services in line with the community pharmacy contractual framework (NHS England and NHS Improvement 2019).
- Intermediate care pharmacist: practice between primary care and secondary care healthcare facilities to support discharge services and reduce hospital

admissions by supporting patients in their home environment (NHS England and NHS Improvement 2019).

- Clinical specialist pharmacist: also known as (Advanced practitioners), they provide a specialist service such as nonmedical prescribing in a specific area of competence (NHS England and NHS Improvement 2019).
- Nonmedical prescriber (NMP): NMP is considered an advancement in clinical pharmacy practice in the UK. Pharmacist with additional qualification of NMP are allowed to prescribe independently within their area of competency (NHS England and NHS Improvement 2019).

The NHS prioritised pharmacists' contribution to key important areas with a healthcare facility.

One of the priorities was management of chronic conditions with many models of care practising in all healthcare organisations. Pharmacist contributions are well appreciated in the management of conditions like diabetes, cancer, cardiovascular and respiratory care (Royal College of General Practitioners 2015). Although patients with CKD are very vulnerable and require input from pharmacists, there was not much focus in the RPS policy statement on GP practise based pharmacists on pharmacist's contribution in the care for patients with CKD.

Another priority of the NHS published by the RPS in the polypharmacy document in the UK is to utilise the pharmacy workforce in polypharmacy management in elderly patients taking more than six medications by reviewing current medicines, consulting and counselling patients, optimising medication used and minimising side effects and drug related hospital admissions (Royal Pharmaceutical Society 2019). Polypharmacy can have complicated medication regimen and may include high cost drugs leading to huge burden on healthcare

system if not addressed timely and efficiently. Pharmacists can help patients understand the need for having multiple medications and can help patients use their medication in safe and effective way (International Pharmaceutical Federation 2012). The NHS Scotland developed a polypharmacy guidance realistic prescribing in 2018 as a roadmap to more rationale prescribing for elderly patients (Scottish Government Polypharmacy Model of Care Group).
One of the additional priorities of the NHS in the UK is to utilise pharmacy workforce in the optimisation of antimicrobial use through antimicrobial stewardship (Gilchrist 2015). Since the start of the stewardship programme, pharmacists accelerated and embedded the development of the programme (Gilchrist 2015).
The positive impact that pharmacists made in providing various clinical services and direct patient-facing care increased the demand for more clinical and patient-centre oriented pharmacy education and both undergraduate and postgraduate level. Qualifying more pharmacists will provide a pharmacy workforce ready to integrate in provision of clinical services once they completed their degree.

1.2.3. Role of clinical pharmacy in the care of patients with CKD

Clinical Pharmacists are involved in different areas of managing patients with CKD, such as patients receiving either type of dialysis (haemodialysis or peritoneal dialysis), patients received kidney transplantation, patients with any stage of CKD (pre-dialysis), acute kidney injuries (AKI), and general patients with renal impairments and other co-morbidities (Joy 2005, Joy and Matzke 2007).
The number of patients with CKD is expanding globally, therefore the need for specialised pharmacists with renal knowledge is crucial (Muros-Ortega 2014).

Within the multidisciplinary team, pharmacists have great scope to provide care to CKD patients (Stemer and Lemmens-Gruber 2011).

There are some key roles for renal pharmacist such as renal drug management cost, which is a huge burden on the healthcare system in any nation and most of the expenditure for this group of patients goes to treatment for co-morbidities like anaemia and expensive drugs such as immunosuppression (Chisholm 2001). Other significant roles that clinical pharmacists play in serving CKD patients is managing some of the complications such as anaemia, renal mineral bone disease and hypertension, in addition to running pharmacist led clinics for general purposes as medication review clinical or more specialised as transplant clinics (Mason and Bakus 2010).

A Joint Opinion by the Nephrology and Ambulatory Care Practice and Research Networks of the American College of Clinical Pharmacy discussing the importance of the clinical pharmacist as an integral member of the multidisciplinary team was published in 2005. The report highlighted the important roles of the clinical pharmacist in the care of CKD patients and emphasised that the clinical pharmacist is one of the important pillars of the multidisciplinary team for providing better care to CKD patients. Figure 1.4 below shows all the multidisciplinary approach to CKD care (Joy 2005).

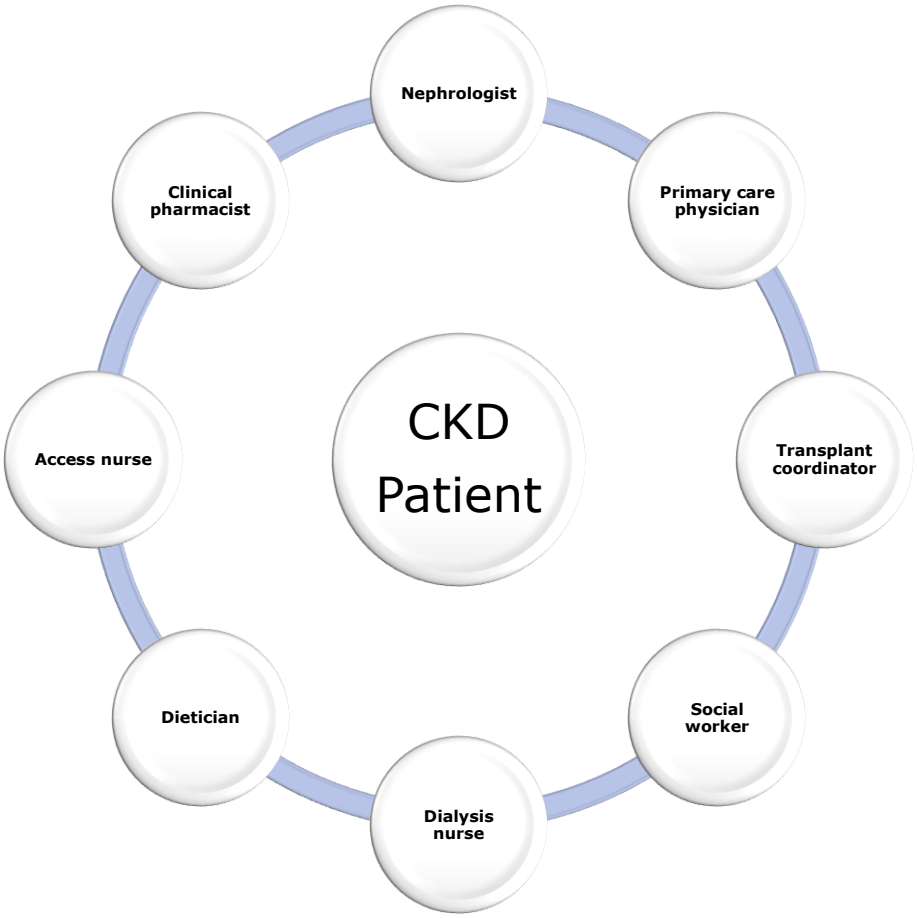

Figure 1.4: Multidisciplinary approach to CKD care. (Joy 2005).

Another study carried out in Spain by Via-Sosa et. al. looking into the value of a drug dosing service provided by community pharmacists in poly-medicated elderly patients with renal impairment concluded that a drug dosing service for elderly patients with renal impairment in community pharmacies can identify and solve drug related problems. However, the study highlighted that the results could be better if the practice is in collaboration with doctors which means that the study could not demonstrate good collaboration between doctors and pharmacist. The control group in the study was taken retrospectively, while the intervention group was prospectively studied which could be taken as a drawback of the study where there might be differences between the two groups (Via-Sosa, Lopes and March 2013).

Recently (2016), Chang et al. published a paper on using pharmacists to improve risk stratification and management of stage 3A chronic kidney disease. The authors conducted a cluster-randomised trial in seven primary care settings in Pennsylvania in the USA to assess the feasibility of pharmacist medication therapy management (MTM) in patients with CKD in addition to other co-morbidities. The clinics were divided into a control (four clinics) and intervention group (three clinics) were the pharmacist were instructed to follow KDIGO driven protocol intended to test for proteinuria as a primary outcome over a follow-up of one year. The study arms were not equally distributed, as the type of patients seen in the control group were different than the ones seen in the intervention group. Also, a follow-up period of one year to assess the development of proteinuria was not sufficient enough to draw a conclusion. This research also emphasised on multidisciplinary collaboration for the success of implementing such services. Although the study appreciated pharmacist's role in MTM yet the authors expressed for future studies to establish the effectiveness of pharmacist MTM on slowing CKD progression and improvement in cardiovascular outcomes (Chang 2016).

The common limitation of both studies mentioned above was the lack of multidisciplinary approach in managing CKD patients. To establish a new service in any healthcare organisation it is important to have support from within organisation or support from an external body. For pharmacists in the UK who are caring for patients with CKD, the UK Renal Pharmacy Group is considered an important external, independent organisation to support the establishment and development of pharmacy practice to provide better care for patients with CKD and other renal diseases.

The next section will highlight the establishment of the UKRPG, the aim and the main responsibilities of the group.

1.3. Professional leadership for renal diseases: The United Kingdom Renal Pharmacy Group

The UK Renal Pharmacy Group (UKRPG) was first established in early 1980s with almost 50 people interested and joined the group. The group was interested in sharing knowledge and experience to help members provide best care in the area of renal medicine. Their aim is 'to facilitate high quality, value-for-money education, training and research for pharmacists involved in provisions of pharmaceutical care to patients with renal disease'. In 2002 the group established its own website (www.renalpharmacy.org.uk) to enable access to all registered members to discussion forms and access various useful resources, with limited access to resources to non-registered members.

The UKRPG is now an affiliated group to the British Renal Association (BRA) to allow working in teams on many renal related projects nationally and internationally.

They have organised many conferences and educational meetings, they established their first printed guide 'An A-Z of drug use and guide to patient counselling in renally impaired adults', almost 1000 copies of this guide were sold. One of the milestones of the group was to publish The Renal Drug Handbook in 1999, which was sold internationally and is a recognised reference to vast majority of renal pharmacists. The latest version of the handbook was the 5th edition which was published in 2018. The UKRPG developed a competency framework for pharmacists providing care to renal patients including CKD patients in 2009. The rationale of this framework was to support advanced-level

of practitioners progressing to the consultant-level of renal clinical pharmacy practice (Bradley 2009). The competency framework also provides guidance to pharmacists working in other clinical areas (such as Critical Care, General Medicine and Care of the Elderly) who will encounter patients with CKD on a regular basis (Bradley 2009). Despite the advancement of nonmedical prescribing in the UK, the competency framework lacked information about pharmacist's role as a prescriber. It is expected to have an updated version of the framework with more focus on pharmacist prescribing for patients with CKD.

1.4. Nonmedical prescribing

Another core element of pharmacist's role in providing care to CKD patients is the ability to prescribe and modify prescribed medications in more effective ways. Unfortunately, this privilege is not legal worldwide, in fact, only a few countries permit this practice. In the UK the first pharmacist prescriber was registered by the Royal Pharmaceutical Society of Great Britain (RPSGB) in 2004 (Tonna 2007). Nonmedical prescribing is aimed to improve overall patient care and optimise pharmacotherapy (Stewart 2012). Many different models of nonmedical prescribing exist but the most common models in the UK are the supplementary prescribing model and independent prescribing model (Stewart 2012). Nonmedical prescribing involves a range of multidisciplinary team members including: pharmacists, nurses, dieticians, physiotherapists and radiographers (Stewart 2017).

The process of prescribing is challenging in patients with CKD because of decline in the renal function and need for multidrug regimen for managing co-morbidities in CKD patients. This challenge becomes even more complex when the pharmacist deals with drugs mainly eliminated through the kidneys. Therefore,

selecting the most suitable drug and dosing modification should be carried out cautiously in CKD patients to prevent the occurrence of drug related problems particularly for renally cleared drugs (Dowling 2010). A recent study by Molnar et al. assessing potentially inappropriate prescribing for patients with CKD reported that involving a pharmacist in the care for patients with CKD can improve prescribing practice, which demonstrates the importance of pharmacist prescribing practice in the process of management for better patient outcomes (Molnar 2020).

1.5. Structure, process, outcomes

This research will be framed within the typology of structures, processes and outcomes based on Avedis Donabedian's Framework for the research of healthcare quality (Donabedian 1990).

Structure (factors that affect the context in which care is delivered) refers to the "characteristics of the settings where the pharmacists perform. This includes tangible resources like facilities and equipment, human resources including the number and qualifications of the practising pharmacists (Donabedian 1988).

Processes (sum of all actions that make up healthcare) represents the nature of services in providing care to CKD patients. It may also include the activities performed by the patient's in order to seek care and the practitioner's activities in the diagnosing process and making therapeutic recommendations (Donabedian 1988).

Outcome (effects of healthcare on patients or society) comprises "the effects of care on the health status of patients and populations", i.e. it encompasses a change in patient health status as a result of a health care service. To ensure a balanced outcome an ECHO model as an approach which further divides the

outcomes into three dimensions (Economic, Clinical and Humanistic Outcomes) (Kozma 1993).

As suggested by Donabedian, a solid and good structure surges the chances of well-developed processes, and good process rises the likelihood of worthy outcomes (Donabedian 1990). Following the adoption of clinical pharmacy as a new way of patient centred practice, a shift from structure and process toward an emphasis on outcomes emerged (Mullins 1996), as outcomes are the ultimate validators determining the extent of benefit or harm to the patient (Donabedian 1966). This, however, does not mean that outcome measures should be assessed in isolation to structure or process measures. Rather, the goal is to establish causal linkages between the three categories of quality measures (Mullins 1996).

1.6. Aims and objectives/research questions of this doctoral programme

In view of the complexity of CKD and the need for medication management in the safest and effective way, pharmacists are positioned well as an important member of the multidisciplinary team to care for these patients. To help characterise the role and experiences of pharmacists caring for patients with CKD, the UKRPG members would be ideal partners to help meet the aim and objectives of this doctoral programme. The proposed research was registered with the research degree committee at the Robert Gordon University (Appendix 1.1). The overall aim of this doctoral research was to explore the experiences and the expertise of clinical pharmacists to scope structure, process and outcome of clinical pharmacy services in the care for patients with CKD.

The aim and objectives/research questions of each stage and phases of this doctoral research are listed below:

A) Aim and research questions of the systematic review (Stage 1)

The aim of the systematic review was to appraise, synthesise and present the available evidence for the structures, processes and related outcomes of clinical pharmacy practice in the care for patients with CKD.

The specific review questions were:

1. What clinical pharmacy practice related resources (structures, e.g. the multidisciplinary team, clinical pharmacy skill mix and time allocation) are in place and how are these matched to healthcare needs and demands to enable provision of care to chronic kidney disease (CKD) patients?

2. What activities are performed (processes, e.g. medication review, prescribing) to care for patients with CKD, how and when are they performed?
3. What are the outcomes of the structure and the processes on the effectiveness (Economic, Clinical, and Humanistic Outcomes (ECHO) model) (Kozma 1993) of care provided?

B) Aim and research questions of the quantitative survey (Stage 2, Phase 1)

The main aim of the survey was to determine the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of care of patients with Chronic Kidney Disease.

Specific research questions included:

1. What are the characteristics of general models of clinical pharmacy practice in terms of structures and processes and how have these models been developed, implemented and evaluated?

2. What are the characteristics models of pharmacist prescribing practice in terms; supplementary vs independent, site of and support for practise, competency areas, process of prescription writing etc and how have these models been developed, implemented and evaluated?

3. What are the positive and negative experiences on development and implementation of these models of practice?

4. What are the key areas for future practise development and what are the recommendations for implementing these developments?

C) Aim and objectives of the qualitative interviews (Stage 2, Phase 2)

The qualitative interview phase aimed to explore from a professional perspective, the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

Specific research objectives included:

1. To describe and characterise the models of pharmacist prescribing practice.

2. To explore the facilitators and barriers relating to implementation of pharmacist prescribing.

3. To describe the plans, actions and parameters used for evaluating prescribing practice.

4. To explore plans to develop pharmacist-prescribing practice further.

Chapter 2: Research methodology.

2. Introduction

This doctoral research was carried out in two stages and the second stage was undertaken in two phases:

Stage 1: a systematic review of the literature

A systematic review of clinical pharmacy practice in the care of Chronic Kidney Disease patients was undertaken; (Chapter 3, Al Raiisi 2017, Al Raiisi 2019).

Stage 2: data generation

Phase 1: a questionnaire based online survey to the pharmacists' members of the UK Renal Pharmacy Group (UKRPG) to determine the behaviours and experiences of clinical pharmacists' members of the UK Renal Pharmacy Group on provision of care of patients with CKD (Chapter 4, Al Raiisi 2020).

Phase 2: semi-structured telephone interviews with participants from the UKRPG to explore from a professional perspective, the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

In this chapter a brief discussion on the Medical Research Council Framework for Developing and Evaluating Complex Interventions (MRC 2016), systematic reviews, research philosophies, different methodologies, theoretical frameworks and method approaches will be described. The use of certain methodological approaches, philosophical paradigms and specific methods for this proposed research will be justified. Characteristics of robustness in quantitative research and rigour in qualitative research will be explained and their use will be justified. Good research governance as an important aspect of good quality research will also be highlighted in this chapter.

2.1. The Medical Research Council Framework for Developing and Evaluating Complex Interventions

The Medical Research Council (MRC) is a UK government funding agency devoted to the improvement of UK people's health through supporting and encouraging high-standard research in all branches of medical science (MRC 2016).

The MRC framework for complex interventions to improve health was developed in 2000 with an aim to develop, evaluate and help implement complex interventions to improve human health. Complex interventions were defined as interventions with different interacting components and dimensions of complexity. Details on the complexity dimensions of an intervention and the implications for development and evaluation are presented in Table 2.1.

Table 2.1: Dimensions of complexity and the implications for development and evaluation of an intervention. Adapted from Craig 2008.

Dimensions of an intervention complexity:
• Number of interactions between components within the experimental and control interventions • Number and difficulty of behaviours required by those delivering or receiving the intervention • Number of groups or organisational levels targeted by the intervention • Number and variability of outcomes • Degree of flexibility or tailoring of the intervention permitted
Implications for development and evaluation of complex studies:
• A good theoretical understanding is needed of how the intervention causes change, so that weak links in the causal chain can be identified and strengthened • Lack of impact may reflect implementation failure (or teething problems) rather than genuine ineffectiveness; a thorough process evaluation is needed to identify implementation problems. • Variability in individual level outcomes may reflect higher level processes; sample sizes may need to be larger to take account of the extra variability, and cluster- rather than individually-randomised designs considered. • Identifying a single primary outcome may not make best use of the data; a range of measures will be needed, and unintended consequences picked up where possible. • Ensuring strict fidelity to a protocol may be inappropriate; the intervention may work better if adaptation to local setting is allowed.

The MRC framework has been used extensively by researchers as guidance to choose the most suitable research methods. The framework has also been used by funding bodies to help assess the constraints on complex intervention evaluation design. The framework was developed to guide stakeholders and end users to weigh up the available evidence for a given intervention considering the methodological approaches and the constraints that could impact their decision in the assessment of complex intervention.

The MRC framework focuses on the development through to implementation of a complex intervention with all necessary steps required for a successful implementation. The development-assessment-evaluation-implementation process is summarised by the MRC framework in Figure 2.1.

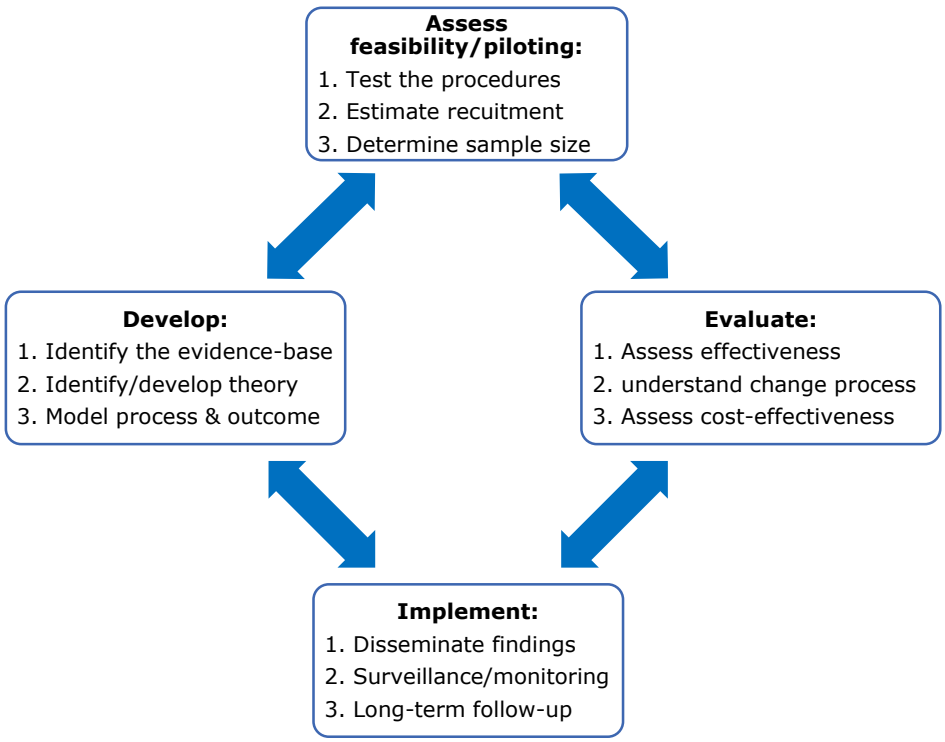

Figure 2.1: The development-assessment-evaluation-implementation process according to the MRC framework. Adapted from Craig 2008.

A) Development phase

The MRC suggests following a systematic development of an intervention by identifying the most suitable evidence-base through systematic literature search, identifying or developing the best available theory and modelling the intervention at early stage before evaluating it at a final phase, such as pre-trial economic evaluations.

B) Feasibility and piloting phase

This stage focuses on the testing procedures in order to be acceptable through appropriate estimation of recruitment process and calculation of suitable sample size. This step is considered vital however, scholars suggest that the step in often neglected (Power 2004). A pilot study within this phase may help highlight the major doubts that rises during the development phase. Cautious interpretation of the pilot phase is warranted to avoid misjudgement of the required sample size for the scaled-up evaluation. To ensure a smooth transition between the pilot and the full-scale evaluation the MRC suggested series of a mix of quantitative and qualitative methodological approaches in order to design a complete scaled-up evaluation.

C) Evaluation phase

It is important to be aware of the most suitable research approach and select the best fit method to answer the research question. In this phase of the MRC framework it is suggested to consider randomisation in order to assess effectiveness since it is the most robust approach to avoid selection bias in two opposing groups. This phase also highlights the importance of having a clear understanding of the processes of the intervention so that it is possible to provide clear justification into the failure or success of the intervention. This also

facilitates optimisation and maintenance of positive outcomes that may relate to the intervention. Similarly, assessing the cost-effectiveness can be of additional value to make the results more meaningful for stakeholders. One of the key aspects of the evaluation phase is the selection of the outcome measures and the ability to deal with multiple outcomes during the data analysis.

D) Implementation phase

During the implementation phase it is essential to disseminate the findings of the research undertaken to evaluate a complex intervention. This will help translate the findings into routine practice or incorporate it in a policy to be accessible to decision-makers. In order to ensure the implementation of an intervention is successful, it is important to understand change in behaviour as well as to understand the facilitators and barriers to the change process which might require further research to support implementation. The MRC framework emphasises during this phase the importance of long-term follow-up and monitoring to be able to identify any adverse events which were not possible to identify in the early phases. Monitoring the long-term outcomes is also considered important to be able to assess whether the outcomes are transferrable to wider practice or not in the long-term.

Despite the wide use of the MRC framework, a number of limitations were identified in the 2000 framework which was considered and incorporated in the revised version in 2008 (Anderson 2008).

The MRC works in partnership with UK Research and Innovation (UKRI), which is a non-departmental public body established in 2017. The UKRI aims to maximise the contribution of all stakeholders to ensure that world-class research and innovation continue to develop in the UK (UKRI 2018). It is formed by seven

research councils including the MRC, innovate UK and Research England (UKRI 2018).

This doctoral research will focus on the implementation phase of the MRC framework given that the clinical pharmacy service provision in the care for patients with CKD is an established role in the UK. The implementation phase has three components (MRC 2016):

1. Dissemination of findings: The initial step to identify if the service provision findings were published or not was to extensively and systematically review the literature to enable understand of whether or not these findings were translated into current practice.
2. Surveillance/monitoring: in order to promote implementation of a service, it is important to explore pharmacists' behaviours and experiences that are vital for the service as well as the consideration for the need to change certain behaviours on a solid scientific ground. It is also vital to reflect on the barriers and facilitators for the implementation of the service as a monitoring process. This was achieved by the first phase of the second stage of this doctoral research through conducting a survey to the pharmacists' members of the UKRPG to identify behaviours and experiences of clinical pharmacists caring for patients with CKD.
3. Long-term follow-up: the second phase of the second stage of this doctoral research focused on evaluating the service of pharmacist prescribing for patients with CKD in the UK through conducting semi-structured telephone interviews with the participants to identify the models of prescribing, long-term follow-up needs and further development of pharmacist prescribing services for patients with CKD.

2.2. Systematic review

To start a research project, it is always beneficial to develop an understanding of what is already known about the selected topic; this will identify the nature of previous work including study design and also identify gaps in knowledge so helping inform the direction and design of this doctoral work.

Systematic reviews are considered to be positioned at the top of evidence-based literature hierarchy as shown in Figure 2.2 (Heaton 2000). A systematic review aims to identify as many as possible relevant high-quality research papers on a particular subject or research question and using explicit methods to synthesise and integrate the findings of these studies (Khan 2001). Figure 2.2 below shows the hierarchy of evidence from literature.

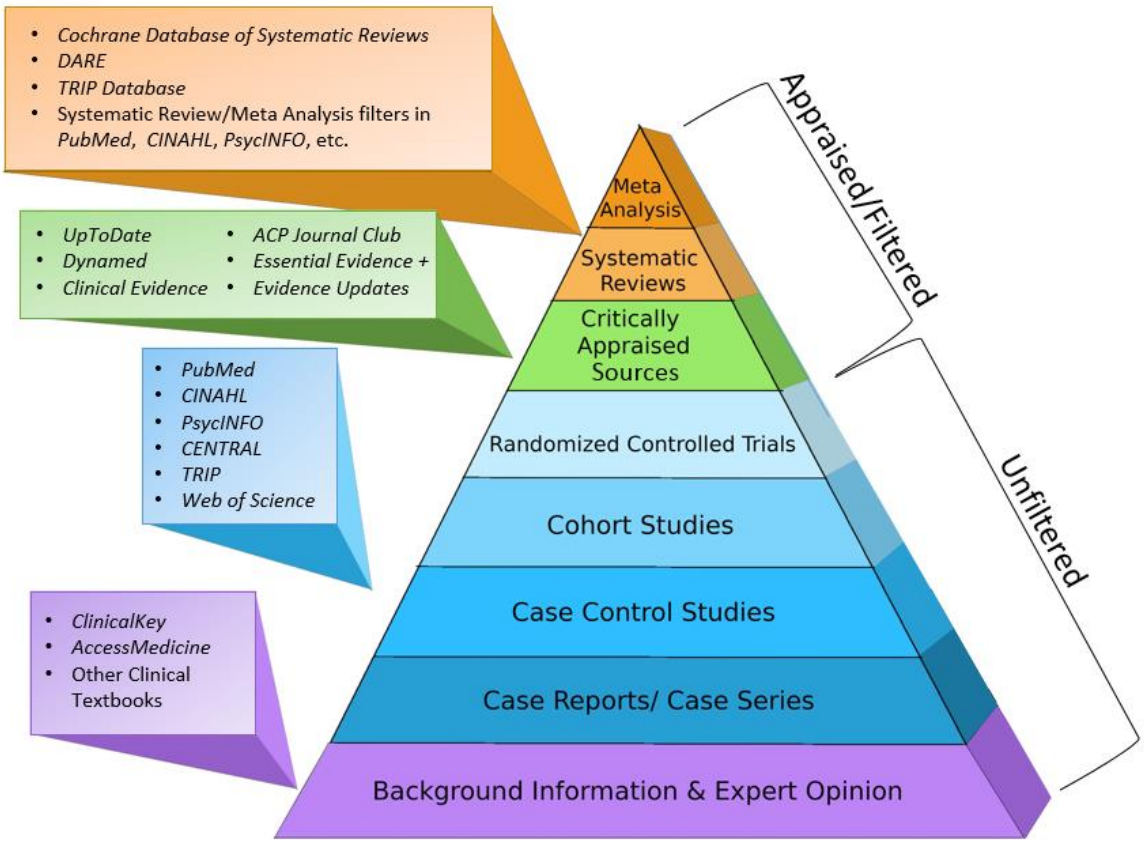

Figure 2.2: Evidence-based literature hierarchy. Adapted from Heaton 2000.

Many different types of literature review are identified in the literature. Fourteen types were described by Grant and Booth (2009) however, a few such as review of reviews and narrative reviews were not included in their paper yet were described by MacLure (2016). Table 2.2 below describes each type of literature review.

Table 2.2: Types of literature reviews. Adapted from Grant and Booth 2009.

Label	Description
Critical review	Establishes extensive literature research and critical evaluation of its quality. It includes analysis and conceptual innovation. Usually results in hypothesis or model
Literature review	Generic term: published materials exploring current literature. Might embrace research findings
Mapping review/systematic map	Identify gaps in research through mapping out and categorising existing literature
Meta-analysis	Uses statistics to combine the results of quantitative studies to present reliable results.
Mixed studies review/mixed methods review	Combination of results from different types of research methods such as combining quantitative and qualitative research or outcome with process studies
Narrative review	Provides latest knowledge description about a specific topic without describing the methodological approach
Overview	Generic term to summarise the literature in an attempt to review the literature and describe its characteristics
Qualitative systematic review/qualitative evidence synthesis	A review technique to integrate or compare the findings from qualitative studies highlighted the themes or constructs generated as a result
Rapid review	Aims to assess what is already known about a policy or practice, within a timeframe by reviewing and critically appraising existing literature
Review of reviews	Tends to systematically review systematic reviews
Scoping review	Preliminary assessment of available research literature to identify the nature and extent of evidence (usually including ongoing research)
State-of-the-art review	Aim to report more current matters and offer new perspectives on an issue
Systematic review	Tends to systematically search, appraise and synthesise literature, usually following guidelines on conducting this type of review (e.g. Cochrane)
Systematic search and review	Merit combination of critical review and comprehensive search process to answer a broad question aiming to produce 'best evidence synthesis'.
Systematised review	Uses some elements of systematic review process (e.g. postgraduate assignments)
Umbrella review	Gathering evidence from multiple reviews with a focus on broad issues. Incorporates evidence from systematic reviews and meta-analyses.

At the start of this doctoral research, the doctoral student carried out a scoping literature search of the available literature on the selected topic to identify the gap in knowledge on the structure, process and outcome of clinical pharmacy practice in the care for patients with CKD. However, in order to develop a comprehensive understanding of the selected topic, the doctoral student carried out a systematic review of clinical pharmacy practice in the care of Chronic Kidney Disease patients.

Systematic reviews aim to appraise, synthesise and present the available evidence on a given topic or to answer a research question (MacLure 2016). Knoll (2018) identified the major elements of a systematic review: identifying, selecting, synthesising and appraising literature that meet set inclusion and exclusion criteria using explicit methods, to answer a research question and obtain reproducible findings, and to identify gaps to be targeted in future research. The importance of publishing *a priori* protocol for a systematic review was also emphasised (Knoll 2018). Figure 2.3 below shows the key steps in conducting systematic reviews (Wright 2007, Knoll 2018).

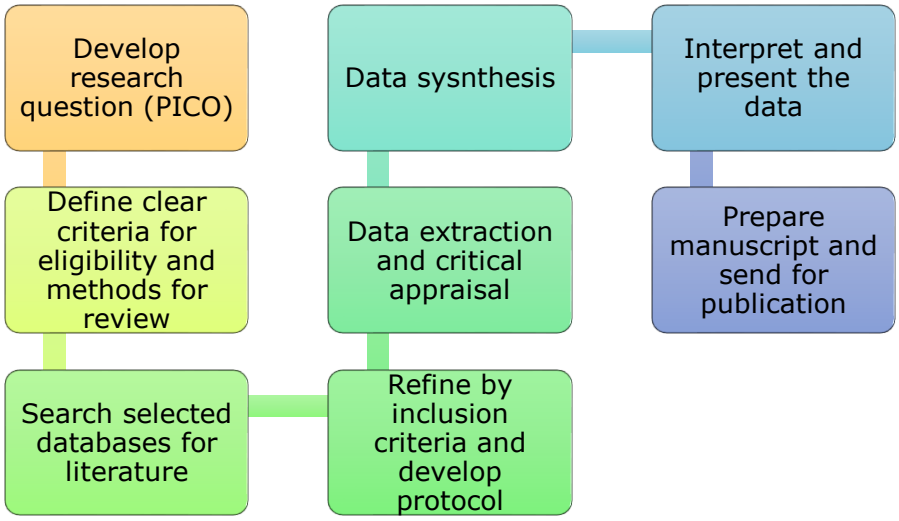

Figure 2.3: Key steps in conducting a systematic review (Wright 2007, Knoll 2018).

The Centre for Reviews and Dissemination (CRD 2015) highlighted that before undertaking a systematic review it is of paramount importance to check in the databases whether or not there is an existing or ongoing review on the topic to justify carried out the review. Another important element of a systematic review is developing and publishing a review protocol which must include the review question/s, inclusion and exclusion criteria, search strategy, study selection, data extraction, quality assessment, data synthesis and the plan for dissemination of the findings (CRD 2015). One of the important benefits of publishing a protocol is to copyright the review being carried out to avoid other researchers duplicating the review.

Systematic review protocols can be developed and published by numerous organisations such as the Centre for Reviews and Dissemination (CRD) at the University of York, the Cochrane Collaboration and the Joanna Briggs Institute.

To enable the doctoral student to become familiar with the protocol writing process and with conducting systematic review a training course was undertaken. This was provided by the Joanna Briggs Institute in collaboration with Robert Gordon University (RGU). The protocol was developed by following the CRD guidance (CRD 2015) to enable the doctoral research to follow comprehensive searching process, determination of inclusion or exclusion criteria and choosing the most appropriate tool for quality assessment with extensive discussions among the research team. The doctoral student developed and published the review protocol with the supervisory team guidance at the CRD (Al Raiisi 2017).

Chapter 3 will provide details of the systematic review carried out by the doctoral student in accordance with the guidance provided by the CRD (2015).

2.3. Research philosophy

There are numerous research philosophies that strengthen a doctoral research (Stewart and Klein 2016). A research philosophy is a way or a belief of ways by which data about a phenomenon are gathered, analysed and used. It is important to address the research philosophy in early stages of a research to ensure the researcher is aware of the beliefs and the assumptions related to the research paradigm and that the research is aligned in terms of research aim, methods used and research outcomes leading to a coherent research design (Creswell 2014).

2.3.1. Research paradigm

Creswell (2018) used the word 'worldview' for paradigms, where he defined it as "essential set of beliefs that guide action" in other word paradigm is known as general philosophical directions towards the nature of research brought to any study" (Creswell 2018).

Paradigm can also be defined as a "Wide outline of beliefs, perceptions and understanding within which theories and practices derive" (Kivunja and Kuyini 2017). Components of a paradigm are explained below and summarised in Table 2.3.

Ontology of a paradigm is related to the researcher's assumptions to believe that something is real or make sense. Ontology helps the researcher to conceptualise the form of reality in order to understand how to make sense of the data gathered (Kivunja and Kuyini 2017).

Epistemology is concerned about the nature of knowledge and how a researcher come to know the truth or the reality. It is about the relation between the researcher and the research participants or subjects (Kivunja and Kuyini 2017).

Axiology is related to the theory of moral and ethical issues and values in a research context. It comprises of defining, understanding and evaluating the behaviours relating to the research (Kivunja and Kuyini 2017).

Methodology of a paradigm is related to the process of research and the approach used to answer a research question (Kivunja and Kuyini 2017).

Table 2.3: Components of a paradigm. Adapted from Creswell 2014.

Component of a paradigm	
Ontology	Science of being (reality)
Epistemology	Theory of knowledge (how/what?)
Axiology	Role of values in research
Methodology	Research approach adopted

2.3.2. Paradigms in qualitative and quantitative research

There are well defined known paradigms in any research that are broadly discussed in the literature: positivism, postpositivism, constructivism, transformative and pragmatism. The most important elements of each paradigm are illustrated in Table 2.4

Table 2.4: Paradigms in qualitative and quantitative research. Adapted from Creswell 2014, 2018.	
Paradigm	**Description**
Positivism	Assumes reality exists and can be measured. Deductive approach. Mostly quantitative.
Postpositivism	Deterministic philosophy where causes determines outcomes. Reduce ideas into small sets to test. Are mostly quantitative approaches. Concerned with experience and empirical observation. Particular knowledge is backed up by scientific verification of theory.
Constructivism	Mostly qualitative. Understandings from a personal perspective. Multiple participant meanings. Generates theories
Transformative	Mostly qualitative but can be quantitative as well. Politically constructed and subjective. Collaborative. Power and justice. Prone to change.
Pragmatism	Can be both qualitative and quantitative (mixed-method). Consequences of actions. Problem-centred. It is focused on real-life practices. Pluralistic.

2.3.3. Research onion

A theoretical concept of research onion proposed by Saunders *et al*. which provides a relation between research philosophies, approach to theory development, methodological choices, research strategies, time horizon and method by which data will be gathered (Saunders, Lewis and Thornhill 2012). Figure 2.4 illustrates the layers of the research onion.

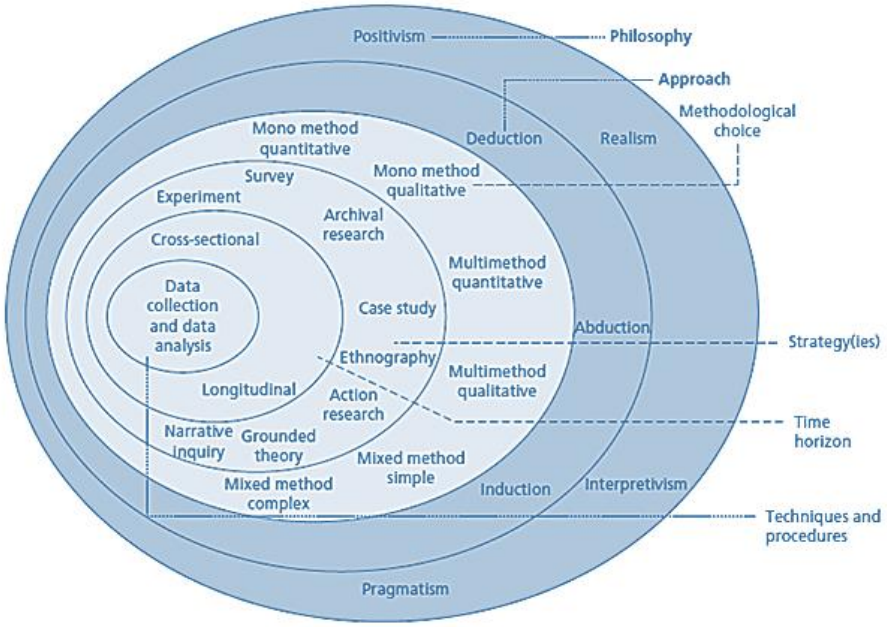

Figure 2.4: The research onion (Saunders, Lewis and Thornhill 2012)

Each layer of the research onion is described as followed:

Research philosophy is considered the infrastructure of a research which defines the nature of reality, sources of knowledge, values, beliefs and ethics of the research (Saunders, Lewis and Thornhill 2012).

Approach to theory development helps distinguish between research which starts with an existing theory leading to the generation of research questions, and research which starts with observing a phenomenon and leads to establishing a theory (e.g. deductive versus inductive) (Melnikovas 2018).

Methodological choices are determination for a choice about an approach to a research either qualitative or quantitative or mixed of both (Melnikovas 2018).

Research strategy is the mean by which data will be generated and analysed (e.g. survey, case study, experimental, grounded theory) (Melnikovas 2018).

Time horizon is the timeframe within which the research will take place whether data will be collected over a specific period of time (cross-sectional) or data will be collected repeatedly over a long period of time (longitudinal) (Melnikovas 2018).

Techniques and procedures (methods used) is about the tools used to generate and analyse data including the choice of sample group and developing the data collection tool (Melnikovas 2018).

2.4. Methodological approaches

Research designs vary from qualitative, quantitative to multi-method and mixed-methods approaches to be able to direct the research towards appropriate procedures in a logical way. Table 2.5 below summarises the different types of research designs elaborating on the characteristics of each design.

Table 2.5: Qualitative versus Quantitative methodologies. Adapted from Andrew and Halcomb 2009, Creswell 2018.

	Qualitative	Quantitative
Purpose	Explore the meaning of individuals experiences, culture, issues and cases	Examining relationships between different variables
Research question / hypotheses	Broad and general research question (no hypotheses)	Narrow and specific research question (hypotheses driven)
Data	Words (interview, case studies), photographs, videos	Numerical data
Data collecting tools used	The researcher is the main data gathering tool (structured or semi-structured or unstructured interviews, narratives, case studies, documentary analysis, focus group)	Designed and validated tools are used (questionnaires, surveys, measurements and other tools) to enable generate numerical data
Analysis	Create themes (inductive, as data formed without use of theory)	Using statistics (deductive, based from existing theory)
Final reports	Narratives	Statistical reports (more rigid)

Limitation	Takes lots of time in transcribing data Results may be biased Misinterpretation of different parameters Trustworthiness and authenticity Not generalisable to population	Numbers can lead to false perceptions More expensive Internal/ external validity Reliability Generalisability

Mixed-method approach involves either combining or integration both the qualitative and the quantitative approaches. Several types of mixed-method research are described in Table 2.6.

Table 2.6: Approaches used in mixed-methods. Adapted from Bowling 2014 and Creswell 2014.

Method	Description
Convergent	Using both qualitative and quantitative methods in parallel.
Explanatory sequential	Usually researcher starts with quantitative approach and after analysing the data builds on it and explains in more details by using qualitative approach.
Exploratory sequential	The researcher carries out a qualitative research first to explore the individuals view, analyse the results and use it to identify and design appropriate instrument and to generated information that are used to carry the quantitative phase.
Transformative	This method is used to assess a theoretical perception at different stages of analysis.
Embedded	In this design only one data collection phase is used, during which a predominant method (quantitative or qualitative) nests the other less priority method (qualitative or quantitative, respectively). It uses one instrument of data collection containing open-ended and close ended questions to generate both types of data at the same time.
Multiphase	This method is a complex design that may involve all the above-mentioned methods (convergent, explanatory, exploratory, transformative and embedded designs). Multiphase mixed-methods enable researchers to examine an issue through a series of phases.

2.4.1. Justification of philosophical approach for this doctoral research

The overall philosophy that fits this doctoral research is the positivist approach. The doctoral research explored structures, processes and related outcomes of clinical pharmacy practice for the care of patients with CKD. Although each phase of stage 2 was aligned within a different paradigm. This doctoral research followed an explanatory mixed-method approach with each phase labelled with a suitable methodological approach (Andrew and Halcomb 2009, Creswell 2018). Each stage and phase of this doctoral research and the use of philosophy is explained as followed.

Stage 1, Phase 1

This phase will be a systematic review aiming to appraise, synthesize and present the available evidence for clinical pharmacy practice in the care of Chronic Kidney Disease patients. This systematic review will focus on quantitative studies which fit-in well with the positivist paradigm.

Stage 2, Phase 1

Phase 2 of this research lines up with positivism paradigm, where the focus is to determine the behaviours and experiences of UK pharmacists providing care to patients with CKD through conducting a cross-sectional survey.

Stage 2, Phase 2

This phase aligns with the constructivism paradigm, where semi-structured telephone interviews with participants from the UKRPG to evaluate the service of pharmacist prescribing for patients with Chronic Kidney Disease in the UK was employed.

2.5. Methods

The next step in any research is to select the appropriate method to answer the research questions. Methods are the techniques that will enable the researcher to generate and analyse the data. Qualitative, quantitative and mixed-method research approaches have different methods.

2.5.1. Quantitative research approaches

A) Philosophical assumption

The quantitative research approach reflects positivism philosophical assumption which postulates the relations between variables to either answer theory guided research questions or hypotheses via experimental research or surveys (Creswell 2018). These approaches depend on the numerical power and their ability to characterise the population in an accurate and vigorous fashion (O'Leary 2017).

B) Methodologies in quantitative research

Different types of methodologies in quantitative research are described in Table 2.7.

Table 2.7: Quantitative research methodologies. Adapted from Watson 2015, Creswell 2018.

methodology	Short description
Case control studies	In a case-control study participant who have been exposed to a risk factor are identified and compared with that of controls or who are not exposed to the risk factor. Risk of selection bias and validation of information is challenging. The statistical techniques for analysing case-control studies are too complex.
Cohort studies	A cohort study uses a defined group (people with a shared characteristic). More informative about how individuals change over time. Are more difficult to conduct and are susceptible to attrition.
Randomised controlled trials	Used to test the effect of treatments on people. Considered to be the best method for testing the link between cause and effect in clinical interventions. Its essential features are randomisation and use of a control group. RCTs should preferably be blind.

	The RCT is rated near the top of the hierarchy of evidence, at level II, as a method of providing evidence for clinical practice.
Survey based approaches	Frequently involve distributing questionnaires, or they may be conducted by interview or observation. Surveys cannot easily distinguish between cause and effect, but they are useful for gathering large amounts of data to describe samples and populations. Are relatively easy to conduct.

C) Quantitative methods

Quantitative methods help researchers to study phenomena of interest through measuring or observation where the researcher acts as an observer with no influence on the participants or the findings of a research (Bowling 2009). Table 2.8 below lists the most common research methods in quantitative approach.

Table 2.8: Quantitative research methods. Adapted from Creswell 2014, 2018 and Bowling 2014.

Method	Description
Correlational	Exploring and observing relationship among variables using numerical analyses. It is mostly descriptive correlation design and observational in nature.
Descriptive	Observation to describe a variable or a phenomenon. Data collection is usually through observation, and includes cross-sectional and longitudinal designs.
Experimental	Focuses on causality with control of independent *manipulated* variables. Most common techniques used with this method is true experiments with control groups
Quasi-experimental	Focuses on causality with control of independent *non-manipulated* variables. Techniques used are pre- and post-test, or post-test only. As well as single-subject

	designs and the use of surveys and questionnaires.

Stage 2, phase 1 of this doctoral research employed quantitative method in a form of cross-sectional online survey which deemed most suitable approach.

D) Survey definition

A survey design is believed to numerically describe behaviours, attitudes, trends, experiences and opinions of a studied population (Creswell 2018). Surveys are widely used method in many disciplines of research due to the advantage of being structured, easy to perform, measurable data generations and statistically sound results. However, it is also important for the researcher to be aware

of the disadvantages associated with surveys which can impact the reliability of the data. These includes: respondents state at the time of completing the survey, leading answers and risk of biases (will be discussed in details later in this Chapter).

E) Survey types

There are few key issues a researcher needs to consider before choosing a survey method due to different surveys types (O'Leary 2017). Table 2.9 describe different survey types and the advantages and disadvantages of each type.

Table 2.9: Survey types and related issues. Adapted from O'Leary 2017.	
Q1: Are you targeting a sample or a whole population?	
Census: does not depend on a sample, involves everyone in a defined population	E.g. all pupils in a specific school
Cross-sectional surveys: uses a sample to represent a population and generalise findings or cross-section of participants	Mostly used, e.g. community survey (targeting a sample to represent the whole community)
Q2: is the intention of the survey is to describe or explain?	
Descriptive surveys: the aim is to describe your participants by gathering either demographic, behaviours and attitudinal information	E.g. political election surveys that describe voters and voting intentions
Explanatory surveys: aim to determine cause and effect and build complex understandings (why certain phenomena occur)	E.g. investigating the causes that leads to customer dissatisfaction and determine the relative weight of each cause.
Q3: will the survey be at a point of time or will it be over a period, would it explore change in time or people?	
Trend surveys: similar to cross-sectional but at more than one point of time and similar participants. The aim is to realise if a classifications or perceptions of participants change over time	E.g. a survey conducted in two phases over a 5-year period, to assess if attitudes towards an issue are changes or remained the same during the 5 years.
Panel study: it involves researching the same participants with same questions at more than one point of time. The aim is to see if people themselves change over time	E.g. same as above with same respondents to assess attitudes are shifted as people get older
Q4: what is the method of administering the survey?	
Face-to-face surveys: Advantages includes high response rate, motivates participants, allow questioning and clarifications, prompting, allow building trust between researcher and participant Disadvantages: lengthy and expensive, limited regions, no confidentiality, and requires training for the researcher	E.g. shopping mall survey, when a participant is stopped by someone with a clipboard to ask few questions
Telephone surveys: Advantages: less expensive, permit wide geographical cover, more anonymous, prompting and allow clarifications Disadvantages: lower response rate, participants can hang up at any point, limited to participants with a phone	e.g. market research (method of choice) but more challenging in social science due to large number of participants getting annoyed
Self-administered mail/e-mail/online surveys: Advantages: very confidential, permit wide geographical cover, allow participants to answer at their own time Disadvantages: risk of low response rate, no room for clarifications or questioning, sometimes costly (snail mail version). Limited to participants with internet access. Risk of not reaching the participant (junk mail)	Includes email and online surveys which saves thousands on printing and postage. Most social science surveys

For the purpose of this research project, the most appropriate survey method was a mix of census and cross-sectional online survey where the whole population of renal pharmacists' members of the UK Renal Pharmacy Group and clinically practising in the UK were targeted in a given timeframe.

F) Survey tools

Questionnaires are the most widely used tool in survey design which can either be paper based format or an online questionnaire (Creswell 2014, O'Leary 2017). Online questionnaires are preferred and popular form of survey tool with wide range of software to create, store and analyse data (O'Leary 2017). Robert Gordon University licensed Bristol online survey tool (JISC) was used to design, distribute and store the data for this phase of the doctoral research.

G) Population and sampling design in quantitative research

In a quantitative research the answer to a research question is considered sufficient if answered by some population rather than the whole population to enable generalise the findings. Therefore, it is important to define the population of interest explicitly before selecting a sample (O'Leary 2017).

Sampling is defined as a process to select a group of subjects that represents a population to answer a research question (Garson 2012). In order to be able to generalise the findings to a population, it is important to ensure that the selected sample is appropriate, represent the population and the selection process was unbiased. To achieve optimum sample size, it is suggested to use a power calculation (Bowling 2002). Two most common sampling techniques are probability and non-probability sampling. Each technique suggests different sampling methods as described in Table 2.10 and Table 2.11. Most of the survey-based research employ random sampling with various strategies such as simple

random sampling, systematic sampling, stratified sampling, cluster sampling and multi-stage sampling (O'Leary 2017).

Table 2.10: Probability sampling techniques. Adapted from Jansen and Laurie 2016, Grove and Gray 2018.

Sampling method	Strengths	Weaknesses
Simple random sample (each unit in the homogenous population has an equal chance of being selected through a random selection process either manually or electronically)	Minimal or no sampling bias. Population characteristics not required. Robust form of sampling. Affordable and accessible for certain population types (e.g. students at a University)	Hard to achieve random sample in practice. Can be extremely costly for dispersed populations (e.g. nation-wide samples). Can lead to insufficient respondents in certain categories of interest for the statistical analysis (e.g. minority ethnic groups). Sampling by an untrained person may lead to misinterpreted instructions and improper selections of sample.
Systematic random sample (sample is acquired by choosing the first sample on random basis and the subsequent sample at planned interval)	Widely used. Easily implementable by anyone. Efficient and easy implementation in real-life situations. Avoid risk of researchers unintentionally selection bias.	Not truly random sampling. Selection of Nth number may prevent selection of certain units.
Stratified sample (dividing the whole population into different subgroup, then employing random sampling within the subgroups)	Superior to simple random sampling because of reduced chance of sampling error. Works well for populations with multiple attributes. Useful when comparing variable group sizes. Useful to observe existing relationships between two or more subgroups.	Can be expensive to perform. More knowledge about the population characteristics is required. Selection of variables to use to stratify the sample may be complicated if the research has many important variables.
Cluster sample (to enable random sampling obtained by selecting clusters or subgroup from a large population)	Allows face-to-face probability sampling when no sufficient contact details of participants are available. Comparable strengths to simple random sampling if structured efficiently.	May be complicated to perform. Extremely expensive if employed for populations spread over large geographical areas.
Multi-stage sample (combination of various sampling techniques)	Enables identifying the limitations and analysis requirements for a given project.	Complex to define and implement. Maybe not the best option for beginner researchers.

Table 2.11: Non-probability sampling techniques. Adapted from Jansen and Laurie 2016, Grove and Gray 2018.		
Sampling method	**Strengths**	**Weaknesses**
Convenience sample (ideal to select the entire population in non-random means)	Fast, easy to perform and inexpensive technique. Beneficial to get initial idea of a research (pilot).	Sampling bias (selected sample might not represent the population). Cannot generalise findings to the wide population.
Quota sample (selecting a convenience sample but within the bounds of predetermined quotas (e.g. 50% male, 50% female))	Similar strengths as convenience sampling, just a little harder. Quotas confirm enough units are selected from each category appropriate to the research.	Sampling bias (selected sample might not represent the population).
Snowball/chain sample (identifies, cases of interest or new participants from participants involved in the research)	A useful technique to identify hard-to-access groups. Helps establish some trust and credibility which may help gain participation in the research. Sometimes the only feasible option.	May impact on participant diversity. Sampling bias (non-representative sample).
Purposive/judgement/theoretical sample (selection of participants based on researcher's knowledge and professional judgment)	Can gain insights that are useful for developing theoretical explanations by targeting specific individuals or groups within a population. Researcher can exercise explicit judgement in identifying who would be most interesting to include in the sample, thus the sampling process benefits from the knowledge and experience of the researcher.	Sampling bias (risk of non-representative sample). The researcher's judgement may unintentionally skew the selection of participants leading to potentially unreliable data.

For the purpose of this doctoral research, the entire population of the clinical pharmacists' members of the UKRPG were targeted with convenience sampling technique followed for the first phase of stage 2 of this doctoral research. Sampling details for the qualitative research will be discussed in section 2.5.2 (F).

H) Data analysis

The data analysis techniques vary in qualitative and quantitative methods; however, the purpose of data analysis remains the same. Data analysis helps obtain useful and practical information to enable describe the data, identify relations between variables and compare them if required and helps predict the outcomes of a research. Data analysis is more than just presenting numbers; therefore, it is researchers' responsibility to deal with the data in a strategic, intuitive and creative way in order to interpret the data. It is suggested to follow a reflective approach for data analysis with awareness of the research question, aim, methodological constraints and the use of relevant theory (O'Leary 2017). The process of reflective analysis as suggested by O'Leary is described in Figure 2.5.

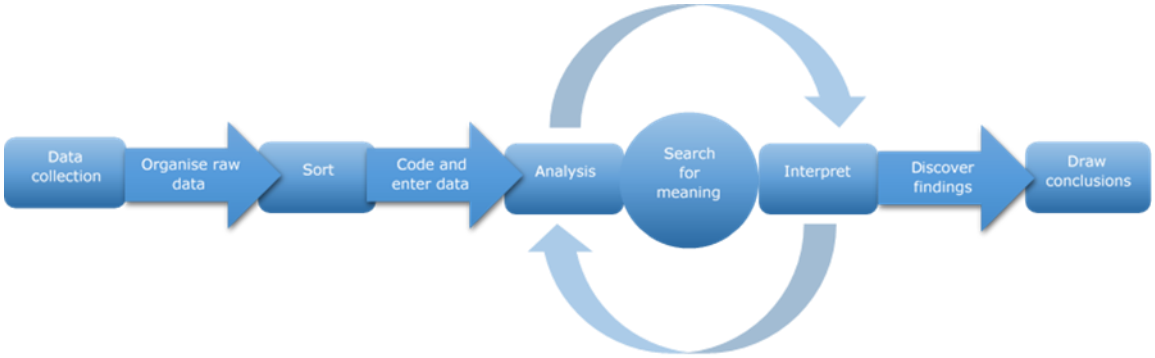

Figure 2.5: The process of reflective analysis (O'Leary 2017).

Quantitative research is associated with statistical analysis and classified into descriptive statistics and inferential statistics, both described in great detail in Table 2.12.

Table 2.12: Statistical analysis for quantitative research (O'Leary 2017).	
Descriptive statistics	**Inferential statistics**
Involved the whole targeted population.	Involves a sample to represent a population and generalise findings.
Used to describe basic features of a data set and summarise variables.	Used to draw conclusions that extend beyond the immediate data.
Help organise, analyse and present data in a meaningful fashion.	Compares, test and predict future outcomes.
Provides measures of central tendency, dispersion and distribution shapes.	Provides analysis of variance and hypothesis tests.
Use nominal, ordinal, interval and ratio data types.	Use nominal, ordinal, interval and ratio data types.
Standard calculations in various statistics programmes.	Huge range of statistical tests available.
Results are presented in form of tables, charts and graphs.	Results are presented in form of probability scores.

For the purpose of this doctoral research the survey data were analysed descriptively since the whole pool of Clinical pharmacist members of the UKRPG and caring for patients with CKD was targeted. The data analysis required the use of a statistical software and the latest version of Statistical Package for the Social Sciences (SPSS® version 25) was used. The survey response was not of sufficient number to allow the use of inferential statistics to determine any differences in sub-groups, hence, was not employed in the analysis.

2.5.2. Qualitative research approaches

Qualitative research has made huge strides in social science research in recent years (Creswell 2018). Qualitative research is best defined as 'its ability to explore and understand the lived experiences of human and social problems' (O'Leary 2017).

A) Philosophical assumptions

It is important to consider the philosophical assumptions, research approaches and the most suitable paradigm prior to undertaking a research project.

Furthermore, considering the most appropriate methodologies and methods for a research is equally important. The philosophical assumptions in relation to qualitative research are described in Table 2.4 above.

For the sake of stage 2 phase 2 of this doctoral research, ontology as a philosophical approach deemed most suitable, since the reality is based on the experiences and views of the participants aiming to explore the development, implementation and evaluation of pharmacist prescribing for patients with CKD in the UK.

B) Methodologies in qualitative research

Research methodology help signpost the stepwise progress of research process to enable generate meaningful findings. There are several qualitative research methodologies including ethnography, grounded theory, case study, narrative and phenomenology. These methodologies are described in Table 2.13.

Table 2.13: Qualitative research methodologies. Adapted from Creswell 2014, 2018.

Method	Description	Suitable study design	Data generation	Analysis
Case study	It focuses on individuals, entities, organizations or events.	In-depth analysis of a case/s, event or process.	The tools used to generate data are mostly observations, reports or documents.	Data analysis by descripting the case/s and themes generation for the case/s
Ethnography	It focuses on culture or context.	Studying similar patterns of actions of a cultural group in a natural setting.	Data collection tools that can be used are observations and/or interviews.	Rich description of the group within the cultural setting and generating themes
Grounded theory	This method derives a general theory of a process grounded in participant's view.	Multiple stage of data collection to Ground a theory in the participant's views.	Tools used for this method are mostly in a form of series of data collection through open and axial coding techniques.	Data analysis through different types of coding.
Narrative	It focuses on sequences of events of individuals to form a consistent story.	Studying the lives of individuals through stories of individual lives.	Data are usually generated by using in-depth interview techniques, as well as analysing documents.	Data analysis by retelling the story into narrative chronology.

Phenomenological	This approach focuses on experience towards a phenomenon to enable develop a theory.	Studying the lived experiences of individuals in relation to a phenomenon and describing it.	The most suitable procedures used for this approach are conducting interviews, focus groups, visiting places, reading documents, videos.	Data analysis through concluding the 'essence' of multiple experiences of a phenomenon.

This phase of the doctoral research (stage 2 phase 2) followed a qualitative research approach. The aim of this phase was to explore the development, implementation and evaluation of pharmacist prescribing (phenomenon) for patients with CKD in the UK. The most suitable methodological approach for this phase was phenomenological approach to address the research aim. This approach was the most suitable methodology to explore the experience of individuals with the same phenomenon in different contexts or settings to enable detailed understanding of the practice hence, suggest further development to the service (Creswell 2018). One important step to consider when employing phenomenological approach is to reflect on, acknowledge and bracket out researchers own experiences in the field.

C) Bracketing

Bracketing is defined as a method to minimise the potentially negative effects of preconceptions that may impact the research process (Tufford and Newman 2010). Bracketing is a way to protect the researcher from the effects of assessing emotionally challenging materials, since the researcher might have a connection with the research topic which may have preconceptions that influence the data gathering and interpretation process (Tufford and Newman 2010). The researcher should address bracketing and incorporate it in the personal background statement where all relevant experiences related to the phenomenon must be highlighted (Creswell 2018). Neutral stance was considered throughout

this doctoral research by acknowledging and bracketing doctoral students professional background.

D) Methods of data generation in qualitative research

Many different types of data generation methods can be employed in qualitative research including observations, interviews, documents and audio-visuals as described in Table 2.14.

Table 2.14: Methods of data generation for qualitative research. Adapted from Creswell 2018.

Data generation methods	Options	Advantages	Disadvantages
Observations	Complete concealed role of participants and research Observer as participant, researcher's role is known. Participant as observer, observation is secondary to participant role. Complete observer, researcher only observes without participation.	Researcher's direct experience with the participant. Researcher can document information timely. Uncommon incidences can be noted immediately. Good approach for noting issues out of the comfort zone of participants.	Researchers might be seen as intrusive. Observed private information cannot be reported. Researcher might not have sufficient observing skills. Certain group of participants (e.g. children) can be challenging.
Interviews	Face-to-face, one-on-one, in-person interview. Telephone-researcher interview by phone. Focus group-researcher interview group of participants. E-mail, internet interview.	Advantageous when participants cannot be directly observed. Historic information can be provided. Line of questioning can be controlled by the researcher.	Provides indirect information filtered through the views of interviewees. Information provided in a designated location, not the natural field setting. Researcher's presence may bias responses. Participants are different with different perceptions.
Documents	Public documents- minutes of meetings or newspapers. Private documents, journals, diaries, or letters.	Allow a researcher to obtain the language and words of participants. Convenient and unobtrusive source of information. Only gives data that participants given attention to. A written work which save time of transcribing.	Participants have different perceptions. Documents might be protected and unavailable for access. Access to information can be in hard to find locations. Need transcribing or scanning. information may be incomplete. Documents may not be reliable and accurate.
Audio-visual digital materials	Photographs Videotapes Art objects Computer messages Sounds Film	May be an unobtrusive method of obtaining data. Allows participants to directly share their reality. Creative and capture attention.	May be difficult to interpret. May not be accessible publicly or privately. The presence of an observer may be disruptive and affect responses.

One-to-one interviews seemed to be the most appropriate method of data collection in phase 2 of the doctoral research to allow data generation from participants individually to allow full exploration of their experiences and views around prescribing for patients with CKD. However, telephone interviews were deemed to be the best choice for interviewing participants for this phase. Most of the interviewees were from different geographical locations in the UK, in addition this approach allowed participants to select the date and time of interview according to their preferences.

E) Interview designs

Since interviews were the selected method for this phase, it is hence important to identify different designs of interviews including structured, semi-structured and narrative or unstructured as presented in Table 2.15.

Table 2.15: Interview types and issues. Adapted from O'Leary 2017.

Type of interview	Definition	Strengths	Weaknesses
Structured interviews	Follow a pre-established set of questions with standard approach of delivery.	Data collection is organised with accurate response. Can be used in large sample. Easy flow of interview due to standard format. Replicable as same structure of interview. Reliable results and quick to obtain.	Assessment scope of results is limited. Loss of detailed responses. Limits participants options of selecting responses. Research forced to follow to the interview schedule. Time consuming.
Semi-structured interviews	A flexible approach with guided set of questions, however, participants response can inform the interview direction.	Defined question plan to allow the researcher to prepare and analyse the questions in advance. Flexible approach to obtain intended data. Most widely used method. Reliable qualitative data generation.	Reliability factors are questionable. Comparison of responses become difficult since no two interviews will be similar.
Narrative/unstructured interviews	Known as described conversation between researcher and participant with an aim in mind to obtain data, mostly in a form of a story with minimal number of questions. It intends to build rapport with the participant in order to obtain rich data.	Very easy to express without being dictated. Detailed response can be obtained. Conversation help participants clarify any doubts about a question. Flexible approach of the whole research process.	Time consuming. Due to unstructured nature, the response reliability is questionable.

The most appropriate interview approach for this phase of the doctoral research was semi-structured interviews, to allow flexible structure to pursue detailed response from the participants in relation to their background and experience. This form of interview will also allow in-depth insight for exploring complex interventions such as prescribing, experiences, opinions and emotions (Longhurst 2009). Semi-structured interview was of added value to researcher to be able to ask probing questions whenever further information was required or more clarification was needed during the interview process.

F) Population and sampling design in qualitative research

As described earlier in this chapter, the whole population of the UKRPG was targeted for the survey, from which a purposive sample was selected for the semi-structured interviews. Furthermore, the researcher also employed snowball sampling technique by requesting the interviewees to suggest other clinical pharmacists prescribing for patients with CKD to increase the number of participants to ensure data saturation.

G) Sample size in qualitative research

The misconception of unimportance of numbers of participants in qualitative research is tackled by many scholars in the literature (Sandelowski 1995, Coyne 1997). The most important aspect of sample size in qualitative research is to ensure the sample is not too large to challenge extracting meaningful rich data and not too small sample to prevent achieving data saturation (Flick 2018). Creswell however suggests that sample size in qualitative research depends on the design used (i.e. narrative research can include one to two participants; phenomenology from three to ten; grounded theory from 20 to 30 participants;

ethnography could employ one single group with multiple artefacts and case studies might include four to five cases) (Creswell 2018).

H) Data saturation

To draw meaningful conclusion from qualitative data analysis, it is important to ensure that the data encompass all information needed in relation to research aim. To achieve that level of significant data analysis, data saturation needs to be attained. Data saturation is defined as the point when no further information or data is generated from the participants (Lowe 2018). Data saturation may also indicate that no further recruitment of participants required. Two main data saturation models described in literature are the thematic saturation model and the theoretical saturation model.

Thematic saturation is achieved when no new themes emerge from the data analysis. In contrast, theoretical saturation is achieved when the data obtained cannot develop any further theory derived from the data (Glaser and Strauss 2009).

Francis et al. proposed four principles for postulating data saturation as described the Table 2.16.

Table 2.16: The four principles for data saturation. Adapted from Francis 2010.

Principle	Description
Setting priori for 'initial analysis sample'	This priori set the sample size at first round of analysis to allow deciding about data saturation. The numbers will depend on the complexity of research question/aim, interview schedule, diversity of participants and the type of analysis used. Sampling should be based on stratification factors that are relevant to the study aim and objective. Initial sample of at least 10 interviews
Setting priori for 'stopping criterion'	How many more interviews are required to perform and analyse with no new emerging themes from the data before deciding that data saturation is achieved. Stopping criterion at further three interviews after the initial 10 interviews without generating new themes.
Independent coders	At least two independent researchers to analysis the data and agreement level reported in order to obtain robust and reliable analysis.
Reporting	To report the data saturation achievement method to enable readers to assess the evidence.

For the qualitative phase of this doctoral research, data saturation was chosen as criteria to stop recruiting more participants for the interviews.

I) Qualitative data analysis

Wide range of different data analysis techniques are available with two main approaches including the deductive approach and the inductive approach. Deductive approach involves qualitative data analysis based on a theoretical predetermined structure whereas, the inductive approach is not based on a theoretical ground and the researcher has may develop theory from analysing the data (Creswell 2018). Five main categories of qualitative data analysis widely discussed in literature as listed in Table 2.17.

Table 2.17: Main categories of qualitative data analysis (Creswell 2018).

Analysis category	Description
Thematic analysis	Defined as identifying patterns of meaning across a set of qualitative data that provide an answer to the research question being addressed.
Narrative analysis	Rearrange participants stories considering the meaning and experiences involved in each case.
Discourse analysis	Analysing verbal data or written data in association to its social context, to understand how language is used in real life circumstances.
Framework analysis	This approach is used to analyse data for a theoretically underpinned research. It is a flexible approach with stepwise process.
Grounded theory analysis	Interpreting qualitative data to develop theory in relation to research question or aim in an inductive fashion.

The qualitative phase of this doctoral research was underpinned by a theoretical framework and the literature, hence, framework approach to analyse the data was the most suitable approach. Details on the use of the theoretical framework is covered in section 2.7.1.

The framework approach is performed in five step process as described in Figure 2.6.

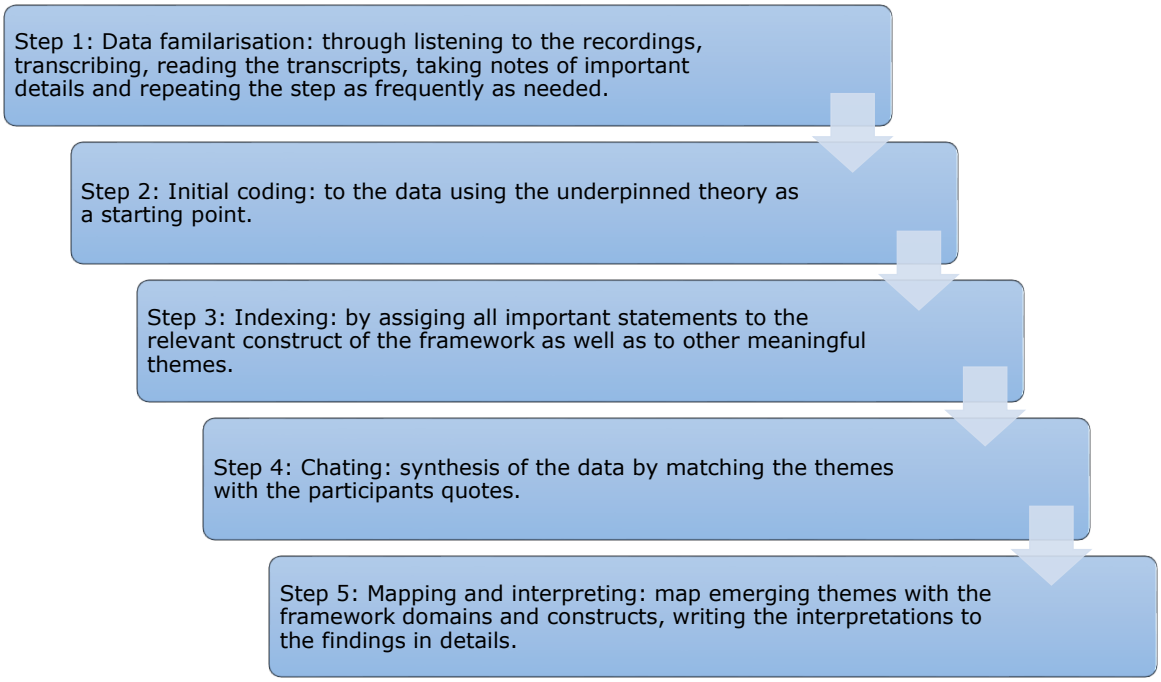

Figure 2.6: Steps of framework approach to data analysis (Creswell 2018).

Thematic approach requires systematic steps to perform as described in Table 2.18.

Table 2.18: Phases of thematic analysis. Adapted from Braun and Clarke 2006.

Step of thematic analysis	Description
1. Familiarisation	This initial phase is to transcribe the data, reading and re-reading the data, to become clearly familiar with its content.
2. Generating initial codes	This phase involves generating concise labels (known as codes) to recognise important features of the relevant data to answer the research question. It also involves coding the complete dataset, and after that, organising all data relevant to each other.
3. Search for themes	Sorting codes into potential themes. Gathering all data relevant to each potential theme.
4. Review themes	Enhance potential themes, confirm codes within theme are coherent together. Ensure different themes are different from each other.
5. Define and name themes	Further analysis to refine the details of each theme, and clearly produce each theme's definition and name to distinguish the themes from each other.
6. Final analysis and report writing	Final analysis of extracts to demonstrate themes

The method used for this qualitative research was semi-structured interviews. Data analysis was performed by following stepwise approach from word to word transcribing (verbatim) to grouping the data and coding as guided by the underpinned theoretical framework. The findings were categorising into themes based on the 29 constructs of the theoretical framework. Starting from an accurate transcript of data followed by coding in most coherent, distinctive and consistent themes in the theoretical context with CFIR. data were then analysed and interpreted by matching the themes to the participants quotes.

2.6. Ethical principles

Healthcare research is subject to consideration to meeting ethics standards ensuring respect to all research subjects and protection of their rights (Masic 2014). The main aim of any research is to add wealth of knowledge in an area of interest but this aim must not take advantage over rights of the involved individuals. It is therefore the responsibility of the research to ensure that the protection of individuals, dignity, integrity, rights, confidentiality and privacy of the participants is protected (Slowther 2006, Masic 2014). This could be achieved by meeting all legal, and ethical standards of the organisation where the research is conducted (Stevenson 2015).

Core ethical considerations for any health-related research includes respect of autonomy, justice, prevention of harm and promoting benefit (Slowther 2006).

2.6.1. Respect of autonomy

To maintain integrity of the participants, it is important to provide them with detailed information sheet with information about the research (accurate, clear and comprehensive), as well as to obtain consent for participation with appropriate documentation.

Participants involved in this doctoral research were provided with information leaflet about the study by sending an introductory email through the UKRPG group administrator. The leaflet included information about the research aim and objectives, research related frequently asked questions and information on participation rights and data protection. The participants were informed that by completing the questionnaire their consent will be given to share the anonymised data with the research team and for publication. However, for phase 2 (interviews) a signed consent was obtained from each participant prior to scheduling the interview.

2.6.2. Justice

The main issued to be considering to maintain justice is the compliance with all legislations and policies of a given organisation and ensuring all participants are treated in the same way in relation to the research.

This doctoral research was in accordance with the research ethics at RGU (Robert Gordon University 2016a) and the research governance and integrity policy (Robert Gordon University 2016b). Details of ethical considerations for each phase of this doctoral research is presented in the relevant Chapter for each phase.

2.6.3. Prevention of harm

A key element of any research ethical codes in the importance to eliminate to minimise the potential risk of harm to participants or even to the research team. Such risks can be associated more with clinical trials however, some potential risks such as identification of participants, disclosure of sensitive information may be potential risks related to any discipline (Slowther 2006).

For the purpose of this doctoral research, all phases of the research were designed with great consideration to participant's identification confidentiality; where needed, participants were described by assigned numbers and all identifiers were deleted from the transcripts to ensure anonymity in accordance with the requirements of the Data Protection Act (2018).

2.6.4. Promotion of benefit

General and specific benefits of the research findings to the participants and the society is an important aspect to encourage participation in the research. These benefits must be clearly indicated at the time of applying for ethical approval by demonstrating the primary aim of the research, rationale of the study and potential benefits to all stakeholders.

The recruited participants for this doctoral research were all professional pharmacists practising in the care for patients with CKD across the UK. All the approached participants were informed in the introductory email that the research findings may help improve patient care and provide evidence base for prescribing practice and clinical practice for the care for patients with CKD.

2.7. The use of theory to underpin approaches to research

Consideration of theoretical underpinning in research is an important aspect to ensure addition of meaningful findings of research to fill the gap in knowledge. Use of theory can enhance robustness and rigour of both quantitative and qualitative research respectively, with an added value when transferring research findings into practice (Stewart and Klein 2016).

Theoretical underpinning may be considered at any phase of a programme of research from developing the research questions, setting aim and objectives,

formulating the proposal, constructing data gathering tools and data analysis to interpreting the results (Stewart and Klein 2016).

Use of theories, models and frameworks in implementation research is gaining popularity across disciplines.

A theory is defined as a statement of relationships between units or constructs observed in the experimental world leading to clarification of why and how certain relationships lead to specific events (Wacker 1998).

A model is best known as a simpler version of a phenomenon and a certain aspect of a phenomenon, which cannot necessarily represent the reality. Models are often similar to theory with no clear differentiation between them, however, models are known to be specifically explanatory, whereas theory is both explanatory and descriptive.

A framework generally represents a structure, overview, system, outline or plan consisting of multiple descriptive categories such as constructs, variables or concepts and the associations between them which are supposed to explain a phenomenon of interest (Nilsen 2015). A framework differs from a theory or a model by not being explanatory but only describing the phenomenon within a category (Frankfort-Nachmias 2008).

The aims of use of theories, models and frameworks in implementation science is to be able to describe and guide the process of translating research findings into meaningful outcomes in practice, to identify the facilitators and barriers for implementation and to be able to evaluate the implementation effectively as described in Figure 2.7.

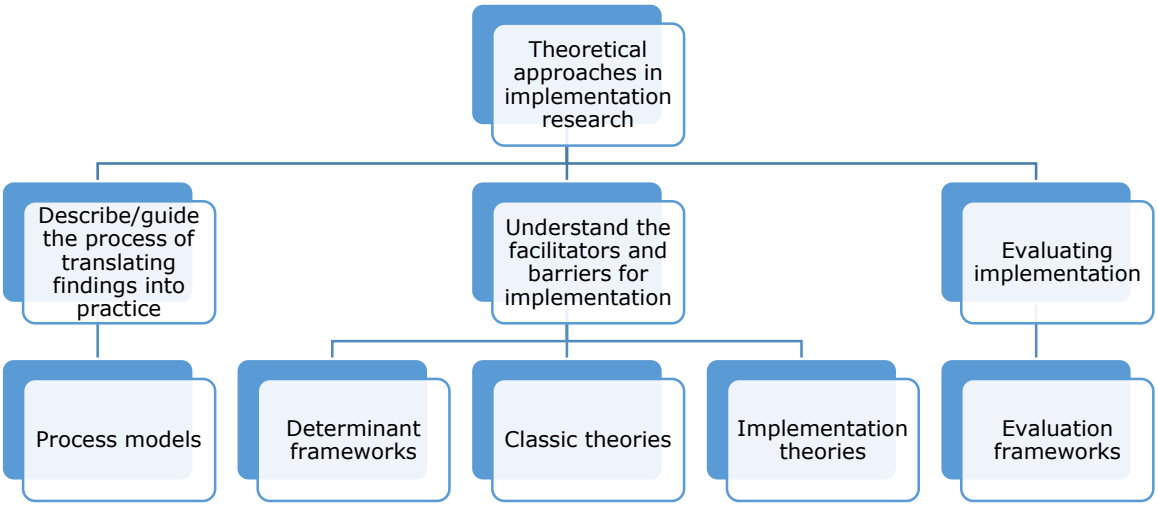

Figure 2.7: Three aims of the use of theoretical approaches in implementation science and the five categories of theories, models and frameworks (Nilsen 2015).

The five main categories of theories, models and frameworks used in implementation research are described in Table 2.19.

Table 2.19: Categories of theories, models and frameworks used in implementation science (Nilsen 2015).

Category	Description
Process models	The aim is to specify the phases in the process of translating research findings into practice.
Determinant frameworks	The aim is to understand and/or explain the facilitators and barriers influencing the implementation outcomes. Some frameworks also specify relationships between some types of determinants.
Classic theories	Classic theories usually originate from different fields, e.g. psychology, sociology and organisational theory. They can be useful to understand and/or explain different of aspects of implementation.
Implementation theories	Implementation theories are developed by researchers (from scratch or by adapting existing theories) to offer understanding and/or explanation of different aspects of implementation.
Evaluation frameworks	These frameworks help evaluate certain aspects of implementation in order to determine implementation success.

This doctoral research was based on the determinant and evaluation frameworks given the aim for this research was to scope structures, processes and related outcomes of clinical pharmacy practice in the care for patients with CKD. There are a number of frameworks to evaluate services or interventions and determine facilitators and barriers referred to in the literature. Some of these frameworks were described by Nilsen (2015) including RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) and PRECEDE-PROCEED (Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation-Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development). Despite evaluation frameworks being described in a category of their own, it has been suggested that the other four categories as listed in Table 2.18 may be used in evaluating services or interventions (Nilsen 2015). Hence, frameworks such as the Theoretical Domains Framework (TDF) (Cane 2012), Normalisation Process Theory (NPT) (Murray 2010) and Consolidated Framework for Implementation Research (CFIR) (Damschroder 2009) have been used as determinant and evaluation theories and frameworks (Nilsen 2015).

Given that the focus of Stage 2 of this doctoral research was to explore pharmacists' clinical and prescribing practice in terms of experiences and behaviours, as well as to determine the barriers and facilitators for implementing such services it was suitable to underpin the research with CFIR which involves large number of constructs for implementation research.

2.7.1. The Consolidated Framework of Implementation Research

The Consolidation Framework for Implementation Research (CFIR) is a meta-framework which goes beyond assessing intervention effectiveness, to identifying

contextual influences that explain the heterogeneity of implementation success across settings using multiple theories (Damschroder 2009). The CFIR was developed in 2009 by researchers associated with the Quality Enhancement Research Initiative (QUERI) to lead research that encourages rapid-cycle evaluation of the implementation of a complex health-related intervention systematically, and the use the findings as a guide to improve implementation (Keith 2017). The CFIR was developed after extensive review of published theories (19 theories, frameworks and models) to help identify and evaluate translation of research findings into practice. Table 2.20 below shows the models reviewed in the development of the CFIR, which has been described as a theoretical framework completing the contribution of the existing evidence base related to implementation research, rather than replacing it (Damschroder 2009).

Table 2.20: List of models analysed for the development of the CFIR. Adapted from Damschroder 2009.
Conceptual model for considering the determinants of diffusion, dissemination and implementation of innovations in health service delivery and organisation (Greenhalgh 2004)
Conceptual model for implementation effectiveness (Klein and Sorra 1996)
Dimensions of Strategic Change (Pettigrew 1992)
Theory-based Taxonomy for Implementation (Leeman 2007)
PARiHS Framework: Promoting Action on Research Implementation in Health Services (Rycroft-Malone 2004)
Ottawa Model of Research Use (Graham 2004)
Conceptual Framework for Transferring Research to Practice (Simpson 2002)
Diagnostic/Needs Assessment (Kochevar and Yano 2006)
Stetler Model of Research Utilisation (Stetler 2001)
. Technology Implementation Process Model (Edmondson 2001)
. Replicating Effective Programs Framework (Kilbourne 2007)
. Organisational Transformation Model (VanDeusen 2007)
. Implementation of Change: A Model (Grol 2007)
. Framework of Dissemination in Health Services Intervention Research (Mendel 2008)
. Conceptual Framework for Implementation of Defined Practices and Programs (Fixsen 2005)
. Will it Work Here? A Decision-maker's Guide to Adopting Innovations (Brach 2008)
. Availability, Responsiveness and Continuity: An Organisational and Community Intervention Model (Glisson 2008)
. A Practical, Robust Implementation and Sustainability Model (PRISM) (Feldstein 2008)
. Multi-level Conceptual Framework of Organisational Innovation Adoption (Frambach 2002)

2.7.2. CFIR domains and constructs

The CFIR is comprised of five major domains: intervention characteristics, outer setting, inner setting, characteristics of individuals and process. There are 39 underlying constructs and sub-constructs that can potentially influence efforts to change the practice and each sub-construct is clearly defined as listed in Table 2.21. The constructs and sub-constructs can be used as implementation and evaluation criteria in three different ways: they may

1. Raise awareness for potential influential factors,

2. Facilitate the analysis of pivotal processes and outcomes and

3. Help organise all findings of an implementation process to explain the outcomes (i.e., to understand what worked where and why).

CFIR can also be used to identify potential barriers and facilitators if used before or during an implementation. This, in turn, helps guide the selection of strategies to address these influential factors (Damschroder 2009).

Table 2.21: Consolidated Framework for Implementation Research Constructs. Adapted from Damschroder 2009.		
Construct		**Short description**
I. INTERVENTION CHARACTERISTICS		
A	Intervention Source	Perception of key stakeholders about whether the intervention is externally or internally developed.
B	Evidence Strength & Quality	Stakeholders' perceptions of the quality and validity of evidence supporting the belief that the intervention will have desired outcomes.
C	Relative Advantage	Stakeholders' perception of the advantage of implementing the intervention versus an alternative solution.
D	Adaptability	The degree to which an intervention can be adapted, tailored, refined, or reinvented to meet local needs.
E	Trialability	The ability to test the intervention on a small scale in the organisation, and to be able to reverse course (undo implementation) if warranted.
F	Complexity	Perceived difficulty of implementation, reflected by duration, scope, radicalness, disruptiveness, centrality, and intricacy and number of steps required to implement.
G	Design Quality & Packaging	Perceived excellence in how the intervention is bundled, presented, and assembled.
H	Cost	Costs of the intervention and costs associated with implementing the intervention including investment, supply, and opportunity costs.
II. OUTER SETTING		
A	Patient Needs & Resources	The extent to which patient needs, as well as barriers and facilitators to meet those needs, are accurately known and prioritised by the organization.
B	Cosmopolitanism	The degree to which an organization is networked with other external organizations.
C	Peer Pressure	Mimetic or competitive pressure to implement an intervention; typically, because most or other key peer or competing organisations have already implemented or are in a bid for a competitive edge.
D	External Policy & Incentives	A broad construct that includes external strategies to spread interventions, including policy and regulations (governmental or other central entity), external mandates, recommendations and guidelines, pay-for-performance, collaboratives, and public or benchmark reporting.
III. INNER SETTING		
A	Structural Characteristics	The social architecture, age, maturity, and size of an organisation.
B	Networks & Communications	The nature and quality of webs of social networks and the nature and quality of formal and informal communications within an organization.
C	Culture	Norms, values, and basic assumptions of a given organization.
D	Implementation Climate	The absorptive capacity for change, shared receptivity of involved individuals to an intervention, and the extent to which use of that intervention will be rewarded, supported, and expected within their organization.
1	Tension for Change	The degree to which stakeholders perceive the current situation as intolerable or needing change.
2	Compatibility	The degree of tangible fit between meaning and values attached to the intervention by involved individuals, how those align with individuals' own norms, values, and perceived risks and needs, and how the intervention fits with existing workflows and systems.
3	Relative Priority	Individuals' shared perception of the importance of the implementation within the organization.
4	Organizational Incentives & Rewards	Extrinsic incentives such as goal-sharing awards, performance reviews, promotions, and raises in salary, and less tangible incentives such as increased stature or respect.

Table 2.21 (continued…): Consolidated Framework for Implementation Research Constructs. Adapted from Damschroder 2009.		
Construct		**Short description**
5	Goals and Feedback	The degree to which goals are clearly communicated, acted upon, and fed back to staff, and alignment of that feedback with goals.
6	Learning Climate	A climate in which: a) leaders express their own fallibility and need for team members' assistance and input; b) team members feel that they are essential, valued, and knowledgeable partners in the change process; c) individuals feel psychologically safe to try new methods; and d) there is sufficient time and space for reflective thinking and evaluation.
E	Readiness for Implementation	Tangible and immediate indicators of organizational commitment to its decision to implement an intervention.
1	Leadership Engagement	Commitment, involvement, and accountability of leaders and managers with the implementation.
2	Available Resources	The level of resources dedicated for implementation and on-going operations, including money, training, education, physical space, and time.
3	Access to Knowledge & Information	Ease of access to digestible information and knowledge about the intervention and how to incorporate it into work tasks.
IV. CHARACTERISTICS OF INDIVIDUALS		
A	Knowledge & Beliefs about the Intervention	Individuals' attitudes toward and value placed on the intervention as well as familiarity with facts, truths, and principles related to the intervention.
B	Self-efficacy	Individual belief in their own capabilities to execute courses of action to achieve implementation goals.
C	Individual Stage of Change	Characterization of the phase an individual is in, as he or she progresses toward skilled, enthusiastic, and sustained use of the intervention.
D	Individual Identification with Organization	A broad construct related to how individuals perceive the organization, and their relationship and degree of commitment with that organization.
E	Other Personal Attributes	A broad construct to include other personal traits such as tolerance of ambiguity, intellectual ability, motivation, values, competence, capacity, and learning style.
V. PROCESS		
A	Planning	The degree to which a scheme or method of behavior and tasks for implementing an intervention are developed in advance, and the quality of those schemes or methods.
B	Engaging	Attracting and involving appropriate individuals in the implementation and use of the intervention through a combined strategy of social marketing, education, role modeling, training, and other similar activities.
1	Opinion Leaders	Individuals in an organization who have formal or informal influence on the attitudes and beliefs of their colleagues with respect to implementing the intervention.
2	Formally Appointed Internal Implementation Leaders	Individuals from within the organization who have been formally appointed with responsibility for implementing an intervention as coordinator, project manager, team leader, or another similar role.
3	Champions	Individuals who dedicate themselves to supporting, marketing, and 'driving through' an [implementation], overcoming indifference or resistance that the intervention may provoke in an organization.
4	External Change Agents	Individuals who are affiliated with an outside entity who formally influence or facilitate intervention decisions in a desirable direction.
C	Executing	Carrying out or accomplishing the implementation according to plan.
D	Reflecting & Evaluating	Quantitative and qualitative feedback about the progress and quality of implementation accompanied with regular personal and team debriefing about progress and experience.

2.7.3. Use of CFIR in healthcare practice research

The CFIR has been cited by more than 1,660 scholars according to PubMed citation report. The CFIR framework has been used across a wide range of health-related research and promoted advancement in implementation research. Findings from CFIR based research help researchers understand more about what works, where and why (Damschroder 2009). Use of the CFIR also aids researchers in predicting implementation success across different settings; it may also be used as a guide to influential evaluation of implementation services (Damschroder 2009). One of the uses of the CFIR framework is in pre-implementation assessments to enable identification of potential facilitators and barriers to implementation of a service or intervention from the perspective of the individuals and organisations involved in the implementation.

The CFIR has been widely used in a range of clinical pharmacy related studies and reviews to explore the implementation of new innovations and services (Robins 2013, Weir 2019, Baumgartner 2020, King 2020).

The CFIR provides a list of clearly defined constructs and sub-constructs which can be used as a guide to aid conceptualisation of the research idea, generate appropriate research questions, help design the data collection tool and analyse and interpret data.

This doctoral research was guided by the use of the CFIR throughout both phases of Stage 2 to categorise and quantify elements of pharmacists' clinical and prescribing practice and to understand the heterogeneity of this practice. Data collection tools for the questionnaire and the interviews, data analysis and interpretation were informed by CFIR constructs.

2.8. Quality assurance in quantitative and qualitative research

To ensure the evidence based on research findings are reliable for quantitative research, trustworthy for qualitative research and applicable for both types of research to a wider context it is important to consider the quality criteria of any research approach. Despite the similarity in quality standards for both qualitative and quantitative research, the approaches are different in terms of conception and operationalisation (Frambach 2013).

2.8.1. Quality assurance in quantitative research

Robustness in quantitative research is achieved by four important principles in order to add new trustworthy knowledge to the body of evidence (Frambach 2013).

The first important principle is the truth value of evidence, which can be attained through internal validity known as the level of accuracy of the findings in relation to the independent variables (Frambach 2013).

The second quality principle is around the applicability of evidence by maintaining external validity of the research. External validity is related to the extent to which the findings are generalisable to the wider population (Frambach 2013).

The third principle is related to the consistency of the evidence by means of reliability which is defined as (the extent to which the findings are consistent if the research is repeated) (Frambach 2013).

The fourth and final principle of research quality is associated with the neutrality of evidence which is achieved through eliminating personal biases that could impact the quality of the research known as objectivity (Frambach 2013).

Table 2.22 presents the four quality principles for quantitative research with potential techniques to enhance research quality.

Table 2.22: The four quality principles for quantitative research. Adapted from Frambach 2013.

Quality principle	Criteria in quantitative research	Techniques to enhance quality
Truth value of evidence	Internal validity	Accurate sample size calculation (power calculation). Sufficient description of intervention. No loss of participants, or clear justification for non-respondents. Standardisation of intervention. Use of control group where appropriate.
Applicability of evidence	External validity	Population generalisability by random or stratified sampling techniques. Potential for replicating the research (ecological generalisability). Confirmability of predicted relationships between variables (construct validation).
Consistency of evidence	Reliability	Ability to repeat measures to ensure internal consistency (classical test theory). Evaluate if any variance impacting the outcomes (generalisability theory). Ability to estimate participants parameters or other variables (item response theory).
Neutrality of evidence	Objectivity	Use of double blinding techniques for data collection. Anonymity of participants identification. Ability to avoid judgemental interpretation to findings. Data protection for accountability.

2.8.2. Quality assurance in qualitative research

To establish rigour in qualitative research for trustworthy findings, it is suggested to follow the four quality principles for qualitative research (Frambach 2013).

The first principle of truth values of evidence can be achieved by credibility which is defined as 'whether or not the findings are consistent with participants views and beliefs in order to be trustworthy by the wider population' (Frambach 2013).

The second principle of applicability which can be accomplished through transferability of the findings to other contexts, other people or other settings (Frambach 2013).

The third quality principle is related to consistency of the evidence by means of dependability which is related to the logical research process (Frambach 2013).

The fourth quality principle is concerned with the neutrality of evidence which could be attained by confirmability that the results are solely based on the extensive process of analysis and reflects participants views instead of researchers' biases (Frambach 2013).

Table 2.23 presents the four quality principles for qualitative research with potential techniques to enhance research quality.

Table 2.23: Quality principles for qualitative research and techniques to enhance research quality.

Quality principle	Criteria in qualitative research	Techniques to enhance quality
Truth value of evidence	Credibility	Use of different data source (data triangulation). Used of multiple methods (methodological triangulation). Involvement of several researchers (investigator triangulation). Use of multiple theories (theory triangulation). Data collection over a timeframe (prolonged engagement). Constant feedback from participants on data and findings (member checking).
Applicability of evidence	Transferability	Detailed description of findings to provide meaningful results (thick description). Thorough explanation of sampling strategy. Ability to compare findings with existing evidence in different context.
Consistency of evidence	Dependability	Reach data saturation until no new themes emerge. Continuous data analysis to inform further data collection (iterative data collection). Regular data analysis to ensure no further themes emerging (iterative data analysis). Being open and flexible towards the research topic and process (flexible research design).
Neutrality of evidence	Conformability	Looking for available literature to confirm or disconfirm findings. Discussion of research process and results with experts in field (peer debriefing). A record of reflection on the process and any influences of the researcher (reflexivity). Clear documentation of the research process, the steps and any decision made during the research with reasoning (audit trail).

2.8.3. Bias in research

Bias is defined as any tendency to diverge from the truth in any step in conducting a research from setting research questions, designing data collection

tool, data collection process, analysis and interpretation leading to false conclusions (Šimundić 2013). Each study type has different methodology-related limitations with potential for various types of biases. Therefore, it is important for the researcher to be aware of the possible sources of biases so that these may be addressed and minimised. Table 2.24 describes the most common form of biases in research whether it is researchers' bias or participants' bias (Sarniak 2015).

Table 2.24: Types of biases and mitigation approaches. Adapted from Sarniak 2015.

Researchers' bias		
Type of bias	**Description**	**Mitigation approaches**
Confirmation bias	Research have certain beliefs and hypothesis and what to confirm these beliefs through participants responses.	To mitigate confirmation bias, researcher must regularly assess participants responses and challenge their own hypothesis and assumptions.
Culture bias	Researcher view at the issues through cultural lens which lead to creates assumptions in relation to influences and motivations. It can also lead to being judgmental towards a culture based on own cultural values.	Researcher need to respect cultural differences and take it into account without making assumptions.
Question order bias	Setting questions in a leading way that could influence answers. Participants are driven to certain answers as an impact to question wording that could affect their thoughts and attitudes to the subsequent question.	Although this type of bias is unavoidable, asking some general questions before being very specific, and positive questions before negative could minimise bias.
Leading question bias	This type of bias lead to biased results as researchers try to achieve contain answer either to confirm a hypothesis, build rapport with respondents or overrate the understanding of the respondents.	This could be minimised by asking questions in participants language and understandings bearing in mind their thoughts. No assumptions should be made about the relationship between respondent's emotions and behaviours.
Halo effect bias	Type of cognitive bias where the researcher or participants have the potential to have an impression on further responses based on a single trait which might influence multiple judgments or ratings. Mostly in qualitative research.	This can be minimised if the researcher knows what are they looking for and how to interpret the responses by asking the right question at the right order. As well as being aware of the source of biases
Respondents' bias		
Acquiescence bias	Also known as 'yes saying' bias, where the respondents tend to pick the positive responses and some would just want to complete the questionnaire with any response.	To mitigate this type of bias, researchers must consider respondents views when designing the tool rather than providing an obvious right answer.
Social desirability bias	This type of bias occurs as participants desire to pick the most liked and acceptable answer to present themselves in best position.	Researcher must assure the respondents about the anonymity of responses and well as making it clear while questioning that it they can answer according to their thoughts and not according to social desirability.

		Using third person language could also help minimise such biases.
Habituation bias	Respondents select similar answers to similar format of questions. Also known as 'biological response'.	To minimise this type of bias, researchers should formulate the questions in a way to keep respondents engaged and use different types of wordings for further questions.
Sponsor bias	When the respondents know the researcher or the sponsor of the research, so they tend to answer in a way that creates bias.	To minimise such biases, researchers must use neutral stance, no reinforcement to certain positive answers.

All types of biases were considered at each stage of this doctoral research. Information on how bias was considered and addressed in each phase is presented in Chapters 4 and 5.

2.8.4. Reflexivity in research

Reflexivity is defined as 'an awareness of the effect of the researcher on the research process' (Barry 1999). In 2017, Attia and Edge classified reflexivity as two interrelating elements: prospective reflexivity which is related to the effect of the researcher on the research and retrospective reflexivity which associated with the effect of the research on the researcher (Attia and Edge 2017). Reflexivity has been used in qualitative research to enable researchers present rigorous and quality findings of their research by being aware about their values and background that may influence the research process (Palaganas 2017). Reflexive practice is considered the gold standard to ensure trustworthiness of research results. Reflexivity is not an easy process yet is considered to be one of the main pillars of qualitative research. A researcher involved in qualitative research can have a great impact on the process of data generation and interpretation, therefore reflexivity, through acknowledgement about self-efficacy and the potential to have unconscious influence on the research, is important (Dodgson 2019).

The researcher account responsible to clearly identify or describe all the relevant associations between themselves and the respondents (such as cultural background, social status, professional stance, ethnicity, sex and age). Acknowledging the similarities or the differences will enhance credibility of the research findings (Berger 2015).

The doctoral student and the research team ensured that all measures as described in literature were considered throughout this doctoral research programme to minimise the impact of the research team's professional background on the quality of the research. The research student's background as a clinical pharmacist was acknowledged and bracketed to eliminate or minimise any bias, however, the research student has no prescribing qualifications nor experience hence, all measures were taken to try to minimise the impact on the qualitative research process. The research student was aware of the impact of being a pharmacist and the potential to affect the research process however, the student acknowledged and bracketed her background throughout the process of this research and was guided by experienced supervisors who are experienced pharmacists and academics to try to minimise any such influence.

2.9. Summary

This doctoral research followed a positivist approach and was performed in two stages. The first stage was a systematic review of the available literature on clinical pharmacy practice in the care of patients with CKD (Al Raiisi 2017, Al Raiisi 2019). Findings of the systematic review were used to identify the gap in the knowledge base hence, informed the development of Stage 2, the data generation stage of the doctoral programme which was in two phases. An explanatory sequential mixed-method approach was employed for this,

underpinned CFIR as a theoretical framework. Data were generated by carrying out two phases of research with members of the UKRPG all across the UK:

Phase 1: an online survey to determine the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of care of patients with Chronic Kidney Disease.

Phase 2: the qualitative interview phase aimed to explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

Chapter 3: Systematic review Clinical pharmacy practice in the care of Chronic Kidney Disease patients: A Systematic Review.

3. Introduction

This chapter provides details on the systematic review carried out by the doctoral student on clinical pharmacy practice in the care of Chronic Kidney Disease patients. A systematic review was performed as phase 1 of this doctoral research to provide a base for the development of the research programme.

The previous chapter illustrated the types of reviews with details on the steps to conduct a systematic review. As described earlier in Chapter 2, systematic reviews appraise, synthesise and report pertinent literature that are directly related to the review questions.

Synthesis of quantitative studies can either be descriptive/narrative or statistical (meta-analysis). Heterogeneous data as analysed descriptively with clearly identifying the source of potential heterogeneity (JBI 2013). This systematic review was appropriate for narrative synthesis due to heterogeneity in the data obtained from the included papers. The systematic review was published in 2019 (Alraiisi 2019).

3.1. Search of existing systematic review on the topic

Following databases were searched to identify and pre-existing systematic review within the topic proposed by the doctoral student: the Cochrane databases of systematic reviews, the centre of reviews and dissemination, Medline, PubMed, International Pharmaceutical Abstracts and google scholar. One similar systematic review was identified. In 2012, Salgado et al. published a systematic review, 'Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review' which included synthesis of the peer reviewed literature to March 2010 (Salgado 2012). Given the developments in clinical pharmacy globally, it was likely that further research has been reported

since that date. There is a need to further establish the evidence base of the impact of clinical pharmacy in the care of CKD patients.

3.2. Systematic review aim and questions

The aim of this review was to appraise, synthesise and present the available evidence for the structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with CKD. The specific review questions were:

• What clinical pharmacy practice related resources (structures, e.g. the multidisciplinary team, clinical pharmacy skill mix and time allocation) are in place and how are these matched to healthcare needs and demands to enable provision of care to chronic kidney disease (CKD) patients?

• What activities are performed (processes, e.g. medication review, prescribing) to care for patients with CKD, how and when are they performed?

• What are the outcomes of the structure and the processes on the effectiveness (Economic, Clinical, and Humanistic Outcomes (ECHO) model) (Kozma 1993) of care provided?

3.3. Ethical considerations

The Ethics panel of the School of Pharmacy & Life Sciences, Robert Gordon University indicated that ethics approval was not required for this systematic review.

3.4. Review protocol development

The protocol was constructed in accordance with PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) standards (Moher 2015). The protocol of this systematic review was accepted and registered with

the International Prospective Register of Systematic Reviews (PROSPERO). The registration number is CRD42017065258 (Appendix 3.1) (Al Raiisi 2017).

3.5. Method

3.5.1. Data Sources

The systematic review was conducted and reported in accordance with PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) standards (Moher 2010).

The Cochrane database was searched to identify any relevant systematic reviews. An electronic search of relevant databases (PubMed, International Pharmaceutical Abstracts (IPA), Cumulative Index to Nursing and Allied Health Literature (CINAHL), Medline and Scopus) was conducted from March 2010 to December 2018 thus providing an update on the review of Salgado et al. (Salgado 2012). The search was carried out using Medical Subject Headings (MeSH) and other appropriate subject headings and text words where applicable. Scoping searches were conducted prior to finalising the search strategy. Boolean operators such as truncations (*), wild cards ($), adjacent search options (e.g. adj2) were used where relevant. The following grouped terms were initially searched separately then in combination by two independent reviewers (FA & SC). The primary search was conducted using the improved search strategy of the same terms as the original review as follows:

PubMed, IPA, CINAHL: ("pharmaceutical services" [MH+] OR "pharmacy" [MH+] OR "Pharmacies" [MH] OR "Pharmacists" [MH] OR "clinical pharmacist*" [TI / AB / SU] OR "clinical pharmacy" [TI / AB / SU] OR "clinical pharmacies" [TI / AB / SU] OR "pharmacist*" [TI / AB / SU] OR "pharmaceutical services" [TI / AB / SU] OR "pharmacies" [TI / AB / SU] OR "pharmacy" [TI / AB / SU]) AND ("kidney

diseases" [MH+] OR "renal replacement therapy" [MH+] OR "proteinuria" [MH+] OR "CKD" [TI / AB / SU] OR "nephropathy" [TI / AB / SU])

Scopus:

("Pharmaceutical care" [TI/ABS/KEY] OR "Pharmacist" [TI/ABS/KEY] OR "Clinical pharmacy" [TI/ABS/KEY]) AND ("Chronic Kidney Disease" [TI/ABS/KEY] OR "Renal replacement Therapy" [TI/ABS/KEY] OR "Haemodialysis" [TI/ABS/KEY] OR "Kidney failure" [TI/ABS/KEY])

The bibliography list of included studies was reviewed to further identify additional references.

3.5.2. Study Selection and Data Extraction

Only quantitative studies (randomised and non-randomised controlled and uncontrolled trials, cohort studies and before and after evaluations) published in peer-reviewed journals were included in the review. Papers published in English and focusing on researching clinical pharmacy practice and the role of the pharmacist in managing patients with CKD were included. Studies not addressing the topic, literature based only on conceptual models, i.e. lacking empirical evidence, grey literature including conference proceedings, abstracts and unpublished studies were excluded. Observational studies were excluded since they did not address the aim of this review.

Title and abstract screening and quality assessment for inclusion were conducted independently by two reviewers (FA and SC), with any disagreements resolved by discussion with a third independent reviewer (DS).

3.5.3. Quality assessment

An independent, duplicate quality assessment of each study was undertaken (DS, TJ, FA & SC). All controlled, uncontrolled and descriptive studies were assessed using the mixed-methods appraisal tool (MMAT) (Appendix 3.2), a validated and unique tool for appraising different types of study designs (Pluye 2011). All controlled studies included in this review were additionally assessed for quality using the Downs and Black's (Appendix 3.3) method in line with the original review (Downs and Black 1998), a validated tool with a scoring scale consisting of 27 questions grouped into five domains (reporting, external validity, bias, confounding and power). The total score is 32 and is expressed as rates, the higher the score the better the quality of the paper in terms of methodology (maximum is 1) (Downs and Black 1998). To classify scores, the approach of Machado et al. was applied (Machado 2007), (i.e. < 0.5 was considered 'weak', 0.5 – 0.69 were 'fair', 0.7 – 0.79 'good' and 0.8 – 1.0 'very good').

3.5.4. Data extraction

Data extracted included: primary author, year of publication, aim/ objectives, design, duration, setting, participants, pharmacist interventions, key findings or main outcomes and conclusion. Structures, processes and outcomes were adapted from Donabedian's quality of care model (Donabedian 1988). Structure was defined as the 'resources required for the pharmacist to be able to provide care to renal patients such as requiring special training, availability of policies and procedures for practice etc.'. Process was defined as 'the activities that are performed by the pharmacist on a daily basis or on specific intervals and how and when they are performed. These activities may include: daily clinical rounds, involvement in patients' management plans, medication reviews, therapeutic recommendations and pharmacist prescribing. Outcome measures included

clinical outcomes such as: clinical parameters, medication-related adverse events, mortality and morbidities, humanistic outcomes such as: quality of life and economic outcomes such as: rate of hospitalisation and cost of inappropriate therapies. In addition, pharmacists' intervention was defined in the previous review as "any action with the aim of modifying the process of use of drugs, either in patients' activities or in medical or health care practitioners' activities" (Salgado 2012).

3.5.5. Data synthesis

Due to heterogeneity in the data obtained from the included papers (type of patients, study design, outcomes measured), only descriptive and narrative synthesis was possible. All findings were considered by two independent reviewers to ensure robustness and consistency in execution of the review process.

3.6. Results

3.6.1. Study Selection and Data Extraction

No systematic reviews were identified from the Cochrane database and no additional primary studies were identified from the bibliography lists of included studies.

Databases searches identified 4140 potential articles to screen further for eligibility as shown in Figure 3.1. Only 47 articles met the inclusion criteria and after quality assessment were of a standard deemed acceptable for inclusion in the review.

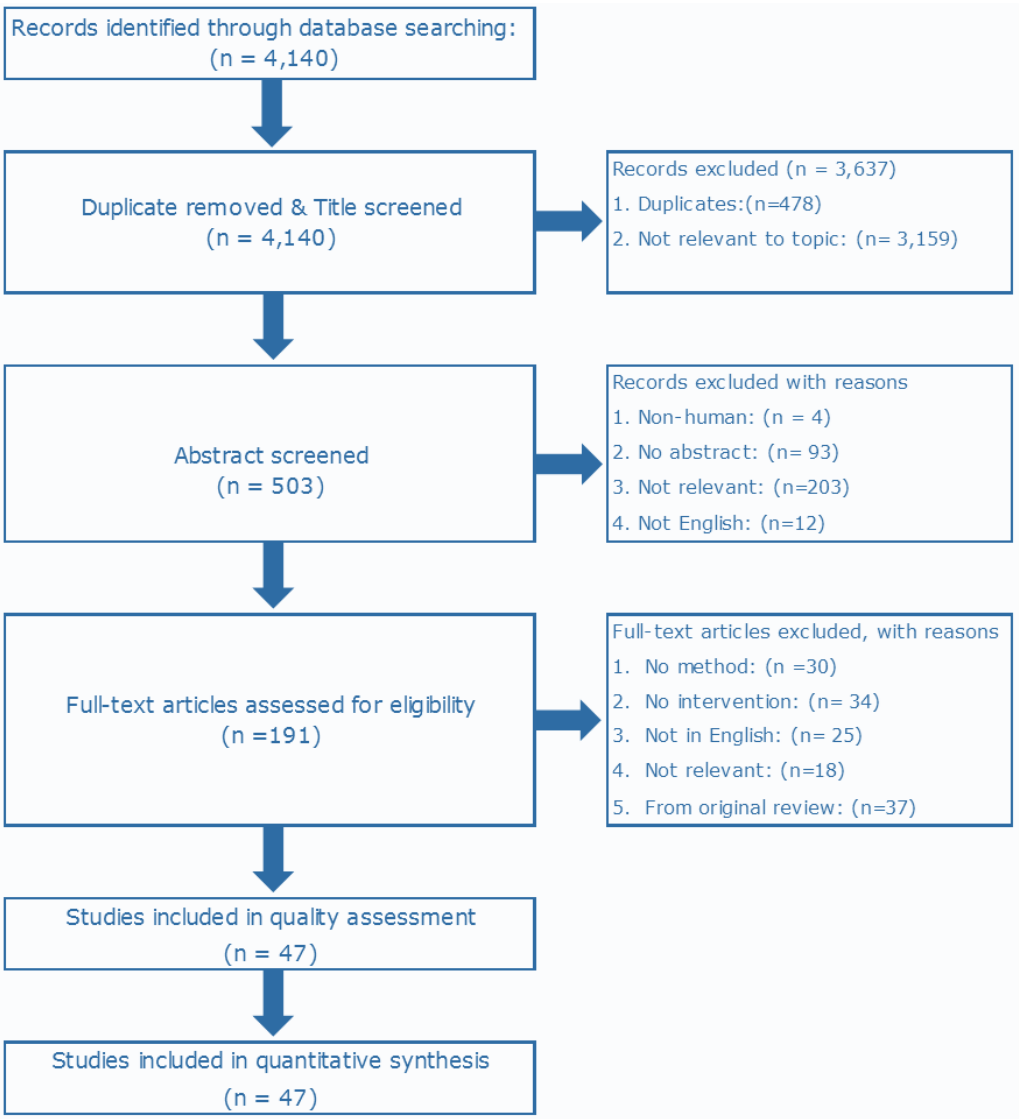

Figure 3.1: PRISMA Chart describing study retrieval and selection (Moher 2009).

3.6.2. Quality assessment

The Downs and Black's mean score of the 20 controlled studies was 0.557 (SD = 0.075). All papers presented 'fair' quality with the exception of four that scored < 0.5 and was therefore considered 'weak' quality. The quality assessment of all the included studies using the MMAT tool for the randomised (n = 10), non-randomised (n = 20) and descriptive studies (n = 17) are shown in Figures 3.2, 3.3 and 3.4.

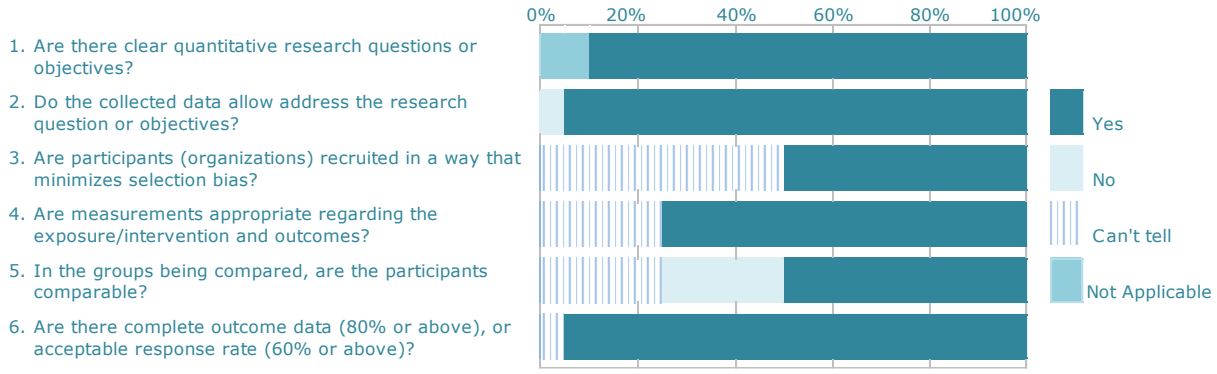

Figure 3.2: Stacked bar chart representing quality of quantitative randomised controlled trials (n = 10)

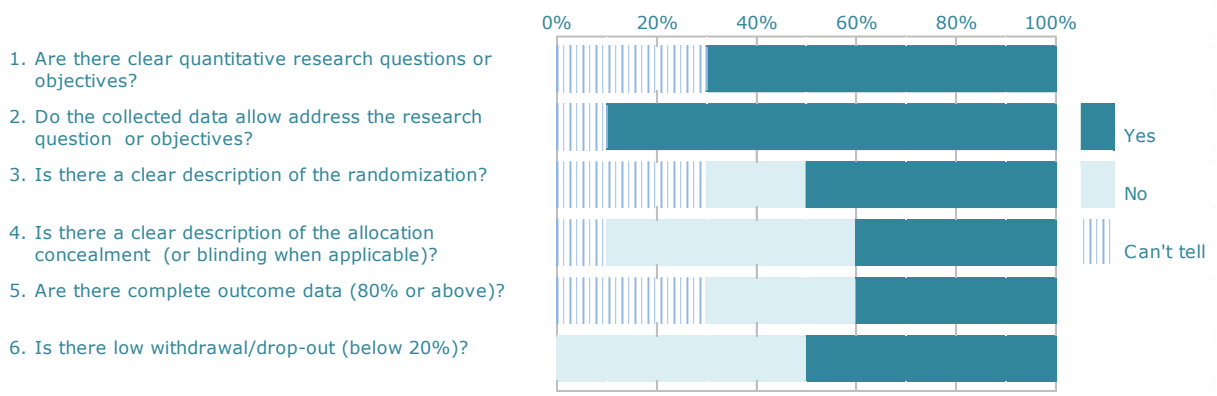

Figure 3.3: Stacked bar chart representing quality of quantitative non-randomised studies (n = 20)

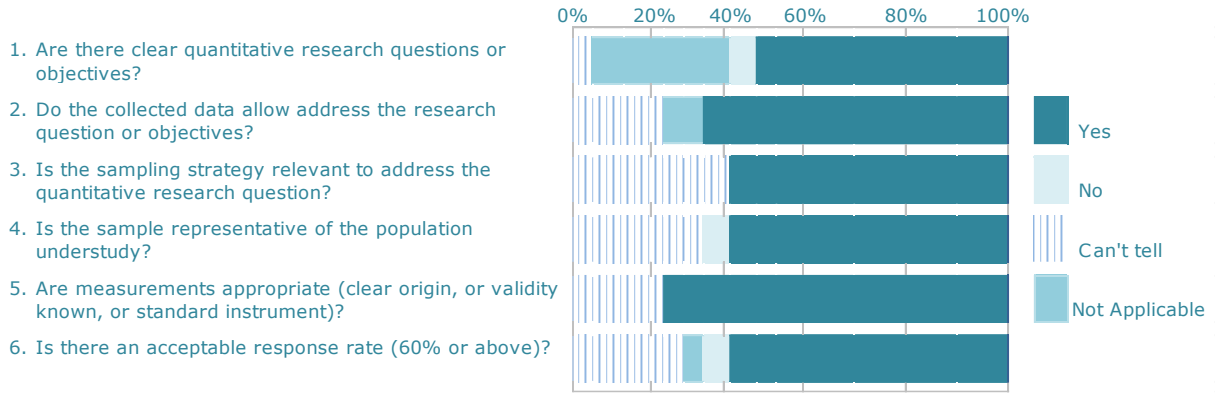

Figure 3.4: Stacked bar chart representing quality of quantitative descriptive studies (n = 17)

Footnote: The % values above represents the proportion for each response as agreed between reviewers for the papers included for each study design.

3.6.3. Data extraction

Tables 1 and 2 detail the data extraction characteristics of controlled and uncontrolled studies included in the systematic review (Cooney 2015, Pourrat 2015, Vessal 2010, Via-Sosa 2013, Gheewala 2014, Staino 2015, Belaiche 2012a, Mousavi 2013, Dashti-Khavidaki 2012, Holm 2015, Chen 2013, Arrabal-Durán 2014, Barnes 2014, Belaiche 2012b, Castelino 2011, Dashti-Khavidaki 2013, Ramadaniati 2016, Qudah 2016, Geerts 2012, Ohnishi 2011, Jiang 2014a, Cabello-Muriel 2014, AbuRuz 2013, Jiang 2013, Aspinall 2012, Jiang 2014b, Aberger 2014, Adibe 2017, Kelly and Booth 2008, Debenito 2014, Chang 2016, Patricia and Foote 2016, Joost 2014, Santschi 2011, Venkateswararao 2016, Rani 2013, Dashti-Khavidaki 2009, Chia 2017, Mateti 2017, Anderegg 2018, Mateti 2018a, Mateti 2018b, Tuttle 2018, Xu 2018, Alshamrani 2018, Chandrasekhar 2018 and Imamura 2018).

Table 3.1: Characteristics of controlled studies included in the systematic review								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Santschi et al. 2011 Canada	Cluster, randomised study (6 months)	Primary Care, Community Pharmacies. Multidisciplinary pre-dialysis clinic	To evaluates the impact of ProFiL on BP control and management of hypertension treatment.	90 CKD patients	ProFiL group 71.9 (10.4), and usual care group 73.3 (7.7)	(1) A 3-h training workshop for community pharmacists. (2) A communication network to facilitate the transfer of clinical information between the pre-dialysis clinic and community pharmacists (3) A pharmaceutical consultation service by hospital pharmacists with expertise in nephrology. (n = 48)	Usual care (n = 41)	Adjusted mean BP changes, were (-6.9/-0.4 mmHg in ProFiL patients) compared with (+4.7 / +2.2 mmHg in UC) (between groups differences, P value = 0.021/0.348). At 6 months, 44% of ProFiL and 24% of UC patients achieved their BP targets. Patients with written hypertension recommendations had a greater decrease in mean systolic BP (-11.6 mmHg; P value = 0.035), and BP was controlled in a higher proportion of them (relative risk, 2.14; P value = 0.011).
Aspinall et al. 2012 USA	Non-randomised controlled study (6 months)	Primary care setting, Medical centers	To compare the quality of ESA prescribing and monitoring for patients with NDD-CKD in Veterans Affairs Medical Centers with and without pharmacist-managed ESA clinics.	572 NDD-CKD patients	Pharmacist-Managed ESA Clinic 73.9 (10.9), Usual-Care 78.4 (8.8), Usual Care at ESA Clinic 76.2 (12.0)	Dosing and monitoring ESA therapy by pharmacists (n = 314) Usual care at ESA clinic site (n = 91)	Usual care (n = 167)	More haemoglobin values were in the target range in pharmacist-managed ESA clinics (71.1% vs 56.9% for usual-care sites; P<0.001). Veterans in pharmacist-managed ESA clinics had more haemoglobin measurements on average (5.8 vs 3.6 in usual-care sites and 3.8 in usual care at ESA clinic sites; P = 0.007).
Dashti-Khavidaki et al. 2013 Iran	Cluster, randomised study (12 months)	Haemodialysis ward of a university affiliated tertiary hospital	To assess the impact of pharmaceutical care on HRQoL of haemodialysis patients.	92 HD patients	Intervention 55.4 (15.7), control 48.6 (14.7)	Receive clinical pharmacist-led pharmaceutical care in addition to the standard care of the ward as the case group (n = 26)	Control group (n = 34)	Not reported.

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Via-Sosa et al. 2013 Spain	Non-randomised controlled study (9 months)	Community pharmacies	To evaluate the effectiveness of the community pharmacist intervention in addressing the problem of dosing inadequacy as a consequence of renal impairment in patients over 65 years that were taking 3 or more drugs when compared with usual care.	40 community pharmacies. 354 CKD patients	Intervention 80.8 (7.3), control 82.9 (7.1)	Pharmacists used a questionnaire to write a report to GPs detailing the DRPs detected and suggesting changes in therapy. GPs to provide written reply to the pharmacists within 14 days (n = 178)	Control group (n = 176)	The difference in the prevalence of dosing inadequacy between the control and intervention group before the pharmacists' intervention was 0.73% (95% CI (−6.0) - 7.5) and after the pharmacists' intervention it was 13.5% (95% CI 8.0 - 19.5) ($p < 0.001$) while the difference in the mean of drug-related problems per patient before the pharmacists' intervention was 0.05 (95% CI(-0.2) - 0.3) and following the intervention it was 0.5 (95% CI 0.3 - 0.7) ($p < 0.001$).
Cabello-Muriel et al. 2014 Spain	Non-randomised controlled study (Unclear)	Internal medicine department of a referral hospital	To demonstrate that the intervention of a pharmacist in a monitoring program for patients with CKD improves the outcome of renal function in these patients.	249 CKD patients	Intervention 82.4 (7.4), Control 81.2 (8.5)	Pharmacist intervention including patient interview, medication history taking, identification of inappropriate doses of nephrotoxic drugs, daily check of laboratory parameters and proposing dose adjustments to physicians. (n = 124)	Control group (n = 125)	Significant differences were noted when comparing CrCl between discharge and admission in both the control and intervention groups (5.1 ± 0.9 vs. 6.4 ± 1.0 $p<0.01$). The rate of acceptance of the pharmacists' recommendations was 74 %.
Debenito et al. 2014 USA	Non-randomised controlled study (6 months)	Primary care setting, health care system	To assess adherence to monitoring guidelines, along with efficacy and safety outcomes, and to quantify medication utilization expenditures among patients using ESA therapy managed by a clinical pharmacy service compared with usual care.	101 CKD patients (pre-dialysis)	Intervention 65.6 (14.1), UC 72(13.3)	Clinical pharmacy services provided to patients attending the Clinical Pharmacy Anticoagulation and Anaemia Service. (n = 31)	Usual care (n = 70)	Time to achievement of haemoglobin target was 28 days in the pharmacist-managed group compared with 41 days in the usual care group (P = 0.135), while the proportion of patients achieving target haemoglobin was 96.8% compared with 95.7%, respectively (P = 0.654). Patients in the pharmacist-managed group used less ESA during the 6-month period, leading to an annualized savings of 1288 USD per patient in drug expenditures.

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Jiang et al. 2014a China	Non-randomised controlled study (12 months)	University affiliated tertiary hospital	To describe the development and implementation of pharmacist dosing adjustment for critically ill patients receiving CRRT and to examine the effectiveness of pharmacist interventions.	209 patients on CRRT	Intervention 58.9 (17.3), No-intervention 61.3 (16.9)	The pharmacists assessed the patients receiving CRRT daily during ICU rounds, and then made dosage adjustment interventions when needed. (n = 106)	No-intervention group (n = 103)	Suspected adverse drug events in the intervention group were significantly lower than the pre-intervention group (35 in 27 patients versus 18 in 11 patients, P<0.001). However, there was no significant difference between length of ICU stay and mortality after pharmacist dosing adjustment, which was 8.93 days vs 7.68 days (P=0.26) and 30.10% vs 27.36% (P=0.39), respectively. The majority of identified ADEs caused significant injury (48.6% in the pre-intervention period and 44.4% in the post-intervention period) to the patients involved; the number of these ADEs differed significantly between the two groups (P=0.02).
Jiang et al. 2014b China	Non-randomised controlled study (12 months)	University affiliated tertiary hospital	To evaluate the effect of clinical pharmacist participation in an ICU team on antimicrobial dosing adjustment intervention for patients receiving CVVH.	180 patients on CVVH	Intervention 62.0 (18.4), Control 59.3 (20.6)	Pharmacists assessed critically ill patients receiving CVVH daily during ICU rounds, and made antimicrobial dosage adjustment interventions when needed. (n = 93)	Control group (n = 87)	Pharmacists made 256 antimicrobial dosing adjustment recommendations for patients receiving CVVH, of which 224 (87.5%) recommendations were accepted by physicians. In control group, pharmacist dosing adjustment resulted in £1637.7 (2669.5 USD) cost savings per patient, and 2.36 times reduction of antimicrobial-related adverse drug events (ADEs) (11 vs 26, P = 0.002), while length of ICU stay and mortality in ICU showed no significant difference (P > 0.05)
Joost et al. 2014 Germany	Non-randomised controlled study (12 months)	Renal transplant unit at a university hospital	To investigate the efficacy of a pharmaceutical care programme for applying adherence management module to enhance kidney transplant patients' adherence to immunosuppressive medication.	74 Tx patients	ICG: 51 (13.3), SCG: 54 (11.9)	Additional pharmaceutical care and counselling provided by the clinical pharmacist after the transplantation. Additional meetings with clinical pharmacist at out-patient transplantation care (minimum once per quarter up to maximum of once a month). (n = 35)	Standard care group (n = 39)	Adherence was significantly improved in patients of the ICG (91%) compared with SCG (75%) during the first year after transplantation (P = 0.014). Daily adherence measures were already improved within 30–40 days after start of intensified patient care. Intensified care patients also showed significantly better results for taking adherence (P = 0.006), pill count (P = 0.008) and drug holidays (P = 0.001).

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Cooney et al. 2015 USA	Pragmatic, randomised, controlled study (12 months)	Primary care	To evaluate the effect of a pharmacist-based quality improvement program on 1) outcomes for patients with CKD and 2) adherence to CKD guidelines in the primary care setting.	2,199 CKD patients	Intervention 75.5(8.2), control 75.7(8.2)	Phone-based pharmacist intervention, pharmacist-physician collaboration, patient education and a CKD registry (n = 1,070)	Usual care (n =1,129)	Improvement in the primary process outcome, measurement of PTH (16.1% in the control arm vs. 46.9% in the intervention arm; P <0.001). Subjects in the intervention arm were prescribed more classes of antihypertensive medications than those in the control arm (P = 0.02). Increased % of subjects with a phosphorus and urine albumin to creatinine ratio measured for intervention arm. Satisfaction with the intervention was very positive; 92% of participants.
Staino et al. 2015 USA	Non-randomised controlled study (3 months)	Renal transplant clinic at a medical university hospital	To determine if a pharmacist-executed comprehensive chart review could serve as sufficient substitution for direct participation during outpatient clinic visits in the post-discharge follow-up treatment of kidney transplant recipients.	219 Tx patients	Intervention 50, comparator 52	Pharmacists provided recommendations via chart review for patients who attended the transplant nephrology clinic. (n = 170)	Comparator group (n = 175)	Not reported.
Chang et al. 2016 USA	Pragmatic, cluster, randomised study (18 months)	Primary care	To examine the feasibility of using pharmacist MTM to improve proteinuria screening and CKD management in a large, integrated health system.	6 primary care sites, 47 CKD patients	MTM 64.0 (13.2), control 70.6 (9.7)	Pharmacist MTM arm received additional support from the pharmacist at the clinic site. These pharmacists received additional education about KDIGO-based screening and management guidelines (n = 24)	Control group (n = 23)	The pharmacist MTM intervention did not significantly improve total proteinuria screening at the population level (OR 2.6, 95 % CI: 0.5–14.0; p = 0.3). However, it tended to increase screening of previously unscreened patients (78.6 % in the pharmacist MTM group compared to 33.3 % in the control group; (OR 7.3, 95 % CI: 0.96–56.3; p = 0.05).

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Qudah et al. 2016 Jordan	Randomised controlled study (6 months)	Outpatient haemodialysis units of a university hospital	To evaluate clinical pharmacists role in the management of blood pressure in haemodialysis patients guided by home blood pressure monitoring.	60 HD patients	Intervention 55.3 (15.1), and control 51.7 (18.5)	Physician-pharmacist collaborative care to optimize antihypertensive pharmacologic therapy (n = 29)	Control group (n = 27)	46% of patients in the intervention arm achieved BP target (mean home BP ≤135/85 mmHg) compared to only 14.3 % of patients in the control arm (p = 0.02). Average decline in weekly mean home SBP was 10.9 ± 17.7 mmHg in the intervention arm (p = 0.004) Weekly mean home systolic blood pressure increased by 3.5 ± 18.4 mmHg in the control arm (p =0.396).
Chia et al. 2017 Singapore	Non-randomised, controlled study (24 months)	Outpatient nephrology clinic of a tertiary hospital	To determine whether a collaborative care (CC) model with pharmacist involvement can reduce admissions and healthcare utilization in patients receiving dialysis, compared to usual care (UC).	134 patients	CC 62 (11.4), UC 60.4 (10.8)	Pharmacists performed medication review, disease and medication counselling. They completed training modules and received 4 sessions of training with an experienced pharmacist before they could provide the service independently.	Usual care (n =190)	CC reduced admissions by 27% (IRR 0.73, 95% CI 0.54–0.99, p=0.047) and shortened mean LOS by 1.3 days (6.7 (2.6) versus. 8.0 (3.2), p<0.001) compared to UC. No significant differences in mortality (p = 0.189) or mean healthcare utilization cost (p = 0.165) between groups. Pharmacists identified 515 DRPs with 429 (83.3%) resolved after review.
Mateti et al. 2017 India	Open-label, randomised control study (15 months)	Dialysis centres of teaching (TH), government (GH), and corporate hospitals (CH).	To assess the impact of Pharmaceutical Care (PC) on the HRQoL among HD patients.	78 patients	PC group 52.78 (10.45) in TH, 49.15 (12.57) in GH and 52.97 (15.12) in CH. Usual care group 49.40 (12.47) in TH, 48 (17) in GH and 53.77 (11.87) in CH	(1) The PC group received the usual care along with pharmaceutical care delivered by a qualified registered pharmacist. The customized care plan was designed and delivered to the patients on monthly basis based on the condition and need of the patient by the WHO-FIP Pharmaceutical care model. (2) The QoL was assessed using validated KDQoL-36 instrument.	Usual care (n = 75)	The HRQoL scores were significantly improved over time in the domains noticed with regard to the "physical functioning, general health, emotional well-being, social functioning, symptom/problem list, and effects of kidney disease" in all the three centres of PC group compared to UC group with P <0.05. The baseline HRQoL score of KDQoL-36 domains such as ESRD-targeted areas were not significantly different in the UC group vs. PC group in all the three HD centres. The pharmaceutical care provided by a trained pharmacist had positive impact in HRQoL of HD patients.

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Anderegg et al. 2018 USA	Cluster randomised trial	32 medical offices from 15 states	To determine if hypertensive patients with comorbid DM and CKD receiving a pharmacist intervention had improved BP control and greater reduction in mean BP at 9 months compared with those receiving usual care.	227 patients	Intervention group 61.7 (11.6), control 63.1 (12.2)	Pharmacist interviewed patients to review medications, assessed knowledge and then educated the patients on HTN. Individualised care plans were prepared and presented to the physician	108 patients	Intervention group had significantly greater mean systolic blood pressure reduction compared with usual care at 9 months (8.64 mm Hg; 95%, CI -12.8 to -4.49, p<0.001). The intervention group had significantly higher BP control at 9 months than usual care (adjusted odds ratio (OR) 1.97, 95%, CI 1.01–3.86, p = 0.047 and OR 2.16, 95% CI 1.21–3.85, p = 0.0102, respectively)
Mateti et al. 2018 a India	Open-label, randomised control study (15 months)	Dialysis centres of teaching (TH), government (GH), and corporate hospitals (CH).	To assess the impact of pharmaceutical care on medication adherence, Hb levels, blood pressure (BP), and interdialytic weight gain (IDW) among HD patients.	78 patients	As (53)	Tailored care plan has been designed and provided to the PC group patients on monthly basis based on the situation of the patient by the "WHO-FIP Pharmaceutical care model".	Usual care (n = 75)	The PC group had significantly reduced its IDW and BP levels in comparison to UC group at different time intervals with a statistical significance of P <0.05. The Hb levels and medication adherence rate scores of HD patients had significantly increased in PC group compared to UC group at different time intervals.
Mateti et al. 2018 b India	Open-label, randomised control study (12 months)	Dialysis centres of teaching (TH), government (GH), and corporate hospitals (CH).	To assess the cost-effectiveness of pharmaceutical care versus usual care on treatment costs in the patients undergoing maintenance HD.	78 patients	As (53)	(1)The pharmacist provided PC to the PC group patients on monthly basis regarding the knowledge about the medications, disease, lifestyle and medication chart review. (2) The annual costs of medications, HD, laboratory tests, and travel were collected. The economic outcomes were assessed by incremental cost-effectiveness ratio (ICER).	Usual care (n = 75)	The incremental cost-effectiveness ratio for academic, government, and corporate hospitals HD patients of PC group compared with UC group were 86,230 Indian Rupee (INR)/Quality adjusted life year (QALY) ~ (1223.03 USD), 231,016.66 INR/QALY ~ (3276.6 USD), and 87,430 INR/QALY ~ (1240.05 USD), respectively.

Table 3.1: Characteristics of controlled studies included in the systematic review (continued…)								
Study Year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Intervention**	**Control**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**			
Tuttle et al. 2018 USA	Single-blind, randomized, controlled trial (3 months)	Hospital setting and home visits.	To determine the effect of a medication therapy management intervention on acute care utilization after hospitalization in patients with CKD not on dialysis.	72 patients	Intervention group 70 (12), control group 69 (10)	A 1- to 2-hour in-home visit from a pharmacist for a medication therapy management (medication review, action plan and list) within 7 days of hospital discharge.	69 patients	The primary outcome (composite of hospitalisation/ emergency department/ urgent care centre visits) occurred in 44% of the intervention group and 41% in control group (p=0.72). Hospital readmission rate was n=19 (26%) in the intervention group and n=18 (26%) in the control group (p=0.95). No difference in achievement of goals for BP, haemoglobin, phosphorus, or parathyroid hormone.
Xu et al. 2018 Taiwan	Non-randomised, controlled study (12 months)	Kidney transplant clinics of a medical centre.	To evaluate the behavioural and physiological outcomes of pharmaceutical care in kidney transplant recipients.	43 Tx patients	RE group 48.6 (8.9). RI group 49.0 (12.8)	The pharmacists provided face-to-face interviews, check-ups for laboratory examinations, and discovery and documentation of DRPs, pharmaceutical consultation, and education.	12 Tx patients	Patients in the RE group possessed better knowledge for self-care (49.6±4.8 vs 38.8±9.1; P < .001); however, the differences at 12 months became insignificant (56.4± 5.9 vs 56. ±4.7; P = 0.72) after patients in the IR group had also received routine pharmaceutical care. Besides, serum creatinine level of the RE patients was stable without significant variation (P = 0.93), but it demonstrated a rising trend in IR patients (P < .01). Patients satisfactory with the intervention was 95.2%.

Abbreviations: ADEs adverse drug effects, BP blood pressure, CI confidence interval, CKD chronic kidney disease, CrCl creatinine clearance, CRRT continuous renal replacement therapy, CVVH Continuous Veno-Venous Hemofiltration, DRPs drug related problems, ESA Erythropoiesis stimulating agent, GPs general practitioners, HD haemodialysis, HRQoL health-related quality of life, ICG intensified care group, ICU intensive care unit, KDIGO kidney disease: Improving global outcomes, MTM medication therapy management, NDD-CKD non-dialysis dependant chronic kidney disease, OR odds ratio, PTH parathyroid hormone, SBP systolic blood pressure, SCG standard care group, Tx transplantation, UC usual care.

Table 3.2: Characteristics of uncontrolled studies included in the systematic review							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Kelly et al. 2008 United Kingdom	Prospective uncontrolled study (18 months)	Diabetes unit of a secondary hospital	To offer stepwise intensive treatment to patients with diabetic nephropathy picked up at the traditional secondary care clinic.	116 diabetic nephropathy patients	63.4 (8.6)	Frequent visits to pharmacist led clinic for treatment optimisation, checking of BP, renal function, HbA1c, ACR, FBC, calcium and phosphate. Medical history taking by two sources.	Significant improvements in BP ($p<0.001$), total cholesterol ($p<0.001$) and HbA1c ($p<0.05$)
Dashti-Khavidaki et al. 2009 Iran	Prospective uncontrolled study (12 months)	Nephrology and infectious disease wards of a large university hospital	To understand the types of services provided by clinical pharmacists in nephrology and infectious disease wards, the acceptance by physicians and the clinical significance of these services.	1,105 CKD patients	52.5 (14.1)	Uniform documentation of all clinical pharmacy residents activities and interventions.	Not reported
Vessal 2010 Iran	Prospective uncontrolled study (4 months)	Nephrology ward of a university hospital	To determine the impact of a clinical pharmacist on detection and prevention of prescription errors at the nephrology ward of a referral hospital.	76 CKD patients	47.7 (17.2)	CP reviewed medication orders and intervention was made after agreement of the attending physician.	Although 89.5% of the detected errors caused no harm, 4(4.7%) of the errors increased the need for monitoring, 2 (2.3%) increased length of stay, and 2 (2.3%) led to permanent patient harm.
Castelino et al. 2011 India	Prospective uncontrolled study (8 months)	Department of nephrology of a teaching hospital	To explore the potential clinical significance of the MRPs and the acceptance of recommendations made by clinical pharmacists.	308 CKD patients	NR	Medication history interview, clinical and medication review by pharmacist. Recommendation were reported to the health care team.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued…)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Ohnishi et al. 2011 Japan	Retrospective uncontrolled study (12 months)	Outpatient haemodialysis unit of a tertiary hospital	To explore the role of the pharmacists' participation, we examined the influence of haemoglobin levels anteroposterior the participation.	84 HD patients	62	Pharmacists provided drug information on renal anaemia to physicians, performed medication use evaluations based on laboratory data, proposed plans to change prescriptions based on medication use evaluations and provided drug information and lifestyle care point to patients.	The counselling by pharmacists significantly decreased haemoglobin levels in the high group (12g/dl) and significantly increased them in low group (10g/dl).
Belaiche et al. 2012a France	Prospective uncontrolled study (6 months)	University hospital based nephrology clinic	To identify DRPs by a trained CP, their frequency and associated comorbidities.	67 CKD patients	70	The CP interviewed patients and established a pharmacological profile, checked for drug–drug interactions, verified dose adaptation according to the last renal function tests and searched for self-medication and its potential nephrotoxicity. The pharmaceutical proposals were validated with the consulting nephrologist so as to optimise therapy during the following renal consultation.	Not reported
Belaiche et al. 2012b France	Retrospective uncontrolled study (15 months)	Nephrology clinics of a university hospital	To assess the impact of clinical pharmacy services in outpatient nephrology clinics.	42 CKD patients	64.9 (2.2)	Identification of DRPs by CP and documentation of recommendations.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Dashti-Khavidaki et al. 2012 Iran	Prospective uncontrolled study (6 months)	Haemodialysis treatment centre of a teaching hospital	To assess the impact of clinical pharmacy services on the management of secondary complications in patients who were on HD, including bone metabolism disorders, anaemia and dyslipidaemia.	86 HD	NR	CP reviewed patients medications and proposed modification according to laboratory data results to treating physicians.	Serum Calcium was increased in hypocalcaemia patients and decreased in hypercalcaemia patients until it reached the optimal range in both groups. A decline in serum Phosphate level was noted in hyperphosphataemia patients. There was an increase and decrease in serum iPTH in suboptimal and supraoptimal range patients, respectively. Haemoglobin concentration increased in anaemic patients and serum ferritin reached target values in all patients. Total cholesterol, low-density lipoprotein cholesterol and triglycerides decreased to near-optimal values in dyslipidaemia patients.
Geerts et al. 2012 Netherlands	Prospective uncontrolled study (unclear)	Primary health care	To assess the therapeutic advice formulated by pharmacists with help of a pharmacy medication alert system based on the renal function of patients aged ≥70 years with diabetes or cardiovascular disease.	650 CKD patients	81 (6.7)	The pharmacists used a pharmacy medication alert system to assess the medication in relation to the reported eGFR and provided an alert for target drugs according to the Dutch guidelines for drug administration in reduced renal function.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Abu Ruz et al. 2013 Jordan	Prospective uncontrolled study (3 months)	Nephrology ward of a general teaching hospital	To implement and evaluate the impact of pharmaceutical care service for hospitalised CKD patients in Jordan	130 CKD patients	56.3 (17.8)	The pharmacist Identified TRPs and interventions were discussed during ward rounds. Patients education and interview to improve patient adherence.	17% of all TRPs were resolved, 5.5 %were improved, and 37.4 %were prevented through the clinical pharmacist interventions.
Chen 2013 Singapore	Prospective uncontrolled study (5 months)	Haemodialysis centre of a general hospital	To evaluate the prevalence of DRPs identified and the types of interventions made by MMS pharmacists.	30 HD	62.3 (10.0)	Patients requested to bring their medication and see the pharmacist before the appointment with their physician. Pharmacist reviewed patients records, counsel the patients, identified and reported DRPs.	Not reported
Jiang et al. 2013 Japan	Prospective uncontrolled study (24 months)	Medical and surgical ICU of a university-affiliated hospital	To evaluate the benefits that may result from involving pharmacists in the care of septic patients receiving CRRT.	144 Pre-intervention (71 patients) Post-intervention (73 patients) CRRT	Pre-intervention: 62.3 (17.0) Post-intervention: 57.9 (15.4)	Pharmacists completed 1 month of training before the study was started. During the intervention period, the pharmacists assessed septic patients receiving CRRT daily and adjusted the dosage of antimicrobial drugs when needed. Recommendations were made to physicians and nurses at that time. All pharmacist recommendations were verbal and recorded on a specially designed pharmacist intervention form.	Dosing adjustments were related to a reduced length of ICU stay from 10.7 ± 11.1 days to 7.7 ± 8.3 days (p=0.037) in the intervention group, and to cost savings of 3525 USD (13463 ± 12045 vs. 9938 ± 8811, p=0.038) per septic patient receiving CRRT in the ICU. Suspected antimicrobial adverse drug events in the intervention group were significantly fewer than in the pre-intervention group (19 events vs. 8 events, p=0.048). Dosing error events were significantly fewer in the post-intervention phase than in the pre-intervention phase (54 in 73 patients vs 194 in 71 patients, p<0.001).

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Mousavi et al. 2013 Iran	Retrospective/Prospective uncontrolled study (12 months)	University hospital based nephrology wards	To evaluate appropriateness of acid suppression therapy in kidney disease patients and to assess the role of clinical pharmacists to decrease inappropriate SUP prescribing and related costs for these patients.	Pre-test phase (375 patients) Post-test phase (236 patients)	Pre-test phase 51.2 (18.3) Post-test phase 50.2 (18.8)	Pre-intervention phase: patient chart review by CP, develop SUP protocol, and provide educational sessions to doctors on SUP. Post-intervention phase: Clinical pharmacists accompanied physicians on the ward rounds and advised on starting or stopping SUP.	Not reported
Rani et al. 2013 India	Prospective uncontrolled study (3 months)	Dialysis unit of a multispecialty university hospital	To assess the medication knowledge of CKD patients undergoing HD, to assess the effect of a CP provided continuous patient education in improving medication adherence and to evaluate the association between medication knowledge and medication adherence behaviour in HD patients.	85 HD patients	50.52 (13.28)	Patient counselling and education (verbally and written). Patient interview to assess medication knowledge using MKAQ. To assess medication adherence pattern using BMQ.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Aberger et al. 2014 USA	Prospective uncontrolled study (4 weeks)	Transplant clinic of a large urban hospital	To describes a telehealth system approach and preliminary results for the management of BP in renal transplant recipients and to enhance patient engagement and improve adherence to medications via a collaborative care, pharmacist-based, MTM program.	66 Tx patietns	54	Telehealth system encompassing: home electronic BP monitoring designed to assess the efficacy of antihypertensive therapy. The pharmacist communicates BP reading data and dose modifications to the physician.	Statistically significant reductions in average systolic and diastolic BP of 6.0mm Hg and 3.0mm Hg, respectively, at 30 days after enrolment ($p<0.01$).
Arrabal-Durán et al. 2014 Spain	Prospective uncontrolled study (10 months)	Hospital wards and emergency department of a general university hospital	To assess the characteristics of pharmaceutical interventions concerning the dose adjustment of these drugs in patients with CRF who are admitted into hospital.	181 CKD patients	77.6 (12.5)	Medical history of each patient was reviewed by CP, recommendations for an adjustment were put in writing for the doctors.	Not reported
Barnes et al. 2014 USA	Retrospective uncontrolled study (12 months)	Primary care setting, Patient - Centred Medical Home associated with a major, academic health system	To increase the identification of CKD as a medical problem, increase the use of aspirin and ACEIs/ARBs in patients with CKD, and ensure that all medications prescribed to patients with CKD were dosed appropriately based on CG calculated CrCl.	146 CKD patients	71.6 (12.2)	Review EMRs to identify CKD patients, review medication list, estimate CrCl and recommendations reporting to the physicians.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued…)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Gheewala et al. 2014 Australia	Retrospective uncontrolled study (12 months)	Aged care facilities	To investigate the number and nature of DRPs identified and recommendations made by pharmacists in residents of aged care facilities. To determine the extent of inappropriate prescribing of renally cleared medications in residents with CKD.	847 CKD patients	84.9 (8.8)	DRPs identified, and recommendations made to resolve those DRPs by CP.	Not reported
Holm et al. 2015 Norway	Prospective uncontrolled study (6 months)	Internal medicine department of a general hospital	To describe the use of renal risk drugs in a population of patients with RI in an internal medicine department and investigate possible risk factors for such DRPs.	79 CKD patients	78.7 (10.2)	The CP reviewed the patients' drug regimen to classify DRPs related to renal function. DRPs identified were discussed with the physician.	There was a significant correlation between the patients' GFR and the number of DRPs, with an increasing number of DRPs with deteriorating renal function ($p = 0.001$, $r = 0.371$).
Pourrat et al. 2015 France	Prospective uncontrolled study (7 months)	Community pharmacies	(1) To evaluate the ability of community pharmacists to identify drug related problems (DRP) in patients at risk for or suffering from renal impairment. (2) To evaluate the proportions of recommendations by CPs that lead to a modification by GP.	177 CKD patients	78.1	The community pharmacist filled an electronic form for each prescription and verify whether the drug had to be adapted to renal function or was contraindicated. Potential modification was proposed to the GP.	Not reported
Venkateswararao et al. 2015 India	Prospective uncontrolled study (6 months)	Dialysis unit of a teaching hospital	To evaluate the patient perception and degree of adherence to various treatment modalities (medication use, dialysis, life style modifications) by renal failure patients on HD. To assess the effect of pharmacist's interventions towards improving the adherence among the study population.	58 HD patients	46.7 (13.3)	Patient counselling once in two weeks (total 3 sessions) was provided. Printed information leaflets and written information on dialysis note in regional language were provided to the patients. Adherence pattern before and after patient educational intervention was assessed.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Patricia & Foote.2016 USA	Prospective uncontrolled study (17 months)	Regional dialysis units	To identify the extent and type of medication discrepancies and MRPs experienced by dialysis patients during pharmacist-initiated medication reviews and determine if the resulting recommendations made by the pharmacy team to the patient's provider were accepted.	90 HD	NR	Patients requested to bring their medication to dialysis unit and medication reconciliation conducted by the pharmacy team.	Not reported
Ramadaniati et al. 2016 Indonesia	Prospective uncontrolled study (3 months)	Medical wards and an ICCU in a major teaching hospital	To identify and evaluate drug-related problems (DRPs) in patients with CKD.	105 CKD	NR	Identification of DRPs through the direct patient interview, discussion with nurses and assessment of patients' medication charts and medical records.	Not reported
Adibe et al. 2017 Nigeria	Prospective uncontrolled study (5 months)	Nephrology units of three tertiary hospitals	To determine the prevalence of DTPs, identify the types of DTPs, and assess the outcomes of DTP interventions among renal patients receiving care in three Nigerian tertiary hospitals.	287 patients with renal illnesses	72.34 (7.56)	Identify and report DRPs. Patient education and counselling.	Not reported
Alshamrani et al. 2018 Saudi Arabia	Retrospective uncontrolled study (3months)	Outpatient haemodialysis unit of a tertiary hospital.	To determine the prevalence of polypharmacy and the Medication Related Problems in haemodialysis patients.	83 HD patients	Median age 63, IQR (49-71)	The pharmacy resident reviewed electronic medical records and analysed each medication regimen for eligible patients to identify MRPs.	Not reported
Chandrasekhar et al. 2018 India	Prospective interventional study (12 months)	Outpatient nephrology department.	To evaluate medication adherence behaviour of patients using questionnaire and enhance adherence by various cost effective interventions which have greater effect on the health of patients with CKD.	163 CKD patients	-	Patient counselling by pharmacist and patient information leaflet was carried out using a proper management plan and with the help of physician and feedback information was collected.	Not reported

Table 3.2: Characteristics of uncontrolled studies included in the systematic review (continued...)							
Study year Country	**Study design (duration)**	**Study setting**	**Aim**	**Participants**		**Pharmacist interventions**	**Main clinical outcomes achieved**
				N (at baseline)	**Age (years), mean (SD)**		
Imamura et al. 2018 Japan	Retrospective uncontrolled study (unclear)	Hospital.	To determine whether multidisciplinary care could help prevent worsening renal function associated with CKD.	150 CKD patients	72.3 (10.5)	The multidisciplinary care was provided by a team of nephrologists, diabetologist, nurses, diabetes educator, dietitians and pharmacists.	The eGFR significantly improved between before and after multidisciplinary care from − 5.46 to − 0.56 mL/min/1.73 m2/year, respectively. Values for uric acid, LDL, and HbA1c were significantly reduced among patients with improved eGFR.

Abbreviations: ACEi angiotensin converting enzyme inhibitors, ACR albumin:creatinine ratio, ARBs angiotensin receptor blockers, BMQ Brief medication questionnaire, BP blood pressure, CrCl creatinine clearance, CG Cockcroft-Gault, CKD chronic kidney disease, CP clinical pharmacist, CRF chronic renal failure, CRRT Continuous renal replacement therapy, DRPs drug related problems, eGFR estimated glomerular filtration rate, EMRs electronic medical records, FBC full blood count, GFR glomerular filtration rate, GP general practitioner, HbA1c glycosylated haemoglobin, HD haemodialysis, ICCU intensive critical care unit, ICU intensive care unit, iPTH intact parathyroid hormone, IQR interquartile range, MKAQ Medication knowledge assessment questionnaire, MMS Medication management service, MRPs medication related problems, MTM medication therapy management, NR not reported, RI renal impairment, SUP stress ulcer prophylaxis, TRPs therapy related problems, Tx transplantation.

3.6.4. Study characteristics

The 47 studies were carried out in a variety of geographic locations: USA (n = 10), Iran (n = 5), India (n = 7), France (n = 3), Spain (n = 3), Jordan (n = 2), China (n = 2), Japan (n = 3), Singapore (n = 2), Nigeria, Taiwan, Australia, Saudi Arabia, Germany, Netherlands, Indonesia, Norway, Canada and the UK, (n = 1 in each country). Two studies from 2008 and 2009 were not included in the systematic review of Salgado et al (Salgado 2012), hence were considered as part of this review. Thirty-one studies were conducted in hospital settings (wards, intensive care units (ICU), clinics, departments and dialysis units) and 16 in primary care settings, including clinics and community pharmacies. The follow-up time in all included papers ranged from 4 weeks to 24 months with a mean of 9.4 (standard deviation, SD = 5.08) months, with four studies with unclear duration.

The majority of studies (n = 27) used an uncontrolled study design, 21 prospective and six retrospectives. The remaining 20 were controlled, ten of which were randomised and ten non-randomised. According to Thomson Reuters Journal Citation Report at the time of publication the median impact factor of the journals of articles included was 1.348 (IQR 0.52 – 2.01), n = 45, two journals did not have an impact factor at the time of publication.

Patient mean age was 46.7 – 84.9 years, with five studies failing to report age (Dashti-Khavidaki 2012, Castelino 2011, Ramadaniati 2016, Patricia and Foote 2016, Chandrasekhar 2018). Of the total of 11,122 patients from all studies, 9,151 were at various stages of chronic kidney disease not on dialysis, 1,036 were haemodialysis (HD) dependent, 533 receiving other forms of renal replacement therapies such as continuous renal replacement therapy (CRRT) or

continuous veno-venous hemofiltration (CVVH), and 402 were transplant patients.

Outcomes were reported in 37 papers, with 25 of these (67.6%) also reporting details of the processes of care, and four (10.8%) reporting structures, processes and outcomes. Outcomes reported were: clinical only (17, 45.9%), economic with linked clinical (5, 13.5%), humanistic with linked clinical (4, 10.8%), humanistic only (2, 5.4%) and economic only (2, 5.4%). The 10 remaining papers did not report outcomes measures with one (2.1%) that reported structure and process indicators only and 9 (19.1%) reported process indicators only.

A) Resources for care provision: structures

Structures were poorly reported in all studies, with only two giving some details of multidisciplinary team involvement (Chia 2017 and Imamura 2018), while, none on the pharmacist skill mix or time allocation. The only aspect of structures reported relating to training which was given in five studies. In one, pharmacists and pharmacy residents were engaged in a two-week training of literature review and patient assessments (Jiang 2014a). A community pharmacist-based study described a workshop covering clinical presentations of CKD, managing drug-related problems and discussing patient cases (Santschi 2011). Similar training was described for community pharmacists, (Via-Sosa 2013) and hospital clinical pharmacists (Pourrat 2015), to enable them to identify patients with renal insufficiency and perform dose adjustments. A four-session course to all members of the multidisciplinary team prior to the study was described in one article (Imamura 2018).

B) Characteristics of clinical pharmacy practice: processes

All studies provided some description of the processes undertaken by the pharmacists, although the detail provided varied considerably and was generally lacking. The majority of processes (often labelled as interventions) included medication chart review to identify any drug-related problems (DRPs) (Cooney 2015, Pourrat 2015, Vessal 2010, Via-Sosa 2013, Gheewala 2014, Staino 2015, Belaiche 2012a, Mousavi 2013, Dashti-Khavidaki 2012, Holm 2015, Chen 2013, Arrabal-Durán 2014, Barnes 2014, Belaiche 2012b, Castelino 2011, Dashti-Khavidaki 2013 and Ramadaniati 2016). Many studies reported pharmacists' interventions in: modifying drug doses and recommending new pharmacotherapy; (Pourrat 2015, Gheewala 2014, Belaiche 2012a, Mousavi 2013, Dashti-Khavidaki 2012, Chen 2013, Arrabal-Durán 2014, Barnes 2014, Castelino 2011, Dashti-Khavidaki 2013, Qudah 2016, Geerts 2012, Ohnishi 2011, Jiang 2014a, Cabello-Muriel 2014, AbuRuz 2013, Jiang 2013, Aspinall 2012, Jiang 2014b, Chia 2017and Alshamrani 2018); interacting with a member of the multidisciplinary team; (Cooney 2015, Pourrat 2015, Vessal 2010, Gheewala 2014, Staino 2015, Belaiche 2012a, Dashti-Khavidaki 2012, Holm 2015, Chen 2013, Barnes 2014, Ramadaniati 2016, Qudah 2016, Ohnishi 2011, Jiang 2014a, Cabello-Muriel 2014, AbuRuz 2013, Jiang 2013, Jiang 2014b, Aberger 2014, Adibe 2017and Kelly and Booth 2008) requesting and monitoring laboratory parameters; (Cooney 2015, Dashti-Khavidaki 2012, Chen 2013, Barnes 2014, Geerts 2012, Ohnishi 2011, Cabello-Muriel 2014, AbuRuz 2013 and Kelly and Booth 2008), assessing appropriateness of medications prescribed for hospitalised patients at each point of care; (Vessal 2010, Mousavi 2013, Castelino 2011, Dashti-Khavidaki 2013, Jiang 2014a, Cabello-Muriel 2014, AbuRuz 2013, Jiang 2013, Jiang 2014b andTuttle 2018). Fewer studies described

pharmacist processes at out-patient, pharmacist-led clinics relating to the management of specific CKD complications, such as anaemia; (Ohnishi 2011, Aspinall 2012, Debenito 2014) hypertension and diabetes; (Anderegg 2018) managing hypertension through telemedicine; (Aberger 2014) optimising dyslipidaemia management; (AbuRuz 2013, Chang 2016) improving haemoglobin A1c levels (HbA1c); (Kelly and Booth 2008) and emphasising smoking cessation; (AbuRuz 2013, Kelly and Booth 2008). Development of protocols and compiling and updating guidelines were also described in two studies (Mousavi 2013, Ohnishi 2011). Performing medication reconciliation (Patricia and Foote 2016); providing patient medication counselling, education on disease status or medication, conducting motivational interviews to improve adherence were also reported (Cooney 2015, Chen 2013, Barnes 2014, Castelino 2011, Dashti-Khavidaki 2013, Ohnishi 2011, Cabello-Muriel 2014, AbuRuz 2013, Adibe 2017, Kelly and Booth 2008, Joost 2014, Santschi 201, Venkateswararao 2016, Rani 2013, Mateti 2018a, Tuttle 2018, Xu 2018 and Chandrasekhar 2018). A number of studies reported pharmacists' participation in ward rounds (Vessal 2010, Mousavi 2013, Jiang 2014a, AbuRuz 2013, Jiang 2013, Jiang 2014b), providing educational sessions to healthcare professionals (Mousavi 2013, Ohnishi 2011) and performing activities such as medication use evaluations (Ohnishi 2011). There were no reports of pharmacist prescribing activities; one study described the process of deprescribing to optimise medication use (Alshamrani 2018).

Fewer studies provided any data on time spent on specific activities. Interaction time between pharmacist and patients were reported in two studies, varying from 15 to 30 minutes (Kelly and Booth 2008, Rani 2013) and the timeframe in which the services were provided ranged from daily (Jiang 2014a, Cabello-Muriel

2014, AbuRuz 2013, Jiang 2013, Jiang 2014b) to every three months (Joost 2014).

Across all studies, the pharmacists identified 5302 drug-related problems in 2933 patients. Pharmacists made 3160 recommendations to healthcare professionals with an acceptance rate varying from 33.3% in a community setting; (Pourrat 2015) 46.43% in a dialysis unit; (Alshamrani 2018) to around 95% in hospital settings (Vessal 2010, Holm 2015, Adibe 2017, Dashti-Khavidaki 2009, Chia 2017, Tuttle 2018). Only three studies reported the clinical significance of recommendations. Of these 26% were of moderate significance (Castelino 2011), 48.8% of major clinical significance (Dashti-Khavidaki 2009) and 47% of serious severity (Staino 2015).

A pharmacist-based quality improvement programme consisting of pharmacists' interactions with the patients and electronic collaboration with the physicians was associated with a significant improvement in the measurement of PTH during the study period (Cooney 2015). Pharmacists' interventions led to medication therapy modifications (Pourrat 2015, Pourrat 2015, Vessal 2010, Via-Sosa 2013, Gheewala 2014, Staino 2015, Belaiche 2012a, Holm 2015, Chen 2013, Arrabal-Durán 2014, Barnes 2014, Belaiche 2012b, Castelino 2011, Ramadaniati 2016, Geerts 2012, AbuRuz 2013, Adibe 2017, Patricia and Foote 2016) and resolving medication record discrepancies (Patricia and Foote 2016, Tuttle 2018). Patients' compliance with ongoing blood pressure (BP) monitoring post kidney transplantation was significantly improved with pharmacists' input (Aberger 2014). Counselling by pharmacists significantly improved medication adherence in patients with CKD (Joost 2014, Rani 2013, Chandrasekhar 2018).

C) Clinical outcomes

The final column of Tables 1 and 2 titled 'Main outcomes achieved' provides a detailed summary of main results and statistical significance values related to each of the studies summarised below. Clinical outcomes only were reported in (n = 17) studies. A pharmacist-based quality improvement programme in a pragmatic randomised controlled study reported that patients in the intervention arm were prescribed more classes of antihypertensive medications than those in the control arm (Cooney 2015). In a six-month cluster randomised trial, pharmacists attending a structured training and communication-network programme (ProFil) and managing hypertension in CKD patients demonstrated larger reduction in systolic blood pressure (BP) of the intervention group compared to the usual care group (Santschi 2011).

Intervention in the management of BP in CKD and haemodialysis resulted in achieving target BP in the intervention versus the control group (Qudah 2016, Anderegg 2018, Mateti 2018a), significant reductions in mean systolic and diastolic BP in a group of kidney transplant recipients (Aberger 2014), and significant reduction in systolic and diastolic BP in diabetic nephropathy (Kelly and Booth 2008). Only one article showed that pharmacists' intervention in an intensive care unit (ICU) setting reduced the length of ICU stay (Jiang 2013). Another study reported reduction in the length of stay in the intervention group by 1.3 days ($p<0.001$) and reduced unplanned admission by 27% ($p = 0.047$) (Chia 2017). One further study showed no difference of pharmacists' intervention compared to usual care on hospital readmission outcomes (Tuttle 2018). Pharmacists were also involved in the monitoring of kidney function in patients with CKD and demonstrated significant differences in measuring CrCl between discharge and admission (Cabello-Muriel 2014). However, one study

demonstrated no difference in the mean serum creatinine or estimated glomerular filtration rate (eGFR) between the intervention and control groups (Xu 2018). A retrospective controlled study reported improvement in eGFR, uric acid, cholesterol and HbA1c in the intervention group compared to the control group after multidisciplinary care, however, pharmacists' contribution to the care was not clearly reported (Imamura 2018).

Four studies gave outcomes of pharmacists managing anaemia in CKD patients (Ohnishi 2011, Aspinall 2012, Debenito 2014, Mateti 2018a), with significant haemoglobin values within target range in pharmacist-led clinic. Time to achieve target haemoglobin was 28 days in the pharmacist-managed group compared with 41 days in the usual care group (Debenito 2014). While the proportion of patients achieving target haemoglobin was not significant, pharmacist intervention significantly improved haemoglobin and iron monitoring by improving compliance to therapy (Debenito 2014). Pharmacist counselling significantly improved haemoglobin levels in one study (Ohnishi 2011), with haemoglobin concentration and Transferrin saturation (TSAT%) increasing significantly and serum ferritin reaching target values in a prospective uncontrolled study (Dashti-Khavidaki 2012).

An uncontrolled study of the impact of on managing secondary complications of haemodialysis patients resulted in significantly increased median serum calcium in those with hypocalcaemia and decreased values in hypercalcaemia, a decline in serum phosphate in patients with hyperphosphataemia, and an increase and decrease in serum iPTH in patients with sub-optimal and supra-optimal levels respectively (Dashti-Khavidaki 2012).

Pharmacists' interventions in a pragmatic, cluster randomised study improved screening of proteinuria between an interventions compared to control group (Patricia and Foote 2016). A non-randomised controlled study of pharmacist involvement in a monitoring program for CKD reported significant differences in CrCl between discharge and admission in both the control and intervention groups (Cabello-Muriel 2014).

D) Humanistic outcomes

In a cluster, randomised study health related quality of life (HRQoL) improved significantly compared to control in a group of haemodialysis patients receiving pharmacist intervention over a 6-month period (Dashti-Khavidaki 2013). In a non-randomised controlled study, HRQoL domains were not significantly impacted by the additional pharmacist care in kidney transplants (Joost 2014). A multicentre RCT reported significant improvement in HRQoL scores in the intervention group compared to control (Mateti 2017).

Patient satisfaction reported in two randomised controlled studies: 92% of patients had positive feelings about pharmacists' involvement in their care and felt that the pharmacist provided beneficial information (Cooney 2015) and 43% of patients were 'very satisfied' with the care received and were willing to receive future care from the pharmacist (Chang 2016). A cross-sectional prospective study demonstrated that patients were greatly satisfied with the intervention (Xu 2018).

E) Economic outcomes

Only seven studies reported economic outcomes resulting from pharmacist input (Mousavi 2013, Jiang 2014a, Jiang 2013, Aspinall 2012, Jiang 2014b, Debenito 2014, Mateti 2018b). One study reported that pharmacists in the ICU could

contribute to significant cost savings in septic patients, with antimicrobial prescribing efficiencies accounted for 34.7% of total savings (Jiang 2013). In a study investigating an ICU pharmacist dosing adjustment programme, the mean ICU hospitalisation costs per patient decreased significantly with total savings of 2669.5 USD per patient (Jiang 2014b). Jiang et al demonstrated that pharmacist dosing adjustment resulted in drug cost savings per patient of 2345.98 USD with antibiotics accounting for 64.5% of all cost savings. The presence of an ICU pharmacist resulted in 2346 USD savings per patient receiving continuous renal replacement therapy (Jiang 2014a). Debenito et al reported that the mean weekly dose of erythropoiesis-stimulating agents (ESAs) was significantly less in the pharmacist-managed group than the usual care group and the annualised ESA cost per patient reduced by 1288 USD (Debenito 2014), whereas, Aspinall et al reported lower average dose of darbepoetin in the pharmacist-managed ESA clinic compared to the usual care (Aspinall 2012). Mousavi et al showed that the cost per patient for inappropriate stress ulcer prophylaxis administration in patients with insufficient renal function was reduced by pharmacists' intervention (Mousavi 2013). A multicentre RCT reported that pharmaceutical care costed more per quality adjusted life year (QALY) gained compared to usual care (Mateti 2018b).

3.7. Discussion

3.7.1. Summary of key findings

There are a number of important key findings that have arisen from this review and these are outlined below. Forty-seven new studies have been published in the intervening eight-year period since a previous similar review (Salgado 2012). Ten of these are of a 'gold standard' RCT design however, the quality of the controlled studies included is generally poor due to lack of providing sufficient

methodological information. Structures and processes were very poorly reported and none of the studies included consideration of pharmacist prescribing – which is considered in several countries, where it has been implemented, to be a significant advance in pharmacy practice. The process indicators in the original review (Salgado 2012) and this review were very similar but this review identified papers with clear shift from only identifying drug-related problems to more involvement of the pharmacist in medication therapy management. Most of the studies in this review continue to focus on and report details of DRPs as an indicator of the process of pharmacy practice. Some of these considered the clinical significance of these DRPs but this was not universal. Less focus on clinical, humanistic and economic outcomes was observed in majority of the papers in both reviews.

3.7.2. Interpretation of findings

Many of the uncontrolled studies had a variety of quality deficiencies including; lack of comprehensive explanation of the pharmacists' intervention, under-reporting of adverse events and insufficient information to allow reproduction of the study for interested readers. Few studies lacked some important information leading to poor scoring of the study, such as lack of clarity in stating the study aim, (Jiang 2014a) the number of participants, the population from where the sample was drawn, duration of the data collection or the study period, frequency of follow-up, and some studies were unable to clearly state the distribution of the confounders in both groups (Cooney 2015, Jiang 2014a, Mousavi 2013, Aspinall 2012, Dashti-Khavidaki 2013, Chang 2016).

The majority of the 20 controlled studies were of 'fair' quality with the exception of four that were considered 'weak' (Mousavi 2013, Mateti 2018a, Mateti 2018b,

Xu 2018). High quality RCTs with low levels of bias generate the highest level of evidence (Burns 2011). However, the availability of high quality evidence in this area is limited with only 5 RCTs out of 47 included papers in this review and 4 in a previous review by Salgado et al (Salgado 2012). The RCTs in both reviews lacked sufficient information on the randomisation process, in addition to poor detail on any blinding process of the care-giver and the care-receiver (however, it might be a challenge to blind in some study designs) so jeopardising the quality of these studies (Mahboobi 2012). It is therefore evident that there has been a limited amount of high-quality research published for the benefits of clinical pharmacy practice in CKD. There is particularly a paucity of evidence from RCTs offering a robust evidence base for practice. Despite this criticism there is a growing body of information in relation to some aspects of clinical pharmacy practice that offers some insights to the developing quality of services provided making real and significant differences to the outcomes of patients. This, however, needs to be verified through even more robust RCTs that are better resourced, designed and executed.

The gathering of more gold standard evidence such as RCTs is essential to enable measuring the impact of clinical pharmacists' intervention in patients with CKD compared to standard care. Furthermore, there is an identified need to carry out studies with explicit details and accurate definitions including the setting, the participants, the randomisation process and the interventions of interest.

It is of paramount importance that detailed descriptions of the interventions, in terms of structures and processes and outcomes, are included in publications to allow them to be reproduced and for readers to consider the studies within the context of their own practice (Salgado 2013). Most papers lacked sufficient

details of the clinical pharmacy practices so making it difficult to fully understand the activity. Without full insight to practice it is difficult to fully understand the context and characteristics of practice and so reproduce the structures and processes in wider settings. This is not just a deficiency of studies in CKD since a study by Schroter et al to assess the replicability of published clinical interventions, in a variety of clinical settings, reported that 57% of the studies had insufficient description of the intervention of interest to make it replicable (Schroter 2012). A tool produced by Correr et al to address the lack of intervention descriptions in clinical pharmacy research (Descriptive Elements of Pharmacist Intervention Characterization Tool) DEPICT is a validated instrument for accurately describing the details of pharmacist interventions performed as part of clinical pharmacy practice (Correr 2013). This tool could be used as a guidance to structurally describe the intervention of interest in pharmacy practice research.

Additionally, it should be noted that in CKD there are no studies that have specifically investigated prescribing as part of clinical pharmacy practice and there are no full description of structure, processes and outcomes as they relate to prescribing practice. A systematic review by Tesfaye et al published in 2017 of the prevalence of inappropriate prescribing and the impact of pharmacists' interventions reported significant reduction in inappropriate prescribing when physicians received immediate concurrent feedback from a clinical pharmacist (Tesfaye 2017). The review showed minimal involvement of the pharmacist in the role of prescribing for patients with CKD. Despite the increased recognition of prescribing models such as independent, supplementary or collaborative (Royal Pharmaceutical Society 2016), there was limited published evidence to lead to the best practice model for prescribing.

There is also a need to stimulate more of a research culture within clinical pharmacy practice. A paper by Peterson et al reported that lack of time, lack of opportunities, lack of training and never being asked to participate in a research were major barriers for pharmacists' engagement in research (Peterson 2008). A systematic review by Awaisu et al. concluded that pharmacists are aware of the value of research to enable them advance pharmacy practice and indicate their willingness to be involved in independent research and in practice-based research networks. However, lack of time, training and support were the main barriers (Awaisu and Alsalimy 2015).

3.7.3. Strengths and limitations

A strength for this review is that the protocol was peer reviewed and registered with PROSPERO. The protocol was devised in accordance with PRISMA-P (Preferred Reporting Items for Systematic review and Meta-Analysis Protocols) standards (Moher 2015) and the systematic review was conducted and reported in accordance with PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) standards (Moher 2010). In terms of limitations, publication bias could potentially affect the selecting process of the articles, since no study was identified to show the negative impact of clinical pharmacy services in caring for patients with CKD. One further limitation is the exclusion of papers in languages other than English potentially leading to the omission of relevant papers.

In conducting RCTs, it has been recognised that it is vital to be careful in the selection and recording of outcomes to build up a coherent dataset (Esposito 2014, Beuscart 2018, Lombardi 2018 and Williamson 2017). Moreover, consistency in the use of outcomes will aid future users of the services and those

involved in resource allocation, planning and implementation of clinical pharmacy services (Lombardi 2018). It is evident from this review that where RCTs were conducted, there was no consistency in the selection and reporting of outcomes. These issues could be addressed with the development and application of agreed standardised sets of outcomes (Williamson 2017). Research on core outcome set definitions for clinical pharmacy practice is ongoing in many areas such as polypharmacy (Rankin 2018) but this appears to be lacking in CKD, which could be a potential area of work in the future.

3.8. Conclusion

There is some evidence for the outcomes of pharmacists' intervention in patients with CKD but this is generally of low quality and insufficient volume. The controlled studies in this systematic review showed that pharmacist interventions improved patients' clinical outcomes such as Hb levels, CrCl, PTH and calcium levels. However, these studies lacked detail on reporting of the humanistic outcomes and there remains a paucity of evidence demonstrating economic impact of pharmacists' interventions.

There is some evidence since the last review that shows positive contributions of pharmacists' involvement in the multidisciplinary team to provide care to patients with CKD. This includes evidence on the structure, processes of care and the outcomes of pharmacists' intervention in patients with CKD. More high-quality research in this area is warranted.

3.9. Further research

The systematic review showed that there is some evidence in the literature carried out to explore pharmacist's contribution in the care for patients with CKD. Nevertheless, the quality of the studies reported and comprehensiveness on

information related to structure, process and outcome of the care were lacking. Very few studies mentioned anything related to structures and limited studies reported outcomes of the care provided to the patients. It is also noted that only one study was included from the UK which shows lack of such research carried out in the UK. None of the studies employed theoretical underpinning in any stage of the research process. None of the included studies focused on pharmacist prescribing although, nonmedical prescribing is one of the most significant developments in the clinical pharmacy practice in the UK in the last 20 years (Tonna 2007). Therefore, it is evident that there is a need for original primary research in this area in the UK. Following the identification of the gap in research, the next stage of this research is in two phases to generate primary data in this area of research. The first phase of the next stage focused on the determination of the behaviours and experiences of pharmacist members of the UKRPG on provision of care of patients with CKD.

Chapter 4: A theoretically based cross-sectional survey on the behaviours and experiences of clinical pharmacists caring for patients with Chronic Kidney Disease.

4. Introduction

A recently completed systematic review as a part of this doctoral research by Al Raiisi et al of clinical pharmacy service provision identified an evidence based derived from mostly poor methodological designed studies (Al Raiisi 2019). There is a need for well-designed studies describing UK practice which reflect recent developments such as nonmedical prescribing. This survey explored in details the models of care pharmacists provide for patients with CKD. This chapter illustrates the description of the models of care pharmacists deliver to patients with CKD and provide detailed views and experiences of the pharmacists in this area of practice. The details about the research aim, research questions, methods, results, discussion and conclusion are reported in great details in this chapter.

4.1. Aim

To determine the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease.

4.2. Research questions

1. What are the characteristics of general models of clinical pharmacy practice in terms of structures and processes and how have these models been developed, implemented and evaluated?

2. What are the characteristics of the models of pharmacist prescribing practice in terms of; supplementary versus independent, site of and support for practise, competency areas, process of prescription writing and how have these models been developed, implemented and evaluated?

3. What are the positive and negative experiences on development and implementation of these models of practice?

4. What are the key areas for future practise development and what are the recommendations for implementing these developments?

4.3. Method

4.3.1. Questionnaire design

The development of the survey tool followed a rigorous iterative process that initially involved reviewing the aim / objectives of the overall project to ensure that the survey tool was designed to meet these. Information from the literature and the previously completed systematic review in this area was used to generate initial ideas and concepts for inclusion. Furthermore, the content of 'Towards Advanced and Consultant Level Pharmacy Practice – A Competency Framework for Renal Pharmacists - UK Renal Pharmacy Group 2009' (BRADLEY 2009) was further used as a guide towards the construction of the questionnaire. The questionnaire design was also supplemented with more up to date resources.

4.3.2. Design of the tool

The constructs were used to frame key sections of the questionnaire. This resulted in robust structure and content that is relevant to the project aims and objectives.

At the outset of the questionnaire, an initial screening question identified those UKRPG members not practicing clinical pharmacy in the UK. Remaining items were grouped into sections of: demographics, clinical practice (characteristics and types of clinical pharmacy services provided for outpatients and inpatients) and prescribing practice (development and implementation of prescribing practice, model of prescribing, areas and frequency of prescribing). Questionnaire items were of various types including, where appropriate, closed type questions and some open questions to allow respondents to provide

explanatory comments. Attitudinal type items on the development of clinical and prescribing practice used a 5-point Likert scale format. In the demographics section of the questionnaire, participants were asked to respond to a question relating to descriptors from Rogers Diffusion of Innovation theory these included whether they felt they were; 'laggards', 'late majority', 'early majority', 'early adopters' or 'innovators' (Lundblad 2003)

Items on development and implementation of clinical and prescribing practice were derived from the Consolidated Framework for Implementation Research (CFIR), which is based on the principles of implementation theory (Damschroder 2009). CFIR includes five major domains (intervention characteristics: aspects on the intervention that may impact the implementation success, outer setting: external influences on intervention implementation, inner setting: characteristics of the implementing organisation, characteristics of individuals: individuals attributes and belief towards the intervention and process: stages of implementation) with 39 underlying constructs and sub-constructs that can potentially influence efforts to change practice (Damschroder 2009). The most relevant constructs were used to guide the development of the survey questions to ensure comprehensive coverage of the most important elements of the clinical and prescribing practice of pharmacists in the care of patients with CKD.

4.3.3. Expert panel review

The questionnaire was developed by the research team (FA, SC and DS) and was checked and evaluated for face and content validity by a panel of experts from the university (KM, TM and KGS), from practice (BP) and from the board members of the UKRPG (CA and CM).

Feedback from the expert panel was received in a written form on the drafted questionnaire. Majority of the comments were related to typo errors and lack of understanding of a few questions. All comments were considered and edited before piloting the survey.

4.3.4. Think a loud testing

Think aloud testing of the tool was a one-to-one procedure where the researcher met with each of the experts (DG, MM and BP) in a quiet office. This procedure allows the readers of the questionnaire to think out loud to verbalise their thoughts throughout the process of reading the questionnaire. Think aloud testing help establishing cognitive validity of the questionnaire to ensure that the survey participants will respond in the manner intended by the researcher. The final version of the questionnaire was developed in 'Online Surveys', JISC, UK (formerly Bristol Online Survey Tool®, https://www.jisc.ac.uk/online-surveys) (Appendix 4.1).

4.3.5. Pilot

Piloting of the questionnaire was aimed to test for face and validity of the content prior to use in the main survey. It was also aimed to predict the response rate of the survey.

The list of pilot participants was selected by a coordinator of the UKRPG and was totally anonymous for the research team. The questionnaire was piloted with a random sample of 14 (around 10% of the target population) members of the UKRPG. An email was sent to invite the UKRPG members to complete the pilot questionnaire with only six responded to the pilot survey (Appendix 4.2). As piloting resulted in only minor formatting changes, pilot data were included in the final dataset.

4.3.6. Techniques to maximise response rate

To enhance the response rate evidence-based techniques were used. Monetary incentive in the form of a prize draw was used to encourage participations. An optional form was linked at the end of the questionnaire to opt in for the prize draw (Appendix 4.3). An information sheet was attached at the start of the questionnaire to familiarise the participants with the objectives and answer to frequently asked questions. Reminders were sent at two occasions on given intervals. The researcher attended the annual conference of the UKRPG which coincided with the launch of the survey. The conference was an opportunity to network with the participants and make them aware about the importance of the survey and encourage participation. The researcher also borrowed four iPads from the university and set them on the survey link for participants willing to complete the survey during the conference.

4.3.7. Content of the questionnaire

Section 1 (Screening question to identify the participants who are practising clinically in the care of patients with CKD in the UK)

Section 2 (Demographics)

Section 3 (About the clinical practice in CKD patient care)

Section 4 (About the prescribing practice in CKD patient care)

Section 5 (Key areas for future development) followed by a link to a separate questionnaire to opt in for prize draw and involvement in further research. In addition to the closed question items in the survey, at the end of each section, participants were asked to share their experiences and views more fully through provision of any open comments.

4.3.8. Distribution of the questionnaire

The chair of the UKRPG was contacted to help distributing the link to the members anonymously. A coordinator was assigned for this purpose and the estimated number of the members was (n = 140). The coordinator was sent the email text (Appendix 4.4) with a link to the survey for distribution to the UKRPG members. There was no direct contact between the researcher and any of the participants. The questionnaire was addressed to the UKRPG member hence anonymous and a deadline for return was clearly stated in bold and highlighted font.

4.3.9. Consent

No separate consent form was included in the questionnaire and any completed response was dealt as consent to participate in the survey.

4.3.10. Reminders

During the pilot phase no reminders were sent and the deadline to complete the pilot questionnaire was set at four weeks.

The original survey had two reminders at two weeks interval sent on beginning of week three and week five (Appendix 4.5 and 4.6).

4.3.11. Survey setting

Across the UK, pharmacist members of the UKRPG and practising clinically in the UK (currently 140 members)

4.3.12. Inclusion and exclusion criteria

A) Inclusion criteria

All pharmacists registered with the UKRPG and clinically practise in the UK.

B) Exclusion criteria

Any members of the UKRPG involved in the development and piloting of the survey tool. Any pharmacist not practising clinically in the UK, or working in a non-clinical role.

C) Sampling frame/size

The sampling frame was 140 pharmacists. No sampling was undertaken since the entire population of pharmacist members of the UKRPG was surveyed.

4.3.13. Data collection

An invitation email, with a link to the questionnaire and the participant information leaflet, was sent to the UKRPG coordinator to distribute to members. Evidence-based approaches were used to enhance the response rate (Nakash 2006), namely an information sheet to outline study objectives and potential benefits, entry into a prize draw, and two reminders at monthly intervals. In addition, the lead researcher promoted the work at the annual UKRPG conference and encouraged the pharmacists to participant in the survey.

Data were collected over a period of six weeks from 17th of September 2018 till 28th of October 2018.

4.3.14. Data analysis

Data were analysed using descriptive statistics using Statistical Package for the Social Sciences SPSS® Statistics Version 25; the population size and number of respondents limited the potential for inferential analysis. Free text comments were analysed independently by two researchers by using the Framework Approach to qualitative data content analysis (Gale 2013).

4.3.15. Ethical considerations

The Ethical Review Panel of the School of Pharmacy and Life Sciences at Robert Gordon University, UK approved this study (S130) (Appendix 4.7). As the study recruited members of a professional network, formal National Health Service approval was not required.

4.4. Results

Seventy-one responses were received from the 140 participants invited to take part giving a response rate of 50.0%. Of the 71 responses, seven were not currently practicing clinical pharmacy giving 64 responses for analysis.

Table 4.1 summarises demographics of the study participants. Almost three quarter were female (78.1%, n = 50) with just over half being 31-40 years of age (51.6%, n = 33). All were mainly practicing in secondary care setting as their main job sector (100%, n = 64), with (45.3%, n = 29) participants had experience of working in community pharmacy and very few in general practice (3.1%, n = 2). A majority of the respondents were practicing in England (75.0%, n = 48). Over a third (35.9%, n = 23) of the pharmacists have been providing care for patients with CKD for 1 – 5 years with 20.3% (n = 13) for 11 – 15 years and fifty-three (82.8%, n = 53) of respondents were nonmedical prescribers. Very few participants held any type of Royal Pharmaceutical Society faculty membership, with (7.5%, n = 5) holding stage II Faculty Member (MFRPSII) and only (4.7%, n = 3) with Faculty Fellow (FFRPS). More than half of respondents (57.8%, n = 37) indicated that they 'think for some time before adopting new ways of working' which corresponds with the 'early majority' category in Rogers Diffusion of Innovation (Lundblad 2003).

Table 4.1: Demographic characteristics of participants (N=64)		
Title	**Categories**	**n (%)**
Sex	Male	14 (21.9)
	Female	50 (78.1)
Age	Less than 30 years	14 (21.9)
	31-40 years	33 (51.6)
	41-50 years	10 (15.6)
	51-60 years	7 (10.9)
	61 year and above	0 (0)
Main job sector of practice	Secondary care	64 (100)
	Primary care	0 (0)
	GP practice	0 (0)
	Community pharmacy	0 (0)
	Other	0 (0)
Geographical area of practice	England	48 (75)
	Scotland	10 (15.6)
	Wales	4 (6.3)
	Northern Ireland	2 (3.1)
Academic qualifications (Multiple selection allowed)	BSc	16 (10.2)
	MPharm	46 (29.3)
	Postgraduate diploma	49 (31.2)
	Postgraduate certificate	11 (7)
	MSc	16 (10.2)
	PhD	3 (1.9)
	Other	16 (10.2)
Years qualified as a pharmacist	less than a year	0 (0)
	1-5 years	9 (14.1)
	6-10 years	13 (20.3)
	11-15 years	17 (26.5)
	16-20 years	10 (15.6)
	More than 20 years	14 (21.9)
	Missing	1 (1.6)
Years worked in hospital pharmacy	Never worked in this sector	0 (0)
	Less than 1 year	1 (1.6)
	1-5 years	11 (17.2)
	6-10 years	12 (18.8)
	11-15years	20 (31.3)
	16-20 years	8 (12.5)
	more than 20 years	12 (18.8)
Years worked in community pharmacy	Never worked in this sector	19 (29.7)
	Less than 1 year	14 (21.9)
	1-5 years	13 (20.2)
	6-10 years	1 (1.6)
	11-15years	0 (0)
	16-20 years	1 (1.6)
	more than 20 years	0 (0)
	Missing	16 (25)

Table 4.1: Demographic characteristics of participants (N=64) (continued…)		
Title	**Categories**	**n (%)**
Years worked in GP practice	Never worked in this sector	38 (59.4)
	Less than 1 year	2 (3.1)
	1-5 years	0 (0)
	6-10 years	0 (0)
	11-15years	0 (0)
	16-20 years	0 (0)
	more than 20 years	0 (0)
	Missing	24 (37.5)
Work terms	Fixed term/temporary full time (35 hours or more per week)	13 (20.3)
	Fixed term/temporary part-time (less than 35 hours per week)	3 (4.7)
	Permanent fulltime (35 hours or more per week)	31 (48.4)
	Permanent part-time (less than 35 hours per week)	16 (25)
	Secondment	0 (0)
	Missing	1 (1.6)
Stage I Faculty Member (MFRPSI)	Currently working towards	9 (14)
	Currently held	0 (0)
	Not applicable	39 (61)
	Missing	16 (25)
Stage II Faculty Member (MFRPSII)	Currently working towards	4 (6.3)
	Currently held	5 (7.8)
	Not applicable	39 (60.9)
	Missing	16 (25)
Faculty Fellow (FFRPS)	Currently working towards	2 (3.1)
	Currently held	3 (4.7)
	Not applicable	40 (62.5)
	Missing	19 (29.7)
Characteristics of the innovation	I resist new ways of working, I am cautious in relation to new ways of working	0 (0)
	I tend to change once most of my peers have done so	4 (6.3)
	I think for some time before adopting new ways of working	37 (57.8)
	I serve as a role model for others in relation to new ways of working	10 (15.6)
	I am innovative with new ways of working	13 (20.3)
Nonmedical prescriber	Yes	53 (82.8)
	No	11 (17.2)

Full data from the survey is provided in Tables 4.2 to 4.3 with key findings from each highlighted below.

4.4.1. Clinical pharmacy services for inpatients

All the respondents were providing care in the inpatient setting (n = 64) in a variety of areas as shown in table 4.2. The majority of respondents (87.5%, n = 56) provided general pharmaceutical care, with pharmaceutical care specifically for dialysis patients provided by 84.4% (n = 54). Individual patient medication related education was provided by 85.9% (n = 55), while 81.3% (n = 52) of the respondents had regular meetings with the multidisciplinary team.

Pharmaceutical care for transplantation patients was provided by 71.9% (n = 46) of the respondents with such services provided with a variety of frequencies but by more than half (54.3%, n=25) on a daily basis during the working week. Medicines reconciliation was the most frequently provided service with 89.1% (n = 57) of respondents indicating that this service was provided throughout the week (i.e. daily weekdays and daily weekdays and weekends) by 85.9% (n=49)

Consulting inpatients with different CKD related conditions was performed by almost three-quarter of the participants, with 76.6% (n = 49) consulting patients with mineral bone disease, acute kidney injury by 76.6% (n = 49), other renal complications by 71.9% (n = 46) and consulting inpatients on haemodialysis or peritoneal dialysis by 70.3% (n = 45). These consultations were provided mostly on daily basis on weekdays or on an ‘ad hoc’ basis by most of the participants in the inpatient setting.

Compared to the above there were 'Areas of care' where respondents indicated they were less involved. Around two thirds of respondents indicated that they attended medical ward rounds with the multidisciplinary team (67.2%, n = 43) with a third of these (37.2%, n=16) indicating doing this on a daily basis during the working week. Targeted disease specific medication review services were also less developed with almost two thirds undertaking anaemia targeted review (65.6%, n = 42), vasculitis by 68.8% (n = 44) and hypertension by 65.6% (n = 42).

Table 4.2: Characteristics of clinical pharmacy services you provide for INPATIENTS with CKD (N=64)							
Area of care	**Provision of care**	**Frequency of 'currently doing' care provision**					
	Currently doing	Daily Weekdays	Daily Weekdays and Weekends	2-3 x/week	Once/week	Ad hoc	Missing
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
General pharmaceutical care	56 (87.5)	33 (58.9)	13 (23.2)	7 (12.5)	1 (1.8)	2 (3.6)	0 (0)
Pharmaceutical care for patients receiving dialysis	54 (84.4)	32 (59.3)	8 (14.8)	6 (11.1)	2 (3.7)	6 (11.1)	0 (0)
Pharmaceutical care for patients at transplantation /follow-up	46 (71.9)	25 (54.3)	8 (17.4)	6 (13)	3 (6.5)	4 (8.7)	0 (0)
Full medication regimen polypharmacy review	50 (78.1)	27 (54)	6 (12)	8 (16)	2 (4)	6 (12)	1 (2)
Targeted CKD renal medication review	50 (78.1)	23 (46)	6 (12)	10 (20)	2 (4)	9 (18)	0 (0)
Targeted renal medication review: transplantation	47 (73.4)	18 (38.3)	7 (14.9)	6 (12.8)	2 (4.3)	13 (27.7)	1 (2.1)
Targeted renal medication review: vasculitis	44 (68.8)	13 (29.5)	3 (6.8)	5 (11.4)	1 (2.3)	22 (50)	0 (0)
Targeted renal medication review: anaemia	42 (65.6)	15 (37.5)	6 (14.3)	9 (21.4)	1 (2.4)	11 (26.2)	0 (0)
Targeted renal medication review: hypertension	42 (65.6)	20 (47.6)	5 (11.9)	4 (9.5)	2 (4.8)	11 (26.2)	0 (0)
Consulting inpatients with mineral bone disease	49 (76.6)	19 (38.8)	6 (12.2)	11 (22.4)	2 (4.1)	10 (20.1)	1 (2)
Consulting inpatients with acute kidney injury	49 (76.6)	23 (46.9)	7 (14.3)	6 (12.2)	3 (6.1)	10 (20.4)	0 (0)
Consulting inpatients with renal complication	46 (71.9)	24 (52.2)	7 (15.2)	9 (19.6)	0 (0)	6 (13)	0 (0)
Consulting inpatients on haemodialysis or peritoneal dialysis	45 (70.3)	24 (53.3)	5 (11.1)	7 (15.6)	3 (6.7)	6 (13.3)	0 (0)
Medicines reconciliation	57 (89.1)	34 (59.6)	15 (26.3)	3 (5.3)	2 (3.5)	2 (3.5)	1 (1.8)
Individual patient medication related education	55 (85.9)	23 (41.8)	6 (10.9)	8 (14.5)	7 (12.7)	10 (18.2)	1 (1.8)
Meetings with multidisciplinary team	52 (81.3)	11 (21.2)	4 (7.7)	13 (25)	12 (23.1)	10 (19.2)	2 (3.8)
Medical ward round with multidisciplinary team	43 (67.2)	16 (37.2)	5 (11.6)	9 (20.9)	8 (18.6)	3 (7)	2 (4.7)

4.4.2. Clinical pharmacy services for outpatients

The provision of care in the outpatient setting was generally less frequent than the inpatient setting. The characteristics of services in the outpatient setting are provided in table 4.3. The most frequently performed activities included; providing general pharmaceutical care by 62.5% (n = 40) and meeting with the multidisciplinary team by 64.1% (n = 41). General pharmaceutical care for patients in an outpatient setting was performed by 40.0% (n = 16) of the respondents on a daily basis during weekdays, whereas, 32.5% (n = 13) were providing the care on an 'ad hoc' basis.

Many of the respondents were providing pharmaceutical care for patients receiving dialysis (59.4%, n = 38) and transplantation (57.8%, n = 37). These activities were provided daily on weekdays by 34.2% (n = 13) and 35.2% (n = 13) respectively. Less frequently provided activities were; consulting for specific conditions including haemodialysis or peritoneal dialysis (34.4%, n = 22), other renal complications (31.3%, n = 20), acute kidney injury (14.1%, n = 9) and mineral bone disease (26.6%, n = 17) mostly on an ad hoc basis.

Individual patient medication related education was performed by 59.4% (n = 38) of the respondents, mostly either on an 'ad hoc' basis by 42.1% (n = 16), 'two to three times a week' by 23.7% (n = 9) or 'once a week' by 21.1% (n = 8) of the respondents. Targeted disease specific medication reviews were again among the least frequently performed activities in the outpatient setting with only a quarter undertaking hypertension reviews (25%, n = 42), 34.4%

conducting vasculitis reviews (n = 22), and 32.8% doing anaemia reviews (n = 21).

Table 4.3: Characteristics of clinical pharmacy services you provide for OUTPATIENTS with CKD (N=64)							
Area of care	**Provision of care**	**Frequency of 'Currently doing' care provision**					
	Currently doing	Daily Weekdays	Daily Weekdays and Weekends	2-3 x/week	Once/week	Ad hoc	Missing
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
General pharmaceutical care	40 (62.5)	16 (40)	4 (10)	4 (10)	3 (7.5)	13 (32.5)	0 (0)
Meetings with multidisciplinary team	41 (64.1)	3 (7.3)	2 (4.9)	10 (24.4)	13 (31.7)	9 (22)	1 (2.4)
Individual patient medication related education	38 (59.4)	3 (7.9)	1 (2.6)	9 (23.7)	8 (21.1)	16 (42.1)	1 (2.6)
Pharmaceutical care for patients receiving dialysis	38 (59.4)	13 (34.2)	3 (7.9)	5 (13.7)	3 (7.9)	13(34.2)	1(2.6)
Pharmaceutical care for patients at transplantation /follow-up	37 (57.8)	13 (35.1)	2 (5.4)	7 (18.9)	5 (13.7)	9 (24.3)	1 (2.7)
Medicines reconciliation	31 (48.4)	8 (25.8)	6 (19.4)	7 (22.6)	4 (12.9)	5 (16.1)	1 (3.2)
Full medication regimen poly-pharmacy review	28 (43.8)	5 (17.9)	1 (3.6)	8 (28.6)	3 (10.7)	10(35.7)	1 (3.6)
Targeted renal medication review: transplantation	29 (45.3)	7 (24.1)	1 (3.4)	6 (20.7)	5 (17.2)	10 (34.5)	0 (0)
Targeted CKD renal medication review	27 (42.2)	1 (3.7)	1 (3.7)	5 (18.5)	4 (14.8)	14 (51.9)	1 (3.7)
Targeted renal medication review: vasculitis	22 (34.4)	1 (4.5)	0 (0)	3 (13.6)	4 (18.2)	14 (63.6)	0 (0)
Targeted renal medication review: anaemia	21 (32.8)	1 (4.8)	2 (9.5)	2 (9.5)	7 (33.3)	9 (42.9)	0 (0)
Targeted renal medication review: hypertension	16 (25)	1 (6.3)	1 (6.3)	2 (12.5)	2 (12.5)	9 (56.3)	1 (6.3)
Consulting out-patients on haemodialysis or peritoneal dialysis	22 (34.4)	2 (9.1)	3 (13.6)	4 (18.2)	1 (4.5)	11 (50)	1 (4.5)
Consulting outpatients with renal complication	20 (31.3)	1 (5)	1 (5)	7 (35)	2 (10)	9 (45)	0 (0)
Consulting outpatients with mineral bone disease	17 (26.6)	1 (5.9)	1 (5.9)	2 (11.8)	5 (29.4)	8 (47.1)	0 (0)
Consulting outpatients with acute kidney injury	9 (14.1)	1 (11.1)	0 (0)	1 (11.1)	1 (11.1)	6 (66.7)	0 (0)

4.4.3. Additional roles of pharmacists to support delivery of services

Additional roles undertaken by the pharmacist to support delivery of patient care are shown in table 4.4.

The most frequently performed additional roles were delivering education and training for other pharmacy staff (90.6%, (n = 58), other healthcare professionals (84.4%, n = 54/64) and students (81.3%, n = 52). The least frequently performed activities were academic research (7.8%, n = 5) and care home support (9.4%, n = 6). A number of respondents were planning to perform these activities within the next 12 months, with a third (34.4%, n = 22) of respondents planning to undertake academic research. Few (3.1%, n = 2), however, were planning to conduct care home support.

Table 4.4: Additional roles undertaken by the pharmacist to support delivery of patient care (N=64)				
Role	**Provision**			
	Currently doing	Planned activity in next 12 months	No plans	Missing
	n (%)	n (%)	n (%)	n (%)
Audits/service evaluations/quality improvements	46 (71.9)	15 (23.4)	1 (1.6)	2 (3.1)
Care home support	6 (9.4)	2 (3.1)	52 (81.3)	4 (6.3)
Academic research	5 (7.8)	22 (34.4)	33 (51.6)	4 (6.3)
Providing education/training for other pharmacy staff	58 (90.6)	5 (7.8)	0 (0)	1 (1.6)
Providing education/ training for other healthcare professionals	54 (84.4)	6 (9.4)	2 (3.1)	2 (3.1)
Providing education/ training for students	52 (81.3)	6 (9.4)	5 (7.8)	1 (1.6)
Providing education/ training for patient groups	31 (48.4)	9 (14.1)	21 (32.8)	3 (4.7)
Providing education/ training for carers	29 (45.3)	6 (9.4)	25 (39.1)	4 (6.3)
Providing mentoring for other pharmacy staff	56 (87.5)	5 (7.8)	2 (3.1)	1 (1.6)
Providing mentoring for other healthcare professionals	32 (50)	7 (10.9)	21 (32.8)	4 (6.3)
Involved in production of national level guidelines, strategy or policy	12 (18.7)	13 (20.3)	35 (54.7)	4 (6.3)
Involved in production of in-house guidelines, strategy or policy	56 (87.5)	4 (6.3)	2 (3.1)	2 (3.1)
Involved in drug and therapeutics committee submissions	48 (75)	7 (10.9)	7 (10.9)	2 (3.1)
Participation in national working groups e.g. UKRPG	29 (45.3)	5 (7.8)	27 (42.2)	3 (4.7)
High cost drugs- predict, plan and monitor new innovations in terms of business care, funding and reimbursement	47 (73.4)	10 (15.6)	6 (9.4)	1 (1.6)

4.4.4. Development and implementation of clinical pharmacy practice

Table 4.5 provides responses to the statements on the development and implementation of clinical pharmacy practice in relation to CFIR domains and constructs.

Overall the respondents held positive views on the statements. However, of the 64 respondents the majority (61.0%, n = 39) agreed or strongly agreed on the need for more evidence around the benefits of clinical pharmacy in CKD within the CFIR domain of 'intervention characteristics: evidence strength'.

The highest levels of agreement were received for the CFIR domain 'process of implementation' and specifically related to opinion leaders (social influences). Almost all agreed/strongly agreed with the statements, "the actions and views of renal specialists influence my practice" (95.3%, n = 61) and, "the actions and views of other members of my profession influence my practice" (89.0%, n = 57).

Within the CFIR domain of 'inner setting: learning climate and process' there was clear disagreement with statements relating to having sufficient time to reflect on practice with more than half indicating they strongly disagree or disagree (56.2%, n = 36) and the 'inner setting: available resources' statement on having sufficient cover for continuation of the clinical services provided when not in the department with 68.8% indicating they strongly disagree or disagree (n = 44).

The majority of respondents strongly agreed or agreed that they were burdened with having to provide other services taking them away from providing care (65.6%, n = 42). Almost two thirds of respondents strongly disagreed or disagreed that they had sufficient administrative support to facilitate their practice (65.6%, n = 42).

The statement associated with the CFIR domain of 'characteristics of individuals' indicates that in relation to 'self-efficacy', a high proportion of respondents strongly agreed or agreed that they are confident in their abilities in general and in working as part of the multidisciplinary team (85.9%, n = 55).

There was also strong agreement with statements relating to the 'outer setting' domain of the CFIR with nearly 60% of respondents strongly agreeing or agreeing to the 'peer pressure' statement "I feel that colleagues in other organisations are ahead in implementing the role" (59.4%, n = 38).

Table 4.5: Development and implementation of clinical pharmacy practice. Responses to items within each of the CFIR domains (Median in bold) (N=64)					
CFIR Domains and constructs	**Statement**	**Strongly agree/Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
INTERVENTION CHARACTERISTICS: EVIDENCE STRENGTH	I feel there is a need for more evidence for the benefits of my role	**39 (61)**	14(21.9)	9 (14.1)	2 (3.1)
INTERVENTION CHARACTERISTICS: QUALITY / COST	I feel that cost of service provision is a deterrent to the development of my role	**45 (70.3)**	8 (12.5)	10 (15.6)	1 (1.6)
CHARACTERISTICS OF INDIVIDUALS: SELF EFFICACY / PERSONAL ATTRIBUTES	I am confident in my abilities	**55 (85.9)**	6 (9.3)	2 (3.2)	1 (1.6)
	I am confident in my ability as a member of the multidisciplinary team	**55 (85.9)**	5 (7.8)	2 (3.2)	2 (3.2)
OUTER SETTING: PEER PRESSURE	I feel that colleagues in other organisations are ahead in implementing the role	**38 (59.4)**	16 (25)	8 (12.5)	2 (3.2)
	Advice and guidance from professional organisation such as UKRPG influence how I practise in my role	**50 (78.1)**	9 (14.1)	4 (6.3)	1 (1.6)
INNER SETTING: GOALS / FEEDBACK	I have clear goals for what I want to achieve when I practise	**49 (76.5)**	12 (18.7)	2 (3.2)	1 (1.6)
	I have clear goals for developing clinical pharmacy services	**41 (64.1)**	13 (20.3)	8 (12.5)	2 (3.2)
	I have clear goals relating to my CPD needs	**46 (71.9)**	11 (17.2)	6 (9.3)	1 (1.6)
INNER SETTING: AVAILABLE RESOURCES / ACCESS TO KNOWLEDGE & INFORMATION	I feel I have sufficient time to practise in my role	11 (17.2)	5 (7.8)	**47 (73.4)**	1 (1.6)

Table 4.5: Development and implementation of clinical pharmacy practice. Responses to items within each of the CFIR domains (Median in bold) (N=64) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
INNER SETTING: AVAILABLE RESOURCES / ACCESS TO KNOWLEDGE & INFORMATION	I feel that I have sufficient cover for continuation of the clinical services I provide when I am not in the department	14 (21.9)	5 (7.8)	**44 (68.8)**	1 (1.6)
	I feel that I am burdened with having to provide other services that take me away from providing care for patient with CKD	**42 (65.6)**	8 (12.5)	13 (20.4)	1 (1.6)
	I feel I have sufficient administrative support to facilitate my practice	10 (15.7)	11 (17.2)	**42 (65.6)**	1 (1.6)
	I feel I have adequate access to patient information (case notes, lab data etc) to practise in my role	**59 (92.2)**	2 (3.2)	2 (3.2)	1 (1.6)
	I have sufficient support from specialists to enable me to practise in my role	**53 (82.9)**	8 (12.5)	2 (3.2)	1 (1.6)
	I feel I have adequate time to attend courses and conferences for my development	17 (26.6)	11 (17.2)	**33 (51.1)**	1 (1.6)
	I feel I have adequate access to funds to allow me to attend courses and conferences to help development in my role	13 (20.3)	11 (17.2)	**39 (61)**	1 (1.6)
INNER SETTING: LEARNING CLIMATE AND PROCESS: REFLECTING & EVALUATING	I feel that my clinical knowledge is valued and used by the multidisciplinary team	**57 (89)**	5 (7.8)	1 (1.6)	1 (1.6)
	I am comfortable in my clinical pharmacy practice to try out new methods of service delivery	**42 (65.6)**	11 (17.2)	10 (15.7)	1 (1.6)

Table 4.5: Development and implementation of clinical pharmacy practice. Responses to items within each of the CFIR domains (Median in bold) (N=64) (continued…)

CFIR Domains and constructs	Statement	Strongly agree/ Agree	Neither agree nor disagree	Disagree/ Strongly disagree	Missing
		n (%)	n (%)	n (%)	n (%)
INNER SETTING: LEARNING CLIMATE AND PROCESS: REFLECTING & EVALUATING	I feel I have sufficient time to reflect and think about my clinical pharmacy practice	13 (20.3)	14(21.9)	**36 (56.2)**	1 (1.6)
	I have ways of monitoring the quality of my clinical pharmacy practice caring for patients with CKD	12 (18.7)	17 (26.6)	**34 (53.1)**	1 (1.6)
PROCESS: OPINION LEADERS (SOCIAL INFLUENCES)	The actions and views of other members of my profession influence my practice	**57 (89)**	4 (6.3)	2 (3.2)	1 (1.6)
	The actions and views of renal specialists influence my practice	**61 (95.3)**	2 (3.2)	0 (0)	1 (1.6)
	I feel my role as a clinical pharmacist is not fully supported by my peers	16 (25)	11 (17.2)	**36 (56.3)**	1 (1.6)
	I feel my role as clinical pharmacist for patients with CKD is not fully supported by my multidisciplinary team	9 (14.1)	6 (9.3)	**48 (75)**	1 (1.6)
	I feel my role as a clinical pharmacist for patients with CKD is not fully supported by my organisation	17 (26.6)	13 (20.3)	**33 (51.5)**	1 (1.6)
	I feel my role as a clinical pharmacist for patients with CKD is not fully supported by specialists	5 (7.8)	10 (15.6)	**48 (75)**	1 (1.6)
PROCESS: OPINION LEADERS (SOCIAL INFLUENCES)	The actions and views of other members of the multi-disciplinary team influence my practice	**57 (89)**	5 (7.8)	1 (1.6)	1 (1.6)

4.4.5. Characteristics of prescribing practice

Three quarters of the respondents (75.0%, n = 48) were qualified nonmedical prescribers and were currently actively prescribing. Most of them were practicing independent prescribing (87.5 %, n= 42). More than half of the respondents had been registered with the United Kingdom General Pharmaceutical Council (GPhC) as prescribers for between one and five years (52.1%, n = 25). The respondents were prescribing in various areas related to CKD as shown in figure 4.1.

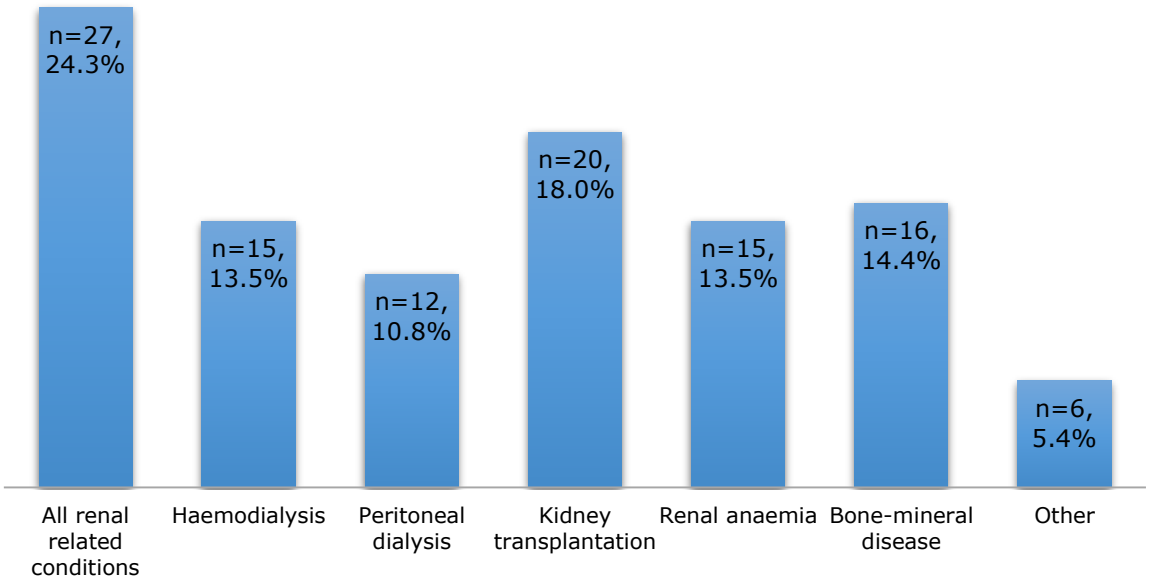

Figure 4.1: Area(s) of prescribing relating to the care of patients with CKD (N=48)

4.4.6. Development and implementation of prescribing practice

Table 4.6 provides responses to statements derived from CFIR on the development and implementation of prescribing practice relating to CKD. The highest level of agreement was reported within the CFIR domain of 'characteristics of individual: self-efficacy/personal attributes'. Statements with highest levels of agreement were, "I am competent to prescribe within the multidisciplinary team" (strongly agree/agree 93.7%, n = 45) and "I am competent in continuing the prescribing of medicines initiated by others" (strongly agree/agree 91.6% n = 44). In relation to the domain of 'characteristics of individuals: other personal attributes' almost two thirds believed that patients would be treated more effectively if a pharmacist prescribes for them (66.7%, n = 32), while 73.0% (n = 35) believed prescribing is more cost-effective if done by the pharmacist.

The highest levels of disagreement for statements related to the CFIR domain of 'process of implementation: construct of social influences', specific responses were, "My prescribing is not fully supported by my multidisciplinary team" (disagree/strongly disagree 83.3%, n = 40) and "My prescribing is not fully supported by my organisation" (disagree/strongly disagree 79.1%, n = 38). The lowest level of agreement was for, "My prescribing is not fully supported by specialists" (strongly agree/agree 4.2%, n = 2).

Through responses to statements in the CFIR domain 'intervention characteristics: evidence strength and quality' more than half of respondents strongly agreed or agreed that they felt there was a need for more evidence for the benefits of pharmacist prescribing for patients with CKD (56.2%, n = 27),

There were mixed responses with statements relating to the 'outer setting' domain of the CFIR in relation to 'peer pressure'. Responses to the statement "I feel that colleagues in other organisations are ahead in implementing pharmacist prescribing in their practice" indicated 52% (n = 25) agreed with the statement and 29.2% (n = 14) disagreeing. Almost two-third (64.6%, n = 31) of the respondents strongly agreed or agreed that 'other professional organisations influence their prescribing practice'.

Within the CFIR domain 'inner setting: available resources' for the statement on having 'sufficient time to prescribe' there was disparity in the responses among respondents. Around a third of the respondents (37.5%, n = 18) strongly agreed or agreed, while 39.6% (n = 19) strongly disagreed or disagreed and the remainder (18.7%, n = 9) neither agreed nor disagreed with the statement.

There was a similar response to the statement related to the sufficiency of administrative support to facilitate their prescribing' with (37.5%, n = 18) in agreement and (41.7%, n = 20) disagreeing with the statement.

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
INTERVENTION CHARACTERISTICS: EVIDENCE STRENGTH & QUALITY / COST	I feel there is a need for more evidence for the benefits of pharmacist prescribing for patients with CKD	**27(56.2)**	12 (25)	7 (14.6)	2 (4.2)
	I feel that cost of service provision are a deterrent to the development of my prescribing practice	**25 (52.1)**	9 (18.7)	12 (25)	2 (4.2)
	I feel that the cost of some drugs used in CKD are a deterrent to my prescribing	6 (12.5)	10 (20.8)	**30 (62.5)**	2 (4.2)
CHARACTERISTICS OF INDIVIDUALS: SELF EFFICACY / PERSONAL ATTRIBUTES	I am confident in my ability to initiate prescribing of medicines for my patients	**38 (79.2)**	5 (10.4)	3 (6.3)	2 (4.2)
	I lack confidence in switching patients from one drug to another when I prescribe	5 (10.4)	12 (25)	**29 (60.5)**	2 (4.2)
	I am confident in my ability to prescribe for patients with CKD when they have been initiated on medicines by others	**41 (85.4)**	3 (6.3)	2 (4.2)	2 (4.2)
	I am confident in my ability to prescribe within the multidisciplinary team	**43 (89.6)**	3 (6.3)	0 (0)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
CHARACTERISTICS OF INDIVIDUALS: SELF EFFICACY / PERSONAL ATTRIBUTES	I lack competency to initiate prescribing of medicines for my patients	6 (12.5)	6 (12.5)	**34 (70.8)**	2 (4.2)
	I am competent in continuing the prescribing of medicines initiated by others	**44 (91.6)**	1 (2.1)	1 (2.1)	2 (4.2)
	I am competent to switch treatments (medicines) when I prescribe for my patients	**42 (87.5)**	1 (2.1)	3 (6.3)	2 (4.2)
	I am competent to prescribe within the multidisciplinary team	**45 (93.7)**	1 (2.1)	0 (0)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
CHARACTERISTICS OF INDIVIDUALS: OTHER PERSONAL ATTRIBUTES	I feel anxious when initiating medicines for patients with CKD	12 (25)	**12 (25)**	22 (45.9)	2 (4.2)
	I feel anxious when prescribing medicines which have been initiated by others	5 (10.4)	11 (22.9)	**30 (62.5)**	2 (4.2)
	I get professional satisfaction when initiating the prescribing for patients	**36 (75)**	8 (16.7)	0 (0)	4 (8.3)
	I get professional satisfaction when prescribing medicines which have been initiated by others	**25 (52.1)**	18 (37.5)	3 (6.3)	2 (4.2)
	If I prescribe for patients with CKD, I believe that patients will be treated more effectively	**32 (66.7)**	11 (22.9)	3 (6.3)	2 (4.2)
	If I prescribe for patients with CKD, I believe that patients will have fewer adverse effects	18 (37.5)	**20 (41.6)**	8 (16.7)	2 (4.2)
	If I prescribe for patients with CKD, I believe that patients will be treated more cost effectively	**35 (73)**	9 (18.7)	1 (2.1)	3 (6.3)
	If I do not prescribe for patients with CKD, I believe that patients may come to harm	14 (29.2)	**11 (22.9)**	21 (43.7)	2 (4.2)
	If I have to switch medications in stabilised patients, I believe that patient care may be compromised	4 (8.3)	**20 (41.6)**	22 (45.8)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
OUTER SETTING: PEER PRESSURE	I feel that colleagues in other organisations are ahead in implementing pharmacist prescribing in their practice	**25 (52)**	7 (14.6)	14 (29.2)	2 (4.2)
	Advice and guidance from professional organisation such as UKRPG influence my prescribing activity	**31 (64.6)**	12 (25)	2 (4.2)	3 (6.3)
INNER SETTING: GOALS / FEEDBACK	I have clear goals for what I want to achieve when I prescribe for patients with CKD	**40 (83.3)**	3 (6.3)	3 (6.3)	2 (4.2)
	I have clear goals for developing services for patients with CKD using my prescribing skills	**25 (52)**	11 (22.9)	9 (18.7)	3 (6.3)
	I have clear goals relating to my CPD around prescribing for patients with CKD	**31 (64.5)**	8 (16.7)	7 (14.6)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
INNER SETTING: AVAILABLE RESOURCES / ACCESS TO KNOWLEDGE & INFORMATION	I feel I have sufficient time to prescribe	18 (37.5)	**9 (18.7)**	19 (39.6)	2 (4.2)
	I feel that I have sufficient cover for continuation of the prescribing services I provide when I am not in the department	12 (25)	1 (2.1)	**33 (68.7)**	2 (4.2)
	I feel that I am burdened with having to provide other services that take me away from prescribing	**31 (64.6)**	2 (4.2)	13 (27.1)	2 (4.2)
	Prescribing systems in my organisation facilitate me in prescribing	**24 (50)**	12 (25)	10 (20.8)	2 (4.2)
	I feel I have sufficient administrative support to facilitate prescribing	18 (37.5)	**8 (16.7)**	20 (41.7)	2 (4.2)
	I feel I have adequate access to patient information (case notes, lab data etc) to prescribe safely and effectively	**43 (89.6)**	2 (4.2)	1 (2.1)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)					
CFIR Domains and constructs	**Statement**	**Strongly agree/ Agree**	**Neither agree nor disagree**	**Disagree/ Strongly disagree**	**Missing**
		n (%)	**n (%)**	**n (%)**	**n (%)**
INNER SETTING: AVAILABLE RESOURCES / ACCESS TO KNOWLEDGE & INFORMATION	I have sufficient support from expert advice and specialists to enable me to prescribe safely and effectively	**41 (85.4)**	4 (8.3)	0 (0)	3 (6.3)
	I feel I have adequate time to attend courses and conferences for my development as a prescriber	16 (33.4)	**7 (14.6)**	23 (47.9)	2 (4.2)
	I feel I have adequate access to funds to allow me to attend courses and conferences for my development as a prescriber	8 (16.7)	7 (14.6)	**31 (64.6)**	2 (4.2)
INNER SETTING: LEARNING CLIMATE AND PROCESS: REFLECTING & EVALUATION	I feel able to express my own prescribing development needs and discuss these with colleagues	**33(68.7)**	7 (14.6)	6 (12.5)	2 (4.2)
	I feel that my prescribing knowledge is valued and used by the multidisciplinary team	**40 (83.3)**	3 (6.3)	3 (6.3)	2 (4.2)
	I am comfortable in my prescribing practice to try out new methods of service delivery	**34 (70.8)**	8 (16.7)	4 (8.3)	2 (4.2)
	I feel I have sufficient time to reflect and think about my prescribing practice	16 (33.4)	**10 (20.8)**	19 (39.6)	2 (4.2)
	I have ways of monitoring the quality of my prescribing	21 (43.8)	**10 (20.8)**	15 (31.3)	2 (4.2)

Table 4.6: Development and implementation of prescribing practice. Responses to items within each of the CFIR domains (Median in bold) (N=48) (continued…)

CFIR Domains and constructs	Statement	Strongly agree/ Agree	Neither agree nor disagree	Disagree/ Strongly disagree	Missing
		n (%)	n (%)	n (%)	n (%)
PROCESS: OPINION LEADERS (SOCIAL INFLUENCES)	The actions and views of other members of the multi-disciplinary team influence my prescribing activity	**40 (83.3)**	5 (10.4)	1 (2.1)	2 (4.2)
	The actions and views of other members of my profession influence my prescribing activity	**36 (75)**	8 (16.7)	2 (4.2)	2 (4.2)
	The actions and views of renal specialists influence my prescribing activity	**43 (89.6)**	3 (6.3)	0 (0)	2 (4.2)
	My prescribing is not fully supported by my peers	6 (12.5)	7 (14.6)	**33 (68.8)**	2 (4.2)
	My prescribing is not fully supported by my multidisciplinary team	2 (4.2)	4 (8.3)	**40 (83.3)**	2 (4.2)
	My prescribing is not fully supported by my organisation	3 (6.3)	4 (8.3)	**38 (79.1)**	3 (6.3)
	My prescribing is not fully supported by specialists	2 (4.2)	5 (10.4)	**37 (77.1)**	4 (8.3)
	The structures and processes within my organisation influence my prescribing activity	**31 (64.6)**	8 (16.7)	7 (14.6)	2 (4.2)
	Increased scrutiny of my prescribing by my organisation is an influence on my prescribing	14 (29.2)	**17 (35.4)**	15 (31.3)	2 (4.2)

4.5. Discussion

4.5.1. Summary of key results

This study has provided evidence that the vast majority of UKRPG pharmacists practicing in CKD are independent prescribers, providing general pharmaceutical care to CKD patients in general and specifically to dialysis and kidney transplant patients. Respondents reported being confident in their own abilities and feeling comfortable in trying new ways of working. In relation to prescribing most were confident in their abilities to initiate prescribing for individual patients within their areas of competence.

4.5.2. Interpretation of results

This work has been underpinned with theoretical approaches throughout its planning and execution. The use of CFIR has provided a framework that has enabled the researcher to develop a comprehensive understanding of positive and negative influences on implementation of clinical and prescribing services, including facilitators and barriers, in CKD. Facilitators for the implementation of new services such as prescribing practice was reported by the pharmacist respondents and included: experience of service provision and confidence in their abilities (characteristics of individuals); having support from multidisciplinary team members (process); having clear goals to for further development (inner setting) and support from professional organisations (outer setting). In terms of barriers to implementing new models of practice respondents indicated there was a lack of evidence for the benefit of new clinical pharmacy services in CKD, this was generally and specifically for prescribing (intervention characteristics/evidence and quality). The lack of funding to support clinical pharmacy services was considered a hindrance to service development (inner

setting/available resources). Many felt burdened by having to provide other clinical and non-clinical services (inner setting/available resources).

Graham-Clarke et al carried out a systematic review and described the facilitators and barriers to implementation of nonmedical prescribing. It included 42 papers and reported on the complex interdependent interplay of themes that could act as facilitators or barriers depending on particular circumstances (Graham-Clarke 2018). Facilitators identified included trust, understanding and confidence of the multidisciplinary team in the nonmedical prescribing role. These social influences are also reflected in the results of this present study where pharmacist respondents felt that they had the support of the multi-disciplinary team, their organisation and specialists. They also expressed high level of self-efficacy with many indicating that they felt confident and competent in their prescribing practice. The systematic review reported that cost and budget limitations were among the main barriers to nonmedical prescribing (Graham-Clarke 2018). However, in this present study resource related responses showed a diversity of views in relation to having sufficient time undertake prescribing activities but there was a clear desire to have more resources for sufficient cover for continuation of the prescribing services during period of absence and lack of resource to cover additional roles and activities that respondent felt diverted them away from the prescribing role. Disparities perhaps indicate the individuality and differential impact of these factors in different organisations where the structures and processes of care provision may vary.

While all respondents were practicing almost exclusively in secondary care, there is potential for community pharmacists to contribute to CKD management. A study published in 2014 reported that community pharmacists are willing to have greater involvement in the care of patients with CKD and that there is a need to

increase awareness of clinic patients of the resource available in the community (Zhu 2014). A recent study from Scotland reported on the growing pharmacy workforce in general medical practice that is delivering clinical and prescribing services (Stewart 2019). There is therefore potential for involvement of this workforce in the shared care of patients with CKD. Al Hamarneh et al. reported that pharmacists in the community setting can contribute in the improvement of the care of patient with CKD by providing comprehensive care services such as medication management, patient education, and prescribing (Al Hamarneh 2018).

The UK National Renal Workforce Planning Group highlighted that pharmacist prescribing will impact on the level and quality of pharmacy services through initiatives such as medication related harm risk minimization, improvement in patient outcomes and support to other healthcare professional (National Renal Workforce Planning Group 2002). It is therefore welcomed that many respondents were active prescribers in CKD but there is a need for research to be conducted and published to evaluate this and add to the evidence base to show that it provides safe, effective and cost-effective care (Al Hamarneh 2018, Al Raiisi 2019).

In view of this it is of some concern that few of the specialised renal pharmacists in this study were involved in any research. Previous studies have reported a variety of barriers to engaging in research activities including; lack of time, availability of funding, lack of research knowledge and logistic issues (Awaisu 2015). To enhance pharmacist's involvement in research, certain strategies have been proposed (Armour 2007, Peterson 2009, Krass 2019). Collaboration with academics and professional organisations can be an attractive tool to develop a

culture, ethos and skill base in pharmacists for research (Armour 2007, Krass 2019). A UK survey of community pharmacies in London and Essex reported that 43% of respondents had participated in some form of pharmacy practice research, which indicates the willingness to participate in research given support (Rosenbloom 2000). A recently published study on the views and experiences of practicing pharmacists in research reported that minority of experienced secondary care pharmacists are involved in performing research-based activities (12.5%, n = 17) however, participants showed an interest in being involved in research-based activities (Stewart 2018).

Specific barriers to clinical and prescribing services reported in this study were time, resources, training and administrative support. These challenges are not unique to this study and have been reported repeatedly in the literature (Salgado 2012, Al Raiisi 2019). A key facilitator to service development is education and training, and indeed, studies suggest that clinical pharmacy education sessions had positive impacts on the management of CKD and that the cost expended on educational sessions are warranted to improve patient outcomes (Nasution 2013).

4.5.3. Strengths and limitations

There are several strengths to this study, including the application of a theoretical framework. Using theory within healthcare research is developing at pace and is leading to enhanced robustness and rigour (Brazil 2005). The UK Medical Research Council Framework for Developing and Evaluating Complex Interventions advocates the systematic use of appropriate theory to develop or evaluate an intervention or new service (Campbell 2000). The findings of this

study offer an original contribution to the evidence base around structures and processes related to pharmacy service provision in CKD. Respondents were from all geographical areas of the UK and so the results are likely to be representative of the breadth of UK practice. Limitations include the fact that the response rate of was around 50% and this may compromise the integrity of the finding. It should be noted however that such a response rate for a national online survey could be considered commendable given the generally poor responses rate for such methods when applied to busy healthcare professionals (Cho 2013). Part of the reason for a reduced number of responses may relate to the desire to carry out a theoretically based, robust and comprehensive study and as such the questionnaire may have been considered too long and involved for some potential respondents. In addition, the research team aspired to be as economically and environmentally efficient through avoidance of a postal survey and therefore opted for online dissemination of the questionnaire. Questionnaire tool design and method have both been shown to have an impact on response rates and this could have been the case in this survey (Nulty 2008). This was a self-completion questionnaire and as such it was not possible to confirm or triangulate the validity of the responses. These, of course, could have been influenced by a number of biases including; non-response, social desirability and conformity, acquiescence and prestige bias (Creswell 2017). Furthermore, members of a professional network like the UKRPG may not be truly representative of a population at large as patients with CKD may also managed by non-renal specialist pharmacists and their views on services to these patients may have added another dimension to the results. In addition, all participants were practicing in secondary care and so the results are obviously viewed in this context. As detailed above clinical pharmacy services are developing rapidly in

other sectors such as primary care in the UK and as such this may be an appropriate are to consider in future studies.

Despite these limitations, it is evident that UK renal specialist pharmacists are highly involved in aspects of care of those with CKD, both in outpatient and inpatient settings. That was both in the areas of general pharmaceutical care and more specialised care in those with dialysis and transplantation. The fact that a higher proportion of respondents currently provide greater levels of inpatient care compared to outpatient care is predictable, given that the role of the hospital clinical pharmacist is more established in the ward setting in the UK at present. However, there may be scope to extend this to outpatient settings and out into primary care with the further development of pharmacist prescribing practice and a policy related aspiration for pharmacists to be responsible for their own case load of patients (The Scottish Government 2017). Furthermore, inpatient care is reflected more in the Competency Framework for Renal Pharmacists produced by the UKRPG (Renal Expert Professional Practice Curriculum 2014). Activities reported by respondents, including education and counselling, discharge planning, medicines reviews and managed introduction of new medicines are those which the UK National Renal Workforce Planning Group highlight as requiring pharmacist input (The National Renal Workforce Planning Group 2002). The statements within the competency framework and the standards of practice produced by the UKRPG for the members to assess their competency levels and benchmark it against advanced practice (Renal Expert Professional Practice Curriculum 2014), may be guiding practice and contributing to the high self-reported levels of confidence and competence (The National Renal Workforce Planning Group 2002). These frameworks and standards should also inform the level of detail to be reported in studies describing care. The

recent systematic review of pharmacist input in CKD noted the lack of published detail relating to the structures and processes of practice (Al Raiisi 2019). There is also a lack of agreement on what constitute appropriate outcome measures for studies exploring clinical pharmacy services in patients with CKD and therefore a lack of consistency of choice and use of outcomes in studies. This lack of detail greatly reduces the usefulness of the evidence generated about the nature and extent of the care. The consequence of this is that it cannot be easily replicated or the results pooled in synthesis and meta-analysis type analysis.

This is highly relevant since in this study respondents expressed a desire to develop and implement innovative novel services to improve patient outcomes. An example of such innovative work includes studies such as Ishani et al's RCT on assessing the role of interprofessional team in CKD management using telehealth which concluded that telehealth is a feasible care delivery strategy but more detailed information, on particularly, the structures and processes of this model of care and clarity on the theoretical basis for the intervention still need to be provided (Ishani 2016). A more detailed evidence base for such services that is well founded in a theoretical basis and robustly researched and reported will enable the connection of evidence to the development of care provision (Donabedian 2005, Raleigh 2010).

There are several potential avenues for further research. In view of the high proportion of pharmacist prescribers working CKD evident from this survey and the healthcare policy direction in relation to development of this role there is a need for qualitative research to allow a more in-depth exploration of pharmacist prescribing in CKD from multiple perspectives. Furthermore, outcomes-based research is required to support further the evidence base.

4.6. Conclusion

Results of this survey indicate high levels of clinical practice including wide-spread nonmedical prescribing activity, demonstrating development of practice, since the previous systematic reviews (Salgado 2012, Al Raiisi 2019). The survey captured detailed information on pharmacists' behaviour and experiences in the care of patients with CKD through robust application of theoretical approaches. Despite the high number of independent pharmacist prescribers among the respondents, there was a lack of details on the facilitators and barriers to the provision of prescribing services for patients with CKD. The results from this survey will inform the current models of clinical pharmacy practice for patients with CKD in the UK. The results will stimulate further discussion among the practitioners on potential ways to overcome the challenges in further developing models of practice in response to healthcare policy changes. This in turn will facilitate practitioners to provide better care for their patients. An additional impact will be that through monitoring and evaluation of the services there will also be ongoing improvements in wellbeing and quality of life of patients. The use of CFIR enabled the identification of facilitators and barriers for the development of clinical pharmacy but lacked details on pharmacist prescribing practice. Insufficient time to undertake additional non-core clinical roles and a lack of involvement in skills base for research among respondents could be considered major barriers to further development of clinical pharmacy practices including prescribing. Further work is planned using qualitative methods to explore these matters in more depth.

4.7. Further research

The findings from the systematic review (Chapter 3) and the results of this survey showed lack in details around pharmacist prescribing for patients with

CKD. Therefore, the next phase of stage two of this doctoral research was focused on the exploration from a professional perspective, on the development, implementation and evaluation of pharmacist prescribing for patients with CKD in the UK.

Chapter 5: A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the United Kingdom.

5. Introduction

This chapter presents the details of the last phase of this doctoral research: semi-structured interviews with pharmacist prescriber members of the UKRPG caring for patients with CKD. In chapter four, the key findings of the survey showed that the majority of the participants were registered prescribers, however, there was lack of depth of information on the structure, processes and outcome of prescribing for patients with CKD. The Government policies in the UK prioritise the development of the pharmacist prescribing role (Scottish government 2013, Department of Health Northern Ireland 2016, Welsh government 2017 and General Pharmaceutical Council 2019). The General Pharmaceutical Council also highlighted that the changing demands from health services and patients across the UK have significantly influenced the use of pharmacist prescribers over the last decade (General Pharmaceutical Council 2019). National pharmacy strategies across the UK appreciate that employing pharmacist prescribers in any healthcare settings allow the best utilisation of pharmacists' prescribing knowledge and skills (General Pharmaceutical Council 2019).

A theoretically underpinned interview was deemed to be a rationale method to obtain an in-depth understanding of pharmacist prescribing practice for patients with CKD in terms of structure, process and outcomes as a part of sequential explanatory mixed-method approach. The CFIR was used throughout this doctoral research with all constructs considered relevant to this phase of the research project (more details are described in Chapter 2). The layout of the chapter includes the objectives followed by methods, findings, discussion and finally the conclusion. This Phase aimed to explore from a professional

perspective, the development, implementation and evaluation of pharmacist prescribing for patients with CKD in the UK.

5.1. Research objectives

The specific objectives in relation to pharmacist prescribing in CKD were:

1. To describe and characterise the models of pharmacist prescribing practice
2. To describe the plans, actions and parameters used for evaluating prescribing practice.
3. To explore plans to develop pharmacist-prescribing practice further.
4. To explore the facilitators and barriers relating to implementation of pharmacist prescribing.

5.2. Methods

5.2.1. Study design

A constructivist, phenomenological qualitative semi-structured interview approach was employed in this phase of the doctoral research. Justifications for following this method as a part of mixed-method approach are described in details in Chapter 2 of this thesis.

5.2.2. Setting

The study was conducted across the UK and was focused on members of the UKRPG with representation across healthcare sectors and from the whole of the UK.

5.2.3. Inclusion exclusion criteria

All pharmacist prescribers registered with the UKRPG and opted to take part in further research during previous parts of this doctoral research were included in the interviews. Any members of the UKRPG involved in the development and

piloting of the tools used for data collection (n = 6) were excluded from the study.

5.2.4. Sampling approach

The intended sampling frame was all of the 71 pharmacists that completed the survey in stage 2, phase 1 and were registered as prescribers in the UK and were currently prescribing for patients with CKD. However, only a proportion of these (n = 48) pharmacists indicated that they were prescribers but only 29 agreed to take part in this further research.

An email was sent to all of these 29 respondents with a request to take part in further research (Appendix 5.1). This included:

- An information sheet about the study (Appendix 5.2) and
- A link to a mini-survey designed to gather brief demographic information (Appendix 5.3) and
- A consent form to be signed and sent back to the researcher via email back before the scheduled interview (Appendix 5.4).

The mini survey used Online Surveys, Jisc® (formerly Bristol Online Survey Tool®, https://www.jisc.ac.uk/online-surveys) and was used to gather demographic information of the participants. The survey also included an information sheet for the participants and questions including:

✓ Participants name, preferred way of contact, email and contact number
✓ Gender: Male, female, prefer not to say
✓ Age: <30 years, 31 – 40 years, 41 – 50 years, 51 – 60 years and >60 years.
✓ Geographical area of practice: England, Scotland, Wales and Northern Ireland
✓ Years qualified as a pharmacist: <1 year, 1 – 5 years, 6 – 10 years, 11 – 15 years, 16 – 20 years and >20 years.

✓ Years of experience as prescriber: <1 year, 1 – 5 years, 6 – 10 years, 11 – 15 years, 16 – 20 years and >20 years.

Two reminder emails were sent to the participants at four weekly intervals. Snowball sampling was used to help identify additional appropriate participants to interview to enable reaching data saturation. This approach was undertaken by asking the interviewees to suggest a prescribing pharmacist for patients with CKD who meets the research inclusion criteria. Two further participants were identified this way. Figure 5.1 shows the recruitment process for this phase of the doctoral research.

The point of data saturation was identified using the approach of Francis et al. (Francis 2010) with an initial sample of 10 and a stopping criterion of three (ie data collection ceased if no further themes were identified from the analysis of the additional three interviews). Details of this approach are provided in Chapter 2.

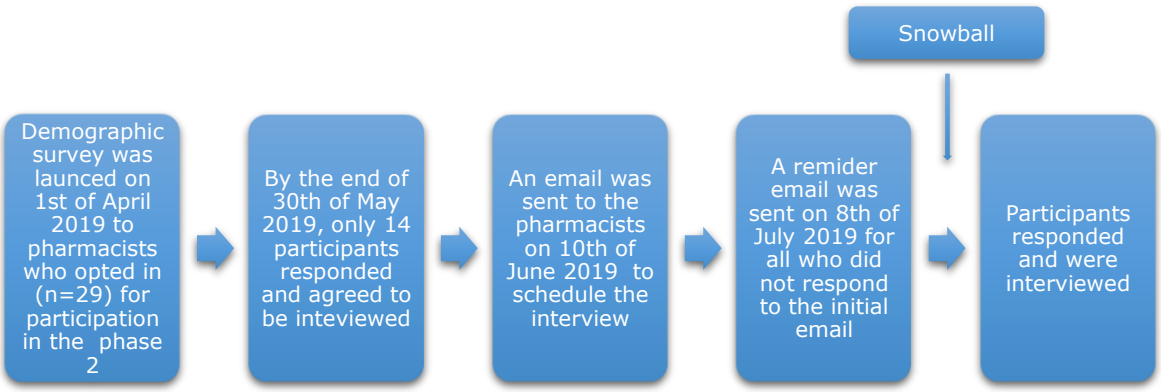

Figure 5.1: Recruitment process of the interview participants.

5.2.5. Data generation tool development

The doctoral student attended multiple training sessions and short courses provided by the graduate school at Robert Gordon University to develop qualitative interview skills.

The development of the semi-structured interview tool (Appendix 5.5) followed a rigorous iterative process that initially involved reviewing of the aim / objectives of the overall project to ensure that the interview tool was designed to meet these. Information from the literature and the previously completed systematic review in stage 1 (Al Raiisi 2019) and the results from the survey in stage 2, phase 1 (Al Raiisi 2020) was used to generate initial ideas and concepts for inclusion.

The semi-structured interview tool was designed based on the principles of implementation theory with constructs and domains of the Consolidated Framework for Implementation Research (CFIR) as described in Chapter 2. The CFIR was used to frame key sections of the interview schedule with consideration of all domains and constructs of the framework (Damschroder 2009). This resulted in rigorous structure and content that was relevant to the research's aim and objectives.

The development of the tool involved discussions and regular weekly meetings with the research supervisors and an expert panel throughout the process of the tool development. The four expert panels included senior academic staff with expert in qualitative research and three of them with prescribing qualification TM, KM, ID and AT who reviewed the interview schedule for credibility (Guba 1981). Only minor comments were received from the experts and were incorporated into a revised copy of the interview schedule. The schedule was tested with two

academic members of staff who were also hospital pharmacists and prescribers in a face to face trial interview in an office within the academic institute. Both pharmacists agreed that the schedule was clear and easy to understand with no suggestions to change it leading to the final version of the interview tool. A pilot interview was carried out with one of the pharmacist prescribers who had completed the recruitment survey and the data were included in the analysis. The pilot interview transcript and findings were discussed with the supervisory team and the feedback was considered and incorporated in the analysis to ensure dependability and credibility.

The structure of the interview was divided into sections including demographics, characteristics of current prescribing practice, questions relating to different relevant constructs of the CFIR and additional aspects of the areas of questioning explored in more detail through additional probing questions.

Use of this framework ensured that all aspects of relevance to the research objectives for this part of the work were fully and comprehensively covered through the constructs and domains of the CFIR.

The semi-structured interview questions were mapped to the CFIR domains and constructs as listed in Table 5.1.

Table 5.1: Interview questions mapped with CFIR constructs.		
Related CFIR construct	**Interview questions**	**Probing questions**
Intervention characteristics	What do you feel are the key factors that have influenced implementation of prescribing practice, generally and in relation to your own practice?	How do you feel you have used evidence to develop your practice? How do you feel that your prescribing has changed your practice? What about the impact on patients? Do you feel that your prescribing practice has changed or developed since you started? What is the complexity of your prescribing practice: consider clinical complexity and logistics What about the costs and savings associated with providing a prescribing practice?
	What do you feel works very well and what needs to improve regarding your prescribing practice?	
Characteristics of individuals	How do you feel your personal characteristics have helped develop and implement prescribing practice for CKD?	How you feel you complement other in the multidisciplinary team in relation to your prescribing? How confident are you with your prescribing? Are you considering developing or changing any aspects of your prescribing practice?
	How you see your prescribing practice developing in future?	Any other traits you have that suit your prescribing practice?
Inner setting	What are the barriers or facilitators, within your organisation, that have helped or hindered the development of prescribing practice generally and in your own practice?	What factors within your organisation do you feel have helped or hindered developments? How communication within your organisation around the development of prescribing practice take place? Do you receive any support for your prescribing role?
	What advice you would give to others who are considering setting up a prescribing service? Are there any pitfalls you should avoid?	What about how nonmedical prescribing is welcomed, encouraged, supported? What happens to cover prescribing practice when a colleague is absent?
Process	How was pharmacist prescribing planned for and implemented within your organisation?	How were you and colleagues involved with this? 'project champions' Was there any external influence on this? How do you assess or evaluate your prescribing practice in term of safety, effectiveness, cost effectiveness?
Outer setting	What about external influences on the development and implementation of pharmacist prescribing in your organisation generally and in your own prescribing practice?	Do you feel that colleagues in other organisations are ahead in implementing pharmacist prescribing in their practice? Does any external body or organisation influence your prescribing practise? Can you tell me about any other external factors affecting your prescribing practice?

The interview tool was reviewed independently for credibility by an expert panel (TM, LK, and AT) selected by the research team. This ensured that each of the question was unambiguous and not leading in any way. It also ensured that the content covered all topics of relevance to the aims and objectives and general area of the research. Think aloud testing of the interview tool was performed by two academic members from the Robert Gordon University (MM and CD)

5.2.6. Data generation

Once the demographics survey was completed, the researcher started to contact the participants via their preferred method of contact to arrange a suitable date and time for the telephone interview. If no response was received from the participants within four weeks, another email with a gentle reminder was sent. As the participants agreed and replied, a date and time was confirmed for the telephone interview. The researcher than booked a room with a telephone line where the interviews took place. Before the scheduled date for the interview, the researcher ensured that a copy of the information sheet, and the consent form was sent to the participants. A signed consent form was obtained from the participants by a return email prior to commencing the interviews.

The researcher was granted permission to audio-record the interview by the participant at the start of each interview. Interviews lasted between 17 – 47 minutes, and were recorded using two digital audio-recorders. All interviews were transcribed verbatim naturalistically by the student researcher and were double checked by an experienced research team member (SC, KM and LK) to ensure accuracy of transcription.

5.2.7. Data analysis

The interview data were analysed thematically, as described in Chapter 2. Initially the demographics of the interviewees were analysed to inform their selection and to ensure participants covered all of the inclusion criteria and the sample is adequately represented. This included consideration of; years of qualification as prescribers, geographical region of practice and the areas of prescribing practice.

To ensure anonymity of all participants the details gathered and reported here were carefully reviewed to ensure that nothing clearly identified individual or organisations.

Once the transcripts were ready for analysis, all interviews were imported to NVivo® 11 software (QSR International Pty Ltd. 2017) for data management and analysis. NVivo® helped sort the CFIR Domains as 'nodes', and the constructs and sub-constructs as 'child nodes'.

The interview data analysis were guided by the CFIR domains and constructs initially. All transcripts were reviewed, coded and discussed by FA and independently by at least one of the team members (SC, LK and KM). Further key themes were generated and reviewed by FA and SC and any disagreements were resolved by discussion among the research team. Findings are presented as quotes from the interviewees and reported in accordance with each CFIR construct. Quotations were reviewed by the supervisory team to ensure that all participants were represented.

Data saturation is described in great details in Chapter 2 which is expected to have been reached once no new themes emerge from the data analysis process according to Francis el al. 2010. Using the Francis approach for this work the

intention was to carry out the first 10 interviews and then thematically analyse these followed by a further 3 interviews. Then if data saturation was not reached, further interviews were to be carried-out and analysed to ensure data saturation.

5.2.8. Data protection

All research related documents including consent forms, transcripts and any analysis reports were stored in secure password protected computers with restricted access by the research team only. Any paper-based files were stored under lock and key with access by the researcher only. All recordings and data were dealt with anonymity of participants to ensure protection of privacy. The standard operation procedures of School of Pharmacy and Life Sciences at Robert Gordon University were strictly followed to ensure data protection.

5.2.9. Research governance

The research was approved by the ethical authority of the Robert Gordon University. School of Pharmacy & Life Sciences Research Ethics Committee (Approval reference S172) (Appendix 5.6). Signed informed consent was obtained from each participant prior to conducting the interviews.

5.3. Findings

5.3.1. Pharmacist recruitment

Forty-eight out of 71 pharmacists who had completed the survey (as reported in Chapter 4) and indicated they were prescribers were invited to participate in the interview. Fourteen pharmacists responded and agreed to participate but only 12 participants responding further. These 12 completed the demographics and returned the consent form and so they were all interviewed. The other two did not respond to any attempts made to contact them by the researcher. Two more pharmacists were recruited through snowball sampling that were suggested by two participants. A total of 14 interviews were conducted to reach data saturation. Initially 10 interviews were conducted and analysed then a further three participants were interviewed and these were analysed. At this point it seemed that data saturation was reached with no new themes being identified. However, one final participant offered to be interviewed so it was decided to include this and from this again no new themes emerged and so this was deemed that data saturation was reached. Demographic details of the participants are shown in Table 5.2. For anonymity the geographical region has been removed from the table. Geographical distribution of the participants was as follows: nine participants from England, three from Scotland and one from each Wales and Northern Ireland.

Table 5.2: Participants demographic details.					
Participant	**Sex**	**Age range in years**	**Number of years in profession**	**Main practice setting**	**Years of experience as prescriber**
Pharmacist 1	Male	41 - 50	More than 20 years	Secondary care	16 - 20
Pharmacist 2	Female	41 - 50	More than 20 years	Secondary care	11 - 15
Pharmacist 3	Female	41 - 50	16 - 20	Secondary care	11 - 15
Pharmacist 4	Female	51 - 60	More than 20 years	Secondary care	11 - 15
Pharmacist 5	Male	31 - 40	11 - 15	Secondary care	11 - 15
Pharmacist 6	Female	41 - 50	More than 20 years	Secondary care	11 - 15
Pharmacist 7	Female	31 - 40	11 - 15	Secondary care	1 - 5
Pharmacist 8	Female	31 - 40	11 - 15	Secondary care	1 - 5
Pharmacist 9	Female	41 - 50	16 - 20	Secondary care	11 - 15
Pharmacist 10	Male	31 - 40	11 - 15	Secondary care	1 - 5
Pharmacist 11	Female	31 - 40	6 - 10	Secondary care	1 - 5
Pharmacist 12	Female	31 - 40	11 - 15	Secondary care	1 - 5
Pharmacist 13	Female	31 - 40	6 - 10	Secondary care	<1 year
Pharmacist 14	Female	51 - 60	More than 20 years	Secondary care	11 - 15

5.3.2. Area of prescribing practice

To ensure anonymity of all participants the details gathered and reported here were carefully reviewed to ensure that nothing clearly identified individual or organisations. Participants were also asked about the area in which they prescribe for patients with CKD. All participants were practising in secondary care with few practising in primacy care and community pharmacy. All participants prescribed a full range of renal medicines in inpatient settings. A few participants also prescribed specific classes of medication in clinic settings. It was noted that specific drug clinics were gaining prevalence as an advanced area of prescribing with some participants running clinics related to the drug tolvaptan and others expressing an interest to run such clinics in future. Details of their areas of prescribing practice are listed in Table 5.3.

Table 5.3: Participants area of prescribing practice.		
Participant	**Area of prescribing practice**	**Quotes reflecting pharmacist's area of practice**
Pharmacist 1	All renal related medicines in inpatient setting - secondary care	"I would go to the ward round, see new patients, if there's anything that we need, maybe change like phosphate binders changing of times, etc. I would do that, if there was something that was missed off and Initiating new drug"
Pharmacist 2	All renal related medicines in inpatient and outpatient setting - secondary care	"I prescribe of all the renal in and outpatient at clinics like anaemia clinic, tolvaptan clinic and prescribe symptomatic relief for the, the dialysis patients. As well as prescribing in the ward rounds and doing discharges."
Pharmacist 3	All renal related medicines in inpatient setting and specific drug clinic - secondary care	"I'm working as a prescriber for outpatient tolvaptan clinics" "prescribing to inpatients, probably picking up medicines have been incorrectly prescribed or admitted during the medicines reconciliation process so correcting errors, and then also dose adjustments of medicines to renal function. For example, antibiotic and antivirals, so we will adjust those independently, and attempts by transplant protocols of our transplant centre"
Pharmacist 4	All renal related medicines in inpatient setting and specific clinic - secondary care	"I do a daily ward round on the transplant unit, So I prescribe immunosuppression and stopping old dialysis drug and antibiotics, protocol driven immunosuppression, and also surgical pain analgesics, as required anti-emetics and whenever necessary" "I do clinics in one half day a week, when I see acute transplant patients for up to the first year just as required and if necessary I will prescribe medicines they can't get through the GP"
Pharmacist 5	All renal related medicines in inpatient and outpatient setting - secondary care	"So currently as a pharmacist independent prescriber I would prescribe for repatriate immunosuppression for primary care for transplantation, that's an entire cohort, ESA and iron therapy for all of anaemia CKD patient's, bone mineral management in dialysis patients, dialysis reviews, and then, any ad hoc treatment such as when they occur, specific programmes for managing anaemia CKD, MBD and transplant."
Pharmacist 6	All renal related medicines in inpatient and outpatient setting - secondary care	"I currently do some of my own prescribing clinics, predominantly working in outpatient area, I've got my own clinic work just do some prescribing, looking at renal risk in patients so looking at cardiovascular risk, hypertension, proteinuria, statin use, that kind of thing" "I do a lot of inpatient prescribing because I work on a haemodialysis unit, prescribing to them antibiotics, any medications at that time on dialysis, I do lots of transplant prescribing as well for our transplant patients "
Pharmacist 7	All renal related medicines in inpatient setting and specific drug clinic - secondary care	"as a combination of an inpatient Kardex's, and, you know, that will be prescribing missing medicines or adjusting a dose depending on what they were on before to come in and, you know, at the request that say the doctor, the dietitian to add something in, then also, I prescribe Aranesp for outpatients where I will review the bloods and then increase or decrease the dose as needed."

Pharmacist 8	All renal related medicines in inpatient setting and specific clinic - secondary care	"I'm working in the transplant outpatient clinic, and every day I have a morning clinic where I see renal transplant patients post their transplant. I do prescribe for these patients and my prescribing scope of practice includes the immunosuppression's that we use, but also for some of our older existing transplant patients, they are on ciclosporin, azathioprine and prednisolone, and I also often prescribe valganciclovir for our patients who has got like straight forward CMV, viremia post-transplant, or some of our patients are on prophylaxis as well." "As an inpatient then I can do prescribing on our med chart"
Pharmacist 9	All renal related medicines in inpatient setting and specific drug clinic - secondary care	"I would prescribe in outpatients and specifically for patients with polycystic kidney disease, and I prescribe tolvaptan in that situation, and both initiating tolvaptan to writing the initial prescription, and adjusting the dose, so providing ongoing prescriptions of tolvaptan and do that independently. For inpatients, I would generally prescribe things occasionally to support the doctors"
Pharmacist 10	All renal related medicines in inpatient setting - secondary care	"So, I do prescribe as part of my role. Unfortunately, most of my prescribing is reactive., Most of my prescribing would centre around small scale into hospital inpatient setting and making sure medications prescribed correctly or there were omissions or the doses were wrong. Occasionally, I will sort of pre-populate, TTO's (to take out) sort of drug sections of discharge summaries"
Pharmacist 11	All renal related medicines in inpatient setting and specific drug clinic - secondary care	"Firstly, it would be when I'm working in my ward role optimising medication, starting and stopping of medications, antibiotic review and optimising medicines for new starter on dialysis that would be prescribing as part of an MDT discussion during the ward rounds, another role would be in the clinic running tolvaptan clinics. I'm reviewing homecare for patients so outpatient prescriptions for medicines for home delivery, and that would be EPO's, predominately or if sometimes I review homecare prescriptions for transplant patients"
Pharmacist 12	All renal related medicines in inpatient setting - secondary care	"I'm usually prescribing the dialysis medication. So, epoetin and iron, any dialysis anti-coagulation, line locks if it got a line, and those types of things"
Pharmacist 13	All renal related medicines in inpatient setting - secondary care	"Basically, attending the ward round and so, it'll be then when dealing with prescribing and also when they come on to the ward, and we do like the medication reconciliation process again I will do some prescribing then"
Pharmacist 14	All renal related medicines in outpatient setting - secondary care	"I'm based in the transplant clinic for the kidney transplant patients, and I prescribe immunosuppression for maintenance. I'll prescribe either for the home delivery supply of the medication for an outpatient supply and also to go into their dosette boxes. I do a lot of prescribing for patients on medication aids, on MTA's, which I will prescribe just about anything as long as it's a continuity of care and it's well documented that what they're on. I'll prescribe erythropoietin, cinacalcet and, you know, anything that's registered that we have the responsibility to do"

5.3.3. Key themes

The findings presented in Table 5.4 below are derived from the qualitative interviews carried out with pharmacists prescribing for patients with CKD in the UK. The findings are presented in a structured manner aligned to the CFIR domains and constructs in order to allow clear relationships to be made between the findings and to the theoretical concepts contained within the CFIR. The findings are provided under each of the five CFIR domains, with key themes linked to each relevant construct within the domain. Occasionally in the process of analysis there was overlap between the themes and the linked constructs, this is highlighted in the presentation of findings below.

Table 5.4: CFIR domains and constructs matched with identified key themes.		
CFIR Domain	**CFIR constructs (Theme)**	**Key themes**
INTERVENTION CHARACTERISTICS	Intervention Source	Prescribing by pharmacist: arisen from a number of disparate sources.
	Evidence Strength & Quality	Lack of evidence of pharmacist prescribing. Anecdotal evidence. Further research required.
	Relative Advantage	Advantages of pharmacist prescribing role.
	Adaptability	Prescribing role adapted from clinical role for pharmacists. Models of prescribing practice.
	Trialability	Trial in small area of practice. More advanced skills are required.
	Complexity	Conflict with MDT. Complexity in process.
	Design Quality & Packaging	Prescribing within competencies. Replicating exemplar models. Prescribing aligned with NHS Trust / Organisation needs.
	Cost	Reduced drug costs. Cost of pharmacist prescribers versus nurses and consultants.
OUTER SETTING	Patient Needs & Resources	Pharmacist prescribing appreciated by and accessibility for patients. Learning and development needs.
	Cosmopolitanism	Collaboration with external bodies. Alliance within NHS Trust units. Centralise the service across regions.
	Peer Pressure	Challenge to advance prescribing role. Competitiveness pressure.
	External Policy & Incentives	Prescribing alignment with local and external policies.

Table 5.4: CFIR domains and constructs matched with identified key themes			
CFIR Domain	**CFIR constructs (Theme)**		**Key themes**
INNER SETTING	Structural Characteristics		Need for more prescribers. Potential areas for development.
	Networks & Communications		Wide range of communication within trust. Good network within organisation.
	Culture		Positive culture for pharmacist prescribing. Avoidance of blame culture.
	Implementation Climate	Tension for Change	Insufficient number of prescribers. Lack of administration support.
		Compatibility	Pharmacists prescribing can fit in with daily duties.
		Relative Priority	Training prioritisations.
		Organizational Incentives & Rewards	Pharmacist prescribing well appreciated. Central funding to train prescribers.
		Goals and Feedback	Clear goals for development. Feedback from stakeholders.
		Learning Climate	Continuous learning. Learning from errors.
	Readiness for Implementation	Leadership Engagement	Support from leaders.
		Available Resources	Limited funding. Personnel shortage. Time to prescribe. Training resources needed. Need for physical space to practice. New technologies needed.
		Access to Knowledge & Information	CPD opportunities. Availability of educational materials. Lack of CKD related prescribing courses.

Table 5.4: CFIR domains and constructs matched with identified key themes			
CFIR Domain	**CFIR constructs (Theme)**		**Key themes**
CHARACTERISTICS OF INDIVIDUALS	Knowledge & Beliefs about the Intervention		Pharmacists well skilled for prescribing. Wide scope for prescribing practice.
	Self-efficacy		Awareness of self-competencies. Experience.
	Individual Stage of Change		Stages of development of pharmacist prescribing. Need to progress through stages.
	Individual Identification with Organisation		Supported by organisation.
	Other Personal Attributes		Awareness of strengths and limitations.
PROCESS	Planning		Pharmacist prescribing implementation planning. Development of prescribing practice. Stakeholders engagement importance.
	Engaging	Opinion Leaders	Support from MDT.
		Formally Appointed Internal Implementation Leaders	Mentors support. Administrative support.
		Champions	Doctors engagement and enthusiasm. Support from stakeholders.
		External Change Agents	Influence from external agents. Academic institution support.
	Executing		Variation in prescribing models.
	Reflecting & Evaluating		Monitoring of prescribing practice. Development of patient feedback systems. CPD / reflection and work-based appraisal systems in place.

5.3.4. Themes under each CFIR domain and constructs

The interview findings are presented according to domains and constructs of the CFIR to enable easy follow up and produce actionable findings for improving implementation.

A) Interventions characteristics

This CFIR domain focuses on the key attributes and features of interventions that influence the success of implementation (Keith 2017).

a) Intervention source

A key theme within this construct was **'Pharmacist prescribing: arisen from a number of disparate sources'.**

The pharmacists believed the intervention was developed with the influence of external forces such as changes to general practitioners' contracts and policies relating to preparing pharmacists to prescribe.

> *"Generally, probably the changes in the GP contracts that asking to get community pharmacist prescribing, in the hospital, it's not really taken off as much, and it just depends on where you are."* *Pharmacist 2*

Pharmacist 5 emphasised that the intervention was developed by the UK government allowing development of pharmacist prescribing services as well as a need to meet the demands of the service providers like the NHS.

> *"The enthusiasm of individuals, the need to make sure that pharmacy is not a supply of drugs medicines profession, but actually part of the solution to meet the demand in the NHS by being professionally integrated into frontline services, the government extending the prescribing roles to other healthcare professionals including pharmacists"* *Pharmacist 5*

Within the organisation, prescribing was developed through demand for specific areas of interest and new initiatives as well as consideration of patient needs.

> *"I'm sure with the hepatitis B vaccination sort of coming in house from primary to secondary care showed there is a lot more prescribing from that point of view"* *Pharmacist 6*

> *"We've got a transplant clinic. So predominantly for transplant clinic, on a Wednesday Thursday and Friday our busy full day they're always full transplant clinics and then on a Monday, we often see there's more a nurse led clinics but I also see some of their patients as well, and on a Tuesday more kind of my admin day and catching up on other kind of guidelines and Directorate work."* *Pharmacist 8*

There has been a transition from supplementary prescribing to independent prescribing within organisations as services developed with involvement of the main stakeholders in the organisation internally.

> *"Just really, that's myself and just developed areas where I'd be able to do it, and initially it was supplementary, with making sure that the areas that the doctor's first happy for us prescribing and now because I've been here so long and it's all new doctors that just accepted that I do prescribing as much as the doctor are prescribing."* *Pharmacist 2*

> *"way before independent prescribing came in I suppose we were first doing the sort of, the drug listing as I mentioned earlier, so making sure patients were, were getting timely discharge prescriptions by the pharmacists starting to list all their discharge medicines in advance"* *Pharmacist 11*

In a few organisations the development of pharmacist prescribing was policy and protocol driven to ensure patient safety and often this was a pharmacy department initiative.

> *"My department is quite pro in pharmacist prescribing, we have non-prescriber amendment of prescriptions policy for pharmacists are actively encouraged to amend prescriptions in the interest of patient safety, when they're not able to get hold of a doctor"* *Pharmacist 12*

There was appreciation that pharmacist prescribing was progressively developed within the organisation to a more independent service.

> *"In terms of the clinic setup so we don't have any consultant in clinic with us. So, we're completely independent in terms of how we do in the clinics"* *Pharmacist 3*

> *"When I first got to prescribing, there was only me in the health board to prescribe, along the way we had a couple of other people, but in our trust that we've got lots of prescribing pharmacists, so I think from those early days prescribing has developed a lot"* *Pharmacist 6*

b) Evidence strength and quality

Key themes emerged within this construct was **'Lack of evidence of pharmacist pharmacists' 'Anecdotal evidence'** and **'Further research required.'**.

There was recognition among the interviewees on the level of evidence to support the efficiency of pharmacist prescribing. Interviewed pharmacists believed there is sufficient evidence for the benefits of pharmacist prescribing for patients with CKD. Most of these data are anecdotal and internally shared within the organisation and are not published in peer-reviewed journals.

"The volume of pharmacist prescribers is clear, as a national lead pharmacist to the renal network, and also, as a practising independent prescriber, huge service transformations have been enabled by changing an independent new service delivery with pharmacist prescribers, and it's actually been held up within NHS [A Great Britain country] *as an exemplar of how to make prudent and values-based healthcare happen. So that is ample evidence out there to impact these things"* *Pharmacist 5*

"We have had some great, some good outcomes here and we've certainly found that by adding a pharmacist to our anaemia MDM for example in our dialysis clinics, and that we've had some really positive improvement in outcomes" *Pharmacist 11*

On the contrary there was a belief that there is little evidence on pharmacist prescribing practice in the area of CKD and renal medicine.

"Just really be literature, from reviews and papers, things like that, but otherwise there is very little evidence in renal anyway." *Pharmacist 2*

A few pharmacists suggested that pharmacist prescribing was well received by the patients with the quality of service provided by the pharmacists.

"At the moment is gathering evidence and trying to demonstrate all of the things that you do on a day to day basis that you see as being really important for our patients" *Pharmacist 8*

"I think it's a positive improvement for patients in the clinics, being an independent prescriber in the clinics, sometimes we find that patients are sort of more willing to perhaps discuss things with pharmacists that they wouldn't want to perhaps waste the doctors time with" *Pharmacist 11*

Additionally, clinicians expressed a preference that a pharmacist prescribes for their patients in comparison to junior doctors.

"Doctors would prefer it, that it was the renal pharmacists that were prescribing for their patients rather than FY1 who don't know anything about nephrology" *Pharmacist 2*

c) Relative advantage

A key theme within this construct was **'Advantages of pharmacist prescribing role in CKD'**.

Pharmacist prescribing was considered advantageous by the interviewees in many different ways. One of the important advantages was to reduce the doctor's workload to allow them deal with more complex cases and share prescribing responsibilities.

"It's entirely redesigned the service, [pause] services are being redesigned and the ability to have more advanced practice being able to take chronic disease management away from physicians including GP's and allowing more time for those physicians to deal with diagnostics and complex cases, especially, enable to complete redesign of the services." *Pharmacist 5*

"Releasing time to care for the, the doctors, be that, so that they can do up things on the wards or in the clinics, and that we are as well great problem solvers when it comes to medicines problems, mm, so, definitely that's been a driving force in our trust I think in getting pharmacists through the prescribing course" *Pharmacist 11*

Interviewees however, were concerned not to compromise junior doctors' skills by doing all the prescribing on the ward.

"The only thing I found is that no, I think you don't want to de-skill the doctors so, you have to kind of sort of step back with the amount of prescribing that I do on the wards, because actually, it's not always that helpful for the pharmacist to do all the prescribing on the wards, because actually, then it is you would de-skill the doctors then they are learning in their sort of junior rotations about renal medicines and what to prescribe and when" *Pharmacist 11*

Patient satisfaction and safety was one of the advantages captured by the interviewees in terms of providing prescribing services in timely manner.

"They are [patients] *just glad to have somebody prescribing in a timely manner for them because the consultant could be a wee bit about of a delay before doctors can come down. You can make changes in a timely manner"* *Pharmacist 2*

"From a patient's point of view as well, because as a pharmacist, I tend to write their prescriptions before they come to clinic so that literally, when they turn up to clinic, they can walk straight over and pick up that prescription rather than having to wait again for that help. I'm sure they appreciate that in terms of the amount of time they have to spend in the hospital and say, Yeah, this one intervention." *Pharmacist 9*

Interviewees mainly agreed that pharmacists are highly knowledgeable about medications and can make safer choices for the patients then doctors.

"I suppose the fact you know the hospitals are busy now, we all have to upskill. The fact that a pharmacist can take the more accurate drug history and experts in medicines, so we can prescribe more accurately what medicines the patient is all before they come in, as well as looking at interactions and things with other medicines and will be started during their admission." *Pharmacist 7*

"I think as pharmacists, we take the pharmacology aspect of the independent prescribing course and is a bit for granted but again for the nurses, and the other AHPs (Allied Health Professionals) undertaking the course, they really struggle with that" *Pharmacist 14*

Another benefit of the prescribing service highlight by the interviewees was that it helps prepare the pharmacy workforce to take new roles and expand the service by moving from product-oriented service to more patient focused service.

"Because of the efficiency of that rather than spending time with the supply function of drugs we actually spend time, improving the health literacy of patients, and the digital literacy patients so that they become more active in their own treatment titrating drugs in response to their accessing their own results, and so patients have a far more robust service mechanism to, to understand their own condition the active partners in their own treatment" *Pharmacist 5*

"We keep band 7s but we are interested in staying in the department and having new roles and then they are more prepared to become 8A's, where is part of their role anyways, we've taken a decision to do that rather than invest in roles like consultant pharmacy post" *Pharmacist 6*

d) Adaptability

Two key themes emerged with the construct of adaptability **'Prescribing role adapted from clinical role for pharmacists'** and **'Progress from basic to more complex models'.**

Some of the interviewees felt that prescribing was adapted into their daily clinical practice, since they were engaged with many clinical activities that enhances prescribing practice.

"I'm happy to prescribe but the confidence to prescribe well you know, say within my ability to prescribe where I feel it could be used better and, in the hospital, would be on admission." *Pharmacist 7*

"I started off by just looking in a kind of MDT fashion, sort of self-reviewing drug charts, in consultation with the consultant and the anaemia nurse, and then changing drug charts in the dialysis units, and optimise therapy. It's a useful tool for reconciliation of medicines, so when drug histories have been done on the ward, and when they've been clerked in, the prescriber who did their medical clerking has maybe not taking on the time to go through the medicines of the patient and maybe they copied it for previous admission." *Pharmacist 11*

A few interviewees commented that pharmacist prescribing is more fruitful when implemented in a focused area of practice where there is a demand for the service.

"The pharmacists that work here are trained as blood prescribers. As part of the anaemia programme so they are involved as me, four blood prescribers in the UK" *Pharmacist 5*

"In terms of prescribing for the main clinic, the main areas from a resource point of view is tolvaptan, so in terms of my learning for that is been a case of reading about tolvaptan myself, and utilising the clinic, the practice skills that I picked up by shadowing the consultants when I was doing the nonmedical prescribing course" *Pharmacist 9*

e) Trialability

Key themes within this construct were **'Trial in small area of practice',** and **'More advanced skills needed'.**

The main concept that arose by the interviewees for this construct was to start prescribing in an ad hoc fashion or in a small area of practice before being an integral part the clinical service at inpatient or outpatient setting.

> *"I think if you're really starting off you just need to take a small bit at a time so you either do the admissions or do the discharge, I don't know if you could do both."* *Pharmacist 7*

> *"For us, it's been tolvaptan works very well, because it was a small cohort of patients, and we were just looking for somebody to fit the funding for about eight hours a month initially, and we were able to get that funding back."* *Pharmacist 9*

One of the aspects of initiating the prescribing service in a niche area and developing slowly was to boost the confidence and provide more structured service.

> *"I encourage people to not, well, to make sure that they're fairly comfortable in their area of practice before you have start prescribing because there are a lot to do on your own and quickly, and you need to know what you don't know basically before you start prescribing."* *Pharmacist 6*

> *"I suppose it's good to try, but it's hard because you've got to go in there to raise the profile, but at the same time, it's important that, you don't always try and be in three places at one time. So, when you move on to a new role and you can get reassessed, and have a new scope of practice within your own arenas."* *Pharmacist 8*

f) Complexity

Key themes arose within this construct were **'Complex process involved'** and **'Conflict with MDT'**.

Difficulty in the implementation of prescribing practice was highlighted by few interviewees in several aspects. The complex process involved in prescribing and becoming a prescriber was brought up by a few interviewees.

> *"I think a lot of your time is taken up by seeing new patients and discharging patient. So, the continuing care patients either have the same amount of time, I mean, I've got nine new patients today. So, if you spend half an hour in each patient that's four and a half hours, had some discharges to do as well, your seven-hour days going, just doing that, it is complicated sometimes"* *Pharmacist 1*

> *"I suppose, what it takes from paperwork is probably a bit too much of that if anything. It did take a while to have to often to get your certificate to praise, for paperwork to fill out and then you have to get registered on the system and it has to get approved, by several different people. I don't necessarily think that's a bad thing but I say you could argue if you compare that to what the doctors have to do which is nothing, or perhaps a mini prescribing test on, on the electronic system just to prove they can use it, it is quite a significant amount of more for nonmedical prescriber, that in some ways that will also makes you feel quite supported."* Pharmacist 11

Having the time to prescribe in addition to the other clinical duties seemed to add complexity to the service.

> *"It takes an awful lot of time and sort of prescribing and, that, that's good and bad I would say [laughter]. It's usually just part of your role but it does take a lot of time"* *Pharmacist 6*

> *"A lot of us have the expertise, but we're not given the time in our day to day job to actually focus on prescribing, and you need to make sure that you're doing, you don't want to be just doing the repeat prescribing"* *Pharmacist 8*

A few interviewees shared some thoughts about doctors' negative perceptions of the pharmacist prescribing concept with some degree of disagreement or resisting pharmacists taking on prescribing responsibilities.

> *"The barriers initially were, the older doctor's reluctance to have people other than doctors prescribing, but that's all kind of changed. I think you've got to be careful as well that you're not de-skilling the doctors and junior doctors, and they also need to be able to prescribe as well"* *Pharmacist 2*

> *"There has been some resistance to that by doctors, because I don't know if they are threatened, and actually, if we start doing more and more we might downsize the number of the clinicians which I don't think what would've happened, but I think that that's part of the wariness."* *Pharmacist 12*

One concern raised by the interviewees was dealing with complex patients and the need to prescribe in such situation could be complex.

"There is always a team to back you up if you do have a very complex patient is always in discussion with the team. It tends to be outpatient setting, I guess the challenges are, for us the lack of a consultant in clinic." *Pharmacist 3*

"So, complexity of the patients I see, they are usually really quite complex so they don't often refer to me people who could easily be managed, and often people are they tried lots of medications and things won't work, so yes it's definitely difficult from that prospective for that kind of complexity" *Pharmacist 6*

Lack of some clinical assessment and diagnostic skills also were highlighted by some interviewees as disruption in providing holistic care for the patients.

"It's also making sure that there's going to be somebody there to clinically check for what we have prescribed as well." *Pharmacist 2*

"I don't feel confident, in terms reviewing that patient holistically, in terms of listening to their chest, or, you know, listening to the heart, I don't have the skills to do that on my own. So that's one of the challenges in the clinics, how to deal with patients that need a more holistic review rather than just to review their tolvaptan and their kidney function." *Pharmacist 3*

Prescribing outside the area of expertise was another issue tackled by the interviewees and was perceived as a challenge.

"So, on the whole if I am uncomfortable with something, I wouldn't prescribe that honestly, I would probably say someone else I am nae happy about this, you go ahead and do it but I am obviously doing that every day" *Pharmacist 1*

"I'd never prescribe anything I wasn't comfortable prescribing, I still find that if I would get the doctors to prescribe with chemotherapy, rather than us prescribe it, so we can then check it, clinically check it, and it's also making sure that there's going to be somebody there to clinically check for what we have prescribed as well." *Pharmacist 2*

g) Design quality and packaging

Key themes within this construct were **'Prescribing within competencies', 'Replicating exemplar models'** and **'Prescribing aligned with trust needs'**. In terms of how the prescribing practice was bundled and implemented, there was different approaches undertaken in different regions and Trusts. Obtaining a prescribing qualification was an important aspect to start the practice.

"We just have a cohort of prescribers, and bits of prescribing document within the trust and says that you can use your prescribing qualification in these circumstances." *Pharmacist 10*

Running independent clinics was a model of prescribing appreciated by the pharmacists.

"As part of the requirements of prescribing tolvaptan, we have to monitor liver function tests monthly, we also need to monitor their kidney function, and we need to assess their fluid balance, and I guess the clinic's kind of gradually I guess evolved, that we're looking more at kind of blood pressure control as well as a part of that clinic" *Pharmacist 3*

"I think obviously I wanted to develop, to, to work closely with consultant, doctors to do the clinics now and probably want to be more clinic focused, like tolvaptan and then vasculitis them sorts of things." *Pharmacist 13*

Designing a quality prescribing service requires that the pharmacist proves there is a need for the service and ensure funding is available to support such services. This was one of the points highlighted by the interviewees.

"It is a mind shift from actually using the expertise of what pharmacists can deliver and a move away from Central pharmacies to dedicated pharmacies for a large regional service employed directly by the renal services to, to reshape services" *Pharmacist 5*

"Make sure you've done the business case to ensure that it is properly funded and received, and you've got the support of all the stakeholders, and whether you do as a pilot service, because what we found in our trust is we have service creep" *Pharmacist 12*

h) Cost

Key themes emerged within the cost construct were **'Reduced drug costs', 'Pharmacist prescribers more expensive than nurses'** and **'Pharmacist prescribers cheaper than consultants'**.

Providing a pharmacist prescribing service required the organisation to secure funding. Many interviewees highlighted that pharmacist prescribers are less costly than having a consultant in a clinic setting.

> *"We would be cheaper pharmacist than a consultant sitting in a transplant clinic so, in terms of costing benefits, actually if you had an independent pharmacist clinic and you've got considerable waiting time for your consultant nephrologist clinic, would it be better for them to recruit another consultant to deal with your waiting times would it be better to have a pharmacist that was able to run a clinic, and would be in terms of consultant in terms specialist knowledge, we would be able to run some of the clinics that they do."* *Pharmacist 12*

> *"Well there is the health economy cost in terms of pharmacist of course are cheaper than doctors so there's that cost saving, I think from the way that the pharmacist will practice, we will tend to question medicines more"* *Pharmacist 14*

A few interviewees, however, reported that other nonmedical prescribers can be less costly in terms of salary but pharmacists are highly knowledgeable about all aspects of medications. This is true to a greater extent than other healthcare

professionals and this can justify the additional cost of having a pharmacist prescriber.

> *"I think the things that make it difficult, sometimes nursing staff, well, some staff more expensive than nursing staff so that could influence these different issues in practice."* *Pharmacist 6*

> *"The cost save obviously nursing staff costs an hourly rate to the band seven nurse is a lot cheaper than a pharmacist"* Pharmacist 9

Some of the cost savings associated with pharmacist prescribing were reported by interviewees were related to prescribing less costly medications without compromising the efficacy and safety of the medication.

> *"It's probably kind of making more savings, because you're just giving the patient what they are actually needing, and you are speaking to the patient first what things like phosphate binders to make sure that it's gonna be something that they are actually going to take, otherwise there is no huge difference between us and the doctors prescribing."* *Pharmacist 2*

> *"Definitely there is loads of savings in renal there is lots of high cost drugs that consultants would like to use. So, you know a very easy example will be myfortic. We're always very focused and trying to use the most, medicines optimisation and kind of use the best cost-effective medicine for that patient, At the moment"* *Pharmacist 8*

Although choosing the most cost-effective treatment option for the patients were always considered by the pharmacists, some interviewees emphasised the importance of engaging the patients in the decision-making process and putting the patients at the centre of care.

> *"I suppose one of the key factors when you are doing cost saving projects and in such projects is the most important thing is that you don't kind of forget about the patient I think in a lot of our cost saving initiative, making sure that they feel engaged as well."* *Pharmacist 8*

B) Outer setting

The outer setting domain includes the features of the external environment or background that has an influence on the intervention implementation (Keith 2017).

a) Patient needs and resources

Two key themes emerged within this construct were **'Pharmacist prescribing is appreciated by and accessible for patients'** and **'Prescribing Pharmacists may still have learning / development needs even after IP qualifying'**.

Patient needs and the available resources to fulfil theses needs was considered by majority of the interviewees as a main driver for providing prescribing services.

> *"I've managed to establish a telephone clinic for the tolvaptan clinic as well. So, we have some patients that were driving for an hour, an hour and a half to come to clinic every month, which was a long time. So,*

manage to negotiate with the consultants to set up a telephone clinic" Pharmacist 3

"In terms of the impact on patients, so for my prescribing on the wards, that means that actually doses get changed a lot quicker. The priority has always been patients and the supply of medication to patients" Pharmacist 9

One of the barriers to meet patients need in order to provide holistic care by pharmacist prescribers was the need to do more clinical training and learn more diagnostic and monitoring skills.

"In terms of barriers, I would say, having that, been able to do the clinical skills course, which wasn't previously funded for pharmacists, I think had that been available when I did the prescriber course in 2012, that would have helped building the confidence and allowing you to have an extra skill to see patients independently in clinical, where you might need to assess them clinically as well as prescribe at the same time" Pharmacist 9

"So, things like the tolvaptan clinics I mentioned, I identified some learning needs to go and find out a bit about genetics and polycystic kidney disease because for example that sort of questions that my patients might ask about sort of genetic testing, and actually you can't just be an independent prescriber and only talks about medicines, if you're dealing, you need to look after the patient holistically" Pharmacist 11

The fact that patients need timely healthcare provision to avoid any delay in receiving treatment was also highlighted by the interviewees and considered a

positive outcome of pharmacists being able to prescribe whether in an inpatient setting or in specific clinics.

> *"I think it's more convenient for patients. The fact that someone I'm talking to and they're in agony or constipated, And I can immediately sort it."* *Pharmacist 4*

> *"Patients now have direct access to specialist services, flexible access to secondary care. They have opportunity for more contact with healthcare professionals, that is [pause] direct points of contact to decision makers, so that's eliminated treatment delays"* *Pharmacist 5*

b) Cosmopolitanism

Key themes within this construct were **'Collaboration with external professional bodies', 'Alliance with other units within the Trusts'** and **'Digitalisation to centralise the service'**.

The majority of the interviewees felt that external independent organisations like the RPS and the UKRPG has positive impact on their prescribing practice as well as the support their learning and development.

> *"In terms of what I actually do, obviously I get a lot of good ideas for the UK renal pharmacy group and at conference and say that it's always good to reach colleagues there, I am on a committee where some people I know, our peer to peer review with someone from the renal pharmacy group something really useful"* *Pharmacist 6*

"I guess, the renal pharmacy group, I guess you could, if that's an external body that would potentially, you know, any discussions in that forum would influence my prescribing" *Pharmacist 9*

Some of the interviewees felt that support in devolved administrations of the UK was from the regional organisations such as the NICPLD in Northern Ireland, NES in Scotland and Health Education England in the NHS in England.

"In [A Great Britain country]*, it's just part of the, sot of process, I would have said as a pharmacist, you go through the system, and I think most pharmacists working in clinical jobs expect to be, becoming prescribers, And NES funded, to the educators, and we've got* [a University name]*, very handy for us so it's all quite straightforward"* *Pharmacist 4*

"It is a part of a programme through in [A Great Britain country], *the* [regional organisation]*, is the organising body. Well that organisation* [regional organisation]*, is the overseeing body that you know carries out that, that programme."* *Pharmacist 7*

Collaboration between renal units within organisations or with units from external organisations was also perceived as an important network source to improve prescribing practice and share experiences.

"Knowledge of what are other pharmacists doing, at other centres. So, being a member of the renal pharmacy group, we find out what's going on nationally in other centres, and I think sharing that practice allows you to then go back to your hospital and implement things, and the same with

going to things like the British Renal Society conference, finding out what's going on nationally, and then bringing that back to influence you in practice." *Pharmacist 9*

"I think that's been the big drive towards independent prescribing for pharmacists outside of the hospital. Umm, so some of my colleagues have gone in and out of community and hospital and they'll be prescribing in GP practices" *Pharmacist 11*

One of the interviewees shared a view on digitalisation of the service to enable networking on a bigger scale.

"By enabling digitalisation of the service. Actually, as a central hub with a large region, means that we can deliver the service to almost half geographical massive areas from a single centre, as well as having digital programmes, we also encourage patients to access that programme digitally" *Pharmacist 5*

c) Peer pressure

Key themes arose from this construct were **'Challenge to consider the advancing role and collaborative approaches with other in NMP e.g. nurses.'** and **'Medical staff pressures of capacity and need to focus on diagnosis skills – gap for NMP pharmacists to fill'**.

Many of the interviewees felt that their peers from other units or organisations were practising prescribing in more established and advanced ways.

"We have got a number of prescribers across our Trust, but people who work in London for example it's gonna be two or three renal pharmacists, in a particular area and so they've got more scope so get into areas."

Pharmacist 6

"We do take that into consideration what other Trusts do. I think they are ahead, in terms of my Trust definitely they ahead, they are ahead in implementing it, because obviously we are smaller, and I think obviously, there's not enough of us to be able to do everything. So, don't be peer pressured, don't prescribe something if you are not confident to do it."

Pharmacist 13

Some of the interviewees, however, highlighted that they practice in an exemplary way, felt they are at the leading edge of prescribing practice and setting a good example for others.

"Some of our colleagues work in community, and there's certainly a pitch for that with sort of pharmacist in general practice, and I think yeah, as a Trust we probably are one of the ones that are ahead" *Pharmacist 11*

"I see, we get in to transplant clinic and actually running my own clinic in my own right is probably be a big step." *Pharmacist 12*

Few interviewees felt they were pressured by the skill's other medical professional such as doctors and nurses have and that they need to be more involved in direct patient care activity and learn such skills.

"You probably are competing with other people as well. There are nurses, and the other nonmedical prescribers, sure other professions will, and I suppose pharmacists got to be careful, it's not left behind" *Pharmacist 1*

"If we done our IP course but actually we haven't had the years of training that the doctors have had to kind of got more of that background knowledge, so, that would be as good at physiology, certainly, not as good as in a diagnosis and patient assessment and a that sort of things. I think nurses have a lot of unique skills that we don't so we've probably still got a lot more to learn about that, they do a lot more on patient assessment and care as well." *Pharmacist 11*

d) External policy and incentives

A key theme within this construct was **'Prescribing align with local and national guidelines and policies'**.

Majority of the interviewees agreed that the governmental and regulatory policies and guidelines are considered for the implementation of prescribing services.

"The externals policies we received mostly that's coming from the (A Great Britain country) government and changing the GP contracts and getting more prescriber" *Pharmacist 2*

"I'm aware there is a guidance out for consultation at the moment for consultation by GPhC and there are people who are inputting on that" *Pharmacist 4*

"We have an independent pharmacist prescribing policy and staff arrangements, which governs what we can do and we can prescribe in accordance with that, and obviously the national drivers to sort of get pharmacists upskilled and prescribe" *Pharmacist 10*

C) Inner setting

This domain involves the main features and structures of the organisation that may influence implementation of the intervention of interest (Keith 2017).

a) Structural characteristics

The two key themes emerged within this construct were **'Need for more pharmacist prescribers'** and **'Potential areas for development'**.

There were mixed views about the maturity and the structural size of the organisation where prescribing services were in place.

"The renal unit is expanding all the time, more dialysis patients coming on and more transplant patients coming back so at the minute I would really only be prescribing for inpatients, and let's say the outpatients, possibly down into the dialysis patients and transplant patients, which is something I don't have access to at the moment." *Pharmacist 7*

"I think when you work at a big organisation where you have like 16 consultants who are nephrologists, we have another, like maybe 16 surgeons, we do see lots of doctors practice in slightly different ways so that does kind of remind you that not everyone has to do the same thing." *Pharmacist 8*

A few interviewees highlighted that within the organisation they have a designated independent prescribing clinic to perform prescribing practice and see patients and take responsibility to prescribe for them in an inpatient setting.

> *"The clinic is independent, and we do have a designated consultant or two nominally responsible for the clinic. So, if we have a clinical query we will spoke out to them"* *Pharmacist 3*

> *"At the moment I'm predominantly in an outpatient role, but from time to time with annual leave, and with cross covering and colleagues on my ward and things, and that weekend, I still do weekends I cover the wards."* *Pharmacist 8*

b) Network and communications

Key themes within this construct were **'Wide range of communication within trust'** and **'Good network within organisation'**.

Within the organisation there were various forms of formal and informal communication related to prescribing practice information or updates. Verbal communication between healthcare professionals whether one-on-one or in meetings were well described in a positive way by the interviewees.

> *"We have regular medical prescribing meetings within the renal directorate, and actually what we've done as a result of that is we've brought examples of our clinic notes and our clinic letters to that meeting and reviewed, and peer reviewed it. We do have regular discussions with either the consultants or the lead for their clinic and sort of get him to*

check when we are not sure on a blood result. In terms of renal we have certainly had clinical medical prescribing meetings, everybody that could attend that meeting is working in a slightly different role." *Pharmacist 3*

"I think obviously because I've built a rapport with the team, and then, you know, I can ask them questions and, you know, they ask me question the thing that helped me develop the practice because you know you can learn from each other." *Pharmacist 13*

A few of the interviewees emphasised on the circulation of written communications in the form of emails or bulletins to share prescribing related information.

"Communication bulletins come up via email and on the website in terms of prescribing errors that we think would have an impact across the organisation so shared learning for errors" *Pharmacist 12*

"We have a global email, that is sent every day, like prescribing, and we have a newsletter every week as well." *Pharmacist 13*

Some interviewees felt that communication with colleagues in local and regional conferences enhanced their prescribing practice

"Going to the annual renal pharmacy group meetings, reading journals, talking to other pharmacy colleagues, and talking to other medical colleagues" *Pharmacist 9*

"When looking at renal as a practice and looking at the UK RPG in attendance at that conference and how forward thinking as one is and how many pharmacists we have in clinics across the country" *Pharmacist 12*

Interestingly, one respondent suggested that working in collaboration to generate local data is a useful tool to communicate outcomes.

"It would be nice to actually collaborate with lots of other renal pharmacists in the same area and all look at the same thing and maybe put a paper together which is a bit more meaningful" *Pharmacist 8*

c) Culture

Two key themes generated within this construct were **'Positive culture for NMP'** and **'Avoidance of blame culture'**.

Most of the interviewees reported that the norms, basic values and assumptions of the organisation towards pharmacist prescribing practice were positive.

"I think what they [organisation] wanted us to do was, you had the experience go and do your independent prescribing, this is going to be beneficial for you, for the ward, for the patient. There is no culture to stop you from prescribing around, everybody is supportive." *Pharmacist 1*

"I think the organisation definitely values the role and encourages people to kind of undergo the qualification. So, I think it's highly thought of and encouraged" *Pharmacist 3*

One respondent felt that there is still a negative culture within an organisation towards pharmacist prescribing.

> *"Sometimes the medics or the nurses can be a little bit, or the cultures that is a bit more of a kind of held account, there's a bit more of a blame culture sometimes and that we're trying to try and roll out."* *Pharmacist 8*

Whereas, another respondent highlighted that within their organisation there are restricted processes before being able to prescribe.

> *"At* [a city name] *hospital it is quite unusual, you have to do sort of comprehensive validation before you're allowed to prescribe"* *Pharmacist 10*

d) Implementation climate

i. Tension for change

Key themes within this sub construct were **'insufficient number of pharmacist prescribers'** and **'Lack of administration support'**.

The majority of the interviewees perceived a few aspects that they felt need to be changed to enable them perform their prescribing duties more efficiently. One of the most reported issues was lack of sufficient prescribers.

> *"I think obviously it's, reduction in availability of medical staff so there is a need to have other people so take on the role. Yes, free up, doctors times for doing other roles."* *Pharmacist 6*

"Certainly, where there's been a shortage we've had a particular problem with a shortage of more junior doctors on the wards, and we've seen some posts that have been converted to pharmacists' posts" *Pharmacist 11*

Another issue highlighted by the interviewees was lack of support to carry out non-clinical duties within the organisation.

"Kind of secretarial or admin support, cause just now we are relying quite heavily on nurse, pharmacy technology and pharmacy technician, but really ideally would be admin staff that would do that, letters to the GPs" *Pharmacist 2*

ii. Compatibility

A key theme within this sub-construct was **'NMP by pharmacists can fit in with daily duties'**.

Most of the prescribing responsibilities fitted well with pharmacists daily clinical duties in a hospital setting as highlighted by some interviewees.

"When you're in the clinic setting where the doctors are running their clinics and the nurses are running their clinics because there's lots of valuable referrals that you get when they have a patient in front of them" *Pharmacist 8*

"We can kind of come up with the process and get that sorted out quicker, so that helps with medicines reconciliation, there's that not often linked in with the trust sequence in terms of, you know, you've got to get your medicines reconciliation sorted out within the first 24 hours" *Pharmacist 10*

Appreciating the role and responsibilities of each member of the multidisciplinary team was another aspect that fitted well with existing workloads and this was highlighted by the interviewees.

> *"I don't feel it's the pharmacist's place to [pause] be assessing patients physically, I think there's a reason doctors go to university first, six years for that, rather than pharmacists doing a course on it. That's, I don't feel that's something that we should be doing"* *Pharmacist 2*

> *"I think for the trust that I work in and certainly within the renal service, you know, we have been encouraged to sort of do an Independent prescribing, and we do also have nurses who do the independent prescribing but actually, as a group of pharmacists we would probably do more than most within our service, we do a lot"* *Pharmacist 14*

iii. Relative priority

A key theme within this sub-construct was **'Training prioritisations'**.
Pharmacists believed that implementation of a pharmacist prescribing service for patients with CKD was a priority for all healthcare providers within an organisation in order to ensure advancement of practice.

> *"Prescribing is essential, and the vast majority of drugs prescribed in the unit of a chronic basis are done by independent prescribing pharmacists, so, it enabled work programmes to be transformed, dedicated for those renal disease areas, and the repatriation from primary care"* *Pharmacist 5*

"Well, we're lucky in renal and it's quite a specialised area. There are lots of different prescribing models within that, so as I said before anaemia, hypertension, do all the different things. Mineral bone disease, a lot with plenty of areas. So that's what works well as a prescriber it in renal."

Pharmacist 6

iv. Organisational incentives and rewards

Two key themes within this sub-construct were **'NMP well appreciated'** and **'Central funding to train prescribers'**.

Although it was felt that there were no significant incentives for the development of prescribing practice by pharmacists there were views that there were some rewards in form of appreciation and acknowledgements of the benefits of the service by patients and the organisation as a whole.

"I suppose, by sort of prescribing, it makes them [the organisation] more thoughtful about my practice and obviously, additional level of responsibility shows off" *Pharmacist 10*

"I think, yeah, just to get a lot of acknowledgments seems growing over last few years as the value that we can add I think. my Trust definitely saw the value of pharmacists in clinics, I think oncology was probably one of the first areas that had two independent pharmacists prescribing in clinics, so we learned from them a little bit, and now we've got pharmacist prescribing in sort of gastric clinics, anticoagulation clinic and renal clinic"

Pharmacist 11

v. Goals and feedback

Key themes emerged from this sub-construct were **'Clear goals for development'** and **'Feedback from mentors, doctors and patients'**. Interviewees highlighted that whether it is organisations goals or personal goals, it is important to focus on specific goals and try to work towards achieving them.

> *"I think it depends on your organisation really, and you in particular department and the goals of the pharmacy department there, I think you need, you need the support of the Clinician's that you're working with to get it off the ground"* *Pharmacist 3*

> *"As a pharmacist you become a prescriber and then you start doing things because, the doctors are unavailable and before you know it becomes your responsibility and it's never been your responsibility, it's not your duty and yet it's fallen to you, and so, trying and avoid, trying and avoid service creep and make sure you've got your business case for your service, if you plan to expand and make sure that funding is there"* *Pharmacist 12*

On the other hand, one of the interviewees emphasised the importance of having a clear vision to develop prescribing practice and try and act upon it in order to persuade the organisation to support the implementation of new services.

> *"I think it was if we did have a sort of clear vision of what potentially we could offer as prescribers, that might bit make it easier to sell to trust themselves and get more support for implementing more prescribers."*
>
> *Pharmacist 10*

A number of interviewees reported that there was a process of feedback relating to the service outcomes or related issues to the stakeholders or staff whenever required.

> *"I feed my views back to my line manager and that goes into senior leadership team within the pharmacy department and they will feed that back to expertise within the trust."* *Pharmacist 10*

> *"I certainly, encouraging other prescribers as well so, reflecting on each other's prescribing and make you leave some feedback that you would do to a doctor perhaps you've identified a prescribing error making sure that we do that with our pharmacist colleagues as well."* *Pharmacist 11*

There was a suggestion by an interviewee that consideration of feedback from the patients was important to enable improvement of the service and tailor it to patient needs.

> *"I think you've got to put the work into, to audit your prescribing and get feedback from your patients as well. So, that's really important because without that feedback you don't really know how your consultation is gone."* *Pharmacist 8*

vi. Learning climate

Two key themes within this sub-construct were **'Continuous learning to improve prescribing practice' and 'Learning from errors'**.

There were similar views among interviewees on the importance of a positive learning climate. This included whether it was identifying own learning needs associated with prescribing practice or learning relevant to sharing development across a team.

> *"We have done that as a kind of way of sharing knowledge and skills to see what's out there, and what has been useful. And it's given us an idea of how other people have approached it made us realise that our practice is very different to other people's practice"* *Pharmacist 3*

> *"I learned a lot, because I was actually still quite new in my role, not with a lot of renal knowledge in my background so it was quite a steep learning curve, and actually it was a really good opportunity to make sure that I actually did know the evidence between, behind those treatments and things like that. I recently had my appraisal and I identified lots of learning needs that I don't think I would have thought of previously, if I wasn't sort of acting more independently with my prescribing and patient review"* *Pharmacist 11*

There was a sense of the importance of each team member having a positive environment to share learning and it was considered this was essential in the process of change towards a better service.

> *"When I've come across problems then gone away and spoken to the consultants about that, and that's helped my learning to understand more about tolvaptan or more about that clinical condition that patients presented*

with and that helped with all of my practice. From a ward point of view, building up that rapport with the consultants and a trust to be able to write a scope of practice that says essentially that we can adjust doses and we can prescribe things, that we feel confident to do, and that they're happy for us to prescribe for their patients as part of the team." *Pharmacist 9*

e) Readiness for implementation

i. Leadership engagement

A key theme within this construct was **'Support from management and leaders.'**.

The interviewees commented on the positive engagement and commitment of the leaders within the organisation from different levels such as pharmacy managers, directorates, clinical leaders and consultants.

"You need the will of the people to help them, whether the managers in the pharmacy, the consultants. I don't think anybody really wants to block you, I think they'd be willing for you to do things, but you need back fill to do your jobs so that you can go and do another job" *Pharmacist 1*

"I think it is very much encouraged both at a clinical level and in the wards, but the pharmacy management are very much proactive about it, and wanting 8A pharmacists to be at clinics prescribing, managing a caseload. The main impact is if you can take on a clinic and have a key fold of patients, and that it's always good to be attracted to pharmacy management and the medical staff as well." *Pharmacist 4*

ii. Available resources

A number of key themes were emerged within this sub-construct **'Limited fund', 'Personnel shortage', 'Time to prescribe', 'Training resources needed', 'Need for physical space to practice'** and **'New technologies needed'**.

The main hindrance in terms of resources was the availability of funds, time and personnel to enable the expansion of the prescribing service. This was expressed broadly by the interviewees.

> *"If you get resources it will help you if you don't get resources they are hindrance, so money, time, personnel, if they want to expand things, they have got to give you time and money for resources"* *Pharmacist 1*

> *"There's not the central funding anymore, so it's not as easy to get the funding to do the course. I think it's you know it's harder and harder to get study leave and the support to do that, so, I think that would be the main barriers."* *Pharmacist 14*

However, in relation to a key theme on **'Training resources needed'** there was an agreement across the interviewees on the fact that the independent prescribing course was supported widely by the organisation and helped in developing more prescribers. There were also other prescribing related courses that were available to the pharmacists to undertake and advance their prescribing skills.

> *"There's a course at* [a hospital name]*, where you can do an advanced clinical practitioner skill. So, I think because you see your patients, and,*

you know, you do a small bit on physical assessment but I wouldn't be an expert" *Pharmacist 8*

"Doing the prescribing course, gives you, this gives you a different way of looking at the way drugs that are prescribed really, if you're different compared to the pharmacist" *Pharmacist 9*

Some interviewees shared more positive responses about the availability of personnel resources **('Personnel shortage')** to implement and further develop the prescribing practice.

"We've managed to train nearly all the 8A pharmacist, and that working in specialties as nonmedical prescribers. So, we've got a large number of our more senior pharmacists that are trained. And we're currently looking at where they're going to be training our specialist sevens as well." *Pharmacist 3*

"Because we've got lots of independent prescribers, a lot more than other hospitals and I think it is just because we've got a lot more pharmacists so there's a lot more capability to cross cover, to support people getting in courses, and we probably as a trust got more money than other trust so we can afford to send people on these courses" *Pharmacist 11*

Some of the available resources highlighted by the interviewees were the availability of electronic prescribing **('New technologies needed')**, attending conferences and having access to books in their area of practice which were all considered of great value to enhance the service.

"The renal drug handbook is great, you know, get some advice based on evidence on practice and custom. Really the best evidence to back it up." *Pharmacist 3*

"I go to conferences, to British renal society conference, and that's kind of influence what I do in practice as well." *Pharmacist 6*

"The fact that the I think the prescribing role has changed over time as well and fact that with resources, with electronic prescribing coming in, a lot of pharmacists now, you get trained up in this specialty you have a good practice for your particular job that you're doing at that time, but it's very much more flexible" *Pharmacist 8*

iii. Access to knowledge and information

Key themes within this sub-construct **were 'CPD opportunities', 'Availability of educational materials'** and **'Lack of CKD related prescribing courses'.** There were various sources of knowledge about prescribing practice reported by the interviewees. Ease of access patients' medical records was deemed an important source.

"I would have the emergency care summary, I'd have clinical vision file, which the renal system, and I have the patient, so obviously the patients would be fit to speak to me, I use them as a big source of, of the medicines." *Pharmacist 1*

"At that time, having access to all the right blood results, having access to, umm, having access to kind of a proper history" *Pharmacist 8*

A few interviewees felt that better information from the drug companies could help improve prescribing of certain medications in CKD.

"The requirement that we could have better information from drug companies around use of their medications and patients with CKD" *Pharmacist 3*

Other aspects related to access knowledge about prescribing and the ability to incorporate it into prescribing practice highlighted by the interviewees include the need for safety alerts, prescribing related bulletins, recording CPDs and attending renal courses and conferences.

"Obviously we did our own CPD we have to make sure we include some prescribing; it should be easy to get CPD cases from our own prescribing practice." *Pharmacist 6*

"A lot of our prescribing, bulletins, and med safety alerts, come from the med safety team so we have like a designated team in pharmacy who produce a monthly bulletin and they help, they actually feed in with the experts in different areas, and then often ask us in renal, is there anything new or developing or a new prescribing, is there any new prescribing advice that you'd like to publish this month" *Pharmacist 8*

D) Characteristics of individuals

This domain comprises of the main characteristics of the individuals involved in the intervention implementation (Keith 2017).

a) Knowledge and beliefs about the intervention

Two key themes within this construct were **'Pharmacists well skilled for NMP'** and **'Wide scope for prescribing practice'**.

The majority of the interviewees believed that pharmacists are knowledgeable about the drugs and related issues such as safety, effectiveness and pharmacokinetics. It was considered that these unique skills put pharmacists at the best position to implement prescribing services.

> *"I think our knowledge of drugs has been good so yeah, and different types of medical staff are always focusing on, on the drug aspects kind of things so that we are passed what they are doing, so as a pharmacy perspective, we're focusing much more on drugs."* *Pharmacist 6*

> *"Our abilities to prescribe that, our knowledge of the interactions, our ability to counsel patients, and the fact that we would be cheaper than the consultants help that they have supported us to be prescribing then"* *Pharmacist 9*

b) Self-efficacy

Key themes within this construct were **'Awareness of self-competencies', 'Experience'** and **'Willingness to prescribe'**.

Interviewees were aware of their own abilities to be able to provide prescribing services and there was clear evidence that pharmacists only tend to prescribe in their area of competency where they feel comfortable to initiate prescribing.

> *"Unless it was fairly simple stuff, I don't tend to get too involved in complicated stuff, I would leave that up to the medical staff. I'm not really too keen on prescribing for patients that I don't really know that well and maybe at another unit. So, I wouldn't tend to get terribly involved with that"* *Pharmacist 1*

> *"I am an 8A hospital pharmacist now specialised in chronic kidney disease, trying to work with my strengths of optimising anaemia and bone health management, and on the ward when I was reviewing patients independently"* *Pharmacist 11*

Some interviewees highlighted that they were aware on the need to develop some skills to allow them to perform better in relation to prescribing practice, especially for patients with CKD.

> *"We've got these pharmacological skills so we can develop interactions and things, I think, actually that's the benefit. So, having those, that clinical knowledge means that our patients who are prescribed tolvaptan are kept safe, so something doesn't interact with it, we, we've picked that up"* *Pharmacist 9*

"I think of all the options. Whereas, before I used to just think about what the option that I wanted and that could give, you can give more weight to alternative options, and I think I'm more cautious because it's me, it's making a decision, so, I feel the weight of it is more, I feel up-skilled in terms of my knowledge base in doing the prescribing qualification so, sort of additional learning considerable additional learning that I developed myself, so I have greater understanding" *Pharmacist 12*

c) Individual stage of change

Two key themes within this construct were **'Stages of development of NMP'** and **'Need to progress through stages'**.

Interviewees demonstrated that there were discrete stages of development from a non-prescriber to a skilled and competent independent prescriber.

"I have started my prescribing as a supplementary prescriber in (a city), and then moved through to [a city] *where I did the conversion to independent prescribing. My experience with working with the renal patients I feel confident prescribing for them, and then because I'm getting older I am probably more forceful than I used to be and confident in what I am prescribing and advising the doctors to do [pause] as well"* *Pharmacist 2*

"I became an independent describer in nephrology about 10 years ago, and just trained a consultant nephrologist. I then worked for the university actually had enough long medical prescribing training programmes, so

involved in academia from that point of view. All pharmacists, who work on my renal unit trained as nonmedical prescribers" *Pharmacist 5*

A few interviewees felt that they need to further develop their prescribing roles into more clinic settings and to more specialised areas of practice.

"I think definitely will be clinic, I think what [colleagues name] *doing there, heart failure, I think that will be the future. Umm, I think, you want specialist pharmacist doing specialist clinics."* *Pharmacist 1*

Interviewees highlighted that there was a need to consider a change in the profession from product oriented to more patient focused services.

"I feel like pharmacy is a profession that really does need to raise its game and you know we are enumerated well as a professional and therefore we need to take responsibility of actually doing moving out to the traditional habits of traditional pharmacies to supply function and actually doing what is needed in terms of using our expertise to deliver frontline care"
Pharmacist 5

A comment by one of the respondents highlighted the difference between younger pharmacists and the more experienced pharmacists in becoming independent prescribers.

"It is interesting how the kind of younger generations of pharmacists seem to be a lot more keen to do it then perhaps the slightly older generation, that maybe always have a more traditional pharmacist roles perhaps" *Pharmacist 11*

d) Individual identification with organisation

A key theme within this construct was **'Supported by organisation'**. Interviewees' demonstrated positive perception towards their organisation and their relationship and level of commitment with the organisation or the NHS Trust they practice in.

"I think my Trust have been really supportive from the outset really, allocated slot on the prescribing courses been oversubscribed with applications of every year since it came out really." *Pharmacist 11*

"I was fully supported by the department, everybody was very keen for me to do it, and yeah, I have not looked back, it's been great." *Pharmacist 14*

e) Other personal attributes

Key themes within this construct were **'Consultation and social skills essential', 'Awareness of strengths and limitations'** and **'Willingness to learn and develop'**.

Some interviewees felt that their experience as a pharmacist had a great impact on advancing their practice to become prescribers.

"I think experiences important, maturity, knowing when to say NO, because when you're younger, sometimes you're doing, you'll be bullied into doing things. So, I think you've got to have the social skills as well, as well as knowing, when to draw a line under something and saying no this, I shouldn't be doing this and know knowing your own attributes and your capabilities as well." *Pharmacist 1*

"It very much depends on the competencies of the pharmacist, and I'm lucky that I've been in my area a long time and feel competent, most of the time, and if I don't, then I would always have a discussion with medical staff." *Pharmacist 4*

Many of the interviewees believed that being confident in what you do is the key to success, and being motivated as well as cautious with approaches help deliver better patient care services.

"I'm usually quite chatty, quite open person, so done little bit of work around consultation skills as well, just to sort of try to, to make sure that I'm appropriate when I'm in the clinic setting with patients, have a really good rapport with our patients. I'm really confident that we can make a positive impact on the patients." *Pharmacist 3*

"I definitely started of, I would say quite cautiously, and in a kind of supportive, supported situation" *Pharmacist 11*

Some also noted that listening to patients concerns during the consultation and being calm and approachable are some important traits of a good prescriber.

> *"I think my characteristics of sort of being calm and listening to my patients and sort of, I want to learn as well, I have got lots of CPD"* *Pharmacist 11*

> *"It's given me more confidence to act as an independent practitioner. As a person I'm quite approachable. So, patients ask me more than they would necessarily ask a doctor so, they never been informed sort of shouting me over when I walk on the ward, and they see me as being more approachable then necessarily interrupting the doctor"* *Pharmacist 12*

E) Process

The implementation process domain of the CFIR is related to the approaches and plans that can influence the implementation of an intervention (Keith 2017).

a) Planning

Key themes within this construct were **'NMP implementation planning', 'Advancement planning', 'Development of prescribing practice'** and **'Stakeholders engagement importance'**.

Although, prescribing practice in the UK was generally developed since 2004, however, none of the interviewees were particularly aware of the early planning process. However, some interviewees highlighted that there is a Trust wide plan to further develop prescribing practice part of which is to increase capacity by supporting the qualification and development of more prescribers.

"It is within the [a regional Trust]*, all the pharmacists are pushed to do their prescribing qualifications, so there has been a push from the top, for the pharmacists to go, and get the prescribing qualification as opposed to what other trust locally, whereas, it hasn't been such a big push and of course there's not many of them [pause] they actually have any of the prescribing qualification"* *Pharmacist 2*

"There has been a Trust drive within our department, to get prescribers, probably about two years ago, we probably had five to ten prescribers, but over the last three years, there has been some different drive where they need to kind of boost prescriber numbers, so was all building upon numbers" *Pharmacist 10*

Some interviewees believed that the plan was according to the needs identified in each Trust.

"I guess when tolvaptan was released, we identified that actually, it was basically quite well designed for the prescriber, because a lot of its around monitoring, seen a lot of diagnosing and you're kind of monitoring the patient and assessing fluid status and actually we felt we were able to do that quite well and the patient has to come back monthly, so again, it's a big clinic burden to put like a registrar or consultant in" *Pharmacist 3*

"It looks at the needs for the department so if we need more like help, you know, surgical admissions obviously the surgical pharmacist would take priority, and the admissions pharmacist because that's when we have

more of the clerking in issues, and then it is funnelled down in case of priority and need." *Pharmacist 13*

Interviewees suggested that pharmacists should not seek to do their prescribing qualification immediately after completion of the undergraduate degree, noting that having some hands-on practical experience would be preferable prior to starting.

"The moment I think as one pharmacist come out as independent prescribers, I don't agree with that. I think they should practice as pharmacists for a while, for two, three years, and then go on and become prescribers, I need to get a good foundation, as a pharmacist when your trade and then you have taken that extra step to becoming an independent prescriber." *Pharmacist 1*

"I know that there's quite a lot of consideration decision making going into that. I mean, I do think it's sensible that you should wait at least for two years after qualification, before you start thinking about taking that step, but it does seem some certainty to enter formal diploma course, because then you've sort of looking at all the different aspects of your potential role, and other external influences." *Pharmacist 11*

b) Engaging

i. Opinion leaders

A key theme within this sub-construct was **'Support from MDT'**.

Most of the interviewees reported that consultants and other senior healthcare professionals within the multidisciplinary team in the organisation had a positive influence and attitude towards the prescribing role of the pharmacist and this was important.

> *"The consultant I worked with was really supportive of me doing the prescribing course, and again, as a result of me doing the course actually met few nurses through it as well, because they recognise the value that we could free up consultant time, and allow them to, again, concentrate on the more complicated patients, and I guess that's pretty good situation here as well."* *Pharmacist 3*

> *"It's about deciding what the consultants are happy for the pharmacist to do in terms of them, stepping away from certain things. In terms of support, and I guess it's having the consultants that when you go to them and say, actually I think the pharmacist could run the tolvaptan clinic and the clinical director saying actually Yes, I agree with that"* *Pharmacist 9*

Conversely, some interviewees shared the opposite view that individuals within some organisations had a negative influence on pharmacist prescribing role.

> *"The head of service at the time basically just blocked it, his view of pharmacy and pharmacists, do the different role of it should be advising about drugs and screening drug charts. I would certainly say that some medical staff within the trust has a fixed view for pharmacist prescribing and that is certainly, definitely a barrier for me"* *Pharmacist 10*

ii. Formally appointed internal implementation leaders

Two key themes within this sub-construct were **'Mentors support'** and **'Administrative support'**. The interviewees reported that there were formally appointed leaders mainly in the pharmacy department who were support for the implementation of prescribing practice.

> *"I think we're quite lucky that* [name] *our clinical lead is very pro, encourage us all to becoming independent prescribers and developing that aspect over our role and that he's always pushing us to do a lot more of doctors roles in particularly and working alongside them and working within kind of more embedded role in the MDT team"* *Pharmacist 8*

> *"I'm sure there's senior management team within my department do network, and the other centres, kind of talk about pharmacist prescribing"* *Pharmacist 10*

iii. Champions

Key themes within this sub-construct were **'Doctors engagement and enthusiasm', 'Nursing support', 'Pharmacy staff support'** and **'Patients support'**.

The interviewees emphasised that the success of prescribing service within an organisation was because of the support from individuals within the organisation who dedicated themselves to overcome any obstacles in the implementation process. The main champions recognised were the physicians and consultants within the renal units.

"It was a renal physician that was my [pause] tutor, and wanted to see exactly what I was going through, but he was more than convinced and then I presented to the rest of the renal unit, and I was, gradually just expanded over the years" *Pharmacist 4*

"Definitely the consultant nephrologist who work here. So, one of them is very proactive towards MDT and separate lots of different roles, helped me develop lots of different roles in terms of prescribing. I have another nephrologist who had the idea of doing this pharmacist led admission clinic. From my point of view, it's mainly been nephrology consultant colleagues who have helped me reinforce my prescribing. On a personal basis I definitely say my nephrologist who's a mentor, who I can discuss with him the cases, and we do meet regularly discussing this. He has been the biggest influence." *Pharmacist 6*

Some interviewees recognised the pharmacy management as champions in the implementation and support of prescribing services whether it was director of pharmacy, head of the service within pharmacy or even other pharmacists within the team.

"When we had a new head of service and sort of, they were supportive of prescribing" *Pharmacist 10*

"I'm really lucky that I've got another pharmacist in the team who would look at my prescriptions with me for me, having a director of pharmacy that wants and drives for prescribing agenda is really helpful and finds the funding. Having a director pharmacist backs you, backs the department and the prescribing it's really, really helpful." *Pharmacist 12,*

iv. External change agents

Two key themes within this sub-construct were **'Influence from external agents'** and **'Academic institution support'**.

Interviewees expressed their thoughts about any individual who was affiliated with another organisation and helped in the advancement of the prescribing practice.

"Probably UK renal pharmacy group is the one that, cause obviously, it's quite specialised, they put in questions, that could influence your prescribing and seeing what other people are doing, and, that's probably, the UK Clinical Pharmacy Association doesn't really have a renal group. It's, it's more the UK renal pharmacy group itself. So, that that's probably the biggest influence on it" *Pharmacist 1*

"We do have like learning at lunches, where we have external speakers that come in and talk about, new drugs etc which again obviously will influence prescribing" *Pharmacist 13*

Although interviewees were positive about the external agents who influence their prescribing there was some concern about being aware of the influence from certain external individuals such as medical representatives.

> *"When the drug company comes to me that's not gonna influence my decision on prescribing, I tend not to see drug reps that often anyway."* *Pharmacist 1*

> *"We all can be influenced by drug reps and drug companies. So, you just need to try and always be aware of that, and always do your own kind of individual literature search and to always have a look at the actual evidence that they're trying to present."* *Pharmacist 8*

c) Executing

A key theme within this construct was **'Variation in prescribing models'**. The majority of the interviewees were engaged in a defined and planned role as a prescriber. One of the well-defined roles was prescribing in an inpatient setting where the pharmacist spends most of their time providing clinical care for patients with CKD.

> *"I do a daily ward round on the transplant unit, So, I see transplant patient prescribing immunosuppression and stopping old dialysis drug and antibiotics, protocol really driven immunosuppression, and also surgical pain analgesics, as required anti-emetics and whatever necessary."* *Pharmacist 4*

"In terms of my prescribing activity is quite varied. So, it would be when I'm working in my ward role and I attend a daily ward round in the morning, optimising medication and starting and stopping of medications, and antibiotic review and optimising medicines for new starter on dialysis for example and all sort of things like that, and so, that would be prescribing as part of an MDT discussion during the ward rounds" *Pharmacist 11*

Another model of prescribing described by the interviewees was running specific outpatient clinics within the organisation and prescribing for defined groups of patients or a defined group of medication.

"I'm working as a prescriber for outpatient tolvaptan clinics, and so in that situation, there's myself and my colleague, the other 8A renal pharmacist, and we run a pharmacist lead clinic which happens every fortnight." *Pharmacist 3*

"In terms of my prescribing practice, I would prescribe in outpatients and specifically for patients with polycystic kidney disease, and I prescribe tolvaptan in that situation, and both initiating tolvaptan to writing the initial prescription, and adjusting the dose of tolvaptan" *Pharmacist 9*

Some interviewees highlighted a combined model of prescribing in an inpatient setting and outpatient setting.

"I prescribe of all the renal in and outpatient, at clinics like anaemia clinic, tolvaptan clinic and prescribe symptomatic relief for the dialysis patients. As well as prescribing in the ward rounds and doing discharges" *Pharmacist 2*

"As a combination of an inpatient Kardex's, and, you know, that will be prescribing missing medicines or adjusting a dose depending on what they were on before to come in and at the request that say the doctor, the dietitian to add something in. Then also, I prescribe Aranesp for outpatients, as an outpatient where I will review the bloods and then increase or decrease the dose as needed." *Pharmacist 7*

Another model of prescribing described by an interviewee was the homecare prescribing model where the pharmacist prescriber can prescribe for homecare patients and arrange delivery to the patients without the need for the patient to visit the healthcare facility.

"I'm reviewing homecare for patients so outpatient prescriptions for medicines for home delivery, and that would be EPO's, epoetin, mircera predominately or if sometimes I review homecare prescriptions for transplant patients" *Pharmacist 11*

d) Reflecting and evaluating

Key themes within this construct were **'Regular monitoring of prescribing practice', 'Internal / external processes', 'Need to develop patient feedback systems'** and **'CPD / reflection and work-based appraisal systems in place'**.

Many of the interviewees were engaged in various types of activities to reflect and assess their prescribing practice and to improve the service and enable delivery of best patient centred care. Mostly the interviewees relied on peer review process to assess prescribing efficiencies or identify any errors.

> *"Well we do a peer review every so often, I haven't done one for a couple of years, but (a colleague) peer reviewed me, she came through, and I showed her three Kardex's. I did the same for her and we evaluated each other."* *Pharmacist 1*

> *"I can only really be peer reviewed, and we have tried setting up peer reviewed groups of pharmacists prescribing in the hospital and the problem is we are not successful at all getting together for regular meetings."* *Pharmacist 4*

Another group of interviewees reported that they depend on the electronic prescribing system within their organisation to generate timely reports and identify any issues related to prescribing.

> *"It's something we have not really done unfortunately, but it's something that we keep thinking of doing, of course we do electronic prescribing, we can be monitored via the electronic prescribing and also through the Datix as well for any errors that we may do, we would be pickup that way."*
> *Pharmacist 2*

"We have an electronic prescribing system, so we can see a log of what we have prescribed and what changes we have amended, literally I press the button it goes through the IT we can audit our work." *Pharmacist 12*

Furthermore, some interviewees used a medication error reporting system as a tool to identify any prescribing related errors within a Trust.

"The Datix, it's the error reporting system in the hospital. So that's what they use in [a hospital name]*, they probably use it in other hospitals as well. So basically, they look at the data access every month, so the error which are under reported."* *Pharmacist 1*

"I know they regularly meet and analyse data and record for example how long it took to do it or how many errors were, you know, picked up whenever the junior doctor did as compared to when the pharmacist do it was it often all the data goes on in that regard but that's not something I'm directly involved in." *Pharmacist 7*

"In terms of safety, we have an incident reporting system so pharmacist prescribers are reported to the same way as the medical prescribers are reported, and if it is an error, and it's sent back to the drug prescriber and reflection takes place." *Pharmacist 12*

A group of interviewees also emphasised the importance of the auditing process to assess prescribing efficiencies in the Trust and sharing these data within the Trust or at other national platforms.

"We have all the data and what's been issued, what doses patients are on, and some of the quick, easy audits I've done have been kind of easy with the raising of our profile so things like I've audited prescribing. I kind of highlighted things like 30% of our prescribing was the dose was incorrect based on the patient's current renal function. I think that's quite powerful to present back to the MDT that actually you know, even within the renal team. I haven't published it yet [laughter]. So, I do have, so I do plan to put the audits that I have done into sub tasks which is at the end of the year." *Pharmacist 8*

"I guess maybe it would be more useful to have a more formal method of audit and reporting. I must say, I have, have a look at my own prescribing myself using the electronic system but it probably would be helpful if we had a formal way of making sure that everybody did that, and that we shared all the learning formally." *Pharmacist 11*

There were a few interviewees who felt that carrying out presentations to highlight any issues related to prescribing and presenting it to all stakeholders is a beneficial way of reflecting on prescribing practice.

"I've started doing a sort of six-monthly sort of lunch time presentation to sort of the junior doctors flagging up some of that sort of prescribing errors that potentially I'm rectifying just simply to try and sort of make sure that the learnings of experiences are shared" *Pharmacist 10*

The results of these qualitative semi-structured interviews are grounded in theory through the use of the CFIR. Clinical pharmacist members of the UKRPG who are prescribing for patients with CKD shared their experiences and views on the structures and processes for the development and implementation as well as evaluation of outcomes of pharmacist prescribing for patients with CKD in the UK. In addition, the findings provide data on their views of the key facilitators and barriers to further implementation and development of pharmacist prescribing for patients with CKD.

5.4. Discussion

This section will cover the key findings of the research followed by interpretation of these findings in wider context. It will also highlight the main strengths and limitations of the research and will end with an overall conclusion.

5.4.1. Summary of key findings

The aim of this phase of the doctoral research was to explore from a professional perspective, the development, implementation and evaluation of pharmacist prescribing for patients with CKD in the UK. The interview schedule was underpinned by CFIR as a theoretical basis and 14 interviews were carried out with experienced pharmacist prescribers until data saturation was achieved. The interviewees were generally very supportive of the development and implementation of prescribing practice and this practice was prevalent in a variety of settings. In term of the characteristics of the development and implementation of prescribing practice many were practising in secondary care with only a few working in primary care settings. They used a variety of models of prescribing including within different settings and in different specialist contexts. These models included independent prescribing in both inpatient and/or outpatient settings, prescribing in a clinic setting either for specific conditions such as CKD associated anaemia or a specific drug clinic such as epoetin clinics. One of the drug specific clinics highlighted frequently by the interviewees was the tolvaptan clinic which seemed to be a new clinic managed by some pharmacists and planned for implementation by others. The use of CFIR helped identify the key facilitators and barriers to implementing and advancing their prescribing practice. The interviewees reported a wide range of facilitators in terms of support and resources compared to a limited number of barriers that included the need for more funding, lack of sufficient number of personnel, no CKD or

renal specific training and lack of time to fit in prescribing practice within daily clinical duties. Interviewees also highlighted that there was insufficient coverage for their prescribing duties when they are away on holiday. The majority of the pharmacists were aware of the plans for the future development of their prescribing practice with many planning to establish clinics within their competence and the future strategic demands of the organisation. The interviewees stated that they were continuously assessing and evaluating their prescribing by various methods and using different parameters to assess their prescribing efficiency.

5.4.2. Interpretation

This research was underpinned by the CFIR framework throughout the research process from setting aim and objectives to completion of the data analysis. All the findings were aligned with the research aim, objectives and the CFIR domains and constructs.

From the themes identified in relation to the first objective of the research namely 'describe and characterise the models of pharmacist prescribing practice' it was evident that there is significant variation in activities related to pharmacist engagement in prescribing practice. Progress has been made for the advancement and development of pharmacist prescribing in the UK with the specialist area of caring for patients with CKD from supplementary prescribing to completely independent prescribing within their competence. Pharmacist were mainly prescribing independently in different care settings. Some pharmacists were prescribing in both inpatient and outpatient clinic settings while, others were either prescribing for inpatients or only in clinic settings. There was clear evidence from the interviewees that prescribing has evolved significantly in terms

of models but also the volume of activity since it started in 2004 from a supplementary or collaborative model to more independent model (Tonna 2007). The interviewees indicated they felt that they met a wide range of competencies in relation to prescribing, with resultant versatility in engaging with different models of prescribing practice. This helps the development of pharmacists working in clinical setting for patients with CKD and makes a difference through the sharing of prescribing responsibilities with other healthcare practitioners. However, literature showed that one of the key challenges to the implementation of pharmacist prescribing is a need for sustainability in these models and it was evident that they felt that this still needs to be addressed (Stewart 2017).

The Royal Pharmaceutical Society published a competency framework for all prescribers stating that 'the patient must be at the centre of care when prescribing a medication, to ensure patients are managed safely and effectively' (Royal Pharmaceutical Society 2016). The interviewees emphasised the importance of building a rapport with the patients and involving them in the decision-making process of prescribing. This exemplifies the construct of 'patient needs and resources' of the CFIR. The framework also helped highlight the key competencies required by the prescribers which were captured in the findings of this research phase. 'Applying professionalism' was reported to be an essential competency which requires using professional codes of conduct when prescribing for patients (Royal Pharmaceutical Society 2016). The interviewees highlighted some important steps to ensure professional practice. This included ensuring that patient needs and safety are always a key priority, adapting consultations to meet patient needs, reflecting on their own practice and learning from it, recognising when support is required and making use of it when required and lastly knowing their own limitations and extent of competencies.

The findings derived in relation to the fourth objective (exploration of the facilitators and barriers relating to implementation of pharmacist prescribing) identified facilitators and barriers related to implementing pharmacist prescribing for patients with CKD with a wide range of facilitators and only a limited number of barriers highlighted by the participants. These facilitators and barriers were reflected in the five domains of the CFIR:

A) Intervention characteristics

Within the 'intervention characteristics' domain the interviewees believed that prescribing within their competency for their patients led to positive outcomes. It is resource efficient since it releases doctors to see more complex patients and offer a more holistic approach to care for patients. Despite these facilitators, the interviewees also highlighted some barriers such as the complex steps required to become a prescriber, no specific courses for CKD or renal related conditions and a few believed that their prescribing creates some conflict with other healthcare professionals since there is some resistance from a few senior doctors to have healthcare professions other than a doctor prescribing. However, work by McCann et al. aimed to look at pharmacist prescribing practice in Northern Ireland reported that pharmacist prescribing provided more continuity of care for patients in a timely manner as well as providing improved patient outcomes (McCann 2011).

B) Outer setting

Facilitators to develop and implement prescribing practice in relation to the 'outer setting' domain were reported and included the benefits of; consideration of patient needs when planning any continuous professional development, collaboration and support from external organisations such as the RPS and the

UKRPG and the benefits of alignment of prescribing practice with the national policies and guidelines. The only barrier reported by interviewees within the 'outer setting' domain of CFIR was the perception of peer pressure by interviewees due to other pharmacists having more advanced practice for patients with complex needs such as running independent prescribing clinics for specific CKD related conditions or a tailored CKD drug related clinic. A study by Bourne et al. has suggested that a national strategy and standards are needed for such complex and specialist practice that go beyond the general specifications of core standards of prescribing (Bourne 2016). The need for this is evident from this research where interviewees were clear that such an approach would enable assurance that their prescribing complies with the national policies and standards within their area of practice and enable them to more confidently progress to advanced practice involving complex patients.

C) Inner setting

In this research aspects of the 'inner setting' domain was evident from findings that show that pharmacist prescribing is a well-recognised role within the organisation with a wide range of communication and networking within professionals in the healthcare facilities. This included involvement in initiatives such as prescribing group meetings, prescribing related bulletins and newsletter communication via internal email, promoting a positive culture to support pharmacist prescribing and clear messages of support from senior managers and clinical leaders. Within the inner setting participants felt there is more need for administrative support, a need for more training opportunities specifically related to CKD and the need to boost the number of prescribers within an organisation by allocating specific funding for prescribing courses and allowing time to take the courses. George et al. reported the challenges in the implementation of

prescribing practice that included inadequate funding as a huge challenge followed by not being recognised by the organisation. This paper, therefore, concluded that it is important to identify the need to build an infrastructure to support prescribing practice (George 2007). Funding is an ongoing challenge when it comes to implementation of innovative services in healthcare systems. Pharmacist prescribing, however, is well established and respected and indeed actively encouraged by the hierarchy of management within organisations (Cross 2018). This includes support and funding in some organisations for pharmacists to undertake the prescribing course and so develop capacity to delivery higher quality patient services through greater availability of prescribers within the organisation.

D) Characteristics of individuals

The findings related to CFIR domain on 'characteristics of individuals' emphasised that pharmacists were appropriately skilled to perform prescribing duties and that they were aware about their area of competence and knew their limitations. They were also confident in their abilities to prescribe for their patients and they were aware of the view that they were considered an asset by the organisation within which they practise. Two study based in the UK published in 2006 and 2007, when nonmedical prescribing was at its infancy, showed that pharmacists were keen to take the role of supplementary prescribing and believed that a more independent prescribing role would be a more appropriate model for secondary care setting (Hobson 2006, Tonna 2007). This current work shows that there have been significant advances in pharmacist prescribing practice across sectors with many different models of prescribing practice and highly qualified and confident practitioners with range of clearly defined competencies (Royal Pharmaceutical Society 2016).

E) Process

Lastly, the process of development of a model of pharmacist prescribing practice as reported by the interviewees always started with completing a GPhC accredited prescribing course which is a mandatory requirement to become an independent pharmacist prescriber. Thereafter, they recognised the need for stakeholder's engagement in the implementation process, then need for support from the multidisciplinary team members and the need for regular monitoring of the prescribing service by peer review process, regular multidisciplinary team meetings or conducting audits. This appears to be supported by the findings of McIntosh and Stewart who reported that participants in their work were in favour of pharmacist prescribing but only after gaining some experience as a pharmacist. They also reported that engaging with the multidisciplinary team is one of the important facilitators to pharmacist prescribing (McIntosh and Stewart 2016).

To date there is no other theoretically based study on pharmacist prescribing for patients with CKD, therefore it was only possible to compare the findings with literature focusing on general nonmedical prescribing or prescribing in other areas such as cardiology and mental health. A paper published in 2013 highlighted some of the challenges faced by a pharmacist prescriber for patients with heart failure and included; the fact that they could be practising out of their comfort zone, the need to learn more clinical skills, insufficiency of time available for practice, complexity of patients and the support needed from other members of the healthcare team (Bateman 2013). Jones et al. found that pharmacist prescribing was appreciated by patients with mental illness due to the continuity of care and scope to build positive relationship with the patients. On the other hand, pharmacists also felt they involved the patients in the decision-making

process and they believed they have the knowledge and experience to prescribe for these patients (Jones 2007).

The themes generated relevant to the last two objectives (the plans, actions and parameters used for evaluating prescribing practice and the plans to develop pharmacist-prescribing practice further) indicate that prescribing was evaluated by various methods to ensure high standards of prescribing practice. These methods included peer review of the prescriptions among pharmacists, feedback from other healthcare professionals and patients, learning from errors, regular meetings related to prescribing and recognition by the organisation. A study by Physick et al. reported that reviewing error reports, clinical audits and patient feedback are of great value to achieve reduction in prescribing errors, ensure accurate data transfer from one point of care to another and improve patient experience and ensure patient safety. The study reported significant reduction in prescribing errors between medic prescribing compared to pharmacist prescribing from 22% to 0.7% respectively (Physick 2016).

The future plans to further develop prescribing practice as reported by the participants included initiation of independent clinics, digitalisation of prescribing service, securing more funds to qualify more pharmacists as prescribers and alliance with more advanced prescribing service providers to enable replicating exemplar models.

In 2016 a review was published that aimed to summarise the evidence on the impact of electronic prescribing on patient safety in a secondary care setting in the UK. It reported that there are future opportunities for digitalisation of the healthcare services in the UK including the integration of the services to improve access to clinical information and so enhance prescribing and improve efficiency.

In addition, the integration of the service interoperability was also highlighted in the review and reported to help improve information exchange between secondary care and primary care (Ahmed 2016). These advancements are in line with the future plans reported by the interviewees in this research. However, it depends on the size of the organisation, the number of pharmacist prescribers and the allocated budget to implement such services. There were few participants already running these advanced services but some articulated a desire to plan for further implementation of such services in the future.

Although, the participants were confident that their prescribing practice had positive impacts on the patients and facilitated an increase pharmacists' confidence in their abilities they mostly agreed that there is a lack of published evidence on their role as prescribers for patients with CKD. This was evident in the recently published systematic review as a part of this doctoral project (Al Raiisi 2019). The systematic review included 47 papers on the clinical pharmacy services for patients with CKD and identified only one paper from the UK (Al Raiisi 2019). Despite the fact that the UKRPG organises annual conference to share the advancement in practice in relation to patients with renal diseases, where a number of pharmacists' present research undertaken in their practice, there is still lack of published evidence in this area. There could be potential reasons for the scarcity of the literature such as busy work environment, lack of time and lack of confidence in writing a research paper as reported by the participants. One of the solutions to this problem could be the potential collaboration between the practitioners and academic researchers to enable teamwork and undertake high quality research.

It is well recognised that underpinning qualitative research with theory results in high quality research that provides comprehensive conceptual understanding of a

phenomenon (Giacomini 2010). It is noticeable that none of the literature was based on a theoretical framework such as the CFIR which was used in this qualitative research. In view of this, there was lack of reporting all aspects of the implementation of prescribing practice in these studies. The use of CFIR was of great advantage to enable in depth evaluation of implementing pharmacist prescribing services for patients with CKD.

5.4.3. Strengths and limitations

A) Strengths

There are several strengths to this qualitative research. Employing a qualitative method is of merit in allowing in-depth understanding of the implementation of pharmacist prescribing service for patients with CKD and enables the generation of rich data related to the topic. The doctoral student received programme of training to develop qualitative research skills with a focus on performing interviews.

A1) Trustworthiness

Trustworthiness is a tool to assess the quality of qualitative research. However, there are certain steps that should be followed to ensure the research is trustworthy. The doctoral student undertook many steps to warrant trustworthiness of this research considering all the elements such as credibility, transferability, dependability, confirmability and Reflexivity (Guba 1981, Korstjens and Moser 2018). These steps included:

Credibility was ensured throughout the research process from selection of the research design, to development of the interview schedule and through extensive literature search. All of this was theoretically underpinned by the CFIR and peer reviewed by an expert team of academics and clinical practitioners (TM, LK, AT,

MM and CD). A rigorous process of independent checks was employed throughout the research process. Analysis was performed by more than one researcher (FA, SC, LK and KM) and verbatim quotes were reported to illustrate the themes generated to enhance credibility.

Transferability of research findings is a challenging aspect of research, since it is difficult to have a similar way of practice among practitioners. However, it is researcher's responsibility to provide detailed information of interviewees, the research process and findings to allow others to consider if the findings of this research are transferable to their setting (Elo 2014). The doctoral student believed that there were aspects of the findings that may be transferable to other care settings with sufficient details provided to ensure transferability was possible to consider.

Dependability can be maintained through transparent description of the research method with clear path from the start with aims and objectives that help outline the required research steps to the final report of the findings (Korstjens and Moser 2018). The doctoral student ensured sufficient details are provided throughout the research process to enhance dependability.

Confirmability is the degree of findings being agreed by other researchers (Korstjens and Moser 2018). Confirmability can also be ensured by providing detailed information about the whole research process and ensuring interpretation of findings that are truly derived from the data and are not impacted by researchers own views and beliefs (Korstjens and Moser 2018). The doctoral researcher ensured that all details and clearly stated and that analysis findings were mapped to CFIR constructs to ensure confirmability of findings.

Reflexivity as described in Chapter 2 is the process of self-reflection as a researcher in a critical manner to consider the potential impact on the stages of the research process of the researchers own believes, biases and perceptions about the research topic. It also considers the researcher's relation with the participants and how this relationship can impact the responses of the interviewees. The doctoral student considered carefully this topic and reflected on her own background as a non-UK registered pharmacist. She also discussed this and its potential impact on the research with the supervisory team. However, it was felt that a salient issue was that the doctoral student carrying out the work was not a prescriber. Given the focus of this stage of the research on prescribing practice this means that the lack of prescribing qualification and experience would minimise its impact in execution of the research work. Being a pharmacist and being a member of the UKRPG allowed the doctoral student to build a rapport with the interviewees throughout the research process.

A2) Theoretical underpinning

Underpinning a research with a theoretical framework is an important part of any research as detailed in Chapter 2 to allow detailed and systematic consideration of all aspects including facilitators and barriers to implementing prescribing practice and to enable meaningful contextualised analysis of the findings. This qualitative research followed theoretical underpinning with CFIR (Damschroder 2009) throughout the research process from the development of the interview schedule to data analysis and interpretation.

A3) Recruitment of experienced prescribers

The participants were practising pharmacists in the UK and were registered and experienced prescribers mainly in secondary care. Recruitment involved sending

an invitation to the pharmacists who had completed the survey phase of this research and had agreed to be involved in further phases of the work. Initially 14 of these pharmacists agreed to be interviewed but in the end it was only possible to interview 12 but a further two were identified through snowball sampling strategy and subsequently included. Generating data from an experienced cohort of pharmacist prescribers for all range of different groups of patients with CKD has enabled a significant addition to the evidence base since there was no published literature to date about pharmacist prescribing experiences for patients with CKD. The participants were committed to provided information and sharing their views and this was evident from the length of interviews and richness of the data obtained.

A4) Participants from across the UK

Participants were recruited from across the UK mainly from England, with smaller numbers from Scotland and one from each Wales and Northern Ireland. Generalisability is not the intention of qualitative research. However, the fact that this work included 14 participants in an area of specialised area of practice with quite a small number of practitioners and also since it was geographically well distributed it may be that the findings offer a view of the current scope and extent of prescribing practice in CKD that does indeed offer a generalised view of the current situation.

A5) Data saturation

Data saturation was achieved by using the process suggested by Francis with an initial number of five to ten interviews to be conducted followed by at least three once data saturation is achieved (Francis 2010). Agreement by the pharmacists to take part in the survey to be involved in further research and through

snowball sampling resulted in interviewing 14 participants and ensured data saturation was achieved as suggested by Francis (Francis 2010).

B) Limitations

With any research it is recognised that there are always limitations which must be acknowledged and mitigated if at all possible. It is acknowledged that this research has some limitations and it is therefore necessary to interpret the findings in the context of these limitations.

B1) Number of participants

The low number of participants is not necessarily a limitation in a qualitative research, only 14 participants from 71 who completed the survey agreed to participant in the interviews. There is a chance that participants who agreed to be interviewed had different views and experiences from those who did not agree to be interviewed. However, having participants geographically distributed throughout the UK may have added value to overcome the low number of participants as well as data saturation was achieved with this number.

B2) Biases

The nature of qualitative data makes it potentially challenging to separate the researcher completely from the participants or from the data making it difficult to maintain objectivity and avoid biases (Galdas 2017). There are two main types of biases in qualitative research; participants bias and researcher bias (Pannucci and Wilkins 2010), detailed in Chapter 2 of this thesis. The doctoral student was aware of these biases and was aware that being a pharmacist might have some influence on the research, therefore all attempts were made to bracket the researcher from the data (Tufford and Newman 2010) as well as consider

reflexivity which was described in Chapter 2. Participants were aware of researcher's background and this might have influenced the interview flow and the responses and social desirability bias was considered. To avoid such bias, the researcher ensured that the format of the questions allowed the participants to feel comfortable in responding with no judgmental comments or responses from the researcher and try and maintain neutrality throughout the interview. The researcher was not a qualified prescriber and this should help eliminate any researcher biases such as confirmation bias and leading question bias. The analysis of the data was carried out by two members of the research team independently, with any disagreement discussed among the researcher team and resolved to avoid analysis and reporting biases (Thirsk and Clark 2017). All data were entered in NVivo® to allow data storage and analysis of the data to provide rigorous findings.

5.5. Conclusion

Overall, the key findings demonstrated positive views on the development and implementation of prescribing practice models for patients with CKD among the pharmacists interviewed. The majority were prescribing in an inpatient setting with some having specialised clinics. The pharmacists were prescribing within various prescribing models. Key facilitators reported by the interviewees included having different models of prescribing practice, administrative support and undertaking the independent prescribing training. The main barriers reported were the need for more funding, lack of sufficient number of personnel, no specific training in CKD and lack of time. Given the complex nature of patients with CKD and the relative risk of medication errors and adverse effects, the pharmacists highlighted the importance of their input in a prescribing role but also the importance of having specific prescribing training for patients with CKD.

The findings for this phase of the doctoral research will inform the current practice models adopted by pharmacists across the UK for prescribing in patients with CKD. The findings will stimulate discussion at local and national levels among pharmacy professional organisations, NHS organisations and individual prescribers on the main barriers to implement such services and ways to overcome such barriers to enable the provision of best prescribing services to their patients.

Chapter 6: Discussion.

6. Introduction

This final chapter of this doctoral research will consider again the overall research aim and the aim of each phase of the research and explore the relationship of the key findings from each phase. The chapter will also recap the overall interpretation of the findings of each stage, recently published relevant literature and the main strengths and limitations associated with each phase of the doctoral research. Potential impact, originality and implications of the findings in practice are considered along with potential for further research. Finally, overall conclusions of the research programme are presented.

6.1. Overall aim of this doctoral research

The overall aim of the doctoral programme was to scope structures, processes and related outcomes of clinical pharmacy practice in the care of patients with CKD. The research was conducted in 2 stages with stage 1 focused on identifying the gap in knowledge through a systematic review and stage 2 in 2 phases. The first phase of data generation was a quantitative survey whereas, phase 2 focused on prescribing by interviewing the participants. This doctoral research was underpinned with a theoretical framework (CFIR) to enable the collection and generation of robust and rigorous data.

6.2. Specific aims and key findings of each stage

6.2.1. Stage 1: Systematic review (Al Raiisi 2017, Al Raiisi 2019)

The aim of the systematic review was to appraise, synthesise and present the available evidence for the structures, processes and related outcomes of clinical pharmacy practice in the care of patients with CKD.

Key findings from the systematic review:

The systematic review identified 47 studies from a variety of countries, with 31 based in a hospital setting. Resources available for service provision were poorly reported in all papers. Positive impact on clinical outcomes included significant improvement in parathyroid hormone, blood pressure, haemoglobin and creatinine clearance. most of the included studies focused on processes such as the process of reviewing drug charts and identifying drug related problems in patients with CKD. Pharmacists' interventions had an acceptance rate of up to 95%. Impact on humanistic outcomes was shown through improvement in health-related quality of life and patient satisfaction. Economic benefits arose from significant cost savings through pharmaceutical care provision. This systematic review showed that there is some evidence of positive impact on clinical, humanistic and economic outcomes, however, high quality studies are still warranted. A detailed interpretation of the review findings was discussed in Chapter 3.

Since the publication of this systematic review several studies have been published which meet the inclusion criteria. The key findings of these studies are as follows.

Hawley et al. explored the clinical services provided by pharmacy residents in a nephrology clinic to patients with nondialysis kidney disease. The pharmacists were able to tackle medication related issues such as polypharmacy, medication discrepancies and drug related problems. The study concluded that involvement of pharmacist in nephrology clinic resulted in identifying medication related problems and recommending changes in therapy which lead to improved care process (Hawley 2019).

A study by Yamamoto et al. assessed the impact of pharmacists' participation in the CKD network on the rate of a patient's hospitalisation as a result of medication related kidney injury. The contribution of pharmacists was included review and where necessary modification of the prescribing and administration of drugs that can cause kidney insult in high risk patients. This included reduced NSAID prescriptions and encouragement of paracetamol prescribing instead as a safer alternative in more than 14000 hospitalised patients. The results of the study showed significant reduction in hospitalisation and concluded that pharmacist participation was of value to the CKD network (Yamamoto 2019).

Yang and colleagues assessed the impact of pharmacist-led post kidney transplant medication therapy management. Pharmacist participation impact was measured by outcomes including cost-saving effect, immunosuppression therapeutic drug monitoring, safety, and blood pressure and plasma glucose levels. The study reported reduction in average medication cost, maintained tacrolimus levels, and better blood pressure control compared to the pre-intervention group (Yang 2019).

Falconer et al aimed to determine the key criteria employed by pharmacists for patient prioritisation for potential medication harm during admission. Although this study did not focus on patients with CKD, the results from this qualitative research reported that the main prioritisation criteria used by pharmacists for determining medication harm was renal impairment, list of high-risk medication and the drugs that need therapeutic drug monitoring (Falconer 2019).

A study in Malaysia explored pharmacists' knowledge, attitude and practice towards medication dose adjustment for patients with CKD. A survey was sent to more than 1500 pharmacists with a poor response rate of 14.7%. The study

results showed that more than 85% of the pharmacists were practising dose adjustment based on patients' renal functions and that younger pharmacists working in secondary care had better knowledge of dose adjustments. Conversely, the main obstacles reported by the pharmacists who were not practising dose adjustment were lack of knowledge of patient's latest kidney function and no access to patient's medical history. Therefore, the study suggested that more training should be provided to pharmacists to improve their knowledge as well as to ensure patients have an alert card with the recent kidney functions to enable better communication between hospitals and primary care (Teh and Lee 2019).

It is noticed that most of these studies were focused on the process of care with only the study by Yang et al. measuring outcomes of pharmacists' contribution in patients care (Yang 2019). Additionally, it should be highlighted that the systematic review findings and the findings from these additionally identified studies were derived from studies with varying methodological quality and none of the studies utilised a mixed-method approach. The key limitations of these studies includes a lack of consistency in the reporting of outcomes of the services provided and the fact that there is no theoretical underpinning of the research. These studies (Hawley 2019, Yamamoto 2019, Yang 2019, Falconer 2019 and Teh and Lee 2019) have therefore added little new evidence to the studies included in the systematic review. Overall, there remains a need for high quality studies with more emphasis on consideration of the structures and processes for clinical pharmacy practice and a critical need for consideration of consensus on a core outcome set for clinical pharmacy services for patients with CKD. This would greatly enhance the quality and usefulness of the available literature.

6.2.2. Stage 2, Phase 1: Quantitative survey (Al Raiisi 2020)

It was evident from the findings of the systematic review and the literature that there is still gap in knowledge of detailed exploration of structure, process and outcomes of clinical pharmacist caring for patients with CKD. Hence, there is a need for a comprehensive primary research in this area. The aim of phase 1 of this doctoral research was to determine pharmacists' behaviours and experiences and the barriers and facilitators to the implementation of models of care in patients with CKD.

The specific research questions for this phase included:

- What are the characteristics of clinical pharmacy practice and how have these models been developed, implemented and evaluated?
- What are the facilitators and barriers related to the implementation of pharmacist prescribing practice?
- What are the key areas for future practice development and what are the recommendations for implementing these developments?

This phase was theoretically underpinned with the CFIR domains and constructs throughout the research process as described in details in Chapter 4. Key findings from this phase of the research showed that the vast majority of UKRPG pharmacists practising in CKD are independent prescribers, providing general pharmaceutical care to CKD patients in general and specifically to dialysis and kidney transplant patients in secondary care setting. Respondents reported being confident in their own abilities and feeling comfortable in trying new ways of working. In relation to prescribing most were confident in their abilities to initiate prescribing for individual patients within their areas of competence. The implementation of clinical and prescribing practice was captured by all the

domains and constructs of the CFIR which has provided a framework that has enabled the research team to develop a comprehensive understanding of positive and negative influences on implementation of clinical and prescribing services, including facilitators and barriers, in CKD. Despite the development of pharmacist prescribing services among pharmacists caring for patients with CKD there was lack of detail on the facilitators and barriers to pharmacist prescribing for patients with CKD and details of the models of prescribing practice. It was clear that there was a need to evaluate in depth the pharmacist prescribing practice specifically for such complex group of patients. Details on interpretations of findings of the survey are described in Chapter 4.

6.2.3. Stage 2, Phase 2: Qualitative interviews

The preceding phase of this stage reported that a large proportion of clinical pharmacists caring for patients with CKD were also prescribers. This phase of the research was developed to explore pharmacist prescribing practice for patients with CKD. The aim for stage 2 Phase 2 of this research was to explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

The specific objectives in relation to pharmacists prescribing in CKD were to:

- Describe and characterise the models of pharmacist prescribing practice.
- Explore the facilitators and barriers relating to implementation of pharmacist prescribing.
- Describe the plans, actions and parameters used for evaluating prescribing practice.
- Explore plans to develop pharmacist-prescribing practice further.

Data saturation was achieved after completion of 14 interviews with pharmacist prescribers' members of the UKRPG. Key findings of the qualitative semi-structured interviews with pharmacists prescribing for patients with CKD demonstrated that there were variety of prescribing models adopted by pharmacists in variety of settings and these models were well appreciated by the different stakeholders. Pharmacists demonstrated overall organisational support for their prescribing role and the underpinning with CFIR domains highlighted main facilitators and barriers to the implementation of prescribing practice which was reported comprehensively in Chapter 5.

6.3. Interpretation of findings

The systematic review conducted at stage 1 of this doctoral research project and the previous systematic review by Salgado et al. (Salgado 2012) provide some evidence for the outcomes of pharmacists' intervention in patients with CKD. Again it is worthy to note that there was clear lack of evidence on the structures needed to practice and on the core outcomes of care in patients with CKD with most of the studies focused on the process of care. Despite the wide practice of pharmacist prescribing in some developed countries, none of the included papers captured pharmacist prescribing. There has been a recent statement by the GPhC and the four UK Chief Pharmaceutical Officers to potentially replace the preregistration year post qualification with a foundation programme to allow newly qualified pharmacists to become independent prescribers. This could be implemented as soon as 2021 and has generated much debate and a diversity of opinions among different stakeholders (Burns 2020). Currently, to become an independent prescriber those registered with the GPhC as pharmacists must have at least two years of relevant clinical practice after completion of the preregistration year. Allowing newly graduated pharmacists to become

independent prescribers is a significant change in the current situation. However, for prescribing within very specialised areas such as CKD it is likely that this will still require advanced level of practice and experience to deal with such complex groups of patients. According to the RPS Advanced Pharmacy Framework, pharmacist must demonstrate advanced stages of practice in the six clusters of expert professional practice, collaborative working relationship, leadership, management, education, training and development and research and evaluation (Royal Pharmaceutical Society 2013). Experienced pharmacists with mastery level of expertise may transfer more advanced skills to newly qualified pharmacists and mentor them to enhance their practice in highly specialised areas of practice. In addition, the RPS have developed a framework for approval of consultant level posts within the NHS and also a system for credentialing individual pharmacists at consultant level (Royal Pharmaceutical Society 2020). Those credentialed will then be able to apply for the approved consultant posts. This is a further progression of advanced practice and prescribing will be an integral part of these roles and it is highly likely that the approved posts will be in specialist areas such as CKD.

The quantitative survey in stage 2, phase 1 of this doctoral research with the clinical pharmacist members of the UKRPG who were clinically practising in the care for patients with CKD demonstrated high standards of clinical and prescribing practice in the UK. There is still limited literature on the structure required and the outcomes of such practices. However, many studies focus only on the process of providing care to patients with CKD. A study by Khokhar et al. published in 2020 aimed to assess the effectiveness of pharmacist intervention model in non-dialysis CKD patients in terms of improving disease knowledge and medication adherence (Khokhar 2020). The study included 120 patients and

were assigned equally to intervention and control group, where the intervention group will receive an extra care as pharmacist intervention model whereas, the control group will only receive the routine management. The study reported that pharmacist intervention model was effective in improving patient's knowledge of CKD hence, better adherence to medication. The study lacked details on the delivery of the intervention and the duration of the research was insufficient to draw firm conclusions (Khokhar 2020). Another recent study focusing on economic outcome reported that dose adjustments by clinical pharmacists for patients with CKD was cost saving to the health organisation (Sukkha 2020). Role of the clinical pharmacist in managing CKD complications such as anaemia was appreciated in literature. A Canadian model of pharmacist involvement in the management of CKD associated anaemia was evaluated by El Nekidy et al. (2020) and the study reported favourable outcomes in terms of dosage optimisations, cost saving and achieving therapeutic targets (El Nekidy 2020).

The primary research of this doctoral project was underpinned with a theoretical framework (CFIR) to allow comprehensive evaluation of the clinical and prescribing services provided by the pharmacists in the care for patients with CKD. However, none of the studies included the systematic review were reinforced by the use of any theoretical frameworks. Grounding the primary research of this doctoral research with CFIR enabled assessing the facilitators and barriers for the implementation of clinical pharmacy services for patients with CKD. Facilitators included: support from the healthcare team and administration, pharmacists' experiences and having clear goals to further advance the practice. Whereas, the main barriers to implementation of clinical pharmacy services for patients with CKD included: lack of evidence, lack of funding and being loaded with non-clinical duties.

The findings from stage 2, phase 2 interviews identified the variation in the models of prescribing practice among pharmacists providing the service for patients with CKD. The research findings also highlighted the main facilitators and barriers to the implementation of prescribing services as reported in details in Chapter 5. Despite the advanced prescribing practice in general and in patients with CKD in particular in the UK with different prescribing models, there is lack in available published evidence. A paper published in 2019 by Scuderi et al. described a model of prescribing practice for patients with CKD which included a physician, renal nurse, renal clinical pharmacist and a renal social worker (Scuderi 2019). Involvement of the pharmacist was valued by the other team members but the role of the pharmacist was only limited to detection and prevention of drug-related problems with no prescribing role (Scuderi 2019, Mongaret 2020). There is still long way to go in many countries to allow pharmacists to become prescribers despite the growing evidence that supports and shows the benefits of pharmacist prescribing.

6.4. Strengths and limitations of this doctoral research

6.4.1. Coherency of study design

The research was carried out in a coherent way throughout the doctoral programme with stage 1 of literature review followed by a sequential explanatory mixed-method design. The systematic review identified the gap in knowledge and helped develop the need for primary research in this area.

In stage 2 of this doctoral research a sequential explanatory mixed-method approach was appropriate given the aim of both phases in stage 2 of primary research.

Stage 1 phase 1 employed a theory driven (CFIR) quantitative survey method aiming to determine pharmacists' behaviours and experiences and the barriers and facilitators to the implementation of models of care in patients with CKD. The last phase was a qualitative semi-structured interview with a sample from the participants of the survey who indicated being prescribers, to enable generate in-depth knowledge to fulfil the aim of this phase which was to explore the development, implementation and evaluation of pharmacist prescribing for patients with CKD in the UK.

The use of theoretical framework (CFIR) was of added value to the whole process of research from generated data collection tools to analysing the data and interpreting the findings.

6.4.2. Trustworthiness

Various steps were taken to improve the quality of the research as detailed in the previous chapters of this thesis, enhancing the validity and reliability of the quantitative research and trustworthiness of the qualitative research. Credibility was enhanced by ensuring the process of choosing the appropriate methodological approach, suitable methods were considered and reflexivity applied throughout the research process. The research student ensured transferability of findings was maintained throughout the research by providing background information, detailed description of the research procedures and involvement of experts in the study design selection and experts in the field of clinical and prescribing practice for patients with CKD.

6.4.3. Biases

To ensure high standard research, it is important to be aware of potential biases and it is researchers' responsibility to undertake all possible actions to minimise

the biases that might occur throughout the research process and may impact the trustworthiness of the research (Barry 1999, Šimundić 2013, Bradbury-Jones, Taylor and Herber 2014). Details of all potential biases and the steps taken to minimise the risk of bias are discussed in Chapter 2.

As a researcher, it is also important to be aware of self-background knowledge and experience in the area of research. Hence, the doctoral student considered a reflexivity approach throughout the research programme which is covered in details in Chapter 2.

6.5. Originality

6.5.1. Novel research design

To the knowledge of the research team the design of this doctoral research is original and novel since no published studies of structure, process and related outcomes of clinical pharmacy practice in the care of patients with CKD have reported a similar approach. The findings of each phase informed the design of the subsequent phases of this doctoral research.

The systematic review of stage 1 of this doctoral research was registered with Prospero (registration number, Al Raiisi 2017) and the completed review was published in 2019 (Al Raiisi 2019) which included a significant amount of published evidence that needed scrutiny with only one study from the UK. The review identified new evidence related to the global practice of clinical pharmacy services for patients with CKD building on the findings of a previous systematic review (Salgado 2012).

The 2 phases of this research in stage 2 which was a mixed-method approach are the first to the knowledge of the research team to employ theoretical underpinning in this area of research. The stage 2, phase 1 survey was published

in 2020 (Al Raiisi 2020). Stage 2, phase 2 of this doctoral research was the qualitative part of the mixed-method approach and focused on depth information of prescribing models and the development and implementation of pharmacist prescribing practice for patients with CKD. The research team are not aware of any similar theory based qualitative research published in the area of this research ensuring an original contribution to knowledge and evidence base. The qualitative phase is under the process and consideration for publication in a peer-reviewed journal.

Overall, the three phases of this doctoral research generated original findings to enable extend the evidence base around the structure, process and outcomes of clinical pharmacy practice in the care of patients with CKD with in-depth focus on elements of prescribing.

6.5.2. Dissemination of research findings

One of the important outcomes of a research is to disseminate the original findings to a broad range of audience and stakeholders whom are concerned with the outcomes of the research. The doctoral research team had a clear plan for disseminating the original findings of this research. A list of disseminated work is highlighted in the foreword to this doctoral thesis which includes all national and international conference abstracts for oral and poster presentations as well as publications in peer-reviewed journals. A list of potential future publications is also highlighted at the start of this thesis. The findings of the doctoral research will also be shared with the main stakeholders the UKRPG members in an effort to inform the group about the findings as well as discuss any potential future research.

6.6. Impact

Impact has been defined by many scholars, Reed 2018 defined impact as "a direct or indirect, immediate or long-term benefit of a research or prevention of harm as a result of a research to the public and it must be demonstrable" (Reed 2018).

The UK research and innovative (UKRI) introduced pathways to impact to enhance and motivate researchers to think in depth about the impact of the research work and how a research can make an impact to different stakeholders (Kearnes 2011, UKRI 2018, UKRI 2020). The UKRI defined impact and categorised it into two major streams:

1. *Academic impact*: Which focuses on the demonstrable contribution that excellent research makes to academic advancement across and within disciplines in terms of theories, methodologies and application of these theories, Figure 6.1 (Kearnes 2011).

2. *Economical and societal impacts*: The demonstrable contribution that excellent research makes to society and the economy. Economic and societal impacts are the major domains to achieve value added impact of any research to benefit individuals, organisations and communities by: developing global economic performance, increasing the efficiency of infrastructure and policies and improving quality of life, health and creative outcomes, Figure 6.1 (Kearnes 2011).

The pathways to impact with potential academic impacts and economic and societal impacts are summarised in Figure 6.1.

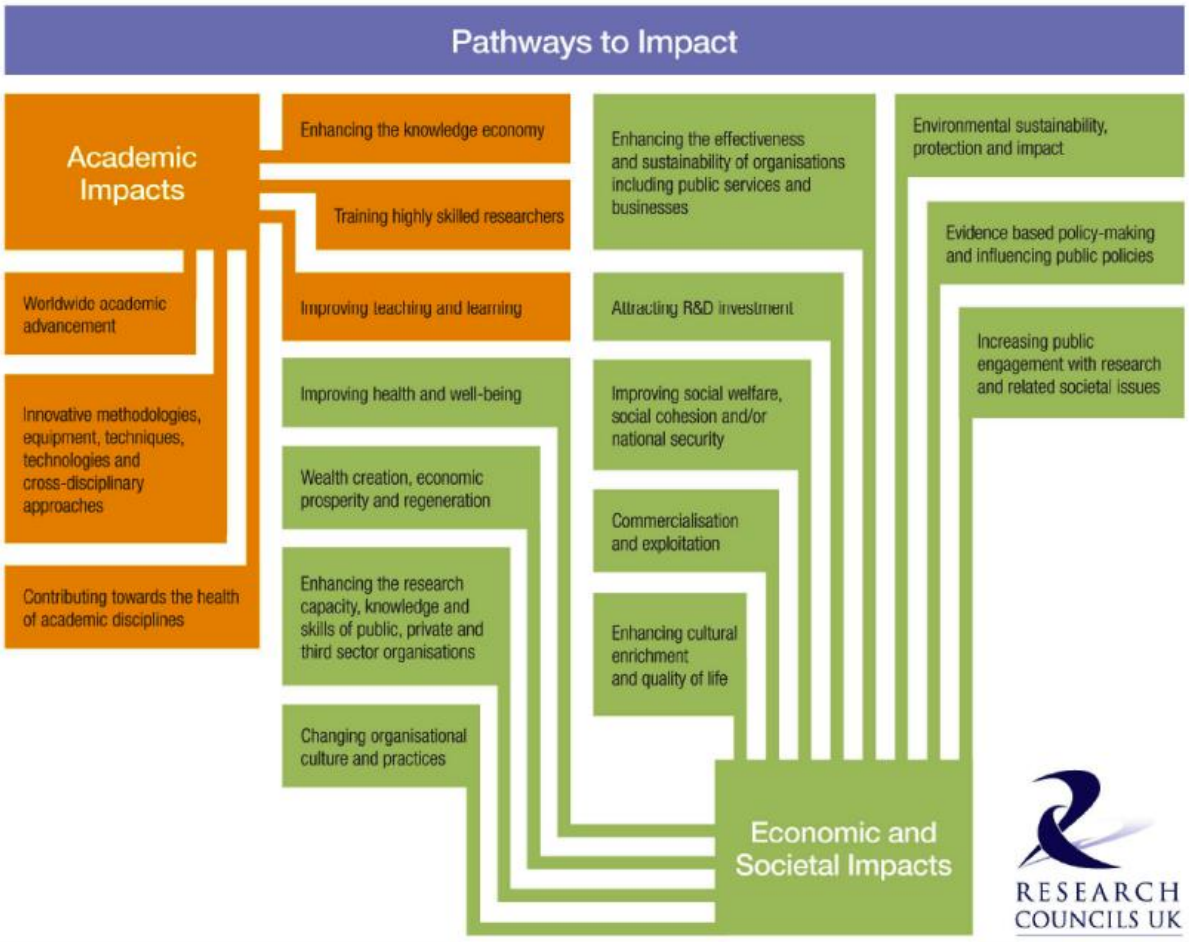

Figure 6.1: Pathways to impact by UKRI (Kearnes 2011).

The impact of this doctoral research based on the pathways on different stakeholders is discussed below.

1. Impact on the pharmacy profession by identifying the core elements of pharmaceutical care and prescribing practice in patients with CKD. The findings of this research identified the facilitators and barriers to providing pharmacist care and prescribing for patients with CKD and addressing such them to potentially overcome the barriers. The findings also highlighted the skills required for prescribing in such complex population and the outcomes of nonmedical prescribing on the patient care. The research findings also provided opportunity for professional development in such a highly specialised

clinical area. The findings will also inform the participants and at a broader level the practitioners' member of the UKRPG to improve prescribing practice by following some exemplar models highlighted in the findings of stage 2 phase 2 of this doctoral research. The research findings may also inform the educational needs as well as other models of practice to support prescribers to prescribe safely and effectively for patients with CKD.

2. The impact on the researcher as a PhD student: this project helped the student to develop her research skills in applying different methodological approaches and helped her understand research philosophies in-depth. Additionally, it helped the student develop her knowledge and skills on the use of theories and building research network.
3. Impact on the organisation (RGU), recognition as a high standard institution and opportunities for training skilled researchers, improving teaching and learning throughout the University. Dissemination of the results of the project at different phases (phase 1 was presented as poster at the UKRPG annual conference) and publishing in peer-reviewed journals will have a positive impact on the organisation.
4. Impact on patients and patient care by improving the quality of care provided to patients with CKD through identifying and addressing the gap in current practice. Developing further models of practice for pharmacists prescribing in CKD will facilitate further develop of the models of care and the contribution pharmacists make along with other healthcare professionals to enhance the quality and efficiency of patient care.

6.7. Implications of the findings in practice

The research showed the practice of clinical pharmacy in the care for patients with CKD and the standards at which pharmacists in the UK practise. Pharmacists

that participated in stage 2 of this doctoral research demonstrated high levels of practice in a very complex and specialised area in the care for patients with CKD. Given the nature of this complexity, pharmacists were providing their services in a variety of settings including clinics focussing on specific renal conditions or providing services in a broader context in inpatient settings. The most challenging barrier for advancing practice was lack of resources. Interviewees expressed concerns that due to insufficient funding of services there is a lack of capacity in terms of other similarly qualified pharmacists for service continuity to cover periods of leave or absence. This could lead to interruption of the services and a reduction in the quality of patient care and safety. Unfortunately, there was no standard way of evaluating the services to demonstrate the importance of the role. Pharmacist always reported lack of time to be able to participate in conducting academic research which is one of the important ways to research the quality of services and provide high quality evidence to the stakeholders. The advanced prescribing practice was evident among the clinical pharmacist caring for patients with CKD with different models of prescribing in line with the RPS Advanced Pharmacy Framework (Royal Pharmaceutical Society 2013). However, there was no documented framework for pharmacist prescribing for patients with CKD. The UKRPG competency framework was published in 2009 with no focus on prescribing. A further work to update the framework with an emphasis on prescribing is warranted. Furthermore, there is a potential to develop a pharmacist prescribing for patients with CKD framework. As mentioned above, recently published guidance on consultant pharmacist practice has outlined the requirements and expectations of consultant level pharmacists providing care in the NHS organisations demonstrated that this level of practice needs expertise in the field of practice at a senior level (NHS 2020). NHS consultant pharmacists

posts have been getting approved through a new system run by the RPS since January 2020 and the tandem process of credentialing individual pharmacists at consultant level will commence in October 2020 (Royal Pharmaceutical Society 2020). Given the growing importance of pharmacist prescribing in policy and practice (Royal Pharmaceutical Society 2016) and the development of consultant level pharmacist practice, it is important to consider the need to advance prescribing practice to be able to prescribe in complex groups of patients such as patients with CKD.

In stage 2, phase 2 interview, pharmacists demonstrated skills and experience to enable them prescribe for patients with CKD nevertheless, they highlighted that there is a need for more resources to enable them perform better and on wider scale. They also emphasised on the need for specific renal and CKD focused prescribing courses.

6.8. Further research

The results and findings of this doctoral research will potentially highlight further research in the development of pharmacy practice and prescribing practice in the UK. The UKRPG developed a competency framework for renal pharmacists in 2009 with no focus on prescribing practice (Bradley 2009). Proposal 1 will focus on the potential to update the framework based on the findings of this doctoral research in collaboration with the UKRPG board members. Furthermore, the research student was funded from the Omani government to develop research skills and support and advance research practice in Oman. Hence, proposal 2 and 3 will focus on research opportunities in relation to advancement of clinical pharmacy services and the potential to develop prescribing services in Oman.

6.8.1. Proposal 1: A study to review the UKRPG competency framework through a Delphi consensus approach to update the requirements for pharmacists providing care to renal patients with a focus on prescribing practice.

Aim:

To review the UKRPG competency framework through a Delphi consensus approach with key stakeholders to update the requirements for pharmacists providing care to renal patients with a focus on prescribing.

Philosophy:

A positivist approach deemed most suitable for this study, which assumes that the phenomena of interest can be observed and measured (Creswell 2018).

Methodology and methods:

A quantitative consensus approach will be followed for this study based on the findings of this doctoral thesis. All findings of the previous phases will be used to collate key statements for this study. A Delphi technique in the form of iterative anonymous questionnaire with experts will be employed to reach agreement around the statements related to competencies to allow update the competency framework and incorporate prescribing practice in the new version of the framework.

6.8.2. Proposal 2: A study, in Oman, to explore the views and experiences of stakeholders on aspects of clinical pharmacy services for patients with CKD with the view to develop a competency framework.

Aim:

To explore the views and experiences of stakeholders on aspects of clinical pharmacy services for patients with CKD with the view to develop a competency framework for Oman.

Philosophy:

The research will follow a phenomenological qualitative approach with an exploratory focus (Creswell 2018).

Methodology and methods:

The study will be grounded in the CFIR (Damschroder 2009), involving semi-structured qualitative interviews with key stakeholders including leaders and nephrology consultants who have influence and are decision makers in the Ministry of Health in Oman. The interview questions will be guided by the CFIR and the findings of previous studies in addition to literature. In order to generate representing data, participants will be selected purposively from range of expert stakeholders at the Ministry of Health in Oman. The targeted key stakeholders will include nephrology consultants, pharmacy directors, administrative leaders (Hospital and Ministry level), heads of clinical pharmacy services and policy makers. Interviews will be conducted face-to-face and will be audio recorded and transcribed verbatim. Thematic analysis following Howitt's steps will be employed.

6.8.3. Proposal 3: An exploration of views and perceptions of stakeholders in Oman on the potential of development of pharmacist prescribing services in Oman; a mixed-methods approach.

Aim:

To explore the perceptions of stakeholders in Oman on the potential of development of pharmacist prescribing services in Oman.

Philosophy:

This study is suggested to follow a pragmatic approach (Creswell 2018) to enable the exploration to examine a phenomenon (pharmacist prescribing) in a wide context.

Methodology and methods:

The proposed methodology suggested for this research is an explanatory sequential mixed-method approach (Creswell 2018). Starting with a quantitative survey to explore stakeholder's perception towards developing pharmacist prescribing services in Oman. The survey tool will be developed from an extensive literature search of relevant databases and will be checked for face and content validity by experienced researchers' team. The data collection tool will be piloted and any modifications will be considered by the research team. The sampling frame will be key stakeholders in the ministry of health involved in providing care to patients with CKD including nephology consultants and clinical pharmacists. The participants will be randomly selected from the sampling frame. The study will focus on gathering data on participants demographics, stakeholders' knowledge and views on pharmacist prescribing, their opinion on

developing such service in Oman in terms of logistics and legal aspects. The data will be considered for descriptive and inferential analysis.

The results from the survey will guide the development of the second phase, the qualitative semi-structured interviews with the stakeholders to further explore in details their views and perceptions on the development of pharmacist prescribing services in Oman. The participants from the survey would be contacted and asked if they would be interested to take part in the face-to-face interviews. Once agreed, the participants will be sent an email with all related information about the research, provide demographic information, contact details and a consent form to be signed and sent back in a reply email.

Interview schedule will be will be designed underpinned with CFIR and guided by the findings of the survey and checked and tested for face and content. Data analysis will follow a Framework approach (Ritchie 2014).

6.9. Conclusion

Despite the available literature on clinical pharmacy services for patients with CKD prior to conducting this doctoral research there was lack of literature for the UK. Clinical pharmacy and prescribing practice are well developed in the UK but there have been few studies published in relation to the UK practice. Given the advancement of clinical pharmacy practice in the UK and the establishment of the UKRPG for pharmacists caring for patients with CKD, exploration of clinical pharmacy and prescribing practice for patients with CKD was needed.

This doctoral research presents an original contribution to knowledge and the findings were rigorous, robust and underpinned with implementation theory to support further development of the services provided by the clinical pharmacists for patients with CKD.

Over two stages of research, where the first stage was focused on systematic literature review to provide evidence on the existing literature related to this doctoral research topic. The review reported positive impact of clinical pharmacists in the care for patients with CKD but there was lack of high-quality research in this area and there is lack of published evidence for the UK practice and none of the studies was grounded with implementation theory. The findings of the systematic review led to the next stage of this doctoral research. The second stage was carried out in two phases with phase one surveying the clinical pharmacists' members of the UKRPG and practising in the care for patients with CKD. Findings showed that pharmacists were positive and enthusiastic about their experiences in clinical practice with majority being independent prescribers. These findings were incorporated into the next phase of this doctoral research of qualitative interviews with pharmacists' prescribers for patients with CKD. Findings from the interviews demonstrated that pharmacist prescribing services were widely incorporated in their daily work routine. The interviewees were competent and focused on their prescribing duties for their patients and their prescribing mostly was well supported and appreciated by their organisation and the stakeholders. The use of CFIR ensured that all aspects of the prescribing service development, implementation and evaluation were captured.

In view of the overall findings from this doctoral research and the advancement in pharmacist prescribing policies (Burns 2020) it is hoped that the findings will contribute in the advancement of the clinical pharmacy and prescribing services in general and in particular for patients with CKD. So, leading to better patient care through transferability of evidence-based models of practice and so comprehensive, high quality service provision by the clinical pharmacist members of the UKRPG.

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Appendices

Appendix 1.1: Research registration with the research degree committee at the Robert Gordon University

RESEARCH DEGREES COMMITTEE

RESEARCH DEGREE REGISTRATION

I am pleased to inform you that the Robert Gordon University's Research Degrees Committee has registered the undermentioned applicant as a student for a research degree.

Fatma Ali Abdulrahim Al Raiisi - MRes/PhD

School of Pharmacy and Life Sciences

TITLE OF PROGRAMME OF RESEARCH: Exploring structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with Chronic Kidney Disease (CKD)

SUPERVISORS: Dr Scott Cunningham, Principal Supervisor
Professor Derek Stewart, Second Supervisor
Dr Moustafa Fahmy M Abdel-Kreem (Oman), Third Supervisor

COLLABORATING ESTABLISHMENT(S): n/a

The period of registration will be at least 30 months with effect from October 2016 subject to the conditions specified in Regulation 5.3

Secretary of Research Degrees Committee: Martin Simpson Date: 13/2/17

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TRANSFER OF REGISTRATION

Registration has been approved with the possibility of transfer to Doctor of Philosophy candidature. Students who wish to apply to transfer should do so within 12 months (for full-time students) and within 24 months (for part-time students) from the date of registration. (Application forms are available from: http://www.rgu.ac.uk/research/graduate-schools/research-degrees (Transferring to PhD section) or the Research Degrees Office.)

At the transfer stage the Research Degrees Committee will require assurances that the student has:

(a) successfully completed the PgCertificate in Research Methods;

(b) successfully undertaken an oral examination/presentation as part of the transfer process;

(c) continually reviewed research ethical issues as appropriate.

EXAMINATION ARRANGEMENTS

The Research Degrees Committee will need to approve:

(a) the arrangements for examining the student on the programme of work;

(b) the external and internal examiners. (Application forms are available from: http://www.rgu.ac.uk/research/graduate- schools/research-degrees (Examination section) or the Research Degrees Office;

(c) the application form should be submitted at least 3 months before the student submits their thesis for examination.

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THE ROBERT GORDON UNIVERSITY

Research Degrees Office Academic Affairs Department

To: Dr Scott Cunningham, School of Pharmacy and Life Sciences

From: Mr Martin Simpson, Research Degrees Officer

Date: 13 February 2017

Subject: Fatma Al Raiisi: Application for Approval of Registration

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Urgent ☐ For Action ☐ For Approval ☐ For Comment ☐ For Information ☐

I now have pleasure in enclosing a copy of the registration certificate for the above named student. I should be grateful if you could inform the other members of the Supervisory Team and pass on the second copy of the certificate to the student.

Martin

MARTIN SIMPSON
Research Degrees
Officer MS/NA/REG I

Enc

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Appendix 3.1: Systematic review protocol

NIHR | National Institute for Health Research

PROSPERO
International prospective register of systematic reviews

The structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with CKD: a systematic review update

Fatma Al Raiisi, Scott Cunnigham, Derek Stewart, Teresa Salgado, Fernando Fernandez-Llimos, Mustafa Fahmy

Citation

Fatma Al Raiisi, Scott Cunnigham, Derek Stewart, Teresa Salgado, Fernando Fernandez-Llimos, Mustafa Fahmy. The structures, processes and related outcomes of clinical pharmacy practice as part of the multidisciplinary care of patients with CKD: a systematic review update. PROSPERO 2017 CRD42017065258 Available from: https://www.crd.york.ac.uk/prospero/display_record.php?ID=CRD42017065258

Review question

• What clinical pharmacy practice related resources (structures, e.g. the multidisciplinary team, clinical pharmacy skill mix and time allocation) are in place and how are these matched to healthcare needs and demands to enable provide care to chronic kidney disease (CKD) patients?
• What activities are performed (processes, e.g. medication review, prescribing) to care for patients with CKD, how and when are they performed?
• What are the outcomes of the structure and the processes on the effectiveness (Economic, Clinical, and Humanistic Outcomes (ECHO) model) and efficiency of care provided?

Searches

An electronic search of relevant databases, as listed below, will be conducted using MeSH and other appropriate subject headings and text words. Scoping searches will be conducted prior to finalising the search strategy. The search will have no time restriction. The following databases will be used to search literature with no language restrictions:
1.MEDLINE (PubMed)
2.Scopus
3.CINAHL
4.International Pharmaceutical Abstracts (IPA)
5.Cochrane Database of Systematic Reviews (CDSR)
6.Google Scholar
7.Centre for Review and Dissemination (CRD) database
The bibliography of included studies will be reviewed to further identify additional references. Relevant international experts will be contacted by email to seek additional studies. Boolean operators such as truncations (*), wild cards ($), adjacent search options (e.g. adj2) will be used where relevant. Refworks® will be used to manage the search results. A draft search strategy is appended alongside the protocol.
Search terms:
The following grouped terms will be searched separately initially then in combination. The primary search will be conducted using the improved search strategy of the same terms as the original review as followed:
('pharmacies[TW]' OR 'pharmacist*[TIAB]' OR 'pharmacists[TW]' OR 'pharmaceutical services[MH]' OR 'pharmacy[TIAB]) AND
('renal insufficiency, chronic[MH]' OR 'hemodialysis[TIAB]' OR 'dialysis[TIAB]' OR 'kidney transplantation[MH]' OR 'renal dialysis[MH]')
Google Scholar will also be searched to further ensure comprehensiveness of the search and that all relevant studies have been identified.
All the selected studies will be imported then to RefWorks® for managing the references and eliminating any duplicates.

Types of study to be included

There will be no restriction on the study designs included, for example any randomized studies, cohort studies and before and after evaluations. Both qualitative and quantitative (including mixed methodologies) studies published in peer-reviewed journals will be included in the review.c) LanguageLanguage of

publication will be restricted to English.Exclusion criteria• Studies not specifically focussed on researching clinical pharmacy practice and the role of the pharmacist. • Literature based only on conceptual models, i.e. lacking empirical evidence.• Grey literature including conference proceedings, abstracts and unpublished studies will be excluded.Screening and selectionTwo researchers will independently screen titles, abstracts and full texts. Disagreements will be resolved by consensus amongst the research team and referred to a third reviewer if required. Authors will be contacted, if necessary, for clarification of information. Study selection will be conducted in three stages•Initial screening of titles and abstracts will be carried out against the inclusion criteria to identify potentially relevant articles.•Screening and selection of full texts.
•Assessment of full papers for inclusion into the review.

Condition or domain being studied

Chronic Kidney Disease (CKD) is defined by many international organisations as a progressive loss of kidney function over a period of time varying from weeks to months. CKD is highly associated with risk of mortality, frequent hospitalisation, and reduced life expectancy.
Most of the patients with CKD have co-morbid conditions (e.g. cardiovascular disease, metabolic disorders, anaemia, and bone mineral disorders) requiring medical interventions including anti-hypertensive drugs, erythropoietin stimulating agents, phosphate binders, immunosuppressive agents if they are a transplant recipient, amongst others. Usually, these patients are prescribed multiple medications, which is a risk for a further insult to the kidneys. The role of the pharmacist, through provision of pharmaceutical services, has the potential to contribute significantly to the multidisciplinary team in order to provide safe, effective and economic care for patients with CKD.
Clinical pharmacy has evolved since it was first introduced in 1960's with a multitude of definitions emerging. New concepts and frameworks of practice such as pharmaceutical care, medication therapy management and comprehensive medication management have evolved. All definition and frameworks embrace the key principle of greater patient facing involvement in all settings, as part of the multidisciplinary care of patients. Given that clinical Pharmacy is perhaps the most widely accepted broad generic term it will be adopted in this work.
An opinion paper by the American College of Clinical Pharmacy (ACCP) published in 2005 highlighted many of the opportunities available for pharmacists to practice in renal units. In the same year, an editorial from the ACCP acknowledged the clinical pharmacist as a fundamental part of the multidisciplinary team in a nephrology. Key clinical pharmacy roles in the multidisciplinary care of CKD patients were described by two renal pharmacy consultants Mason and Bakus in 2010. These roles include specific areas such as managing anaemia, renal mineral bone disease and hypertension, as well as more general medicines selection and review. Another major role pharmacists can contribute to is renal drug cost management. Medicine costs in CKD can be a huge burden on the healthcare system in any nation and most of the expenditure for this group of patients goes to treatment for co-morbidities like anaemia and on expensive drugs for immunosuppression.
An emerging role is the potential for the pharmacist to prescribe and modify medicines, which has now been implemented into practice in several countries.
In the United Kingdom (UK), the first pharmacist prescriber was registered by the Royal Pharmaceutical Society of Great Britain (RPSGB) in 2004. The UK Renal Pharmacy Group (UKRPG) developed a competency framework for pharmacists providing care to renal patients including CKD patients in 2009. The rationale of this framework was to support advance-level of practitioners progressing to the consultant-level of renal clinical pharmacy practice. The competency framework also provides guidance to pharmacists working in other clinical areas (such as Critical Care, General Medicine and Care of the Elderly) who will encounter patients with CKD on a regular basis. Currently, the framework is being updated by the UKRPG and is likely that prescribing will be captured within the revision.
There is a need to establish the evidence base of the impact of clinical pharmacy in the care of CKD patients. In 2012, Salgado et al. published a systematic review, 'Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review' which included synthesis of the peer reviewed literature to March 2010. Given the developments in clinical pharmacy globally, it is likely that further research has been reported since that date. A scoping review using the search terms of the original review from April 2010 to March 2017 has identified a further 102 papers. Since the publication of the original review by Salgado et al, the prescribing practice is continually developing and embedding into clinical pharmacy practice. Moreover, the model of care and advancement in practice is changing and evolving. Hence, there is a need to update and extend the review. The update and extension of this review will be in collaboration with the original authors to include relevant evidence published until March 2017.

Participants/population
The review will include articles with participants of the multidisciplinary team including nephrologist, renal nurses, and pharmacists practising in primary, secondary or tertiary healthcare facilities. The KDIGO Guidelines 2013 will be used to define all the forms and grades of CKD that should be considered for inclusion.

Intervention(s), exposure(s)
Literature relating to the structures, processes and outcomes of clinical pharmacy practice will be included. This review will consider studies that evaluate all forms of clinical pharmacist input within multidisciplinary team in providing care to renal patients whether in primary, secondary or tertiary level of care. The review will also consider papers focused on non-medical prescribing for patients with CKD.

Comparator(s)/control
Comparators might be identified in papers aiming to compare intervention and control groups.

Main outcome(s)
This review will include any research that reported the effects of a clinical pharmacist on providing care to CKD patients within a multidisciplinary team in terms of structure, processes and outcomes.
Structure items may include any resources required for the pharmacist to be able to provide care to renal patients such as requiring special training, availability of policies and procedures for practice etc..
Process items may include the activities that are performed by the pharmacist on daily bases or on specific intervals and how and when they are performed. These activities may include: daily clinical rounds, involvement in patients' management plans, medication reviews, therapeutic recommendations and pharmacist prescribing.
Outcome measures may include clinical parameters, medication-related adverse events, mortality and morbidities, quality of life, rate of hospitalisation.

Additional outcome(s)
None.

Data extraction (selection and coding)
A data extraction tool will be developed based on the aims and review questions and will be piloted using two research papers. The following key data will be extracted:
• Details of the authors, country of publication/study, year of publication
• Details of study design: setting, population, setting, aim, participants
• Details of whether the study is focussed on structure, processes or outcomes or a combination of these
• Details of the nature of the structures included and measured
• Details of the nature of the processes included and measured
• Details of the nature of the outcomes included and measured
• Key results or findings
Independent data extraction of each included study will be undertaken by two team members and cross checked. Disagreements will be resolved by consensus amongst the research team and referred to a third reviewer if required.

Risk of bias (quality) assessment
An independent, duplicate quality assessment of each study will be undertaken. Validated tools will be chosen based on the literature identified. It is likely that this will include tools such as those developed by the Critical Appraisal Skills Programme (CASP) (CASP 2013 and / or Downs and Black (DOWNS 1998).
Risk of bias assessment will be conducted for randomised controlled trials using the Cochrane Collaboration tool for assessing risk of bias (HIGGINS 2011). Studies will not be excluded based on quality criteria alone.
Outcome(s):
This review will include any research that reported the effects of a clinical pharmacist on providing care to CKD patients within a multidisciplinary team in terms of structure, processes and outcomes.
Structure items may include any resources required for the pharmacist to be able to provide care to renal patients such as requiring special training, availability of policies and procedures for practice etc..
Process items may include the activities that are performed by the pharmacist on daily bases or on specific intervals and how and when they are performed. These activities may include: daily clinical rounds, involvement in patients' management plans, medication reviews, therapeutic recommendations and

pharmacist prescribing.
Outcome measures may include clinical parameters, medication-related adverse events, mortality and morbidities, quality of life, rate of hospitalisation.

Strategy for data synthesis

Data assessed and passes for quality will be extracted and synthesised by using the latest version of the DEPICT tool (Descriptive Elements of Pharmacist Interventions Characterization Tool) will be included in this review (ROTTA 2015). All findings will be handled and entered by two independent reviewers to ensure homogeneity and quality.
All similar type of data from similar types of studies will be pooled together. Outcomes of quantitative data will be assembled and synthesised and statements will be generated and categorised according to similarities in meaning. These categories are then subjected to a meta-synthesis in order to produce a single comprehensive set of synthesised findings that can be used as a basis for evidence-based practice.
Whereas, quantitative data will be gathered and analysed statistically. All results will be entered twice for quality purpose. Effect sizes expressed as odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals will be calculated for analysis.

Analysis of subgroups or subsets

Heterogeneity will be assessed statistically using the standard Chi-square and also explored using subgroup analyses based on the different quantitative study designs included in this review. Where statistical pooling is not possible the findings will be presented in narrative form including tables and figures to aid in data presentation where appropriate.

Contact details for further information

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Organisational affiliation of the review

Robert Gordon University
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Review team members and their organisational affiliations

Mrs Fatma Al Raiisi. Robert Gordon University
Dr Scott Cunnigham. Robert Gordon University
Professor Derek Stewart. Robert Gordon University
Dr Teresa Salgado. Virginia Commonwealth University
Dr Fernando Fernandez-Llimos. University of Lisbon
Professor Mustafa Fahmy. Oman Pharmacy Institute

Type and method of review

Systematic review

Anticipated or actual start date

15 May 2017

Anticipated completion date

31 December 2017

Funding sources/sponsors

Robert Gordon University

Conflicts of interest

None known

Language

English

Country

Scotland, Oman, Portugal, United States of America

Stage of review
Review Ongoing

Subject index terms status
Subject indexing assigned by CRD

Subject index terms
Humans; Interdisciplinary Studies; Pharmacy Service, Hospital; Renal Insufficiency, Chronic

Date of registration in PROSPERO
08 May 2017

Date of first submission

Details of any existing review of the same topic by the same authors
This review is an update of an earlier systematic review by Salgado et al. published a systematic review, 'Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review' and being conducted to incorporate the new evidence in the developments in clinical pharmacy for CKD patients. The citation of the existing review is SALGADO, T.M. et al., 2012. Pharmacists' interventions in the management of patients with chronic kidney disease: a systematic review. Nephrology, Dialysis, Transplantation; 27(1), pp. 276-292

Stage of review at time of this submission
The review has not started

Stage	Started	Completed
Preliminary searches	No	No
Piloting of the study selection process	No	No
Formal screening of search results against eligibility criteria	No	No
Data extraction	No	No
Risk of bias (quality) assessment	No	No
Data analysis	No	No

The record owner confirms that the information they have supplied for this submission is accurate and complete and they understand that deliberate provision of inaccurate information or omission of data may be construed as scientific misconduct.

The record owner confirms that they will update the status of the review when it is completed and will add publication details in due course.

Versions
08 May 2017

Appendix 3.2: Mixed methods appraisal tool MMAT`

Mixed Methods Appraisal Tool (MMAT) – Version 2011
For dissemination, application, and feedback: Please contact pierre.pluye@mcgill.ca, Department of Family Medicine, McGill University, Canada.

The MMAT is comprised of two parts (see below): criteria (Part I) and tutorial (Part II). While the content validity and the reliability of the pilot version of the MMAT have been examined, this critical appraisal tool is still in development. Thus, the MMAT must be used with caution, and users' feedback is appreciated. Cite the present version as follows.

> Pluye, P., Robert, E., Cargo, M., Bartlett, G., O'Cathain, A., Griffiths, F., Boardman, F., Gagnon, M.P., & Rousseau, M.C. (2011). *Proposal: A mixed methods appraisal tool for systematic mixed studies reviews.* Retrieved on [date] from http://mixedmethodsappraisaltoolpublic.pbworks.com. Archived by WebCite® at http://www.webcitation.org/5tTRTc9yJ

Purpose: The MMAT has been designed for the appraisal stage of complex systematic literature reviews that include qualitative, quantitative and mixed methods studies (mixed studies reviews). The MMAT permits to concomitantly appraise and describe the methodological quality for three methodological domains: mixed, qualitative and quantitative (subdivided into three sub-domains: randomized controlled, non-randomized, and descriptive). Therefore, using the MMAT requires experience or training in these domains. E.g., MMAT users may be helped by a colleague with specific expertise when needed. The MMAT allows the appraisal of most common types of study methodology and design. For appraising a qualitative study, use section 1 of the MMAT. For a quantitative study, use section 2 or 3 or 4, for randomized controlled, non-randomized, and descriptive studies, respectively. For a mixed methods study, use section 1 for appraising the qualitative component, the appropriate section for the quantitative component (2 or 3 or 4), and section 5 for the mixed methods component. For each relevant study selected for a systematic mixed studies review, the methodological quality can then be described using the corresponding criteria. This may lead to exclude studies with lowest quality from the synthesis, or to consider the quality of studies for contrasting their results (e.g., low quality vs. high).

Scoring metrics: For each retained study, an overall quality score may be not informative (in comparison to a descriptive summary using MMAT criteria), but might be calculated using the MMAT. Since there are only a few criteria for each domain, the score can be presented using descriptors such as *, **, ***, and ****. For qualitative and quantitative studies, this score can be the number of criteria met divided by four (scores varying from 25% (*) -one criterion met- to 100% (****) -all criteria met-). For mixed methods research studies, the premise is that the overall quality of a combination cannot exceed the quality of its weakest component. Thus, the overall quality score is the lowest score of the study components. The score is 25% (*) when *QUAL=1 or QUAN=1 or MM=0*; it is 50% (**) when *QUAL=2 or QUAN=2 or MM=1*; it is 75% (***) when *QUAL=3 or QUAN=3 or MM=2*; and it is 100% (****) when *QUAL=4 and QUAN=4 and MM=3* (QUAL being the score of the qualitative component; QUAN the score of the quantitative component; and MM the score of the mixed methods component).

Rationale: There are general criteria for planning, designing and reporting mixed methods research (Creswell and Plano Clark, 2010), but there is no consensus on key specific criteria for appraising the methodological quality of mixed methods studies (O'Cathain, Murphy and Nicholl, 2008). Based on a critical examination of 17 health-related systematic mixed studies reviews, an initial 15-criteria version of MMAT was proposed (Pluye, Gagnon, Griffiths and Johnson-Lafleur, 2009). This was pilot tested in 2009. Two raters assessed 29 studies using the pilot MMAT criteria and tutorial (Pace, Pluye, Bartlett, Macaulay et al., 2010). Based on this pilot exercise, it is anticipated that applying MMAT may take on average 15 minutes per study (hence efficient), and that the Intra-Class Correlation might be around 0.8 (hence reliable). The present 2011 revision is based on feedback from four workshops, and a comprehensive framework for assessing the quality of mixed methods research (O'Cathain, 2010).

Conclusion: The MMAT has been designed to appraise the *methodological quality* of the studies retained for a systematic mixed studies review, not the quality of their *reporting* (writing). This distinction is important, as good research may not be 'well' reported. If reviewers want to genuinely assess the former, companion papers and research reports should be collected when some criteria are not met, and authors of the corresponding publications should be contacted for additional information. Collecting additional data is usually necessary to appraise *qualitative research and mixed methods studies*, as there are no uniform standards for reporting study characteristics in these domains (www.equator-network.org), in contrast, e.g., to the CONSORT statement for reporting randomized controlled trials (www.consort-statement.org).

Authors and contributors: Pierre Pluye[1], Marie-Pierre Gagnon[2], Frances Griffiths[3] and Janique Johnson-Lafleur[1] proposed an initial version of MMAT criteria (Pluye et al., 2009). Romina Pace[1] and Pierre Pluye[1] led the pilot test. Gillian Bartlett[1], Belinda Nicolau[4], Robbyn Seller[1], Justin Jagosh[1], Jon Salsberg[1] and Ann Macaulay[1] contributed to the pilot work (Pace et al., 2010). Pierre Pluye[1], Émilie Robert[5], Margaret Cargo[6], Alicia O'Cathain[7], Frances Griffiths[3], Felicity Boardman[3], Marie-Pierre Gagnon[2], Gillian Bartlett[1], and Marie-Claude Rousseau[8] contributed to the present 2011 version.

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PART I. MMAT criteria & one-page template (to be included in appraisal forms)

Types of mixed methods study components or primary studies	Methodological quality criteria (see tutorial for definitions and examples)	Responses			
		Yes	No	Can't tell	Comments
Screening questions (for all types)	• Are there clear qualitative and quantitative research questions (or objectives*), or a clear mixed methods question (or objective*)?				
	• Do the collected data allow address the research question (objective)? E.g., consider whether the follow-up period is long enough for the outcome to occur (for longitudinal studies or study components).				
	Further appraisal may be not feasible or appropriate when the answer is 'No' or 'Can't tell' to one or both screening questions.				
1. Qualitative	1.1. Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)?				
	1.2. Is the process for analyzing qualitative data relevant to address the research question (objective)?				
	1.3. Is appropriate consideration given to how findings relate to the context, e.g., the setting, in which the data were collected?				
	1.4. Is appropriate consideration given to how findings relate to researchers' influence, e.g., through their interactions with participants?				
2. Quantitative randomized controlled (trials)	2.1. Is there a clear description of the randomization (or an appropriate sequence generation)?				
	2.2. Is there a clear description of the allocation concealment (or blinding when applicable)?				
	2.3. Are there complete outcome data (80% or above)?				
	2.4. Is there low withdrawal/drop-out (below 20%)?				
3. Quantitative non-randomized	3.1. Are participants (organizations) recruited in a way that minimizes selection bias?				
	3.2. Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?				
	3.3. In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?				
	3.4. Are there complete outcome data (80% or above), and, when applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?				
4. Quantitative descriptive	4.1. Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?				
	4.2. Is the sample representative of the population understudy?				
	4.3. Are measurements appropriate (clear origin, or validity known, or standard instrument)?				
	4.4. Is there an acceptable response rate (60% or above)?				
5. Mixed methods	5.1. Is the mixed methods research design relevant to address the qualitative and quantitative research questions (or objectives), or the qualitative and quantitative aspects of the mixed methods question (or objective)?				
	5.2. Is the integration of qualitative and quantitative data (or results*) relevant to address the research question (objective)?				
	5.3. Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data (or results*) in a triangulation design?				
	Criteria for the qualitative component (1.1 to 1.4), and appropriate criteria for the quantitative component (2.1 to 2.4, or 3.1 to 3.4, or 4.1 to 4.4), must be also applied.				

*These two items are not considered as double-barreled items since in mixed methods research, (1) there may be research questions (quantitative research) or research objectives (qualitative research), and (2) data may be integrated, and/or qualitative findings and quantitative results can be integrated.

PART II. MMAT tutorial

Types of mixed methods study components or primary studies	Methodological quality criteria
1. Qualitative Common types of qualitative research methodology include: A. Ethnography The aim of the study is to describe and interpret the shared cultural behaviour of a group of individuals. B. Phenomenology The study focuses on the subjective experiences and interpretations of a phenomenon encountered by individuals. C. Narrative The study analyzes life experiences of an individual or a group. D. Grounded theory Generation of theory from data in the process of conducting research (data collection occurs first). E. Case study In-depth exploration and/or explanation of issues intrinsic to a particular case. A case can be anything from a decision-making process, to a person, an organization, or a country. F. Qualitative description There is no specific methodology, but a qualitative data collection and analysis, e.g., in-depth interviews or focus groups, and hybrid thematic analysis (inductive and deductive). Key references: Creswell, 1998; Schwandt, 2001; Sandelowski, 2010.	**1.1. Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)?** E.g., consider whether (a) the selection of the participants is clear, and appropriate to collect relevant and rich data; and (b) reasons why certain potential participants chose not to participate are explained. **1.2. Is the process for analyzing qualitative data relevant to address the research question (objective)?** E.g., consider whether (a) the method of data collection is clear (in depth interviews and/or group interviews, and/or observations and/or documentary sources); (b) the form of the data is clear (tape recording, video material, and/or field notes for instance); (c) changes are explained when methods are altered during the study; and (d) the qualitative data analysis addresses the question. **1.3. Is appropriate consideration given to how findings relate to the context, e.g., the setting, in which the data were collected?** * E.g., consider whether the study context and how findings relate to the context or characteristics of the context are explained (how findings are influenced by or influence the context). "For example, a researcher wishing to observe care in an acute hospital around the clock may not be able to study more than one hospital. (…) Here, it is essential to take care to describe the context and particulars of the case [the hospital] and to flag up for the reader the similarities and differences between the case and other settings of the same type" (Mays & Pope, 1995). The notion of context may be conceived in different ways depending on the approach (methodology) tradition. **1.4. Is appropriate consideration given to how findings relate to researchers' influence, e.g., through their interactions with participants?** * E.g., consider whether (a) researchers critically explain how findings relate to their perspective, role, and interactions with participants (how the research process is influenced by or influences the researcher); (b) researcher's role is influential at all stages (formulation of a research question, data collection, data analysis and interpretation of findings); and (c) researchers explain their reaction to critical events that occurred during the study. The notion of reflexivity may be conceived in different ways depending on the approach (methodology) tradition. E.g., "at a minimum, researchers employing a generic approach [qualitative description] must explicitly identify their disciplinary affiliation, what brought them to the question, and the assumptions they make about the topic of interest" (Caelli, Ray & Mill, 2003, p. 5).

*See suggestion on the MMAT wiki homepage (under '2011 version'): Independent reviewers can establish a common understanding of these two items prior to beginning the critical appraisal.

Types of mixed methods study components or primary studies	Methodological quality criteria
2. Quantitative randomized controlled (trials) Randomized controlled clinical trial: A clinical study in which individual participants are allocated to intervention or control groups by randomization (intervention assigned by researchers). Key references: Higgins & Green, 2008; Porta, 2008; Oxford Center for Evidence based medicine, 2009.	**2.1. Is there a clear description of the randomization (or an appropriate sequence generation)?** In a randomized controlled trial, the allocation of a participant (or a data collection unit, e.g., a school) into the intervention or control group is based solely on chance, and researchers describe how the randomization schedule is generated. "A simple statement such as 'we randomly allocated' or 'using a randomized design' is insufficient". *Simple randomization:* Allocation of participants to groups by chance by following a predetermined plan/sequence. "Usually it is achieved by referring to a published list of random numbers, or to a list of random assignments generated by a computer". *Sequence generation:* "The rule for allocating interventions to participants must be specified, based on some chance (random) process". Researchers provide sufficient detail to allow a readers' appraisal of whether it produces comparable groups. E.g., blocked randomization (to ensure particular allocation ratios to the intervention groups), or stratified randomization (randomization performed separately within strata), or minimization (to make small groups closely similar with respect to several characteristics).
	2.2. Is there a clear description of the allocation concealment (or blinding when applicable)? *The allocation concealment protects assignment sequence until allocation.* E.g., researchers and participants are unaware of the assignment sequence up to the point of allocation. E.g., group assignment is concealed in opaque envelops until allocation. *The blinding protects assignment sequence after allocation.* E.g., researchers and/or participants are unaware of the group a participant is allocated to during the course of the study.
	2.3. Are there complete outcome data (80% or above)? E.g., almost all the participants contributed to almost all measures.
	2.4. Is there low withdrawal/drop-out (below 20%)? E.g., almost all the participants completed the study.

Types of mixed methods study components or primary studies	Methodological quality criteria
3. Quantitative non-randomized Common types of design include (A) non-randomized controlled trials, and (B-C-D) observational analytic study or component where the intervention/exposure is defined/assessed, but not assigned by researchers. A. Non-randomized controlled trials The intervention is assigned by researchers, but there is no randomization, e.g., a pseudo-randomization. A non-random method of allocation is not reliable in producing alone similar groups. B. Cohort study Subsets of a defined population are assessed as exposed, not exposed, or exposed at different degrees to factors of interest. Participants are followed over time to determine if an outcome occurs (prospective longitudinal). C. Case-control study Cases, e.g., patients, associated with a certain outcome are selected, alongside a corresponding group of controls. Data is collected on whether cases and controls were exposed to the factor under study (retrospective). D. Cross-sectional analytic study At one particular time, the relationship between health-related characteristics (outcome) and other factors (intervention/exposure) is examined. E.g., the frequency of outcomes is compared in different population sub-groups according to the presence/absence (or level) of the intervention/exposure. Key references for observational analytic studies: Higgins & Green, 2008; Wells, Shea, O'Connell, Peterson, et al., 2009.	**3.1. Are participants (organizations) recruited in a way that minimizes selection bias?** At recruitment stage: For cohort studies, e.g., consider whether the exposed (or with intervention) and non-exposed (or without intervention) groups are recruited from the same population. For case-control studies, e.g., consider whether same inclusion and exclusion criteria were applied to cases and controls, and whether recruitment was done independently of the intervention or exposure status. For cross-sectional analytic studies, e.g., consider whether the sample is representative of the population. **3.2. Are measurements appropriate (clear origin, or validity known, or standard instrument; and absence of contamination between groups when appropriate) regarding the exposure/intervention and outcomes?** At data collection stage: E.g., consider whether (a) the variables are clearly defined and accurately measured; (b) the measurements are justified and appropriate for answering the research question; and (c) the measurements reflect what they are supposed to measure. For non-randomized controlled trials, the intervention is assigned by researchers, and so consider whether there was absence/presence of a contamination. E.g., the control group may be indirectly exposed to the intervention through family or community relationships. **3.3. In the groups being compared (exposed vs. non-exposed; with intervention vs. without; cases vs. controls), are the participants comparable, or do researchers take into account (control for) the difference between these groups?** At data analysis stage: For cohort, case-control and cross-sectional, e.g., consider whether (a) the most important factors are taken into account in the analysis; (b) a table lists key demographic information comparing both groups, and there are no obvious dissimilarities between groups that may account for any differences in outcomes, or dissimilarities are taken into account in the analysis. **3.4. Are there complete outcome data (80% or above), and, when applicable, an acceptable response rate (60% or above), or an acceptable follow-up rate for cohort studies (depending on the duration of follow-up)?**

Types of mixed methods study components or primary studies	Methodological quality criteria
4. Quantitative descriptive studies Common types of design include single-group studies: A. Incidence or prevalence study without comparison group In a defined population at one particular time, what is happening in a population, e.g., frequencies of factors (importance of problems), is described (portrayed). B. Case series A collection of individuals with similar characteristics are used to describe an outcome. C. Case report An individual or a group with a unique/unusual outcome is described in details. Key references: Critical Appraisal Skills Programme, 2009; Draugalis, Coons & Plaza, 2008.	**4.1. Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?** E.g., consider whether (a) the source of sample is relevant to the population under study; (b) when appropriate, there is a standard procedure for sampling, and the sample size is justified (using power calculation for instance).
	4.2. Is the sample representative of the population understudy? E.g., consider whether (a) inclusion and exclusion criteria are explained; and (b) reasons why certain eligible individuals chose not to participate are explained.
	4.3. Are measurements appropriate (clear origin, or validity known, or standard instrument)? E.g., consider whether (a) the variables are clearly defined and accurately measured; (b) measurements are justified and appropriate for answering the research question; and (c) the measurements reflect what they are supposed to measure.
	4.4. Is there an acceptable response rate (60% or above)? The response rate is not pertinent for case series and case report. E.g., there is no expectation that a case series would include all patients in a similar situation.

Types of mixed methods study components or primary studies	Methodological quality criteria
5. Mixed methods Common types of design include: A. Sequential explanatory design The quantitative component is followed by the qualitative. The purpose is to explain quantitative results using qualitative findings. E.g., the quantitative results guide the selection of qualitative data sources and data collection, and the qualitative findings contribute to the interpretation of quantitative results. B. Sequential exploratory design The qualitative component is followed by the quantitative. The purpose is to explore, develop and test an instrument (or taxonomy), or a conceptual framework (or theoretical model). E.g., the qualitative findings inform the quantitative data collection, and the quantitative results allow a generalization of the qualitative findings. C. Triangulation design The qualitative and quantitative components are concomitant. The purpose is to examine the same phenomenon by interpreting qualitative and quantitative results (bringing data analysis together at the interpretation stage), or by integrating qualitative and quantitative datasets (e.g., data on same cases), or by transforming data (e.g., quantization of qualitative data). D. Embedded design The qualitative and quantitative components are concomitant. The purpose is to support a qualitative study with a quantitative sub-study (measures), or to better understand a specific issue of a quantitative study using a qualitative sub-study, e.g., the efficacy or the implementation of an intervention based on the views of participants. Key references: Creswell & Plano Clark, 2007; O'Cathain, 2010.	**5.1. Is the mixed methods research design relevant to address the qualitative and quantitative research questions (or objectives), or the qualitative and quantitative aspects of the mixed methods question (or objective)?** E.g., the rationale for integrating qualitative and quantitative methods to answer the research question is explained.
	5.2. Is the integration of qualitative and quantitative data (or results) relevant to address the research question (objective)? E.g., there is evidence that data gathered by both research methods was brought together to form a complete picture, and answer the research question; authors explain when integration occurred (during the data collection-analysis or/and during the interpretation of qualitative and quantitative results); they explain how integration occurred and who participated in this integration.
	5.3. Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data (or results)?

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Appendix 3.3: Downs and Black's tool

Checklist for measuring study quality

Reporting

1. *Is the hypothesis/aim/objective of the study clearly described?*

yes	1
no	0

2. *Are the main outcomes to be measured clearly described in the Introduction or Methods section?*
   If the main outcomes are first mentioned in the Results section, the question should be answered no.

yes	1
no	0

3. *Are the characteristics of the patients included in the study clearly described ?*
   In cohort studies and trials, inclusion and/or exclusion criteria should be given. In case-control studies, a case-definition and the source for controls should be given.

yes	1
no	0

4. *Are the interventions of interest clearly described?*
   Treatments and placebo (where relevant) that are to be compared should be clearly described.

yes	1
no	0

5. *Are the distributions of principal confounders in each group of subjects to be compared clearly described?*
   A list of principal confounders is provided.

yes	2
partially	1
no	0

6. *Are the main findings of the study clearly described?*
   Simple outcome data (including denominators and numerators) should be reported for all major findings so that the reader can check the major analyses and conclusions. (This question does not cover statistical tests which are considered below).

yes	1
no	0

7. *Does the study provide estimates of the random variability in the data for the main outcomes?*
   In non normally distributed data the inter-quartile range of results should be reported. In normally distributed data the standard error, standard deviation or confidence intervals should be reported. If the distribution of the data is not described, it must be assumed that the estimates used were appropriate and the question should be answered yes.

yes	1
no	0

8. *Have all important adverse events that may be a consequence of the intervention been reported?*
   This should be answered yes if the study demonstrates that there was a comprehensive attempt to measure adverse events. (A list of possible adverse events is provided).

yes	1
no	0

9. *Have the characteristics of patients lost to follow-up been described?*
   This should be answered yes where there were no losses to follow-up or where losses to follow-up were so small that findings would be unaffected by their inclusion. This should be answered no where a study does not report the number of patients lost to follow-up.

yes	1
no	0

10. *Have actual probability values been reported (e.g. 0.035 rather than <0.05) for the main outcomes except where the probability value is less than 0.001?*

yes	1
no	0

External validity

All the following criteria attempt to address the representativeness of the findings of the study and whether they may be generalised to the population from which the study subjects were derived.

11. *Were the subjects asked to participate in the study representative of the entire population from which they were recruited?*
    The study must identify the source population for patients and describe how the patients were selected. Patients would be representative if they comprised the entire source population, an unselected sample of consecutive patients, or a random sample. Random sampling is only feasible where a list of all members of the relevant

population exists. Where a study does not report the proportion of the source population from which the patients are derived, the question should be answered as unable to determine.

yes	1
no	0
unable to determine	0

12. *Were those subjects who were prepared to participate representative of the entire population from which they were recruited?*
The proportion of those asked who agreed should be stated. Validation that the sample was representative would include demonstrating that the distribution of the main confounding factors was the same in the study sample and the source population.

yes	1
no	0
unable to determine	0

13. *Were the staff, places, and facilities where the patients were treated, representative of the treatment the majority of patients receive?*
For the question to be answered yes the study should demonstrate that the intervention was representative of that in use in the source population. The question should be answered no if, for example, the intervention was undertaken in a specialist centre unrepresentative of the hospitals most of the source population would attend.

yes	1
no	0
unable to determine	0

Internal validity - bias

14. *Was an attempt made to blind study subjects to the intervention they have received ?*
For studies where the patients would have no way of knowing which intervention they received, this should be answered yes.

yes	1
no	0
unable to determine	0

15. *Was an attempt made to blind those measuring the main outcomes of the intervention?*

yes	1
no	0
unable to determine	0

16. *If any of the results of the study were based on "data dredging", was this made clear?*
Any analyses that had not been planned at the outset of the study should be clearly indicated. If no retrospective unplanned subgroup analyses were reported, then answer yes.

yes	1
no	0
unable to determine	0

17. *In trials and cohort studies, do the analyses adjust for different lengths of follow-up of patients, or in case-control studies, is the time period between the intervention and outcome the same for cases and controls ?*
Where follow-up was the same for all study patients the answer should yes. If different lengths of follow-up were adjusted for by, for example, survival analysis the answer should be yes. Studies where differences in follow-up are ignored should be answered no.

yes	1
no	0
unable to determine	0

18. *Were the statistical tests used to assess the main outcomes appropriate?*
The statistical techniques used must be appropriate to the data. For example non-parametric methods should be used for small sample sizes. Where little statistical analysis has been undertaken but where there is no evidence of bias, the question should be answered yes. If the distribution of the data (normal or not) is not described it must be assumed that the estimates used were appropriate and the question should be answered yes.

yes	1
no	0
unable to determine	0

19. *Was compliance with the intervention/s reliable?*
Where there was non compliance with the allocated treatment or where there was contamination of one group, the question should be answered no. For studies where the effect of any misclassification was likely to bias any association to the null, the question should be answered yes.

yes	1
no	0
unable to determine	0

20. *Were the main outcome measures used accurate (valid and reliable)?*

For studies where the outcome measures are clearly described, the question should be answered yes. For studies which refer to other work or that demonstrates the outcome measures are accurate, the question should be answered as yes.

yes	1
no	0
unable to determine	0

Internal validity - confounding (selection bias)

21. *Were the patients in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited from the same population?*
For example, patients for all comparison groups should be selected from the same hospital. The question should be answered unable to determine for cohort and case-control studies where there is no information concerning the source of patients included in the study.

yes	1
no	0
unable to determine	0

22. *Were study subjects in different intervention groups (trials and cohort studies) or were the cases and controls (case-control studies) recruited over the same period of time?*
For a study which does not specify the time period over which patients were recruited, the question should be answered as unable to determine.

yes	1
no	0
unable to determine	0

23. *Were study subjects randomised to intervention groups?*
Studies which state that subjects wererandomised should be answered yes except where method of randomisation would not ensure random allocation. For example alternate allocation would score no because it is predictable.

yes	1
no	0
unable to determine	0

24. *Was the randomised intervention assignment concealed from both patients and health care staff until recruitment was complete and irrevocable?*
All non-randomised studies should be answered no. If assignment was concealed from patients but not from staff, it should be answered no.

yes	1
no	0
unable to determine	0

25. *Was there adequate adjustment for confounding in the analyses from which the main findings were drawn?*
This question should be answered no for trials if: the main conclusions of the study were based on analyses of treatment rather than intention to treat; the distribution of known confounders in the different treatment groups was not described; or the distribution of known confounders differed between the treatment groups but was not taken into account in the analyses. In non-randomised studies if the effect of the main confounders was not investigated or confounding was demonstrated but no adjustment was made in the final analyses the question should be answered as no.

yes	1
no	0
unable to determine	0

26. *Were losses of patients to follow-up taken into account?*
If the numbers of patients lost to follow-up are not reported, the question should be answered as unable to determine. If the proportion lost to follow-up was too small to affect the main findings, the question should be answered yes.

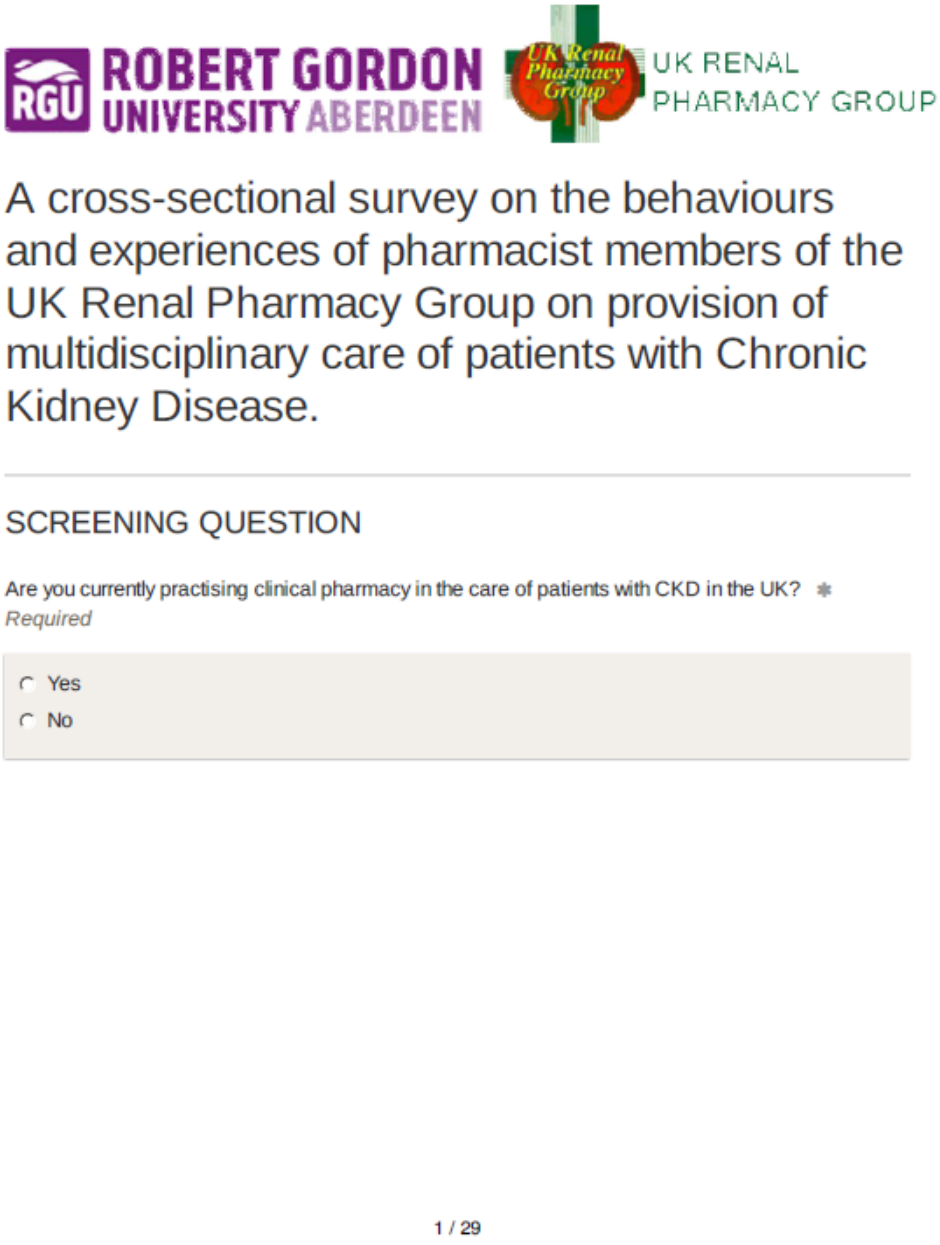
yes	1
no	0
unable to determine	0

Power

27. *Did the study have sufficient power to detect a clinically important effect where the probability value for a difference being due to chance is less than 5%?*
Sample sizes have been calculated to detect a difference of x% and y%.

	Size of *smallest* intervention group	
A	$<n_1$	0
B	n_1–n_2	1
C	n_3–n_4	2
D	n_5–n_6	3
E	n_7–n_8	4
F	n_8+	5

Appendix 4.1: The survey tool snapshot



ROBERT GORDON UNIVERSITY ABERDEEN

UK RENAL PHARMACY GROUP

A cross-sectional survey on the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease.

SCREENING QUESTION

Are you currently practising clinical pharmacy in the care of patients with CKD in the UK? *

Required

- Yes
- No

1 / 29

Appendix 4.2: Pilot Launching e-mail

Pilot Launching email

Dear UKRPG members

It gives me pleasure to invite you to participate in the piloting of a survey. This survey is part of my PhD and is being done collaboratively between UKRPG and Robert Gordon University.

The aim of this survey is to in determine the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease.

It will take approximately 20 minutes to complete the survey and we will appreciate a response before 20th of August 2018.

By way of thanks, you will be able to opt in to a Prize draw for a £50 Amazon voucher at the end of the survey.

Your response is very important to us in order to further improve the content and the layout before launching the actual survey to the members of the UKRPG.

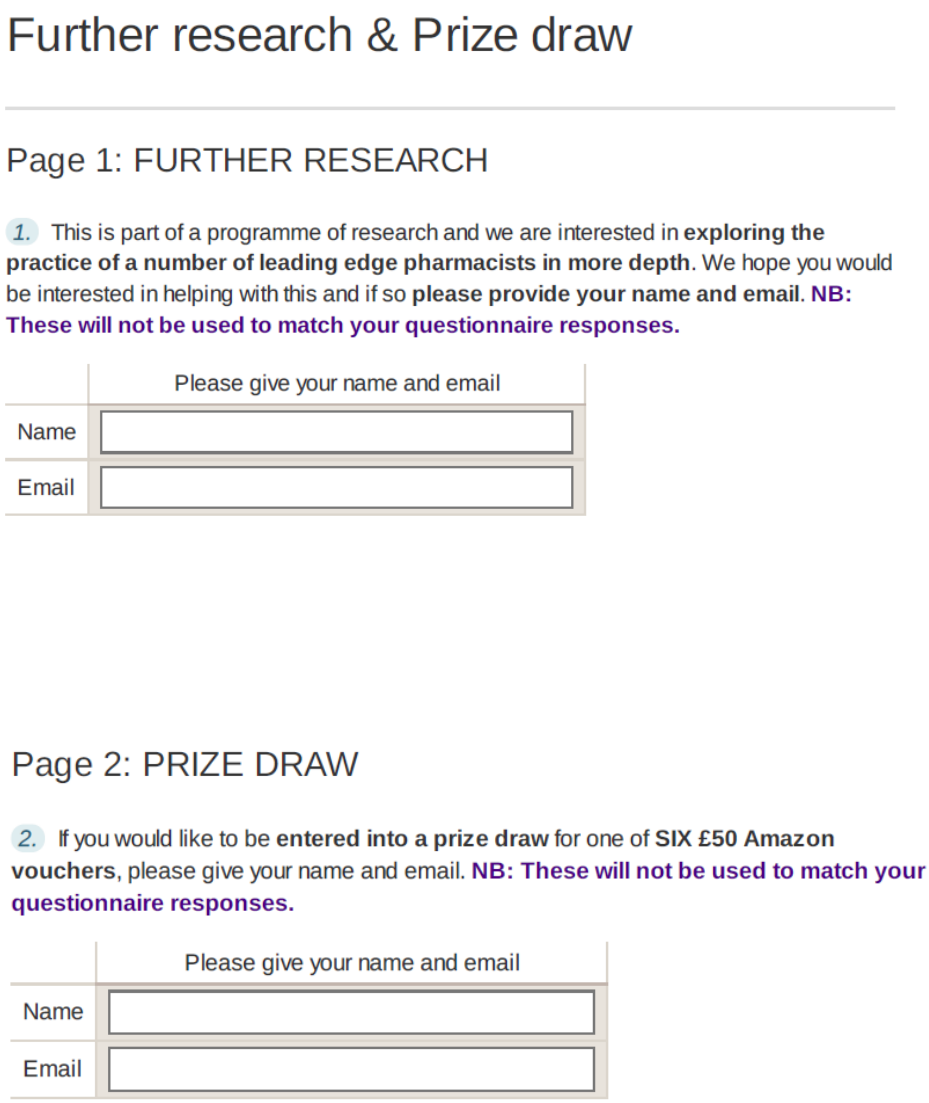
Please click the link below to access the survey:

ACCESS SURVEY

Thank you very much for your support and help.

Fatma Al Raiisi

Appendix 4.3: Further research and prize draw form snapshot



Further research & Prize draw

Page 1: FURTHER RESEARCH

1. This is part of a programme of research and we are interested in **exploring the practice of a number of leading edge pharmacists in more depth**. We hope you would be interested in helping with this and if so **please provide your name and email**. **NB: These will not be used to match your questionnaire responses.**

	Please give your name and email
Name	
Email	

Page 2: PRIZE DRAW

2. If you would like to be **entered into a prize draw** for one of **SIX £50 Amazon vouchers**, please give your name and email. **NB: These will not be used to match your questionnaire responses.**

	Please give your name and email
Name	
Email	

Appendix 4.4: Survey launching e-mail

Survey launching email

Dear UKRPG members

It gives me pleasure to give you advance information of an upcoming online survey that will be sent to all member of the UKRPG. This survey is part of my PhD and is being done collaboratively between UKRPG and Robert Gordon University.

The aim is to in determine the **behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease**.

Your input will be very valuable to us. It will help us understand what services are being provided and how we can plan to improve things further in the future.

We will be sending out invitation emails with a direct link to the survey in the next few weeks. Please look out for it.

By way of thanks, you will be able to opt in to a Prize draw for a £50 Amazon voucher at the end of the survey.

Please do consider completing the survey once it is launched.

Thank you very much for your support.

Fatma Al Raiisi

Research Team

Fatma Al Raiisi, Ass. Professor Caroline Ashley, Dr Scott Cunningham, Professor Derek Stewart and Professor Moustafa Fahmy.

Appendix 4.5: First reminder e-mail

Gentle reminder

Dear UKRPG members, it was great seeing some of you at the conference last weekend and thanks for everyone who have completed the survey so far. Please accept my apologies for receiving this reminder again but unfortunately for the sake for data protection we cannot separate the names of those who completed from those who did not yet. So please ignore this email if you have completed the questionnaire.

Dear members please do consider completing the questionnaire for mutual benefit to the renal services in the UK and globally. It will take approximately 20 minutes to complete the survey and we will appreciate a response before **31st October 2018**.

By way of thanks, you will be able to opt in to a Prize draw for a £50 Amazon voucher at the end of the survey.

We value your response and participation towards the best of renal pharmacy services within the UK and globally.

Please click the link below to access the survey:

ACCESS SURVEY

Thank you very much for your support and help.

Fatma Al Raiisi

Research Team

Fatma Al Raiisi, Ass. Professor Caroline Ashley, Dr Scott Cunningham, Professor Derek Stewart and Professor Moustafa Fahmy.

Appendix 4.6: Second reminder e-mail

Gentle second reminder

Please could I encourage you, if you haven't already, to complete the on-line research questionnaire which is part of an RPG members PhD, looking at behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease. RPG member input is imperative to this research and which could ultimately benefit the renal pharmacy workforce. Many thanks for your support.

Andrea Devaney

RPG Chair

Dear UKRPG members, Thank you for all who completed the questionnaire so far, we received 45 responses corresponding to 32% of the members. This is an important study to allow full description and understanding of pharmacist input to the care of renal patients. To be able to generate meaningful data we are aiming for a response rate of 50% or more. Please if you didn't already completed the questionnaire, do spare 20 minutes for the sake of this important research with mutual benefit to all members and the profession.

Please accept my apologies for receiving this reminder again but unfortunately for the sake for data protection we cannot separate the names of those who completed from those who did not yet. So please ignore this email if you have completed the questionnaire.

We will appreciate a response before 31st October 2018.

By way of thanks, you will be able to opt in to SIX Prize draw for a £50 Amazon voucher at the end of the survey.

We value your response and participation towards the best of renal pharmacy services within the UK and globally.

Please click the link below to access the survey:

ACCESS SURVEY

Thank you very much for your support and help.

Fatma Al Raiisi

Research Team

Fatma Al Raiisi

Ass. Professor Caroline Ashley

Dr Scott Cunningham

Professor Derek Stewart

Professor Moustafa Fahmy

Appendix 4.7: School of Pharmacy and Life Sciences ethics approval for the survey

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Robert Gordon University
Sir Ian Wood Building
Garthdee Road
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AB10 7GJ
United Kingdom
Tel: 01224 262500/2800
www.rgu.ac.uk

Ref: S130

16 May 2018

Dear Fatma

Re.: A theoretically based cross-sectional survey on the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease.

The School Research Ethics Committee has assessed the amendments you submitted and the overall decision is that there are no ethical issues with your project.

I can now confirm that you are able to proceed with your research and any further ethics applications.

Should there be any further amendments to this project during the research we would advise you to consult with the convener of the ethics committee as to whether a further ethical review would be required.

We wish you success with your project.

Regards

Convener of the School Ethics Review Panel

Appendix 5.1: Interview recruitment e-mail

Interview email

Dear UKRPG member,

Thank you very much for responding previously to a survey on the behaviours and experiences of pharmacist members of the UK Renal Pharmacy Group on provision of multidisciplinary care of patients with Chronic Kidney Disease at the end last year.

You kindly agreed, at the end of the survey, to consider helping with further research to allow us to explore some aspects in more detail. That is why I am contacting you again now.

The final part of this doctoral research will be interviews focused on prescribing practice care of patients with Chronic Kidney Disease.

I would like to carry out and interview with you – over the phone – towards the end of June /start of July 2019.

Please find below a link to a mini survey (It will take only 1 minute to complete it). This is simply complete some demographic and contact information of the participants to enable us to prepare for the interviews.

Mini survey link

Thank you,

Fatma Al Raiisi

Appendix 5.2: Information leaflet

A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK

Research Team

Robert Gordon University Dr Scott Cunningham, Professor Derek Stewart, Mrs Fatma Al Raiisi | **UK Renal Pharmacy Group** Ass. Professor Caroline Ashley| **Oman Pharmacy College** Professor Moustafa Fahmy Mohamed

You are invited to take part in a research study being conducted by Robert Gordon University. We want to explore the service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK. Please take the time to read the following information carefully. It is important that you understand why the research is being done and what it will involve. Please ask if there is anything that is not clear or if you would like more information. Take your time to decide whether or not you wish to take part.

What is the purpose of the study?

We are interested to explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease (CKD) in the UK.

Why have I been chosen?

This invitation has been sent to all pharmacists members of the UK Renal Pharmacy Group who opted in for further research in the previous phase of this doctoral research.

Do I have to take part?

No. Participation in this study is voluntary; you may withdraw at any. To withdraw from the study, please contact the researchers via the contact details below. All data, audio recording and consent forms will be destroyed if you decide you no longer wish to be a part of the study. Your relationship with the research team will not be affected by your decision to take part or if you withdraw.

What will happen to me if I take part?

We will ask for your name, e-mail address and phone number and brief demographic details so that we may contact you about your participation. We will then send you an invitation for the interview and will ask for suitable date, time and place for the interview to be carried out (the interview will take no longer than 45 minutes). Please note, that if you agree, steps will be undertaken to ensure that your confidentiality is protected.

What are the possible benefits of taking part?

There is no direct benefit to you from participating in this study. However, it is possible that findings will help to clarify aspects of developments and implementation of pharmacist prescribing for patients with CKD.

Will my contribution to this study be kept confidential?

All information which is collected about you during the course of the study will be kept confidential. You will not be named in any reports or publications that result from this study.

What will happen to the results of the research study?

A short report of the findings will be made available. The full findings of the study will form part of a PhD and may be published in a health care journal and presented at a conference.

Who is organising and funding the research?

This project is organised by a Robert Gordon University led research team.

Who has reviewed the study?

The study has been reviewed and approved by the School of Pharmacy and Life Sciences Ethics Review Panel.

What next?

Please keep this information sheet for future reference. If you decide you would like to participate in the study, we will contact you on the telephone number you have provided to arrange an interview date and time. We are hoping to conduct the interviews in the coming months and will be in contact in the next few weeks.

What if something goes wrong?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions. If you remain unhappy and wish to complain formally, you can do this by contacting Dr Scott Cunningham from School of Pharmacy and Life Sciences at RGU, by telephone (01224 262533) or via email (s.cunningham@rgu.ac.uk).

On behalf of the research team, thank you for your time and consideration in reading this information sheet. If you have further questions about this study please contact either:

Dr Scott Cunningham

School of Pharmacy and Life Sciences

Sir Ian Wood Building

Robert Gordon University

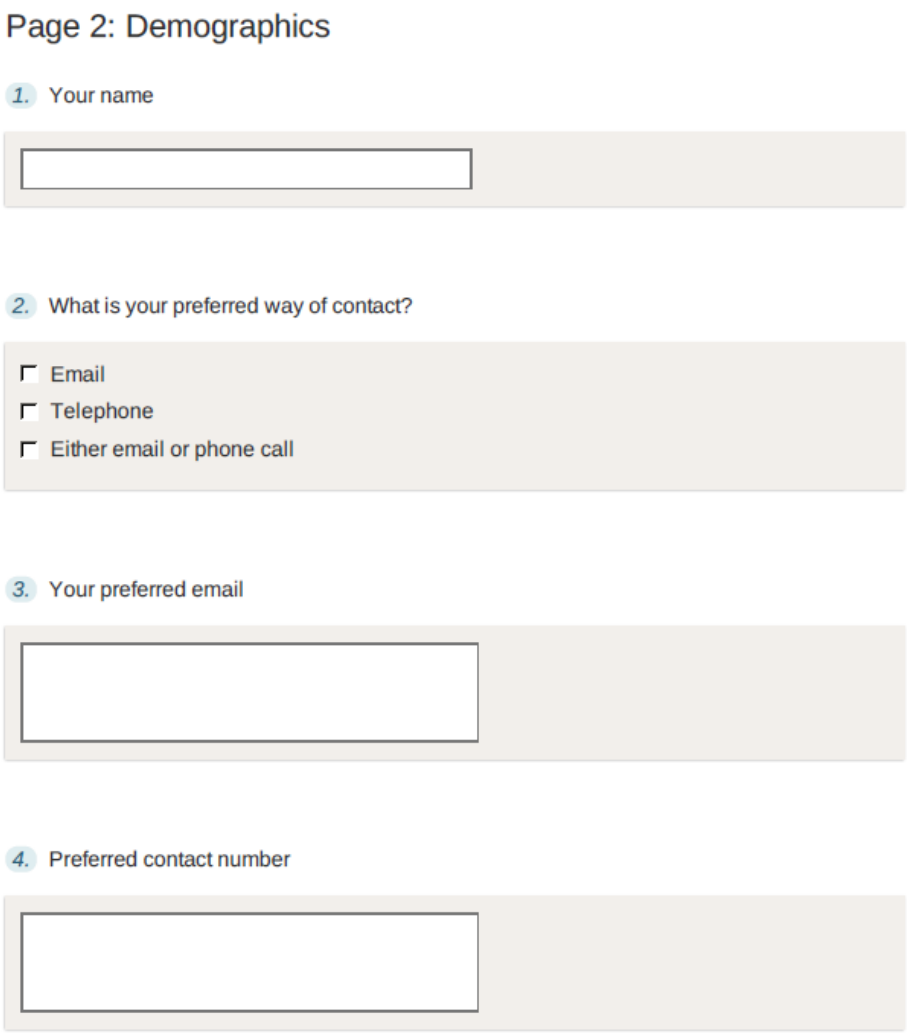
Garthdee Road

Aberdeen

01224 262533

s.cunningham@rgu.ac.uk

Appendix 5.3: Interview participants demographic questionnaire snapshot



Appendix 5.4: Interview consent/copyright forms

Interview consent form

Title of the project: A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

Name of the principal investigator: Fatma Al Raiisi, school of Pharmacy & Life Sciences, The

Robert Gordon University, Aberdeen

Statements of agreement	Tick the box
I confirm that I have read and understand the information sheet dated / /2019 for the above study.	
I understand that my participation includes an interview session lasting 45 minutes.	
I agree that the interview will be audio recorded and transcribed into a paper document.	
I understand that my name will not be included anywhere in the report of the findings.	
I understand that my participation in this study is entirely voluntary and I am free to withdraw at any time without giving a reason.	
I agree to take part in the above study.	

Name of participant Date Signature

_____ _____ _____

Name of Person taking consent Date Signature

(if different from researcher)

_____ _____ _____

Researcher Date Signature

_____ _____ _____

Interview copyright clearance form

Research Project: A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK.

Date: / /2019

Location:

The purpose of this agreement is to ensure that your contribution is used according to best

practice and in strict accordance with your wishes. All material will be preserved for the life

of the research project and may be used in publication, education, lectures, broadcasting

and on the internet.

All contributions will be anonymised and all identifying materials will be stored separately

to preserve anonymity and confidentiality.

I hereby assign the copyright in my contribution to The Robert Gordon University School of

Pharmacy and Life Sciences research project.

Signed_____ Date_____

Name in Block Capitals_____

Appendix 5.5: Semi-structured interview schedule

ROBERT GORDON UNIVERSITY ABERDEEN

Dr Scott Cunningham Prof Derek Stewart
Fatma Al Raiisi

Prof Moustafa Fahmy

A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK

Contact: Dr Scott Cunningham by phone 01224 262533 or email s.cunningham@rgu.ac.uk

SEMI-STRUCTURED INTERVIEW SCHEDULE for UK Renal Pharmacy Group members

*****SWITCH ON THE AUDIO RECORDER***** **Put the phone on 'Speaker phone' (loud speaker button at bottom right on the CISCO RGU phones). Check volume is sufficient for recording.** **Phone the pharmacist: dial '9' for outside line and then the pharmacists phone number.**	**Participant ID code**	**Date**	**Time** **00:00**

A. Introduction

Hello, can I speak to [pharmacist name], please?

IF NO: OK, I had arranged to call at this time. Should I call again in ten minutes or email them to re-schedule?	Write the outcome in your diary chart and take the appropriate action (call back, email)

Hello, [pharmacist name]. I'm [Fatma Alraisi], the doctoral research student from Robert Gordon University ringing / visiting to interview you about your prescribing practice for patients with Chronic Kidney Disease.
Please, can I check you have read the participant information sheet.
The main purpose of this interview is to explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease (CKD) in the UK.
Your participation is voluntary and you may withdraw at any point.
If you do not want to answer a specific question, then please let me know.
There are no right or wrong answers and I am interested in your personal opinion.
The identities of all participants will remain strictly confidential and it will not be possible to identify individuals from the study results.
Are you okay to do the interview now? It will take around 30-40 minutes.

IF NO: That's okay. When would you like me to call back? (offer to email if pharmacist is not sure) Thanks [name]. I'll call again on day/date/time. Bye.	Write the new day/date/time here and in diary chart:

IF YES continue: That's great, thank you.

B. Housekeeping

As you are aware from the information sheet and consent form, this conversation is being audio recorded to make sure that I don't miss important points by relying on my memory or notes but I would emphasise that it is confidential. Are you still OK with that?

IF NO: That's fine. I won't use the audio recorder but I'll need a bit more time to write down notes as we go through the sections and I may ask you to repeat some answers.	Reminders: Make sure the audio recording is activated Take time to write detailed notes If in doubt, ask the pharmacist for clarification before you move on to the next section

If you decide after the interview you no longer wish to be a part of the research, please let us know within the next seven days. The contact details are on the information sheet. ***** IF YES, CHECK THAT AUDIO RECORDING IS ACTIVATED*** Technical problem? Keep calm!** Explain, apologise and rearrange interview day/date/time

Aim

To explore the development, implementation and evaluation of pharmacist prescribing for patients with Chronic Kidney Disease (CKD) in the UK

Objectives

The specific objectives in relation to pharmacists prescribing in CKD:

1. To describe and characterise the models of pharmacist prescribing practice.
2. To explore the facilitators and barriers relating to implementation of pharmacist prescribing.
3. To describe the plans, actions and parameters used for evaluating prescribing practice.
4. To explore plans to develop pharmacist-prescribing practice further.

SECTION 1. Your current prescribing practice

1. Could you please describe your current involvement in prescribing for your patients?

- Can you elaborate more on aspects of that – it may be useful for you to describe a typical week…
  - Resources / Facilities / Funding; who else is involved, where this takes place, length of consultations, pharmacist consultations or team consultations, number of days per week.
  - Processes: sources of information, regular follow-up of patients, documentation, communication channels
- What is your area / areas of prescribing practice; e.g. haemodialysis, transplant
- Which settings – inpatient / outpatient?
- Supplementary / independent prescribing?
- Which medicines / groups do you routinely prescribe?

2. **We are interested to know more about the background and development of your practice as a prescriber -where have you worked/trained, who has influenced you along the way:**

- After you qualified as a prescriber - Can you outline the steps in your development to your current level of practice – Initially: which areas, how much time, and any supervision / ongoing: how did things develop /change over time?
- How do you feel prescribing fits within other aspects of your clinical practice in CKD? e.g. meds rec / review, patient counselling, education / training of others.
- What help did you get – if any – to develop your prescribing practice? From whom: e.g. line manager, colleagues, nurses, doctors. Nature of help: extra staff, mentorship, shadowing / observation of others, suggestions for reading, support at meetings etc)

SECTION 2. CFIR Constructs

CFIR: intervention characteristics

3. **We are interested to understand what you feel are the key things/factors that have influenced implementation of prescribing practice, generally and in relation to your own practice.**

- In our survey – that you completed - 56% of the pharmacists who responded felt there is need for more evidence for the benefits of pharmacist prescribing for patients with CKD, how does this relate to you? What do you think of this response? How do you feel you have used evidence to develop your practice?
- How do you feel that your prescribing has changed your practice? What about the impact on patients?
  Do you feel that your prescribing practice has changed or developed since you started? If so – why, in what way, and how easy was this?
- What are your views on the complexity of your prescribing practice: consider clinical (complex patients) and non-clinical (complexity in logistics)
- What about the costs and savings associated with providing a prescribing practice for patients with CKD – do you feel the health service get 'value for money'?

CFIR: characteristics of individuals

4. **Prescribing practice is based on the actions and behaviours of individuals within a multidisciplinary team. How do you feel your personal characteristics have helped develop and implement prescribing practice for CKD.**

- Outline how you feel you complement other in the multidisciplinary team in relation to your prescribing in CKD; what knowledge, beliefs and skills do you have

- How confident are you that your clinical knowledge and prescribing skills can make a difference. Why is this?

- Are you considering developing or changing any aspects of your prescribing practice? Why is this? How supportive do you feel your workplace is to your prescribing practice?

- Can you tell me about any other traits or personal characteristics you have that suit you to prescribing practice? Things like motivation, values, learning style, confidence (only give the prompts if needed)

CFIR: process

5. **We are interested in the actual steps taken in the development and implementation of pharmacist prescribing for CKD in your organisation generally and your own practice.**

- How was pharmacist prescribing planned for and implemented within your organisation?
- How were you and colleagues involved with this? What about multidisciplinary team members?
- Were there any particular 'project champions' allocated at all? If so, who were they?
- Was there any external influence on this?
- How do you assess or evaluate your prescribing practice in term of safety, effectiveness, cost effectiveness?
- Prompt; peer review, analysis of prescribing data, audits …. any formal, informal, how select, any research etc

CFIR: outer setting

6. **What about external influences on the development and implementation of pharmacist prescribing in your organisation generally and in your own prescribing practice?**

- More than half the respondents felt that colleagues in other organisations are ahead in implementing pharmacist prescribing in their practice, what do you think about that? Why do you think it is right? What do you think they do better then you?

- Does any external body or organisation influence your prescribing practise? How this supports the advancement of your practice – if at all? e.g RPS, UKRPG, BRA, NES, CPPE, NPC, GPhC etc

- Can you tell me about any other external factors affecting your prescribing practice?

CFIR: inner setting

7. **We are keen to explore the barriers or facilitators, within your organisation, that have helped or hindered the development of prescribing practice generally and in your own practice.**

- What factors within your organisation do you feel have helped or hindered developments?
  - MDT team make-up, expertise, experience
  - maturity of nonmedical prescribing practice in organisation
  - identified need / strong drivers for change
  - Lack of 'fit' of your prescribing practice with others e.g. junior doctors?
  - Pharmacy and other management support

- Thinking about communication within your organisation around the development of prescribing practice, do you think that; had any impact. e.g. bulletins, email circulars, meetings, informal networks.
- Do you receive any support for your prescribing role?
  - Prompt: colleagues, peers, administration
- What more could your organisation / employer do to help enhance your practice?

- How do you feel the 'culture' helps or hinders development of prescribing practice - within the organisation?

- What about how nonmedical prescribing is welcomed, encouraged, supported?

- One of the main issues raised in the questionnaire study phase of this work was what happens to cover prescribing practice when a colleague is absent / away. Can you outline what happens in your organisation?

General final questions

8. What do you feel works very well and what needs to improve regarding your prescribing practice?

9. What advice you would give to others who are considering setting up a prescribing service? Are there any pitfalls you should avoid?

10. How you see your prescribing practice developing in future?

11. Is there anything else you would like to add about your prescribing practice for patients with CKD?

Appendix 5.6: School of Pharmacy and Life Sciences ethics approval for the interviews

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Sir Ian Wood Building
Garthdee Road
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United Kingdom
Tel: 01224 262500/2800
www.rgu.ac.uk

26th February 2019

Dear Fatma

Re.: A qualitative service evaluation of pharmacist prescribing for patients with Chronic Kidney Disease in the UK

The School Research Ethics Committee has assessed your application and the overall decision is that there are no ethical issues with your project.

I can now confirm that you are able to proceed with your research and any further ethics applications.

Should there be any amendments to this project during the research we would advise you to consult with the convener of the ethics committee as to whether a further ethical review would be required.

We wish you success with your project.

Regards

Dr Colin Thompson
Convener of the School Ethics Review Panel