UNIVERSITY OF HULL

THE FACTORS IMPACTING CRITICAL CARE NURSES' DECISION-MAKING PROCESSES IN CONTINUOUS RENAL REPLACEMENT THERAPY

being a thesis submitted in fulfilment of the

requirements for the degree of

Doctor of

Health Studies

in the University of Hull

by

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August 2022

Acknowledgements

Firstly, I would like to thank my supervisors, Dr Judith Dyson, Dr Moira Graham, Dr Tim Alexander and Dr Mary Laurenson for their ongoing insights, encouragement, and patience over the course of this submission. I will be forever grateful for all your help in getting me over the line.

I would also like to thank my wife, Leanne and children Mia, Lucy and Alex for their help and motivation in producing this work, I could not have done it without them. I am especially grateful for Leanne's patience and her ability to turn a blind eye to my 'filing system'.

I am also grateful to my parents, Dale and Ken, for their support and encouragement over the years. I just wished I had got on with it, so my dad could have seen the finished product, (not that he would have understood a word of it).

Thank you also to the Intensive Care Foundation Fellowship for Nurses and Allied Health Professionals for the grant award which enabled me to deliver this work.

Finally, to all my colleagues and the willing participants, thank you for taking the time out of your busy lives to spend it with me talking about Continuous Renal Replacement Therapy, without you there would be a lot of empty pages.

Dissemination Plan

Oral Presentations- Delivered

Smith N, Laurenson M, Alexander T. Contemporary exploration of Critical Care Professionals Decision making. Sigma Theta Tau International Biennial European Conference. Cambridge. June 2018.

Smith N, Laurenson M, Alexander T. Continuous Renal Replacement Therapy and the Factors that Determine Nurses' Management. AKI & CRRT Conference, San Diego, March 2019

Conference Poster Presentation/Abstracts - Delivered

Smith N, Alexander T, Dyson J. An Exploration of Critical Thinking in non-newly registered Critical Care Nurses. Presented by NS – BACCN Virtual Conference, September 2020.

Smith N, Laurenson M, Alexander T. Continuous Renal Replacement Therapy and the Factors that Determine Nurses' Management. Presented by NS – AKI and CRRT 2019, San Diego, USA. March 2019.

Smith N, Laurenson M, Alexander T. What influences health care practitioners' decision making in Critical Care? Presented by NS – Faculty of Health and Social Care, University of Hull, PhD Spotlight Conference. January 2017

Abstract

Introduction

Continuous Renal Replacement Therapy (CRRT) is a common treatment intervention in critical care units worldwide. It provides supportive therapy for critically ill patients with severe kidney dysfunction. Efforts to optimise its clinical effectiveness through modifying treatment regimens over recent years have proved largely unsuccessful. However, studies have not explored the human element of critical care nurses delivering CRRT.

Aim

This study is designed to understand the influences on critical care nurses' decision-making in the management of CRRT. In doing so, develop and highlight areas where modifications in practices can be adopted, in order to improve both the patient and organisational quality indicators associated with CRRT delivery.

Methods

This study used an adaptive Interpretive Description approach. The study was conducted across four linked United Kingdom critical care units. Twenty- one (n=21) registered critical care nurses undertook the California Critical Thinking Disposition Inventory (CCTDI) and of these, 10 nurses were interviewed face to face in semi-structured audio recorded interview, which were then transcribed and thematically analysed.

Results

Four major themes influencing critical care nurses decision-making regarding CRRT were identified, with a further two contributing an overarching influence. These themes were the Individual; Organisational; Practice; Support, these themes were complex and intertwined and in themselves highlighted issues about Variability and Competing demands whilst delivering CRRT.

Discussion

The themes in this study showed an alignment with some of the findings from other critical care decision-making studies, including the influence of the individual nurse, experience, and support. However, this work has also been able to introduce significant new knowledge on the perceptions and insights of critical care nurses. These findings generate new knowledge and contextualise these understandings of individuals, the organisations, the wider interactions, and relationships between colleagues, and the CRRT technology, and provide insights to enable a holistic approach to understanding the provision of CRRT and potentially enable

improvements in treatment delivery. In understanding these aspects, it has elucidated avenues for improvements in practice, identifying areas that can be engineered to improve CRRT practice and characterises elements within individuals which contribute to CRRT delivery.

Recommendations

This study draws up a number of recommendations from the themes identified, these recommendations focus on the 'Individual' and the 'Organisational' themes. They include the introduction of a harmonised training, educational and competency programmes with integrated in situ hi-fidelity simulation provision, alongside bespoke high quality clinical supervision, to facilitate critical care nurses self-awareness.

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Abbreviations

A and E	Accident and Emergency Department
ACCP	Advanced Critical Care Practitioner
ADQI	Acute Disease Quality Initiative
AfC	Agenda for Change
APTT	Activated Prothrombin Time
CCTDI	California Critical Thinking Disposition Inventory
CFAM	Cerebral Function Analysing Monitor
CRRT	Continuous Renal Replacement Therapy
DipHE	Diploma in Higher Education
ERBP	European Renal Best Practice
ICNARC	Intensive Care National Audit and Research Centre
ICU	Intensive Care Unit
KDIGO	Kidney Disease: Improving Global Outcomes
KRT	Kidney Replacement Therapy
NHS	National Health Service
NIV	Non-Invasive Ventilation
NMC	Nursing and Midwifery Council
SHO	Senior House Officer
TMP	Trans Membrane Pressure
U's & E's	Urea and Electrolyte blood test

Glossary

Adsorption	Adherence of molecules to the semipermeable membrane.
Balloon Pump	Slang for Intra-Aortic Balloon pump, an intravenous vascular catheter inserted into the aorta of a patient to augment their cardiac output
Convection	The movement of molecules across a semipermeable membrane during Ultrafiltration.
Diffusion	The movement of molecules from a high concentration to low.
Enteral	Feeding or administration by the normal digestive process (usually via tube).
Extracorporeal	Procedure undertaken outside the body.
Fresenius	Fresenius-Kabi, a healthcare company providing products and services for dialysis.
Hyperkalaemia	Excessive concentration of Potassium in blood.
Iatrogenic	Illness caused by medical intervention.
Inotropes	Medications used to affect cardiac muscle contractions
Norad [sic]	Slang for Noradrenaline/Norepinephrine a vasoactive medication
Obs [sic]	Clinical Observations
Oliguria	The production of abnormally small amounts of urine.
Prismaflex	The Prismaflex System (Baxter Healthcare) delivers all therapy modalities of Continuous Renal Replacement Therapy.
SOPs	Standard Operating Procedures

Swan Ganz Catheter	A central intravascular catheter inserted through the patient's heart in order to measure cardiac output and a range of other haemodynamic parameters
T:I Ratio	Total to ionized Calcium ratio, a measure to assess systemic citrate accumulation.
Thromboembolic	Pertaining to formation of a clot, which then becomes free flowing in the circulatory system.
Ultrafiltration	Movement of fluid through a semipermeable membrane.
Vascath	Vascular Access Catheter used for renal replacement therapies.

Chapter 1 Introduction

1.1 Background.

Most decisions within critical care units are complex and multi-faceted, with processes often involving a wide range of professionals throughout a patient's critical care stay. Advances in the supportive interventions associated with increased patient acuity means that timely, effective, and efficient decisions need to occur to provide the best standard of care (Lighthall and Vazquex-Guillamet, 2015).

One common intervention that highlights these issues, within critical care, is the use of Continuous Renal Replacement Therapy (CRRT). Whilst CRRT is a medically initiated intervention, it is predominantly a nurse-managed process. The intervention is labour intensive, and, in the UK, guidance suggests it requires a minimum patient/nurse ratio of 1:1 (Faculty of Intensive Care Medicine and The Intensive Care Society, 2022). This makes it costly both in nursing time - requiring trained and experienced clinicians, but also in the cost of consumables. CRRT is also inherently risky, predisposing patients to infection risks, medication errors, inefficient treatments, and the occurrence of thromboembolic events (Finkel and Podoll, 2009).

There is a plethora of high-profile research investigating the clinical utility of CRRT in critical care (Ronco et al, 2000; Bagshaw et al, 2008; RENAL Study Investigators, 2009; Karvellas et al, 2011). These studies are focused on the techniques and characteristics of the treatment provisions used, and the subsequent clinically associated outcomes. Yet little research into the influence of the human elements associated with CRRT provision and the role of the individual/organisation has been undertaken.

This research will centre on health professionals' involvement in providing CRRT, focussing on exploring the influences on their clinical decision-making during its provision.

1.2 Kidney Replacement Therapy Modalities.

CRRT is not the only form of Kidney Replacement Therapy (KRT) available. There are two main modalities: peritoneal dialysis or extracorporeal.

1.2.1 Peritoneal Dialysis

Peritoneal dialysis (PD) consists of a catheter being inserted through the peritoneum and then a dialysate fluid being introduced into the cavity to elicit solute and fluid movement via osmosis (Vardhan & Hutchison, 2014). PD is particularly useful for patients where there is haemodynamic instability, the need to avoid vascular access or to aid mobility (Ponce et al, 2017). However, it has a

lesser ability for solute clearance and volume control (Cerdá & Ronco, 2016), making its utility in sicker patients limited, due to the rapidly escalating fluid retention, electrolyte dysfunction and the subsequent clinical manifestations associated with these, like cardiac arrythmias and respiratory failure.

1.2.2 Extracorporeal Blood Purification

The extracorporeal modalities of blood purification are forms of haemodialysis. These are more suited when there is a requirement for clinical urgency or the need to be more efficient in removing solutes or fluid from patients. This extracorporeal process of blood purification is designed to mimic the function of the kidney for extended periods (Bellomo, 2006).

1.2.2.1 Intermittent HaemoDialysis

Intermittent HaemoDialysis (IHD) is most often performed in an outpatient scenario for around 3-to-4-hour periods, up to three times a week. The intermittent approach is the mainstay for individuals suffering from stable chronic kidney failure and offers the potential for bridging to transplantation where appropriate. Access to the patients vascular system is most frequently via an arteriovenous fistula (specifically created for long term vascular access).

1.2.2.2 Continuous Renal Replacement Therapy (CRRT)

Unlike the intermittent modalities, CRRT is usually performed 24 hours per day. Blood is removed from the patient via a dedicated dual lumen intravascular catheter and mechanically pumped through a filter, where waste and water are removed, via the processes of convection, diffusion, ultrafiltration, and absorption. Blood is returned to the patient via the alternate lumen on the intravascular catheter (See Figure 1 Schematic of CRRT (From Tolwani, 2012, p2508)). The provision of the continuous approach is complex and involves a highly specialised nursing workload (Langford et al, 2008).

The Continuous Renal Replacement Therapy treatment option is widely used in critical care areas around the world, primarily to treat Acute Kidney Injury (AKI), along with other infrequent non-renal indications. There are many indications for CRRT use in AKI, including hyperkalaemia, severe metabolic acidosis, oliguria, and uremic control. The other potential non-renal indications include sepsis, removal of ingested toxins, temperature control, and raised intracranial pressure (Intensive Care Society, 2009; Tolwani, 2012). Continuous Renal Replacement Therapy is particularly valuable in the haemodynamically unstable patient, whereas Intermittent Haemodialysis may exacerbate these problems (Richardson & Whatmore, 2015; Graham & Lischer, 2011).

There remains ongoing debate on the utility of both these treatments in the ICU. IHD is the dominant modality in the United States, whereas within Australasia, United Kingdom, and the rest of Western Europe, CRRT is the typical modality used. In the UK >95% of ICUs used CRRT (Gould et al, 2022) and in a multinational week-long observational study, Hoste et al (2015) identified that 75% of KRT sessions used a continuous modality. This worldwide variability and ultimately clinicians choice of KRT is determined based on individual patient need (Cerdá and Ronco, 2016), culture, resources, and expertise (Intensive Care Society, 2009; Bellomo & Schneider, 2014). It may also be due to knowledge gaps in best practice, availability of different CRRT modalities, together with a lack of quality measures for CRRT care (Rewa et al, 2015).

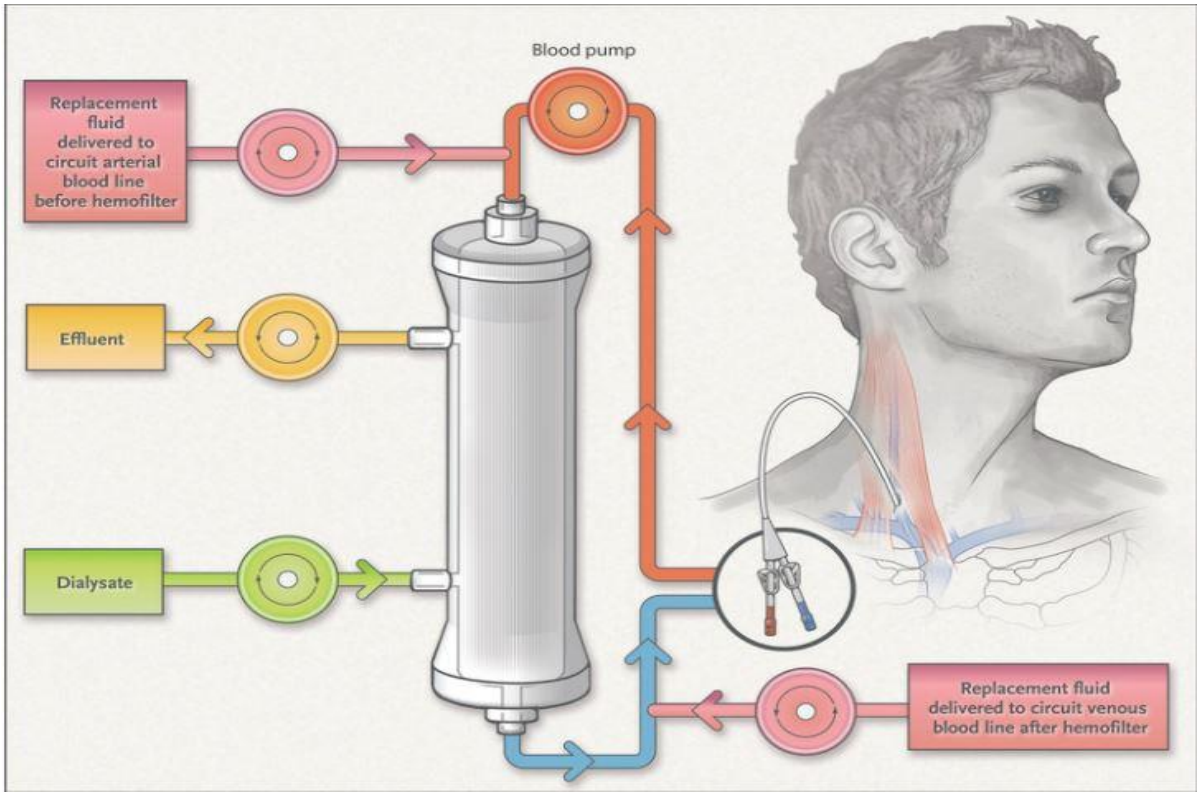

Figure 1 Schematic of CRRT (From Tolwani, 2012, p2508)

In the UK, the most recent data available is from the 2018-2019 Intensive Care National Audit and Research Centre's (ICNARC) Case Mix Programme, it indicates that approximately 10% (n=17,679) of all ICU admissions required a form of KRT, this equated to a total of 94,394 days of support which was equivalent to 9.8% of all patient days in critical care areas (ICNARC, 2019).

Prior to the COVID 19 pandemic, the need for renal replacement therapy has been observed in up to 13.5% of ICU patients (Hoste et al, 2015). In the early phases of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic in China, CRRT use increased and was noted to occur in 5.6% to 61% of patients across Chinese ICUs (Baduashvili et al, 2020).

1.2.3 Models of care provision for CRRT

Three models of CRRT provision are described by Martin (1997) and Graham and Lischer (2011), these largely detail the nursing infrastructure required to support the delivery of CRRT. Although, they are closely intertwined with the medical support offered.

- The Nephrology model uses the nephrology nurses to care for the CRRT system 24 hours a day, 7 days a week, and relies on renal physicians to prescribe treatment, whilst the critical care team manage everything else. This is the preference for critical care units with infrequent CRRT usage and lack of access to outpatient renal services. It can become cost prohibitive with the requirement of two nurses at the bedside (Martin, 1997).
- The Critical Care model assumes the responsibility for the provision of CRRT lies with the critical care nurses and physicians. Whilst this model enables expedited initiation of treatment, it can become an encumbrance when trying to address many other aspects of the patient care. Critical care sites with regular exposure and expertise in CRRT adopt this method, however it is reliant on maintaining both skills and staff within departments.
- A Collaborative model offers joint nephrology and critical care responsibilities. The nephrology role varies from providing advice or performing agreed aspects of CRRT. Whilst this model enables a high level of expertise in patient management, roles and responsibilities become ambiguous and priorities vary.

Much like the variation between CRRT and IHD, worldwide there appears to be discrepancies in the provisions of these services. Moreover, at a national level, model preferences were identified as variable (Italy, Ricci et al, 2016; UK, Wright et al, 2003; Australia, RENAL study Investigators, 2008).

There is limited evidence describing organisations' decision-making when adopting these models. Furthermore, there is little research to describe the effect these models have on patient outcomes. In an observational study by Cole et al (2000) they looked at data from three critical care units which newly adopted a critical care CRRT provision model, and found actual mortality was 10% lower than the predicted mortality and that only 11 patients became dialysis dependent at discharge. This difference in outcomes was attributed to a systems approach and a practice effect which was associated with the ability for critical care staff to carefully monitor and act aggressively to take

preventative measures. The authors believed this demonstrated both the safety and efficacy of this approach. Mottes et al (2013) also looked at quality measures when transitioning from a collaborative approach to a critical care led one, and highlighted a greater lifespan in CRRT filters, albeit after the instigation of a hi-fidelity simulation educational package. The benefits of increasing the lifespan of the CRRT filters has ramifications for cost effectiveness and also a potential in reducing patients exposure to further risk by preventing unnecessary filter changes.

However, neither the Kidney Disease Improving Global Outcomes (KDIGO) group (2012) nor the European Renal Best Practice Group (ERBP) recommendations (Jörres et al, 2013) refer to the overarching model of provision for CRRT care within critical care units, leaving decisions to clinicians and organisations.

1.2.4 Current UK practice

Specific UK practice advocates the provision of KRT (including CRRT) in critical care areas are based on Guidelines for the Provision of Intensive Care Services (V2.1) (Faculty of Intensive Care Medicine and The Intensive Care Society, 2022). These in turn advocate adherence to the KDIGO (2012) and National Institute for Heath and Care Excellence (NICE) recommendations (CG169, 2013) and subsequently replaced by NG148 (2019).

1.3 The Future of CRRT.

Ronco et al (2015) describe the ideal future renal replacement technology as using an adaptive control model (see Figure 2). It describes the salient interactions between the patient, CRRT equipment, and treatment delivery. The information from these concepts is currently synthesised by the practitioner at the patient's bedside, and clinical decisions and judgements are ultimately made to facilitate treatment delivery.

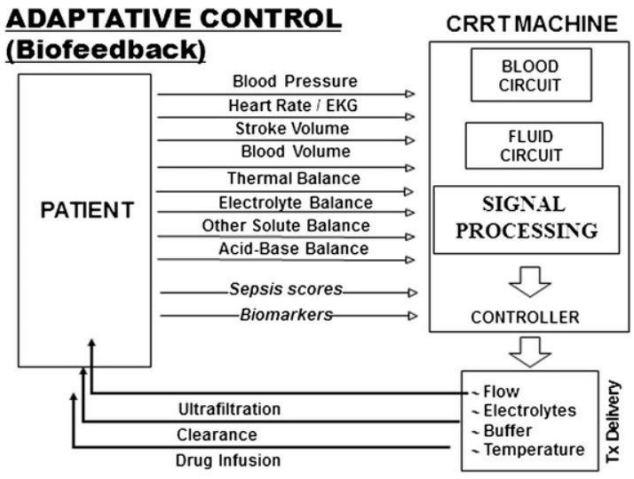

Figure 2 The 'ideal' future renal replacement technology (From Ronco et al, 2015).

This model was further refined by the Acute Disease Quality Initiative, demonstrating the flows of data and information. It highlights specifically the 3 means of biofeedback; Automatic, Authorised and Manual (Figure 3). Two of which need input from a nurse, indicating that whilst the future technological advances within health care will become automated,

human interaction remains important. Therefore, understanding the role and influences on the nurse delivering CRRT is important now.

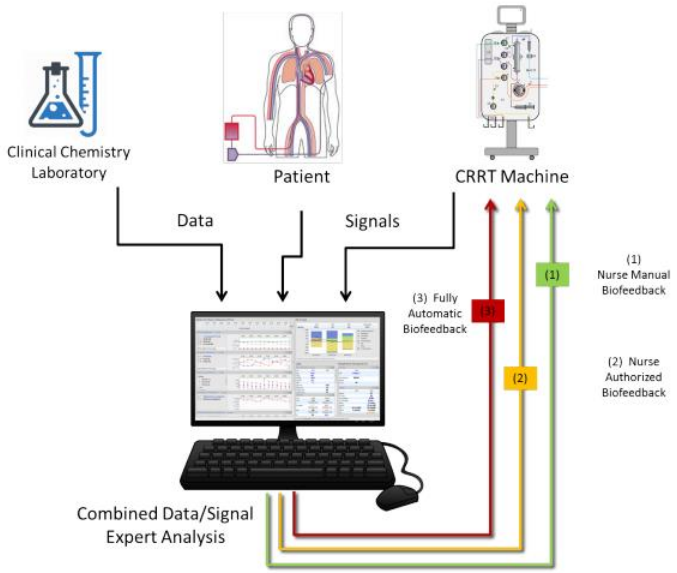

Figure 3 Different options for CRRT Feedback (From ADQI, 2016)

1.4 Rationale for investigating the human elements of CRRT.

Healthcare provision and interventions are complex, they often comprise of ill-defined boundaries, staff using internalised mental rules and models, along with nonlinear and unpredictable interactions (Plesk and Greenhalgh, 2001). Critical care areas are no different, with Drews (2013) identifying that failing to acknowledge that critical care units are a complex sociotechnical system will result in the failure to improve patient safety and the ICU environment.

Sociotechnical systems in healthcare are contexts where an interactive, interdependent dynamic network of social and technological components are required to enable the delivery of work activities (Noy et al, 2015). Understanding context is of vital importance, Howarth et al (2016) stress that it has remained an understudied concept in comparison to that of specific interventions, and that there is a requirement for a deeper understanding between the interactions of context and interventions and ensuring that the real-world application of an intervention is understood. The provision of critical care and more specifically CRRT falls within this area. In this context theoretically understanding individuals, the organisations, the wider interactions, and relationships between colleagues, and the CRRT technology, would enable a holistic approach to understanding the systems' provision of CRRT and potential enable improvements in treatment delivery.

In practice however, the management of patients undergoing CRRT is multi-faceted and requires ongoing attention to a wide range of patient physiological parameters, in conjunction with continuing observation for complications and evaluation of treatment efficacy. Personal experience and the literature identify that there are variations in the delivery of CRRT. This is unsurprising based on the overtly different delivery models highlighted previously by Graham and Lischer, (2011) and Martin (1997). In addition to these higher-level organisation variances, there are variations in the hands-on treatment provision of CRRT (Connor and Karakala, 2017). These exist because of the current debates over treatment modality, anticoagulation, prescribed and achieved CRRT dosage, timing of CRRT initiation and treatment downtime (Uchino et al, 2003), all of these variations appear to contribute to less favourable outcomes for patients (Elseviers et al, 2010; Tolwani, 2012; Fealy et al, 2015; Tseng et al, 2018).

Accordingly, in recent years there has been a drive to determine Key Performance Indicators (KPIs) for CRRT, to help address the variability in CRRT practice. In doing so, Rewa et al (2017) performed a systematic review of Quality Improvement (QI) initiatives related to CRRT. Whilst they identified that there were programmes in the literature, these predominately focussed on the technological aspects, prescription delivery, training, and outcomes, with less focus on the organisation and human elements involved in delivering CRRT. This is demonstrated through large variations in treatment provision (Cottle et al, 2016; Tolwani, 2012; Uchino et al, 2005 and Vesconi et al, 2009). So, whilst knowledge gaps do remain and there is a significant time lag for research evidence to embed into clinical practice (Morris et al, 2011) there are best practice guidelines available for practitioner to deliver what is considered optimum CRRT.

Continuous Renal Replacement Therapy devices are now sophisticated and able to meet the needs of patients and clinicians in a variety of scenarios. However, despite these improvements in technology and critical care, mortality and morbidity remain high (Uchino et al, 2005; Allegretti et al, 2013; Mehta, 2015). The provision of individual sessions of CRRT are expensive (Benfield et al, 2015) with costs of up to several thousand US dollars per day (depending on the care model employed) and require skilled operators to ensure effective delivery. This expense is compounded by the costs associated with the replacement of extracorporeal circuits, in the event of unplanned interruptions in therapy, and the associated increased workload.

Therefore, a key consideration for all KRT techniques is maintaining the integrity of the circuit to enable adequate solute and fluid management. Interruptions of CRRT are frequent and subsequent downtime is often prolonged (Black et al, 2015). These unplanned and premature interruptions decrease the effectiveness of the therapy and increase costs and workload and become clinically

relevant (Joannidis and Oudemans-van Straaten, 2007; Intensive Care Society, 2009). A role of the critical care nurse is to limit interruptions by ensuring the integrity and patency of the CRRT circuit. These are dependent on a number of interrelated factors, and whilst prevention of premature clotting may sometimes be unavoidable, a number of approaches by the critical care nurse can be taken to minimise its incidence. Such as

- Optimisation of vascular access
- Optimisation of CRRT settings
- Effective anticoagulation
- Training of the nurses

Exploring the understanding of the critical care nurses role in these aspects will shed light on activities that need to be undertaken to prevent any avoidable unplanned interruptions. In particular, slow reactions to pump alarms contributes to stasis of blood flow and early filter clotting (Joannidis and Oudemans-van Straaten, 2007; Richardson and Whatmore, 2014). Whilst these slow reactions may be down to competing priorities for staff time, they may also be related to technical difficulties resolving problems and making clinical decisions. To that end, the continuous nature of CRRT provides greater opportunity for operation by inexperienced personnel, increasing the risk of problems and inefficiencies. The use of standardised protocols and restricting CRRT management to trained individuals limits these operations and aids patient outcomes (Mehta, 2015).

Importantly human elements play a role in patient outcomes through either patient or staff characteristics or behaviours (Bray et al, 2013; Rewa et al, 2015; Roeder et al, 2013). Opgenorth et al (2022) identify that whilst CRRT is delivered as per individual unit protocols the practice related elements of CRRT like anticoagulation, initiation strategies and CRRT dose delivered are inconsistently monitored, it is this lack of monitoring and standardisation that leads to institutional variance and the worsening of patient outcomes. It is conceivable that the documented wide variations in the bedside approach to CRRT management plays a role in patients' outcomes. Mehta (2015) suggests the interplay of the underlying patient characteristics, process of care and external events contribute to these variations and could influence patient outcomes. These potential systems and human elements have an influence on CRRT, and by bringing the theoretical components of CRRT provision mentioned in Ronco et al (2015) and the ADQI (2016) to the bedside in order to deliver effective CRRT is difficult (Cottle et al, 2016). Furthermore, Cottle et al (2016) suggest that removing human elements is important in CRRT to prevent these variations in treatment. However,

the frequency of human error in the KRT process and its effect on renal recovery is not known, but the suggestion is human errors might have a significant effect on outcome (Palevsky et al, 2005). Accordingly, Brain et al (2014) advocate that the human element of CRRT requires further exploration.

1.5 Overview of Evidence

A number of other important aspects exist to the successful and safe delivery of CRRT, including the choice of anticoagulation and the timings of commencing and terminating CRRT. However, this work limits itself to those aspects where the individual clinician is centric.

There are 33 GRADE recommendations within the KDIGO guidance (2012) on dialysis interventions in AKI, only 8 are supported by level 1 evidence, that is evidence obtained from at least one properly randomised controlled trial (Canadian Task Force on the Periodic Health Examination (1979). These recommendations are:

We recommend using anticoagulation during RRT in AKI if a patient does not have an increased bleeding risk or impaired coagulation and is not already receiving systemic anticoagulation. (1B)
For anticoagulation in intermittent RRT, we recommend using either unfractionated or low-molecular-weight heparin, rather than other anticoagulants. (1C)
In a patient with heparin-induced thrombocytopenia (HIT), all heparin must be stopped and we recommend using direct thrombin inhibitors (such as argatroban) or Factor Xa inhibitors (such as danaparoid or fondaparinux) rather than other or no anticoagulation during RRT. (1A)
We recommend using ultrasound guidance for dialysis catheter insertion. (1A)
We recommend obtaining a chest radiograph promptly after placement and before first use of an internal jugular or subclavian dialysis catheter. (1B)
We recommend using bicarbonate, rather than lactate, as a buffer in dialysate and replacement fluid for RRT in patients with AKI and circulatory shock. (1B)
We recommend frequent assessment of the actual delivered dose in order to adjust the prescription. (1B)
We recommend delivering a Kt/V of 3.9 per week when using intermittent or extended RRT in AKI. (1A)

The remaining recommendations are left ungraded or are based on lesser quality literature. These recommendations ultimately do nothing to resolve the current worldwide variations in practice.

As a result, there is a need for quality improvement initiatives to ensure effective CRRT, including ensuring the prescribed dosage target is achieved (Palevsky et al, 2013). Whilst these initiatives exist in the form of educational opportunities (Mottes et al, 2013; Przybyl et al, 2015) or organisation programmes (Graham and Lischer, 2011) there still is an acknowledgement that there is limited literature focussing on nursing care and management in CRRT. Therefore, more research needs to be undertaken to provide robust evaluation of nursing action in the future (Richardson and Whatmore, 2014). This evidence needs to consist of understanding the challenges to nurses and others in providing optimal CRRT and thereafter developing solutions or interventions which would address these challenges. It is unlikely that the educational or organisational programmes highlighted are able to address all the potential findings. Therefore, greater insights into how the care is provided in this domain could enable improvements in patient care.

1.6 Research Problem

Continuous Renal Replacement Therapy is an integral part of critical care practice. Recommendations exist for the management of CRRT, yet few are based on high quality clinical evidence, leaving variability in practice and outcomes. Authors have suggested that human elements play a role in CRRT, which need further exploration (Brain et al, 2014; Palevsky et al, 2005; Cottle et al, 2016).

In conjunction with this, a number of research priority setting exercises have identified a need for further investigations into the discussed topics. Thompson et al (2013) highlighted an agenda for clinical decision-making and judgement in nursing research. They stressed the paucity of evidence in respect of fostering effective clinical reasoning at the point of care, and also in recognising what conditions technology is effective in supporting nurse's decision-making. The time critical nature of CRRT decision-making makes this an ideal situation to examine both these elements. Furthermore, Blackwood et al (2011) highlighted research priorities in intensive care to which 'factors influencing nursing staff behaviours' was highlighted as an issue. A focus on the individual worker and examination of their decision-making in relation to CRRT would generate an understanding of behaviour. The consequence of this may enable improvements in learning and teaching, usability of CRRT technologies and subsequently improvements in patient outcomes.

1.7 Research Question and Aims

This research looks to answer the question of

- What are the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy?

In doing so the research aims

- To develop an understanding of the factors that influence critical care nurses' decision-making in the management of patients receiving Continuous Renal Replacement Therapy.
- To highlight areas where improvements in practices can be made to improve both patient and organisational related quality indicators of CRRT.

1.8 Thesis Overview

This thesis is structured across six chapters.

Chapter 1 provides an overview of CRRT and builds a rationale for the focus of this research.

Chapter 2 aims to identify issues that relate to critical care decision-making and specifically CRRT.

Chapter 3 presents the methodological approach and research design elements used to address the research questions.

Chapter 4 Explores the themes and sub themes derived from the semi structured interviews and conceptualises them with one another.

Chapter 5 Contextualises the themes with the wider literature and identifies the strengths and limitation of this work alongside the implications for practice and suggestions for future research.

Chapter 6 provides the final conclusions based on the finding and adds personal reflections.

Chapter 2 Literature Review

The evidence presented within Chapter 1 alludes to the absence of literature on the role of decision-making in regard to CRRT management. Therefore, this chapter aims to detail the searches of the literature that were undertaken to identify an existing body of evidence on clinical decision-making associated with the management of CRRT, within critical care units in the United Kingdom. In turn, this will highlight any specific subject areas within the topic where there are gaps/omissions in the evidence and set up the methodologies to investigate the influences on decision-making in CRRT.

Reviewing the literature available in this subject area in a manner that is both systematic and comprehensive enabled the determination of whether there was a research question that needs to be answered, ensure the development of a clear research question, and highlight the relevant knowledge and methods associated with this subject area (Hek et al, 2000).

2.1 Literature Search questions

The primary question the exploration of the literature sought to answer was.

- What are the key factors that influence critical care practitioners' management of Continuous Renal Replacement Therapy?

This further developed into

- How does clinical decision-making occur in respect of CRRT, and does it differ from clinical decision-making performed elsewhere in critical care units?

2.2 Literature Review Search Strategy

To answer these questions, a number of systematic, expansive approaches were taken in reviewing the literature. This involved a number of independent literature searches, attempting to discover works in this field. The rationale for performing these independent searches was a consequence of the lack of dedicated literature identified in preliminary scoping literature searches in the combined subject areas of decision-making in CRRT.

For each approach, a unique search structure was created, including search terms, keywords, and Boolean Operators in a variety of search domains, i.e., title, abstract, and subject heading. The title, abstract and full content (where available) were reviewed, for the returned entries. For records where only the title and/or abstract were available, and it was felt they could be of potential value to the literature review, attempts were made to obtain them from alternative sources, to allow for an assessment. All of the available literature was assessed against a set of specific inclusion and

exclusion criteria. These criteria were believed to be relevant to answering the specific literature search question.

In using this approach, it was envisaged that it would fulfil a number of the key principles of associated with a high-quality literature review, such as incorporating systematic, explicit, thorough, and rigorous approaches (Hek et al, 2000; Aveyard, 2014). All citations were exported into a reference manager software (RefWorks, ProQuest, Michigan) to enable future citations, and into an Excel (Microsoft, Washington) spreadsheet, which was used to manage and enumerate the breakdown of excluded citations. These searches began with a narrow specific focus, centred on CRRT decision-making expanding to include the domain of critical care in the absence of specific literature.

2.2.1 Search One – Continuous Renal Replacement Therapy

The first search focused on 'What is the current evidence base describing clinical decision-making for practitioners using CRRT?' This search was conducted in June 2015 and used the terms and Boolean operators including:

Table 1 Search Terms

Continuous Renal Replacement Therapy OR CRRT OR renal replacement therapy OR CVVHDF OR Dialysis OR RRT OR CVV* OR haemofiltration OR hemofiltration OR hemodialysis OR haemodialysis OR filtration.	AND	Critical Care OR intensive care unit OR icu OR intensive care OR high dependency OR "high dependency unit" OR hdu OR "critical care unit"	AND	Decision making OR clinical decision making	AND	NOT Ethics NOT Ethical NOT end of life NOT palliative care NOT palliative NOT palliation NOT limitation* NOT withdraw* NOT Withold*.

The EBSCO (Ipswich, MA) databases of CINHAL Complete, Academic Search Premier, and Medline, were interrogated, alongside those of the International Bibliography of the Social Sciences (IBSS) (ProQuest, Michigan), Scopus (Elsevier, Amsterdam) and Web of Science (Clarivate, Philadelphia)

These returned a number of unique publications (see Figure 4), which were then subject to assessment, by a single reviewer, first at a title and abstract level against an exclusion criterion. This criterion comprised of excluding studies where they were; not CRRT focussed, relating to end-of-life care, not decision-making, not written in English, no clinical application, and editorials. As the focus of the search was to retrieve literature with a direct reference to clinical decision-making and CRRT, it was felt these criteria removed publications that were not relevant.

This left seven remaining papers which were obtained in full text and were reviewed for suitability against the original literature review question 'What is the current evidence base describing clinical decision-making for practitioners using CRRT?'. After review, no publications met the inclusion criteria and subsequent secondary searches of their references were conducted but provided no further insights. The PRISMA flowchart below (Figure 4) demonstrates this breakdown.

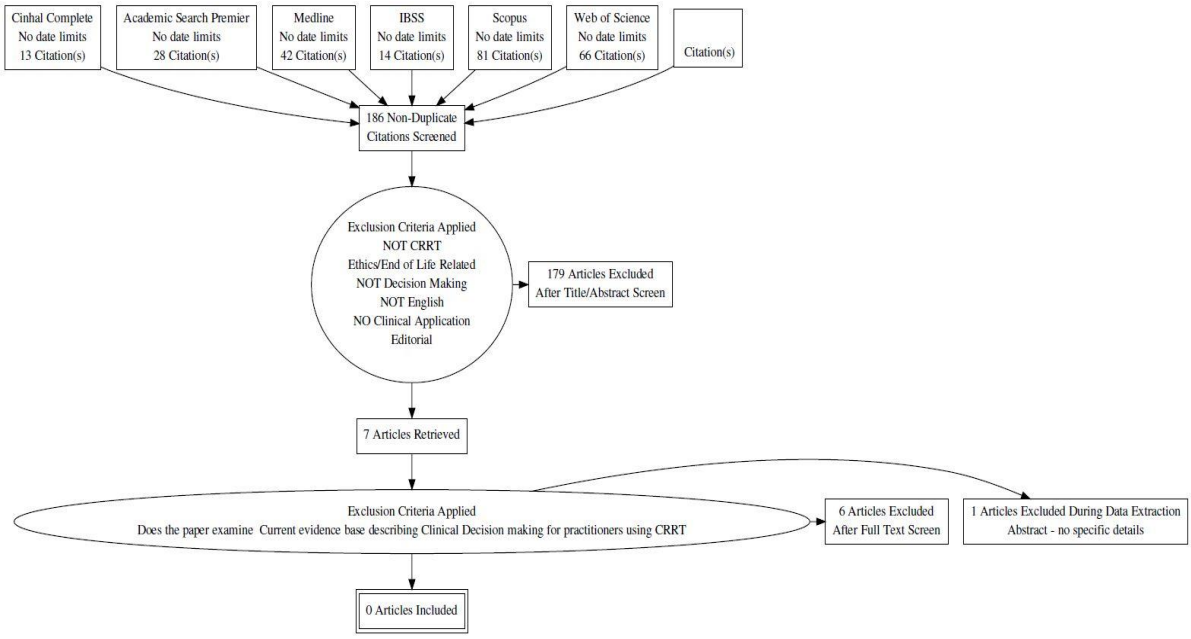

Figure 4 Search One PRISMA Diagram

2.2.2 Search Two – Critical Care

Due to the lack of suitable papers in search one, a broader search encompassing the literature on decision-making in critical care was conducted in July 2015. The same keywords, synonyms, and Boolean Operators as the first search were employed (Table 1), with the exception of the deliberate omission of the CRRT keywords. This search was also designed to identify any literature on CRRT clinical decision-making that was not captured by the first search. Due to the expected high output, the search was limited to the clinically focussed EBSCO (Ipswich, MA) databases (CINHAL Complete, Academic Search Premier and Medline). A total of 476 non duplicate citations were returned (see

Figure 5 Search Two PRISMA Diagram). An exclusion criterion was applied by a single reviewer, based on the content of titles and abstracts of the returned records, this included removing studies that were non primary research, had a paediatric focus, published prior to the year 2000, had no decision-making content, not related to critical care, had an end-of-life focus, no clinical context, and were not written in English. A further 98 full-text publications were unable to be retrieved to enable a thorough review. As a result, a total of 412 records were removed during this process, with the complete breakdown detailed in Figure 5 Search Two PRISMA Diagram. The remaining 64 publications were obtained in full text and underwent a further review, with the application of additional exclusion criteria in an attempt to maintain the focus on the original literature search question. This exclusion criterion entailed ensuring studies were clinically relevant with only those published after the year 2010 included, addressing recent technological advancements and changes in practice. This left 22 papers suitable for inclusion within this review as seen in Table 2.

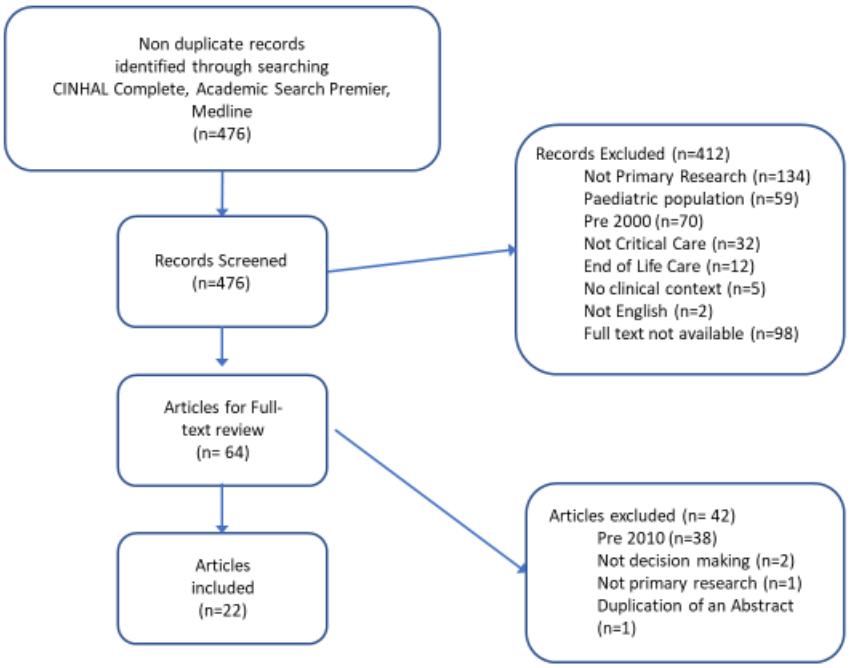

Figure 5 Search Two PRISMA Diagram

2.3 Critical Appraisal of the Literature

Tod et al (2022) suggest a 5-step approach to ensuring a comprehensive critical appraisal of the literature. These steps include; the identification of study types of the individual papers, the use of appropriate criteria and checklists, selecting an appropriate checklist, performing the appraisal, and summarising, reporting, and using the results of the critical appraisal. This approach was adopted during this review and demonstrated throughout sections 2.3, 2.4 and 2.5.

The literature which was identified from the database search as needing a full text review were appraised using two methods, to enable a systematic approach in assessing the studies trustworthiness and value for this review. Data were extracted to a bespoke spreadsheet, based on Aveyard (2013, p144), which consisted of the headings Author(s) and year of publication, purpose of the study, type of study and data collection methods, setting and participants, major findings, recommendations and a commentary of the studies' design and overall value in relation to the literature search's objective (see Appendix A). At this point, after the data extraction of each publication, and due to the acquired familiarity with the publication, it was then immediately subjected to a review using a methodologically appropriate appraisal checklist tool (see Appendix B), used to assess the quality of the publication. The mixture of papers made it difficult to use a sole tool to aid this process. Therefore, for the qualitative and cohort studies the Oxford University Critical Appraisal Skills Program (CASP) (https://casp-uk.net/casp-tools-checklists/) checklist tools were used. For the mixed methods studies a combination of the available CASP checklists were adapted to facilitate these reviews, applying the methodological relevant questions where necessary. In reviewing many critical appraisal tools, the CASP version was used because it provided simplicity and the structure to raise the pertinent questions during the review of the journal articles. Other families of tools were also explored, such as those from the Joanna Briggs Institute, and McMasters University. The Mixed Methods Appraisal Tool (MMAT, 2011 Version) (Pace et al, 2012) was discounted because whilst it covered all the methodologies, in comparison with other tools, it lacked the depth to consistently prompt me to ask the challenging questions to elucidate the important quality aspects of the publications. Additionally, whilst the Joanna Briggs Institute tools also contained a number of different methodologies there was no specific reference to mixed methods studies. Consequently, I chose to use the formatting and structure of the CASP tools and combine some of the insights from across this family of tools to provide complete critical appraisal coverage of all the publications.

Adopting this range of tools, derived along a common framework, allowed a straightforward all-encompassing process of appraisal, whilst enabling the uniform assessment of rigour, relevance and value required in the process of the critical appraisal of this literature. Whilst the CASP tools are not designed to facilitate a (numeric) scoring system for literature (CASP, 2018). They enabled an objective, formulaic, standardised approach to critically appraise the literature. The CASP tools provided me with the opportunity to carefully consider each question and sub question, recording observations and opinions directly on to the CASP checklist as an objective measure on the quality of the literature reviewed. Consequently, the quality of the literature was determined based on the

reviewers assessment of the literature to answer the questions posed within the tool, an example of which is shown in Appendix B.

Full-text publications were uploaded to NVivo (QSR International Pty Ltd, Burlington, USA), qualitative data analysis software in order to organise, analyse and link themes identified in the literature.

2.4 Search 2 Results

The clinical context of the 22 suitable papers, was focussed solely on critical care, although there was a large variety of clinical situations included. There was a distinction between the research concerning those studies related to generic decision-making and those related to patient care decision-making. This allowed for the separation between staff or patient related contexts to be examined. There were more papers associated with generic concepts of decision-making (n= 12) in topics regarding experiences and responses to uncertainty in practice (Cranley et al, 2012) and the association between sleep and clinical decision-making self-efficacy, and staffs' decision regret (Scott et al, 2014). In comparison, decision-making related to direct patient care included studies (n=10) such as Sørensen et al (2013) who examined reasoning and actions of experienced nurses' for care of patients on Non-Invasive Ventilation (NIV). Whilst Villa et al (2012) investigated patterns in processes of ventilation weaning and extubating patients post cardiothoracic surgery.

The patient related group of studies identified a number of high interest areas in clinical decision-making. These areas were predominately focussed on ventilator weaning, pain and sedation management. In addition to this, the geographical contexts of the studies were variable, with 13 different primary locations identified. Whilst some papers compared practice between two different countries (Kydonaki et al, 2012, 2014) others looked at continental perspectives (Egerod et al, 2013). Despite the large variety in locations, it is noteworthy that the countries identified within the papers of this literature search were all 'Developed Countries' (United Nations Development Programme, 2020, p241-244). The omission of lesser 'Developed Countries' from this body of literature may be due to a number of reasons, including the organisation of critical care infrastructure in these developing nations or due to their different research focuses. However, these retrieved papers allow for specific application to UK practice in critical care decision-making, on a socioeconomic basis.

With reference to the methodological stance of the highlighted papers, the preferred paradigm in examining critical care decision-making, was a qualitative methodology (n=14). However, there were also a number of quantitative research papers (n=6) and also two papers which incorporated mixed methods approach.

The overall quality of the literature was high. This viewpoint was determined by the outcome of the CASP review on aspects including methodological appropriateness, the credibility, transferability and dependability and confirmability of the data, and perceived contribution these studies would make to answering the question in this literature review. All studies presented clear aims and had adopted an appropriate methodology and design for the areas under investigation. Sampling approaches were largely overt with a clear rationale to enable reproducibility. However, this was notwithstanding some minor methodological or logistical problems associated in some of the studies. For example, while most of the qualitative papers appraised acknowledged the impact of the researcher/participant relationship, in some there was a distinct lack of discussion of this relationship (Subramanian et al, 2012 and Evans et al, 2010).

The assessment of the reporting of the findings, conclusions and recommendations demonstrated a large variability. In particular some studies used standardised tools, either as direct instrument measures, or as part of a framework analysis. In doing so some authors failed to provide sufficient detail regarding the application of these tools, to allow the reader to further explore their appropriateness in the research contexts (Papathanassoglou et al, (2014) and Subramanian et al, 2012)

All studies did provide useful, usable, and often pragmatic recommendations on future practice based on their findings, such as in Wøien et al, (2013) where sedation and pain assessment tools were perceived to support decision making and improve the quality of patients' care in these aspects, or in Scott et al (2014) who recommended greater consideration into shift patterns as a means to improve decision regret.

All literature included was sourced from journals with a self-declared robust peer review process, most of which with proportionally high impact factors (IF) including the Journal of Clinical Nursing (Wiley, Online ISSN:1365-2702), Journal of Advanced Nursing (Wiley, Online ISSN:1365-2648). Along with others with a dedicated focus on critical care nursing; Nursing in Critical Care (Wiley, Online ISSN:1478-5153), Dimensions of Critical Care Nursing (Lippincott Williams and Wilkins, Online ISSN: 0730-4625) and Intensive and Critical Care Nursing (ScienceDirect, ISSN 9643397).

In reviewing the papers, initially a wide range of unique themes emerged (Table 2). These themes included aspects such as experience, communication, culture, patient assessment, autonomy, influence of others, patient status, and task complexity. To manage these effectively, similar themes were consolidated and once all the unique sub themes had been categorised, six major themes were established. These themes consisted of:

- Experience
- Collaboration
- Culture/local organisation
- Decision processes
- Individual Clinician Aspects
- Context

These themes are discussed in detail in in the following sections.

Table 2 Themes and Sub Themes

	Experience	Collaborative Approach	Culture and Organisation	Decision Processes	Individual Clinician Aspects	Context
Aitken et al, (2011)		Seeking Help		Assessment, management diagnosis, planning, evaluation, and clarification		
Cranley et al, (2012)		Teamwork/support		Cycle of Assessment, reflecting, questioning and being unable to predict aspects	Cognitive affective strategies to manage uncertainty	
Egerod et al, (2013)		Collaborative Approach	Culture			
Evans et al, (2010)			Culture		Autonomy	
Görges et al, (2011)				Information Decision Accuracy, speed Workload		
Haslam et al, (2012)				Assessment		
Karra et al, (2014)		Collaborative Communication		Nursing process		Independent Vs Dependent Decisions
Kydonaki et al, (2012)				Assessment		

Kydonaki et al, (2014)		Collaboration Communication	Organisation		Autonomy	
Lavelle et al, (2011)	Experience	Working Environment (collaboration)	Use of protocols	Clinical reassessment	Education Confidence	Physiology Medical History and Current Ventilation
Lin et al, (2013)		Teamwork Communication	Conflicting Goals			
Lundgren-Laine et al, (2013)			Organisational Culture	Information Acquisition Real Time and accuracy		
Marshall et al, (2011)	Experience	Communication		Information Accessibility		
Marshall et al, (2013)	Experience				Role	
Nathanson et al, (2011)		Teamwork	Culture			
Papathanassoglou et al, (2014)			Measuring instruments		Attributes of ICU management Knowledge & Knowledge awareness Accountability	Knowing the patients, Patient Characteristics Task complexity and task condition

Scott et al, (2014)					Fatigue Decision Regret Decision Satisfaction Cognitive Behavioural Outcomes	
Sørensen et al, (2013)	Expert Nurses					Prioritisation Complexity
Subramanian et al, (2012)		Shared Decision Making	Training Guidelines	Assessment	Autonomy	
Tingsvik et al, (2015)				Assessment of Patients	Nurse Status	Patient Status
Villa et al, (2012)		Culture	Standardising Competence Organisation	Clinicians Assessments	Organizations	
Wøien et al, (2013)	Experience	Collaboration		Assessment	Clinical Judgement	

2.4.1 Experience

The notion of ICU experience influencing clinician decision-making was suggested in a number of papers (Marshall et al, 2011, 2014; Wøien et al, 2013; Sørensen et al, 2013; Lavelle et al, 2011). The theme of experience comprised of two unique sub themes, the concept of the expert nurse and a general reference to nurses' experience. Experience was conceptualised in all but four papers (Haslam et al, 2012; Nathanson et al, 2011; Karra et al, 2014; Lin et al, 2013) but with varying levels of commentary.

The most detailed discussion of the relevance of experience within critical care decision-making was in Sørensen et al (2013), who studied the reasoning and actions of experienced nurses caring for patients on NIV due to acute respiratory failure from chronic obstructive pulmonary disease. They showed that experienced ICU nurses had developed a 'practical wisdom' for caring for patients with chronic obstructive pulmonary disease requiring NIV. These data highlighted the conceptualisation of the complexities of nurses' reasoning and actions, with insights describing components of how nurses' experience, influenced practice. These components involved 11 types of reasoning and actions to facilitate successful NIV, including perceptual attention, ongoing data evaluation, immediate solutions, and clinical imagination.

Practical examples of these include how the nurses intuitively decided which mask to use, based on perceptions rather than using formal tools or guides. This facet was also highlighted by Wøien et al (2013), who found the attitudes of experienced nurses, having to use pain and sedation assessment tools, was that they had to put aside their experience in order to carry out the tasks. They also indicated that there was a consensus that making judgements based on assessment tools was not sufficient and that the potential reliance on these tools by inexperienced nurses could lead to incomplete patient assessment. It is also evident in Wøien et al (2013) that any previous experiences dominated judgements and decisions within this experienced sample of nurses', clinical practice. Accordingly, it was felt by participants that the integration of these tools was not necessary for them to maintain safety or provide clinically effective care. It was also identified that nurses use experience and clinical judgement in their daily assessment, pinpointing a multifaceted system built on routine in linking central cues that help them prioritise action. In the discussion, the authors note the evidence for the proactive behaviour of experienced ICU nurses with an ability to recognise the pattern of responses and intuitively grasp the clinical situation.

Therefore, the usefulness of the tools was always second best to personal knowledge and experience, although they were often used as a contributory factor in decision-making. The

authors conclude by stating that clinical guidelines were viewed favourably and support experienced nurse's decision-making. However, they should be seen as complimentary data sources amongst the complex processes that contribute to the use of clinical judgements in ICU. Also of note was that most participants in the study stated using a weaning protocol was best employed in combination with their own experience, and that decisions were made more effectively without having to refer constantly to a protocol.

Consequently, these studies indicate a preference for the adoption of decision-making behaviours based on clinical experience in a critical care setting rather than tools or guidelines. However, from this evidence it is difficult to identify whether this preference is based upon experienced individuals protecting their positions based on extensive knowledge and experience and the reluctance to lose autonomy.

Experience was also evident in Sørensen et al (2013) when demonstrating problem solving abilities, between experienced colleagues. This experience was vital in the tailoring and individualising of patient care and prevented delays through anticipation and working independently. This study demonstrates that understanding how nurses think and act may help optimise continuing professional development and the education of junior staff.

The importance of the concept of experience in clinical decision-making is further discussed by Lavelle et al (2011) who examined which factors influence nurses when weaning patients from mechanical ventilation. The study consisted of semi structured interviews guided by a vignette. Six central themes emerged with nurse's experience, confidence and education being the most pertinent to this theme. Nurses' experience was actively revealed within interviews, with many experienced participants stating that they could intuitively tell a patients' readiness to wean. Moreover, the participants felt patients were weaned constantly but this was not reflected in documentation. The authors also highlighted that the participants responses suggested that the more experienced nurses noticed immediately how seriously ill the patient described in the vignette was, compared to the inexperienced nurses.

Marshall et al (2013) explore the use of information by nurses making decisions in clinically uncertain situations (enteral feeding). They found a strong preference for using colleagues as a source of information. One of the characteristics identified in seeking an individual as a source of information, was the level of their clinical experience. This aspect was highlighted by a number of observations in the study's findings, in which registered nurses stated they would seek information from more experienced individuals, due to their knowledge, more exposure to ICU and length of service. This was largely seen as a way to access reliable information based on a perceived link between level of experience and level of knowledge. However, some

participants did recognise that experience did not necessarily reflect particular individual's level of knowledge. The authors' also recognised context of experience, irrespective of length of ICU practice, in that junior members of staff would approach certain colleagues with specific clinical experience, for example in cardiothoracic nursing. Although it was clinical experience rather than expertise used most often in selecting an individual as an information source. This may have been down to the availability or proximity of individuals with particular expertise in the area required, though using educational credentials as a proxy for experience was also acknowledged (Lavelle et al, 2011; Marshall et al, 2013).

However, disparity in its role was noted with data from Marshall et al (2013) suggesting it was not always appropriate to use experience as a proxy from knowledge, as participants in their study recognised that educational experience and particular individual's level of knowledge was not always synonymous of clinical experience. Whilst in Lavelle et al (2011) participants viewed colleagues with educational credentials and experience as providing the credibility to wean patients. Marshall et al (2013) conclude that there is a heavy reliance on information gained from colleagues more so than the content of the information imparted.

This evidence suggests that more experienced clinicians abandon the use of guidelines and protocols and are happy to use their experience and intuition in their decision-making. The absence of associated outcome data for the success of decision-making makes it difficult to conclude the efficacy of this stance. The important role of the experienced nurse is also apparent in this literature. It is evident they are a valuable resource to junior staff in respect of advice and verifiers of decision-making to other senior colleagues.

2.4.2 Collaborative Approach

A theme of collaboration became evident throughout the literature. With sub themes consisting of assisting junior staff members, communication and working with the multidisciplinary team (MDT). In Cranley et al (2012), they formulate a model of 'recognising and responding to uncertainty', by underlining the role of collaborating with nursing colleagues and the MDT. Collaboration was often used as a strategy when staff were managing uncertain situations. As in Lavelle et al (2011) and Marshall et al (2013), they describe how nurses asked peers for support and how they particularly sought advice from their peers for information alongside decisional and emotional support. For this, particular colleagues were sought, dependent on the nurse and the situation, with the use of collaboration differing depending on the experience of the nurse. Those more experienced used the process as means to seek reassurance from colleagues and validate that their thinking was on the 'right track'. Further strengthening the role of experience in decision-making.

Team working was also considered in the same theme within the Cranley et al (2012) model. Centred on ward round activity, it was viewed from the perspective of enabling individuals to gain from colleagues' experiences, rather than a reciprocal exchange of ideas. The concept of collaborative decision-making on ward rounds is supported by Egerod et al (2013), in their survey of sedation practices in European ICUs, which indicated that 62% of sedation decisions were made in a collaborative format. However, this was tempered with significant variation between cultures, as Nordic nurses reported 83% of decisions being collaborative in nature compared to 61% of non-Nordic nurses. Compounding this, more physician led decisions occurred in non-Nordic nurses' ICUs (38%) compared with Nordic nurses' ICUs (16%). The authors conclude by determining that collaboration affects sedation practice within European ICUs.

Kydonaki et al (2014) also recognise the issue that collaboration and communication were not encouraged in some ICUs, leading to inefficiencies. Whilst intra-professional relationships were competitive and nurse/doctor relationships were often full of conflict. Nathanson et al (2011) presented evidence that demonstrated both a disparity of opinions and statistically significant differences on the satisfaction of collaboration between nurses and junior doctors in the ICU. With the amount of collaboration in decision-making rated by nurses as inadequate, compared to the junior doctors who were satisfied with the quantity of collaboration. Whilst this evidence implies the use of collaboration with colleagues was used to bring about better clinical decisions, Marshall et al (2011) suggest that in uncertain clinical situations conferring with colleagues may be used as a strategy to distribute responsibility and accountability for the decision. Whilst also advocating this may primarily be applicable for exchanges between inexperienced nurses and more experienced peers.

Finally, in returning to the concept of confidence in decision-making, Evans et al (2010) stressed the importance of supportive relationships among critical care nurses and how fostering these collaborative relationships strongly contributes to confidence and in turn improves decision-making capabilities. These relationships were found to be easily established by individuals being there to answer questions, or coming to help with the care of patients, especially during periods of high acuity. These behaviours ultimately engendered nurses' confidence.

It is clear that effective collaboration improves individuals' decision-making, whilst the absence of collaboration often disrupts this process. The need for collaboration is evident with individuals constantly looking for peer support in making decisions.

2.4.3 Culture and Organisation

This theme focuses on a number of cultural issues that have influenced decision-making, whilst also alluding to the organisational influences. In terms of this review, culture encompasses both national and organisational properties of culture. The theme identifies that there is accepted customs and practice that influence decision-making within critical care as well as the organisational practices that dictate the way decisions are performed. Whilst culture tends to be embedded in practice with the concept 'we've always done it like this', organisational aspects develop from needing to implement practice for logistical reasons such as institutional protocols.

In a survey study, Egerod et al (2013) exhibited differences in the reported sedation decision-making practices between Nordic and Non-Nordic nurses; specifically, in regard to who the decision maker was. Their evidence shows that 83% of the nurses surveyed from Nordic countries claimed collaborative decision-making in this process whilst non-Nordic countries identified a collaborative approach in 61% of participants. The authors surmised that these differences might be a result of cultural reasons. Highlighted within their results is evidence of significantly smaller ICUs, higher nurse/patient ratios and greater inter-professional collaborative decision-making in Nordic ICUs.

Other authors identified other cultural differences in practice. Kydonaki et al (2014) suggest the nurse/patient ratio of 1:3 that was customary in Greek ICUs in their study, may have partly contributed to the delayed decision-making about weaning decisions. However, when contrasting the Scottish nurses in their study, who worked 12-hour shifts, they noted that they were often allocated to different patients every day, limiting the nurses' familiarity with the weaning patients, which also challenged their decision-making ability.

Villa et al (2012) also pinpoints cultural aspects of weaning from mechanical ventilation in Italy. Historically a culture of nurses being ancillary to medical staff existed, due to national legislation. The consequence of this materialised in their research as all nurses within the ICU, irrespective of experience, education, or role did not make decisions to wean and extubate patients. Instead, they provided data and proposed the decision but ultimately the doctor always made this. However, in the 10 years since legislation changed to provide nurses with the responsibility to make autonomous decisions, consequently the unit's culture prevented nurses making clinical decisions. Moreover, there existed embedded unwritten rules between expert and novice nurses regarding the expected responsibilities in this role. This was reinforced by the nurse manager who despite believing that expert nurses were able to make independent decisions, permission to expand their autonomy, within a process, was refused.

Despite the documented culture differences across nations, there were some similarities in ICU culture. Kydonaki et al (2014) found that both Scottish and Greek nurses did not perceive it to be their role to wean patients from mechanical ventilation, due to the lack of support provided by professional bodies regarding their accountability. This was demonstrated through the lack of decision autonomy observed, during their study, in the weaning process.

Unit specific culture and organisation contributing to clinical decision-making, was more apparent in the literature. Evans et al (2010) describe a critical care subculture in which the nurses' ability to make clinical decisions autonomously was 'normative and integral' to being a member of the multidisciplinary team. In joining this subculture, participants felt protected and supported by their peers, resulting in their confidence improving and succeeding more rapidly. This support for decision-making in junior nursing staff was also noted in Lin et al (2013), where they observed a culture of the senior ICU staff support inexperienced team members, inside and outside the ICU, and within the context of discharging patients from ICU. However, it was identified that this was partly to ensure that the efficiency of the discharge process continued.

Tingsvik et al (2015) also looked at weaning from mechanical ventilation found that the ICU nurse was influenced by a number of factors which related to both the patient and the prevailing care culture. This culture was deemed unique for every situation and to each individual nurse. Although there was a lack of a consensus from the participants about whether decision-making was influenced by factors not directly related to the patient, the authors felt that every staff member's actions and interactions influenced the prevailing culture of the specific unit. The conditions under which the team worked was felt to influence decision-making, particularly team member attitudes and the collaboration between team members. They believed their data demonstrated that unit managers and the medical leadership had an important role in how weaning decisions were made. The unit leadership, they observed, showed a proactive approach to weaning and the unit culture was to wean from mechanical ventilation as soon as possible. However, like in the Villa et al (2012) study, these rules were unwritten. This generated a unit ethos, which evolved based on individual staff input, which consequently directs behaviours.

Despite the contrasting findings between Villa et al (2012) and Tingsvik et al (2015) suggest that whilst decision-making is a complex nursing intervention it is influenced by the care culture, which if highlighted appropriately can make the weaning process more efficient. However, the disparity Nathanson et al (2011) highlights between the satisfaction of nurses and junior doctors in collaborative decision-making is potentially culture based. The junior

doctors' opinions mirrored those of more senior colleagues, breeding a dysfunctional culture which can demonstrate a negative impact on both patient care and retention of nursing staff.

This evidence indicates those critical care units who integrate staff by providing support and collaboration working environment subsequently engenders their decision-making process, improves confidence and facilitates an improved culture. Those units that seek to restrict or do not support decision-making have a negative impact on the culture, organisation, and staff.

2.4.4 Decision Processes

A number of sub themes were revealed within the literature about the process components of the decision-making. The focus of these papers was on Information Acquisition, Assessment, and the role of a process cycle, specifically the Nursing Process (Yura and Walsh, 1978).

2.4.4.1 Information Acquisition

The activity of assessment and subsequent decision-making is reliant on the presentation of information. Lundgren-Laine et al (2013) examined the information needs of charge nurses in Greek and Finnish ICUs. They identified that the crucial information charge nurses in both countries needed, were related to organisation and management of work, in that it provided the ability to make decisions on everyday practice in organising, prioritising, and managing workload. For situations that were rapidly changing and required immediate decisions, the information systems already in place did not support charge nurses' decision-making, and that the information required was also devoid in an electronic format. Consequently, the authors suggest that accurate and real time information is a prerequisite for charge nurses to be able to perform their roles and undertake tasks. Similarly, Marshall et al (2011) also discusses the accessibility of information for nurses in the decision-making process, with participants preferentially choosing colleagues as sources of information in uncertain situations. This was prompted by the need for instantaneous resolution of problems, whilst simultaneously obtaining information that they deemed accurate and reliable. This approach was supported by evidence from Marshall et al (2011) who found participants considered obtaining print and electronic information was too cumbersome and time consuming. Whilst not directly contrary the Lundgren-Laine et al (2013) findings on charge nurse electronic resource preferences, it does further highlight the differences between the concepts of preferences and practicalities of obtaining information.

Further exploring the presentation of data, Görges et al (2011) observed that two new ICU monitor designs significantly reduced the median decision-making time in comparison to the nurses' usual monitor, with nurses ultimately making their decision 34% faster. Decision accuracy was also significantly improved in the two new displays, within two different patient

conditions (stable vital signs and infusion pump reminders). The study proposes that current patient monitors are not designed to support a nurses' workflow in the ICU and that there is a constant triage process which nurses use to make decisions on who needs care most. They identify that the use of the think aloud method or eye tracking technology, could provide insight into why certain displays are more effective.

How information is acquired plays a role in the individuals' subsequent ability to make decisions. Whilst this evidence (Görges et al, 2011) suggests that appropriate displays can reduce decision-making time; there is contradictory preferences on how that information should be presented, it is likely that the context of the information, potentially clinical or managerial, plays a role in this preference.

2.4.4.2 Assessment

The ability to perform the processes required to make decisions was manifested throughout the literature. These processes largely followed the format of the nursing process (Yura and Walsh, 1978) i.e., Assessment, Planning, Implementation and Evaluation.

The process of assessment was viewed as a key phase in the decision-making activity. Lavelle et al (2011) and Tingsvik et al (2015) found a number of important factors, which influenced decision-making, during the overall assessment of the patient in the weaning of patients from mechanical ventilation. The nurse assessment and ultimate decision(s) were based on the evaluation of the patient's physical health, with information garnered from a number of different sources (clinical examination, x-rays). Some of which were unrelated to the patient's respiratory parameters i.e., temperature or blood pressure. It was this assessment that was fundamental in being able to make the relevant decisions regarding weaning, with demonstrating the importance of physiological assessment in this patient population. This was irrespective of whether the nurse made this decision autonomously or there was collaboration with the multi-disciplinary team.

Haslam et al (2012) looked at pain descriptors in critical care. A majority of the patients notes they reviewed (71.4%) had a narrative description of pain assessment documented during their ICU stay. Whilst the descriptors varied in origin type (behavioural, physiological) it is clear the assessment of pain or its absence is key to prompting a decision about a required intervention, and the use of these narratives to provide the rationale or justifications for interventions highlighted the importance of assessment in this cohort of patients. However, 17% of the narratives reviewed indicated that analgesia was administered without any concurrent evidence of pain descriptors. This might indicate an omission of assessment and further insight into how decision-making occurred on these occasions would be key to

understanding behaviours. The potential for the administration of analgesia to have been given by or directed from another individual is important, so too is the potential that these were due to the absence of assessment or suitable documentation. To this end, Kydonaki et al (2012) identified that the understanding of how critical care nurses use assessment information to direct patient care, enables strategies to be designed to improve their skills in making accurate and high-quality clinical decisions in weaning management. Wøien et al (2013) also attempts to address this with their evidence that the use of standardised assessment tools resulted in assessments, during decision-making, to be performed more regularly, combined with the perception of improved quality and consistency of assessment, enabling a more integrated approach to treatment.

2.4.4.3 Process Cycles

Others have noted the integration from assessment to treatment decision-making within the literature particularly regarding the process of reaching a clinical decision. Whilst direct reference was made to the nursing process (Yura and Walsh, 1978) by Karra et al (2014), others described a cyclical process which incorporates many of the key facets of the nursing process, (Aitken et al, 2011; Cranley et al, 2012). Allied with this, Villa et al (2012) emphasised that the role of the nurse was in the assessment of the patient, and in the collection of data as a means to stimulate plans for weaning from mechanical ventilation. Whilst in Villa et al (2012), there was no role for nurses in making an autonomous decision to begin weaning, the process of assessment and evaluation against a predefined criterion was nonetheless followed, albeit with varying consistency, this was dependent on the nurses' experience to facilitate a medical staff review.

Aitken et al (2011) focussed on the most appropriate methods to identify and describe decisions made in critical care units related to sedation assessment and management. They categorised decisions into assessment, management, diagnosis, planning, evaluation, clarification and seeking help. These categories were based on previous work by Thompson et al (2004) and Bucknall (2000). Using this framework to ascribe decisions, the authors encompass the constituents of the ongoing nursing behaviours. Predictably, the major constituents of the framework are modelled on the cycle of the nursing process, a concept that is taught to pre-registration nurses in Australia, where the study was conducted. The most common sedation decision identified by the registered nurses were focussed on assessment and management aspects of patient care, with more decisions being identified through a 'thinking aloud' process than through clinical observations. In contrast, more management-based decisions were made through observation.

The authors indicate a number of decisions that do not overtly present as an observable behaviour i.e., evaluation, are more fully captured using a think aloud technique, because it is focussed on cognitive processes. As a result, those decisions that do not result in observable outcomes are therefore more likely to be systematically under reported where research observations occur.

Karra et al (2014) also specifically noted the resemblance of the decisions they observed with the nursing process, the resultant categorisation of the decisions observed included evaluation, prevention, clinical information seeking, and clinical priorities setting. In the assessment process, physiological parameters were again considered important. It was observed that the nurses rarely implemented physical examination techniques, such as auscultation or palpation, to acquire information to make decisions, despite subsequent diagnosis decisions involving the interpretation of other signs and symptoms. Decisions were made in the context of medical diagnosis. Intervention decisions were classified into opposite pairs, i.e., take action or no action required, independent or dependent on medical orders, based on or based without research evidence, and interventions with or without patients' participation. Evaluation of the effectiveness of interventions was also observed to complete the cycle. Despite this distinct cyclical format, the authors acknowledged that there was no actual formal implementation of the nursing process.

A process cycle was also evident in Cranley et al (2012) where nurses' narratives on recognising uncertainty in critical care decision-making exhibited four interrelated themes, forming a clear process. This incorporated:

1. Assessing to get a clear picture.
2. Reflecting on own knowledge and experience.
3. Questioning self and others' judgements.
4. Being unable to predict what is going to happen.

Their process of assessment contained elements of how nurses experienced continuous assessment when information was scarce. In order to obtain a 'clear picture' of the patient, a participant described the piecing together of information. The consequence of this assessment process meant that the planning of patient care was often disrupted.

Consequently, this published literature demonstrates that an understanding of the pertinent assessment criteria associated with the decision to make is essential. The method of not exploiting certain assessment methods may lead to decisions being made without the support

of the assessment. Determining the utility of assessment criteria and the process of how these are reinforcement for different clinical scenarios is significant in ensuring decision-making processes are robust and efficient.

2.4.5 Individual Clinician Aspects

The largest number of unique sub themes were categorised under this theme. It is expected that a large number of unique factors which directly influence the individuals decision-making within critical care relate to them personally. These aspects were related to individuals' traits and attributes, or circumstances that affect individuals in a non-uniform manner. These highlights the importance and central role of the individual in making decisions and potentially influencing patient outcomes.

One of the most pertinent papers was Scott et al (2014) who examined the role of sleep loss and the effect of fatigue on cognitive performance. The study findings showed 29% of respondents reported decision regret and indicated that those who had decision regret were more likely to have worked nights and 12-hour shifts. There were significant differences in the decision regret in those who were more acutely fatigued, had daytime sleepiness, those with less inter-shift recovery, and poor sleep quality. Using logistical regression, they demonstrated those individuals who were more likely to report decision regret were male nurses, working 12-hour shifts and were less satisfied with their decisions. It was longer shifts and not sleep disturbances, led to decision regret. This study raises two key issues in respect of decision-making.

1. The organisational aspects effect on individuals. i.e., shift patterns effect on an individual's decision-making ability.
2. As decision regret exists in this study, the connotation is that in hindsight the individuals would have made different decisions if they were more awake/less fatigued.

Cranley et al (2012) and Tingsvik et al (2015) identified a number of factors that influence decision-making, knowledge and experience, cognitive styles, values attitudes and beliefs and physiological and affective responses including aspects of the ICU nurse's personality. Personality was defined as comprising of confidence, professional approach, attitude, and interest in weaning from mechanical ventilation. It was identified that some nurses felt confident in making autonomous decisions about changing the settings on the ventilator, whilst others desired formal written medical prescription for respiratory support treatments in order to guide their decision-making. There were also differences in nurses' interests and attitudes to weaning, with some actively caring for patients to enhance recovery from periods

of weaning, whereas others would delay weaning because they deemed it more convenient. Differing attitudes were also apparent in the patient interaction components of weaning. Some nurses would comply with patient wishes to be returned to the ventilator, despite assessment that being off the ventilator was beneficial to the patient, whereas others would motivate patients and drive them forward on the assumption that continuing weaning would be in their best interests.

These studies identify the role of individual traits and personal characteristics and allude to how each nurse influences the decision processes and influences patient care and potential outcomes. Identification of those personal traits and characteristics that enhance decision-making abilities would enable individuals to concentrate on augmenting their current skills to support their decision-making ability.

A number of the studies (Evans et al, 2010; Kydonaki, 2014; Subramanian et al, 2012) looked at the role of autonomy in decision-making. In Evans et al (2010) they particularly focussed on the phenomenon of confidence in the ICU. Their findings describe how the development of confidence grew as autonomous decision-making was being consistently made in the day-to-day care of patients. Furthermore, the ICU setting was deemed ideal as it offered repeated opportunities for nurses to encounter these decision-making scenarios. There was also an expectation for individuals to make autonomous decisions whilst they were working within this supportive environment. As a result, participants felt there was a direct link between autonomous decision-making and growth in confidence. Accordingly, this cycle proliferated, and the researchers found that participants highly valued autonomous decision-making, and it was a major factor in feeling satisfied with critical care nursing. The authors concluded that the ability to make clinical decisions autonomously in the critical care unit is normative and integral to full participation in the critical care culture and membership in the multidisciplinary team. As a result, Evans et al (2010) indicate that an individual's autonomous decision-making is indispensable in performing effectively in critical care.

Highlighting the contextual issue of autonomy, Kydonaki et al (2014) found that nurses showed a lack of decision autonomy which corresponded to the level of support they received from the senior nurses in both critical care units in Greece and the UK. Against a backdrop of the traditionally medically dominated area of ventilation weaning in Greece, it is unsurprising that there were barriers to enabling nurses' involvement in the weaning decision-making. However, these results are more surprising of a UK ICU where there is an advocated desire for increased autonomy. Participants' also highlighted the requirement for clarity over what constitutes an autonomous nursing decision in weaning practices and whilst both clinical environments did

not encourage collaboration and communication amongst clinicians, the authors advocate that this could enable nurses the space for autonomy in their part of the weaning process. Subramanian et al (2012) identified a desire for staff to have less autonomy in the pain management of critically ill patients, this was associated with a lack of confidence in making decisions in the context of accessible pain experts (anaesthetists/intensivists).

Overall, these individual focussed aspects like values, attitudes, confidence, tiredness, and degree of autonomy all contribute to decision-making. This theme therefore highlights the extensive number of individual traits that exist in influencing decision-making, but within each of these traits the degree to which they influence a decision is challenging to determine. However, the role of confidence in the individual's decision-making process appears vital. The association between confidence and successful decision-making is likely paramount to ensuring the reinforcement of behaviours. There is though, a lack of literature exploring the individual's role in decision-making and within the literature retrieved there is a lack of unanimity for these individual factors and refining the key aspects associated with decision-making, making further exploration key.

2.4.6 Context

The circumstances in which decisions are made, also transpired as a recurrent theme throughout the literature (Karra et al, 2014; Lavelle et al, 2011; Papathanassoglou et al, 2014; Sørensen et al, 2013; Tingsvik et al, 2015). These encompassed the influence of context on the decision process and how the decisions were ultimately arrived at.

The background of the decision was seen to be important, particularly on a nursing basis. In Karra et al (2014) 60% (n=220) of the intervention decisions, were made independently of medical orders. Most of the intervention decisions related to basic nursing care and were made exclusively by the nurses after a process of evaluating the pertinent data. However, only two of the intervention decisions (changing the ventilator connection and treating hyperglycaemia) had any documented supportive research evidence to back up their rationale, which Karra et al (2014) believed raised an issue of adoption and adherence to evidence-based practice. Likewise, Lavelle et al (2011) and Tingsvik et al (2015) also recognise that participants' decision-making about mechanical ventilation weaning was altered, dependent on certain conditions, such as past medical history, patients' condition over the previous 24 hours, and current clinical condition. In addition, the psychological status of the patient also guided participants decision-making.

The type of task being performed was also relevant as identified by Papathanassoglou et al (2014). They noted 'task complexity and task conditions' scored highest when critical care

nurses were asked to assign the greatest importance to understanding the clinical problem and the decision-making conditions. Unfortunately, this study was primarily designed to determine the utility and validity of a questionnaire for factors influencing critical care nurses' decision-making and is currently in abstract format, resulting in the omission of potentially significant detail. Though in the study by Sørensen et al (2013) participants identified complex scenarios which comprised of a mixture of either physical, social, psychological, clinical, or ethical support to the patient, these mixtures led to decision conflicts. Irrespective of this subsequent task prioritising decisions were well managed by experienced nurses who were able to use their previous experience to integrate the variety of problem with solutions.

Critical care comprises a of complex environment with complex patients with a variety of needs, whilst the complexity of the types of decisions required influences the individual's ability to decide, it was again evident that the experienced members of staff were able to sufficiently prioritise and deal with the decision-making in superior manner.

2.5 Summary

In reconciling these six themes, it is apparent that there is a range of evidence and an interrelationship between the themes which defines their influences on decision-making in ICU. Consequently, these themes were associated with three distinct domains. These are:

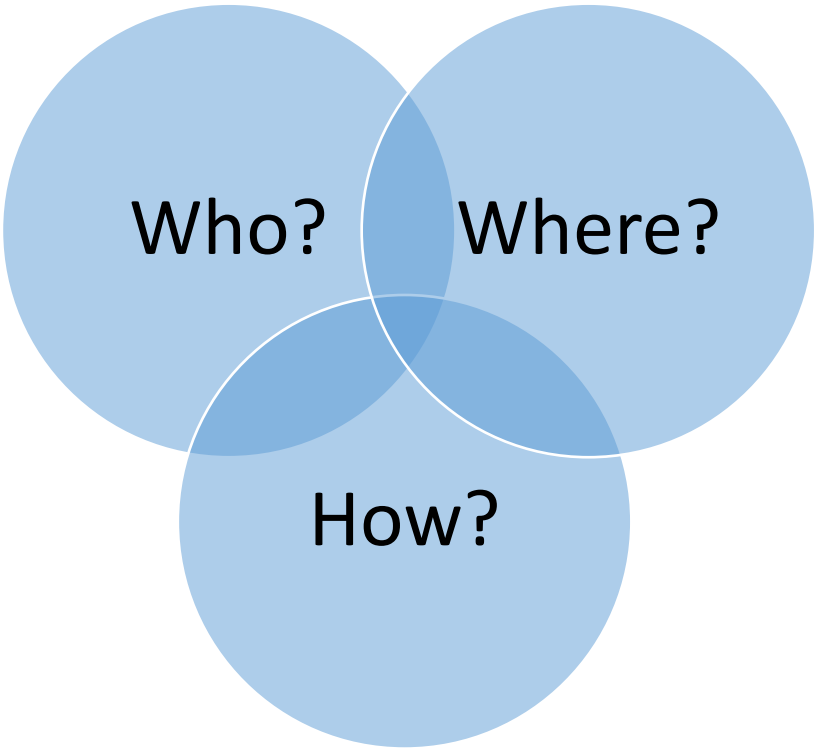

Figure 6 Interrelationship between critical care decision-making themes

2.5.1 Who?

The 'Who' domain is dominated by the three themes: experience, individual clinician factors, and collaboration. The constituents of this domain affect the individual's practice and are of key importance when arriving at a decision. As a result, examination of this component in the decision-making process may lead to specific insights into improving individuals ability to operate within a decision pathway.

The themes of both experience and individual clinician factors were recognised as being unique to the persons and constituents of their identity. It is conceivable that when looking at changing decision-making behaviours, these factors are difficult to modify. In respect that experience is often difficult to acquire without sufficient support, but personalities and attitudes are usually entrenched traits of individuals which often need both internal and external drivers to facilitate change. Whilst collaboration between individuals is often reciprocal and can be stimulated through the elements in the Where? domain.

2.5.2 Where?

The Where? domain consists of the culture and organisation theme. There are understandable differences between the culture and organisation demonstrated between a number of the critical care units discussed in this review. It appears that this variability between units is grounded in influences, both at a national and local organisational level. Consequently, highlighting its importance in influencing clinical decision-making. Of particular significance to the UK was the Egerod et al (2013) study, which commented on the nurse/patient ratio. In UK ICUs, there is a standard 1:1 nurse patient ratio for the highest acuity patients. This has been associated with safer care and increased inter-professional collaboration (Rose et al, 2011). Deviation from this cultural norm would have significant consequences on nurse decision-making and the potential consequences to patient outcomes.

2.5.3 How?

The decision processes and context themes were significant for 'How?' decisions are made. Contexts are often very fluid over the course of a nurses' shift, with patients' conditions being frequently unstable. This makes decision-making assessments complex and multifaceted, with challenges to the nurse in predicting future events. Therefore, decision-making scenarios are exposed to a large number of variables, which in order to resolve are reliant on the efficacy of the nurses' decision-making skills. Meanwhile, decision processes were integral to arriving at a decision with the role of assessment appearing paramount.

Chapter 3 Methodology

3.1 Introduction

As highlighted in Chapter 1, CRRT is a common occurrence in critical care and is managed by the critical care nurse. The absence of evidence on the influences of critical care nurses managing CRRT is also then highlighted in Chapter 2. These chapters largely feature previous evidence focussing on quantitative approaches to the answering of hypotheses related to the technical mechanisms of delivering CRRT, or the qualitative investigations on the influences directed at other critical care interventions or attributes.

This chapter will explore the research approaches taken to answer the question 'What are the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy?' in doing so it will examine the methods taken 'to develop an understanding of these influences'. This will include discussing the philosophical elements underpinning the design choices, the details of the research design, namely the methodological approach, sampling, and recruitment techniques. Subsequently the approaches and rationale to the data generation and analysis methods used will be discussed. With specific focus on generating the findings as a means to ultimately 'highlight areas where improvements in practices can be made to improve both patient and organisational related quality indicators of CRRT'. Alongside these the associated ethical considerations encountered will be examined.

3.2 Philosophical Assumptions

The design and conduct of research are influenced by the researcher's philosophical assumptions worldview or paradigm, and research methodologies are associated with particular ontological, epistemological, and methodological assumptions (Creswell, 2007). These paradigms according to Guba and Lincoln (1989, p2000) reflect 'the nature of the 'world' and the individual's place in it'.

A positivistic approach is the predominate type of inquiry within critical care (Charlesworth and Foëx, 2016). It is based on an objectivist ontology, whereby phenomena are considered to exist in a high level of consensus (Vogt, 2005) and therefore can be discovered and totally understood (Howell, 2013). Furthermore, the epistemological perspective is that this meaning is consistent and observable and therefore measurable. This results in a methodological approach which is focussed on hypotheses testing, through experimental methods and the manipulation of variables (Howell, 2013). This is done through quantitative methodologies

with the adoption of methods like randomised controlled trials or the use of case-controlled studies (Charlesworth and Foëx, 2016).

Diametrically opposed to this perspective is an interpretivist paradigm. An interpretivist paradigm consists of a constructivist ontology. That is, phenomenon do not exist in isolation, and as individuals (or groups of individuals) we construct meaning and generate our perceptions of phenomena. Epistemologically this means that interpretivism 'accepts a constantly changing world with unstable definitions and meanings' (Charlesworth and Foëx, 2016, p147). Consequently, researchers interrogating and interpreting these phenomena are the constructor of these realities. As a result, the methodological position is one that incorporates study designs focussed on obtaining subjective data on opinions or behaviours and the processes of interaction amongst individuals, with the researcher interpreting context and constructing meanings.

With the aims of this research focussed on the 'what' are the influences on critical care nurses, and understanding that influences would be dependent on individuals, perceptions and context, and the acknowledgement that qualitative methods use constructivist philosophical assumptions to conduct research, (Creswell, 2014) a decision was made to use an interpretivist approach throughout this study to construct and understand the individuals reality of these influences.

3.3 Qualitative Approach

The crux of this study was to answer the question 'What are the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy?' Moreover, the aim included developing an understanding of the factors of these influences. Answering this question and achieving these aims are well-matched to using a qualitative method as 'an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem' (Creswell 2014, p4).

Clark et al, (2011) highlight that qualitative research is conducted in a natural setting, it is an inductive process which moves from data to themes or theory, that the role of the researcher is critical, and they use tools such as interviews, observations, and records as sources of data. These characteristics are ideally suited to explore the opinions of staff on managing CRRT. Moreover because of the paucity of evidence on CRRT, discussed in the literature review, and as the setting is within the context of a larger body of evidence exploring decision-making in critical care, it makes it the ideal methodology to examine clinical decision-making with CRRT within critical care. In doing so, Marshall and Rossman (2016) propose that research which

involves the exploration of an area of practice, or that explores in depth the complexities and processes or where little is known about phenomena are ideally suited to the strengths of a qualitative methodology.

This is further evidenced by research into the processes of clinical decision-making in healthcare in which there is a bias towards qualitative approaches. This is undoubtably because qualitative approaches enable the research question to be answered in the natural setting. This is extremely important because as previously discussed in Chapter 2, the Context, Culture and Organisation were key themes highlighted within the current decision-making research in critical care.

In regard to the context of qualitative research in critical care, Charlesworth and Foëx, (2016) argue that qualitative research is an under used research tool in critical care and that the ability to deeply understand an observed phenomenon can improve the way critically ill patients are cared for. Similarly, Heasman and Reader (2015) found that qualitative investigations in critical care were highly useful to show patient and staff perspectives, and in distinguishing the worth of clinical practices. They particularly highlighted the value in understanding organisational culture and teamwork.

The aspects mentioned above support the idea of utilising a qualitative approach to understand the influences affecting the critical care nurses decision-making in CRRT. The ability to seek detailed and rich insights from participants to reveal key topics was essential in order to ensure that any implications for improvement measures could be elucidated and appropriately considered for implementation.

3.3.1 Common Qualitative approaches

Creswell (2007) identifies five common qualitative approaches to inquiry, Narrative, Case studies, Phenomenological, Ethnography and Grounded Theory. All of which were considered in the design of this study. An overview of each method and the rationale for opting for an alternate approach is described here.

A narrative inquiry which focused on the elicitation and interpretation of the stories from individual's experiences was considered. It was felt it would provide the depth and granularity that was sought after on the individuals experiences with managing CRRT, where there is a lack of available data. It would be able to ideally place aspects of temporality and sociality (Lewis, 2014) into context, delivering authenticity from their experiences. However, after consideration it was believed that the extent to which it would be required to embed with a participant would be difficult to attain. Also, in view of the widescale use of CRRT worldwide,

the focussed exploration would whilst providing very personal understandings and meanings, would not be able to reflect the wider realities that exist and ultimately aid in the broader implementation of improvements strategies for the critical care nursing workforce.

Case study approaches involve the creation of case or cases in which the researcher develops an in-depth insight into individuals, activity, processes, events, or programs (Creswell, 2014). Whilst the subject of the cases was easy to identify (provision of CRRT), it was much more difficult to highlight and understand how activity and processes could be reliably engaged with, and the absence of specific events or programs made this approach a logistical challenge. For the participants it was also felt that the focus on the individual would mean, much like in a narrative inquiry, that there would be difficulty to generate a broad enough scope to highlight those improvement measures for delivering CRRT.

A Phenomenological approach was also considered, whereby the focus would be on describing the *lived experiences* of critical care nurses delivering CRRT. This would have again provided an authentic understanding of experiences (Usher and Jackson, 2014). It was rejected again because it was felt that whilst it would offer vivid insights into the experiences of delivering CRRT. These would only be reinforcing experiences known to the wider critical care nurse community and would fail to address sufficiently, the improvement elements of the study.

The consideration of ethnography, where entire cultural groups could have been explored over extended periods of time (Creswell, 2007) was also appealing. The opportunity to spend extensive periods of time through a participant observation role, where engaging and interviewing staff who looked after patients on CRRT, would have enabled real-time authentic perspectives to be generated. However, due to the logistical challenges associated with workloads and the potential role conflicts, a purely ethnographic approach was not considered to be viable.

A Grounded Theory (Glaser and Strauss, 1967; Corbin and Strauss, 1990; Charmaz, 1995) methodology was a considered option. This was due to the lack of data on the subject area. Grounded Theory represents a methodology that is both inductive and exploratory with a proclivity for qualitative data. It has been increasingly used in nursing research to generate theories related to everyday clinical practice (Lazenbatt and Elliott, 2005). Despite its evolution over the past 50 years, Goulding (2002) suggest that at its core Grounded Theory is a method that enables researchers to generate a theory that:

- enables exploration of behaviour.
- useful in advancing a theory.

- applicable to practice.
- providing a perspective on behaviour.
- guide and provide a style for research on a particular behaviour.
- provide clear enough categories and hypothesis so theory can be verified.

Grounded Theory has a basis on symbolic interactionism, in that individuals interact with their environment and generate their own interpretations of these realities (Blumer, 1969). The complexity associated with this decision-making research, namely the non-uniform manifestation of decisions and variety of influences, would have reaffirmed the utility of a Grounded Theory approach in this research. In order to achieve this, data gathering approaches would have evolved with the data. Whilst attempting to allow for a process of triangulation to enable corroboration and elaboration of different data, strengthening the research's validity.

A number of the methods associated with Grounded Theory, such as constant comparative analysis, field notes and memoing were also felt to have good utility in exploring this topic area. All these components align with the aims of this research which would have enabled the justification of the use of a Grounded Theory methodology to address the research question. Ultimately however a Grounded Theory approach was rejected on the basis that the generation of a theory describing critical care nurses decision-making was not necessarily warranted and an interpretivist approach would be better able to explore the topic and answer the research questions.

Each approach was considered with respect to this research and rejected in place of the Interpretive Description approach (Thorne et al, 1997). An overview and the rationale for using an Interpretative Description approach follows in section 3.4.

3.4 Interpretive Description

Interpretive Description is an alternate approach to the classical qualitative designs mentioned in the previous section (3.3.1 Common Qualitative approaches). It was proposed with an aim to provide a bespoke approach in nursing, in order to address critique from methodological purists when nursing research failed to 'adhere rigorously to tenets of grounded theory, phenomenology, and ethnography' (Thorne, 2016, p13). Interpretive Description is proposed as a 'generic' nursing approach that enables nursing researchers to build methods that are grounded in their own epistemological foundations and adhering to nursing's own systematic reasoning, whilst producing knowledge legitimate for practice.

This approach aligns with constructivist and naturalistic considerations and acknowledges the contextual nature of healthcare experiences, whilst allowing for shared realities, and as a result it enables users to avoid the slurring of methods, and associated criticism of this when using classical approaches. As it was developed to address the specific needs within nursing science it also recognises the applied nature of nursing research (Thorne et al, 1997). The Interpretive Description philosophical framework believes that the understanding of a phenomenon is impossible through just empirical analysis (Hunt, 2009). Therefore, to properly understand the realities that exist for individuals, it is important to investigate the local context and persons gaining insights that are socially and experientially based. The researcher and participants then co-construct understandings, influencing one another.

The adoption of Interpretive Description has become wide ranging since its proposal in 1997. It has been used as an approach to explore the experiences of relatives and caregivers, such as after medically assisted death in Canada (Beuthin et al, 2022), or for patients in understanding their experience of survival after being treated with extracorporeal membrane oxygenation (Knudson et al, 2022). From a staffing perspective it has been utilised to exploring registered ICU nurses experiences of providing end of life care in a community hospital (Wong et al, 2020), and also in getting student nurses perspectives on equality, diversity, and inclusion in open educational resources (Lapum et al, 2022). With over 600 records identified just on the CINHAL Complete journal indexing database (EBSCO, Ipswich, USA), Interpretive Description has gained a significant and wide-ranging uptake in the past 25 years and has grown to involve the conduct in other healthcare professionals such as in physiotherapy (Atkinson and McElroy, 2016; Lawler et al, 2019).

Whilst Interpretive Description is viewed as an applied qualitative methodology, its broad adoption and inclusivity to a variety of research methods has led Thorne (2016) to support the integration of quantitative data, into an Interpretive Description study design in order for it to enable a more comprehensive and integrated way of viewing the world and phenomena. The reasons for this are that in doing so it enables the thorough examination of clinical phenomenon with the goal of identifying themes and patterns amongst subjective perspectives whilst accounting for variation between individuals. Interpretive Description recognises the importance that the researcher brings to the study, with their existing knowledge, as expert clinical knowledge is viewed as a significant basis for research design (Hunt, 2009) and this consequently provides authenticity and validity in the interpretation of the findings.

In terms of data analysis, the significant affiliation between interpretive description and clinical practice means that findings will be constructed in such a fashion that that they can of use to healthcare professionals and as such ensure that they have direct applications in understanding the complexities of healthcare and progressing practice development.

Interpretive Description identifies a number of components such as sampling selection, analytical frameworks, data sources, data analysis and rigor of qualitative inquiry and suggests how its application differs from those in the classical approaches or generic qualitative inquiry. The Interpretive Description stance will be discussed with specific reference to these components and this thesis further on throughout the research design sections of this chapter. The exception to this is the analytic framework, which refers to the pre study design work and is discussed here.

Whilst generic qualitative inquiry could have been used in this thesis overall, the decision to adopt an Interpretive description approach was based on its ability to remain focussed on clinical practice, and the ability to explore the phenomenon of influences of critical care nurses decision making in CRRT using multiple data collection options. This needed to be done with an approach that was sensitive to both enabling the understanding of multiple realities, and the subjective human experience usually identified through a phenomenological approach. This was alongside describing the peoples, cultures, customs, habits and mutual differences which are the focus of ethnographic investigations, all whilst avoiding the restrictions from a predetermined theoretical stance. Additionally, the originally planned incorporation of quantitative data to elucidate the participant selection also aligns with this Interpretive Description approach, without compromising methodological integrity.

A central tenet of Interpretive Description is providing the generation of clinically relevant, directly usable findings to aid in the development of practice. Therefore, in using this Interpretive Descriptive approach, it was important that, throughout the analysis, to ensure the research goes beyond reporting the findings and to interpret what the findings mean, not only in relation to one another and the context of the study and future healthcare delivery, but also in terms of interpreting the link between practitioners experiences and beliefs in relation to their reported actions.

3.4.1 Analytic Frameworks

Thorne et al (1997) suggest that any pre-existing knowledge or clinical interpretation should be considered as ‘foundational forestructure’ for a qualitative inquiry and specifically recognise that the concept of ‘going in blind’ as counterproductive. In generating these new insights or using pre-existing knowledge, the researcher has the ability to construct a framework on which

to build a qualitative design and enables better understanding and establishes expectations as to the direction of the study. This approach is contrary to those ideas proposed in a Grounded Theory design, where topic areas of which there is little known about it are considered ideal applications, and the use of formal literature reviews are delayed as a means to reduce the impact of any existing theories or knowledge on researchers and subsequently on the study outcomes (Birks and Mills, 2015).

In the context of this study, adopting an Interpretive Description approach rather than Grounded Theory, enabled the conduct of early literature reviews to highlight the paucity of evidence directly related to CRRT decision-making in critical care nurses, but also enabled the generation of the wider themes of critical care decision-making, (Who? Where? How?) which directly facilitated the focus of the study and informed study design considerations.

3.5 Methodology Overview

In this research, exploring the influences of critical care nurses decision-making around the management of CRRT, an Interpretive Description approach was used to '[quest for knowledge and] apply it to real human beings caught in complex and difficult human health problems so that their quality of life could be improved in some manner' (Thorne, 2016, p25). In doing so enabled the pursuit of a specific nursing qualitatively focussed exploration.

3.6 Research Questions

In reviewing the aims of this research, the design of this study was to answer the question:

- What are the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy?

This was in the context of a desire to:

- To develop an understanding of the factors that influence critical care nurses' decision-making in the management of patients receiving Continuous Renal Replacement Therapy.
- To highlight areas where improvements in practices can be made to improve both patient and organisational related quality indicators of CRRT.

As such the design decisions were made to facilitate the generation of data that could address these.

3.7 Setting

A majority of ICUs have around 11-20 beds (CCN3, 2020) and most units are labelled as 'General' units delivering care to patients with a mixture of clinical aetiologies, with other specialist critical care units focussed on specific types of conditions like neurosurgery or cardiothoracic surgery. Critical care units provide for patients with varying levels of care.

> Level 2 critical care patients require more detailed observations or interventions including CRRT, including support for a single failing organ system, or post-operative care, and those 'stepping down' from higher levels of care.
>
> Level 3 critical care patients require advanced respiratory support alone, or basic respiratory support together with support of at least two organ systems. This level includes all complex patients requiring support for multi-organ failure and encompasses CRRT (The Kings Fund, 2020; Intensive Care Society, 2021).

This study was conducted across four critical care units in a single healthcare organisation. In comparison to other ICUs in the UK as described above, these sites represent a typical cross section of critical care units in medium to large NHS Hospital trusts throughout the UK. The units consist of a total of 44 beds which provide for a mixture of critical care dependency, both level 2 and 3 patients. Three units are classified as 'general' ICUs, for patients admitted under a wide range of medical specialities and one unit as a cardiothoracic ICU dedicated to support patients primarily after cardiothoracic surgery, or those needing advanced cardiac support.

The units are consultant intensivist led with 24-hour cover 7 days a week. Approximately 180 permanent registered nursing members of staff make up the nursing establishment. They are contracted from 6 hours to 37.5 hours per week, adopting a range of shift patterns including 12-hour day/night shifts and 6-8 hours early and late shifts, with a range of skills, experience, and roles. Four nurse clinical educators are employed to facilitate ongoing nurse education and training. The medical staff incorporate a group of 20 consultant intensivists complemented by approximately 30 junior medical staff at various stages of training. These are supported by five trainee Advanced Critical Care Practitioners. A team of physiotherapists, dieticians and pharmacists compliments the critical care specific staff. They strive to deliver Intensive Cares Services in line with Guidelines for the Provision of Intensive Care Service V2.1 recommendations (Faculty of Intensive Care Medicine and The Intensive Care Society, 2022). All units can provide CRRT to a maximum of three patients simultaneously.

Local registry data collected as part of the ICNARC Case Mix Programme (https://onlinereports.icnarc.org/Home) indicates that across all sites in this study, around

5.5% of patients receive a form of renal replacement therapy and of which 8% of all critical care inpatient days there is some form of renal replacement therapy occurring. It was envisaged this would provide sufficient opportunity to enable an insight at both an individual and organisational level.

Access to site and participants was gained by virtue of the researcher's current role, delivering clinical research across the critical care units. Enumeration of staff and those who manage Continuous Renal Replacement Therapy systems was readily accessible from the clinical nurse educator team.

3.8 Data Collection Methods

The requirement of this study was to obtain rich detailed perspectives from critical care staff in order to understand what influences their decision-making practice in CRRT and subsequently guide improvements for future CRRT practice. The primary tool to acquire data was the semi structured research interview, however in view of what was expected to be variations in the characteristics of the staff involved, it was decided that participants critical thinking disposition would be quantified in order to contextualise any findings and help, alongside identifying individuals' professional roles and experiences to subsequently aid sampling. After a review of the available tools to measure critical thinking disposition the California Critical Thinking Disposition Inventory (CCTDI) (Insight Assessment, San Jose) was selected.

3.8.1 California Critical Thinking Disposition Inventory (CCTDI) Evidence Base and Use in Nursing

The CCTDI was devised and developed by Facione and Facione (1992) as a means to allow for the exploration of the dispositional dimensions of individuals' critical thinking, namely the motivational component. A concept which was derived from a Delphi study by the American Philosophical Association (1990).

The CCTDI is a questionnaire to assess individuals critical thinking disposition via the seven sub scales of Truth Seeking, Open Mindedness, Analyticity, Systematicity, Critical Thinking Self-confidence, Inquisitiveness and Cognitive Maturity. Grading is performed via a sum of the individual sub theme scores, indicating an individuals' general disposition to thinking critically.

Since its inception its use throughout the literature is largely focussed on the exploration of undergraduate critical thinking (Shin et al, 2006) along with their transition from student to practitioner (Stewart and Dempsey, 2005; Wangensteen et al, 2010) and has been used across a number of countries. However, its use, in its original format, within a critical care

environment is not widespread (Smith-Blair & Neighbors, 2000) additionally no published evidence of its use in UK critical care units could be found.

In terms of reliability and validity the CCTDI meets the threshold for strong, internal consistency reliability with a Cronbach alpha of 0.92 for their OVERALL Scores, (Facione, Facione and Sanchez, 1994) which are observed to maintain this performance in all samples of adequate variance.

Examining the participants seven CCTDI attributes was planned to highlight if participants were outliers in respect to either a positive or negative tendency to critical thinking disposition. Applying this information into the interviews was used to help focus discussions which provided additional participant specific data.

For example, in practical terms this consisted of, for those individuals with a strong positive response to Inquisitiveness, their questions were geared towards exploring how this applies to individual's CRRT practice i.e., do they question theirs or the departments practice decision? Do they trial different settings looking for better responses? Whereas if participants had a strong negative response to Inquisitiveness, exploration would have consisted of investigating if and why they feel indifferent about CRRT, and does the protocolisation of CRRT affect this inquisitiveness?

3.8.2 California Critical Thinking Disposition Inventory (CCTDI) Application

Post consent a short demographic questionnaire (see Appendix C) describing the participants' previous experience was embedded into the online CCTDI questionnaire platform and administered immediately prior to the CCTDI. This provided perspective on participants levels of experience and exposure to managing CRRT. These data were expected to take a maximum of 10 minutes to complete. Following completion of the demographic questionnaire participants were asked to complete the California Critical Thinking Disposition Inventory (CCTDI) (Insight Assessment, San Jose) (See Appendix D) to establish an individuals' perception of how they view themselves as critical thinkers. The rationale for administering this instrument was to contextualise individuals' disposition in respect of any data derived from involvement in this study's participation. The test is a 75-item questionnaire and was administered online and scheduled to take approximately 20 minutes to complete. Items consisted of a Likert type scale with the respondent choosing from one of six answers. These data were also collected via the online system provided by the publisher. The CCTDI was required to be used under license from Insight Assessment (San Jose, California).

The purpose of the CCTDI in the context of this study was to elucidate and inform subsequent participant selection for interview, whilst simultaneously aiding in the development of a bespoke schedule to guide their semi structured interview. This process enabled the use of the disposition domains as a means to maximise insights from participants throughout their involvement in the study.

3.8.3 Qualitative data collection instrument

The purpose of this research was to obtain insights and build deep understandings (Johnson and Rowlands, 2012) from critical care staff about their decision-making on CRRT. It was considered that in order to obtain the most authentic, rich insights, that these should be sought in a critical care-based environment. Consequently, a number of techniques were considered including the use of interviews; structured, semi-structured, unstructured and focus groups, alongside other tools like participant observation, the 'talk aloud' method and the use of vignettes.

The use of vignettes is a commonly used tool in qualitative research, enabling the researcher to define their own fictional or fictionalised situation(s) and scenarios (Bloor and Wood, 2006) which then enable the participant to explore and provide opinions on. Hughes (2008) identified that they were particularly valuable when exploring perceptions, attitudes, and behaviours on topics. Despite this, and with consideration to the context of this study, even with the thoughtful generation of a fictionalised clinical scenario, the use of a vignette would potentially lead to the participant focussing and continually coming back to the 'what' they would do, rather than the influences and the 'why' they would take specific actions. Additionally, consideration to the challenges of generating a hypothetical or several hypothetical situations, that were felt to be realistic and authentic, was debated, and likewise in order to prevent participants concentrating on critiquing and focussing in on the minutiae of the scenario, which would be distracting, and detract from the objectives of the study, the use of vignettes was discounted.

Following on from contemplating the use of vignettes, the use of the 'Think Aloud' method was also considered. This was in part based on the review and critique of the Aitken et al (2011) study and the desire to document first-hand the experiences of the critical care staff delivering CRRT and to avoid or mitigate some of the inherent biases associated when participants are asked to self-report. The 'Think Aloud' method (Ericsson and Simon, 1980) is an approach which involves participants verbalising their thoughts as they perform tasks or whilst they problem solve, providing rich verbal data (Fonteyn et al, 1993). It has been used in

a variety of clinical contexts to investigate clinical decision-making processes, alongside usability testing.

The decision to not use the Think Aloud method was based on the challenges associated with its delivery in the clinical area. Whilst the Think Aloud method has been used in critical care areas (Aitken et al, 2011; Teece, 2022) the decision not to use it in the context of this study was based on the risk of cognitive strain and pressure put on participants in an active clinical environment rather than a simulated one.

3.8.3.1 Interviews

Interviews are a commonly used means of acquiring data in qualitative research studies (Sandelowski, 2002; Flick, 2022). They offer the opportunity to hear first-hand the perspectives and opinions of research participants whilst providing flexibility, on the content, over alternatives like questionnaires (Gillham, 2005) and other real-time qualitative data gathering techniques like the Think Aloud method. In doing so, interviews seek to describe peoples inner thoughts and experiences (Roulston and Choi, 2018).

Approaches to the conduct of interviews range along a continuum from unstructured to structured, each with its own usefulness depending on the research context. Whilst no interview can be completely unstructured (DiCiccco-Bloom and Crabtree, 2006), an unstructured interview is the process by which broad open-ended questions are asked of participants, as a means to gather data on opinions and topics. The lack of structure often means that these discussions are subsequently interviewee driven (Roulston and Choi, 2018), depending on the skill or desire of the interviewer. Unstructured interviews are ideal for studying relatively new or unique areas, allowing for participants to freely reveal aspects they consider important. The are often used when depth on a topic is sought, with Birks and Mills (2015) suggesting the less structure involved is better in allowing the researcher to follow the path of the conversation. They are best used in situations where participants are skilled at articulating their opinions. Firman (2012) states that due to their lack of rigidity, unstructured interviews also have the ability to ensure the participant and their opinions remain the centre of the interview, rather than that of the specific question. This then leads to a shift in power towards the interviewee, which can have the consequence of relaxing the participant and easing the pressure on them, often allowing them to feel comfortable to engage in more open conversation.

Conversely, structured interviews use a standardised set of interview questions across all of the participants in a research study. These questions largely result in factual responses from participants (Barker,1996) akin to the use of questionnaires. They enable the use of consistent

researcher prompts in order to elicit personalised responses from interviewees on specific aspects of interest. These processes enable the reduction in researcher bias, based on the situation and participant interactions and has significant utility where a number of interviewers are involved in the collection of data. Structured interviews allow for focussed question and answer sessions with participants, this approach is therefore common in regard to data acquisitions in situations where quantitative data are sought, when inferential statistics are required or where direct comparisons between groups wish to be made, in themselves they are easy to administer and analyse (Barrett and Twycross, 2018). From a logistical perspective, structured interviews play an important role when the use of questionnaires is prohibitive. Such as when response rates are expected to be low and then using an interview method may improve the collection of data. Alternatively, in populations who may struggle to focus on the topics under investigation, those with developmental disabilities, where broader open questions are asked, structured interviews may be of benefit.

In this study a semi-structured interview approach was taken (Flick, 2022). This was to enable the inclusion of some of the broad themes identified in the literature review, utilise the findings from the results of the CCTDI, but more importantly to enable the interviews to follow the emerging data generated and seek further immediate clarification on aspects raised during the interviews. On that basis an interview prompt guide was developed (see Appendix E) as a result of the findings from the literature searches detailed in Chapter 2, this was to enable the researcher to focus on the key topics that emerged from the critical care decision-making literature. The focus of this portion of the research revolved around the decision-making of health professionals at a clinical level, so discussions were guided to address these subjects rather than the organisational logistics associated with senior management decision making.

Due to the nature and unpredictability of semi-structured interviews and the planned iterative approach taken on the content, the interview and the guides were not piloted in their entirety before interviewing the first participant. However, the interview prompt guide was reviewed by two senior nursing leaders in the critical care department (a Charge Nurse and a Clinical Nurse Educator). Feedback from these individuals was that the topics were appropriate and broad, but that it would also enable tangents to develop and different discussions to evolve. They also stated that due to the novelty of the subject matter they were unsure whether the prompts would elicit the responses required. On that basis and the opportunity to use the interviews iteratively as study recruitment progressed, no changes were made to the core questions in the interview prompt guide.

However, the iterative development of the interviews and interview schedule over the course of the study was vital to ensure that topics of conversations and analysis generated from previous participants could be developed with subsequent interviewees. In practice what occurred was that prior to each interview, and as part of the selection of the next participant, the individuals' demographic details and CCTDI scores with associated proclivities were reviewed. Alongside this the developing themes from the ongoing analysis were also incorporated into the core interview schedule questions in order to further develop themes or provide evidence to contradict. For example, in topics discussing the 'allocation of staff' generated by Band 5 nurses, would also be discussed with Band 6 nurses to gather their insights and perspectives. This iterative development of the interview questions came from notes made at the time of discussions with previous participants, along with notes from the initial analysis of the interview data and the scores in the domains of the CCTDI. These preparatory notes included handwritten annotations to the core questions on the interview prompt guide (Appendix E), enabling them to be drawn into discussion at the appropriate junctures of the interview. Annotations took the form of topics for discussion rather than precise questions.

Interviews were conducted in person, on a one-to-one basis, in a private room at a location (on the hospital campus) and at a time that was deemed acceptable to the interviewee. The rooms varied in location, depending on the hospital site that the participants were most comfortable or convenient to visit. The private rooms were a room dedicated to having difficult conversations with patients' family members. These rooms meant that the interviews were conducted in comfortable chairs and surrounded by more home-like furnishings. The alternative rooms chosen were the unit seminar rooms, these interviews were conducted across tabletops with office furnishings. All interview areas were very familiar to participants and used frequently by them during their working week. A notice was applied to each door to indicate that an interview was in progress as a means to prevent interruptions or distractions and maintain the confidentiality of the participants and the content of the interviews. All interviews were arranged to be conducted outside of the participants working hours, with participants attending on their days off or coinciding interviews on the same day as any mandated training. This avoided any conflict of interest, undertaking interviews in paid time or the pressures of having to return to work and the associated lack of focus on the interviews. There was no form of renumeration (financial or lieu time) or hospitality for participating in the interviews. However, it was identified and advocated that participants could use participation in the study as part of the process for revalidation with the Nursing and Midwifery Council.

Interviews were recorded on a digital audio recorder (Coredy Digital Voice Recorder Model No CR-B5) connected via a 3.5mm audio jack to an unbranded condenser microphone. The interviewer used a single sheet of A4 paper with an annotated interview guide and a notepad and pen to reference particular points of interest that would require follow up during the review of the interview transcripts, along with comments related to behaviours or actions during the interview that may not be picked up during the audio recording. Whilst the interviews were represented as important data collection instruments during the invitation and informed consent discussion, in practice they were relaxed events and took the form of a semi-formal discussion between co-workers with a mutual interest in CRRT, rather than a prescribed question-and-answer session. Rapport was built quickly in part due to existing professional relationships with participants.

Prior to any interviews being conducted, specific training on conducting a research interview was undertaken in order to appreciate the theoretical background of interviewing techniques and gain exposure and practice to a range of interview styles and approaches, such as structured, semi structured and artifact interviews.

The details of the number of interviews and their length are shown in Chapter 4.

3.9 Participants

This study focuses on the influences on individuals' clinical decisions therefore it requires a specific population of critical care nurses, to elucidate meaningful and representative understandings of the influences on their practice. It was envisaged that the key groups of individuals were AfC Band 5 and 6 nurses who have day to day involvement in the processes and delivery of CRRT and were therefore best placed to describe these influences on themselves and colleagues.

To select these participants a simple inclusion criterion was devised. Which entailed identifying suitable candidates who were:

- Employees who work permanently on one of the four critical care units across the study setting.
- Participants who were registered with the Nursing and Midwifery Council.
- Have had hands on exposure to Continuous Renal Replacement Therapies.
- Had a willingness to undertake an interview and a period of clinical observation.

It was hoped that this criterion was broad enough to interest enough participants but also provided a focus on experience, in order that interviews could be productive and elucidate the required data.

3.10 Sampling

A purposive sampling method was the approach taken in this study. A purposive sampling approach is a non-probabilistic technique where participants are selected based on a variety of researcher defined criteria such as knowledge, capacity, and willingness to be involved (Oliver, 2006). In this study it enabled a bespoke and directional method to sample participants to ensure that the research objectives could be met (Given, 2008). In acknowledging that participants had a variety of experiences and influences it allowed the selection, recruitment and interview of participants using a maximum variation sampling technique to select participants who would represent the broadest perspective of the critical care nurse workforce. This was facilitated by the use of the CCTDI scores as an adjunct to existing researcher insights and the demographic details provided by participants. This process was the primary method to decide on the sequence of participants interviews. This selection was based on the discussions in previous interviews, for example, the first 5 interviews were conducted with participants with Band 5 roles. This had allowed the initial development of themes central to their practice, however at this point it was decided that it was important to understand whether the role of a Band 6 nurse provided a differing or supportive perspective to the Band 5 nurses. Subsequently, the outcome of the Band 6 nurse interview then had raised questions that it was then felt important, at this point to obtain some further corroboration or otherwise from another Band 6 nurse for the next interview.

This approach was to ensure the desired variation in the sample selected for interview, in reference to participant characteristics like length of experience, AfC banding, and uniquely participants CCTDI attributes. This aimed to secure the discovery of knowledge applicable to applied practice, particularly in a subject area without an extensive evidence base. This was practically maintained through the continual cross-referencing of the participants demographic and CCTDI details prior to each decision to invite the next participant to interview. Ensuring the next participant possessed characteristics that would enable further exploration of the aspects raised in earlier interviews.

Additionally, its use in this study is appropriate as there was a limited but potentially accessible population available. It was impractical and implausible to interview the whole population and there is likely to be variation in opinions and perspectives across the staff group. Purposive sampling ensured that both supporting or contradicting evidence was sought from other

participants for the emerging descriptions, whilst also ensuring that the specific exploration of emerging data that appears to be either anomalous or artefact occurred.

Due to the inclusion criteria and the staffing breakdown of the critical care units, it was expected and desired that the vast majority of potential participants would be Agenda for Change (AfC) Band 5 and Band 6 Nurses. AfC Band 5 nurses comprise of entry level registered nursing positions, whereby the role largely entails the assessment of patients and delivery of nursing procedures, in comparison AfC Band 6 Nurses take on a team leadership role which in addition to the above activities also includes clinical and managerial leadership to support staff and ensure the effective running of a ward or unit (NHS Employers, 2021).

3.10.1 Size of sample

Due to the emerging nature of this methodology the exact sample size and descriptions were unable to be described in detail beforehand. A total population in this setting, fulfilling the inclusion criteria is approximately 180-200 registered nurses. Based on data from the qualitative studies in the literature review, the number of participants ranged from 7 – 29, with other non-critical care studies, exploring non-probabilistic sampling, also highlighting similar recruitment numbers (Guest et al, 2006). The plan was to aim to recruit a total number of participants towards the higher end of this range, which would account for up to 15% of the accessible population.

Instead of an arbitrary sample size and due to the use of purposive sampling, participant recruitment to further interviews ceased at the point of data saturation (Mason, 2017). This stop in recruitment was predefined prior to commencing the study. The predetermined halt was the point where all the existing constructs of the influences on CRRT decision-making had been explored and supported with data. This assessment was made through the concurrent analysis of interview transcripts between participants and a decision to stop recruitment when there were no new themes or sub themes generated across two concurrent participants. Whilst this approach risked the potential of not obtaining new themes from future interviewees, it was deemed a sensitive and practical approach to maximise data and was based on and supported by findings in Francis et al (2010) and Hennink et al (2016).

In practical terms in this study, data saturation occurred after participant 7; no new themes or sub themes were created as a result of conducting interviews with the last two participants. That is, there were no significantly new topics of discussion being raised and the interviews acted to corroborate previous participants points of view.

3.10.2 Sampling technique

To successfully achieve the purposive sampling approach there needed to be a number of consented participants whose CCTDI and demographic questionnaire had been completed. This then allowed for the CCTDI and questionnaire data to be reviewed and guide the choice of subsequent participant selection and the content of the interviews, in the context of emerging data from the previous observations and interviews.

As a result, when interested staff provided consent, they were asked to complete the CCTDI and associated questionnaire as soon as possible. For the first interview there was an initial influx of participants (n=3), so these data were reviewed concurrently, and the first interview was arranged. Recruitment of participants then continued until the maximum variation in the sample was obtained and data saturation was reached (Mason, 2017).

This approach provided an efficient and robust way to select participants so that they could provide timely relevant data for exploration. The consequences of adopting this approach, was that it required the swift analysis of both the CCTDI and interview data to determine who would be appropriate as the next interview candidate. However, for the participants it meant there needed to be flexibility in the arranging of the interviews. The most significant challenge was that of reviewing the initial interviews ensuring that the important themes were highlighted to enable discussion points to be drafted ready for the next interview. This often led to protracted gaps between interviews and prolongation of the overall interview phase of the study.

3.11 Recruitment

Potential participants were initially approached via two methods. Firstly, a poster advertisement (Appendix F) was placed in staff social areas (with unit management permission), identifying the types of individuals required and inviting them to participate and providing them with the researcher's contact details. This was followed by a group invitation email, sent from departmental and educational leads to staff who they had identified from training records would be suitable for participation in the study. The email contained a copy of the participant information sheet (Appendix G) and provided points of contact for interested individuals (email address, telephone number, and physical work address) to obtain further information.

This email was sent by the departmental and educational leads to ensure that staff privacy was maintained and to avoid any perception of researcher coercion to participate. The departmental and educational leads acted as an intermediary and had no vested interest in the

individuals' participation in the study. The invitation email made it clear that participation was purely voluntary. In order to optimise recruitment a follow up invitation email was sent two weeks after the original study invitation email.

Participants were given a sequential, unique identifier at the point of consent, in order to anonymise their data and act as a reference point. The numbers were prefixed with NU to identify the participant was a nurse, i.e., NU001, NU002, NU003…, this method was used in preparation for any further work that may involve other healthcare professionals.

3.12 Procedure

This section details, chronologically, the procedures that took place for participants in the study.

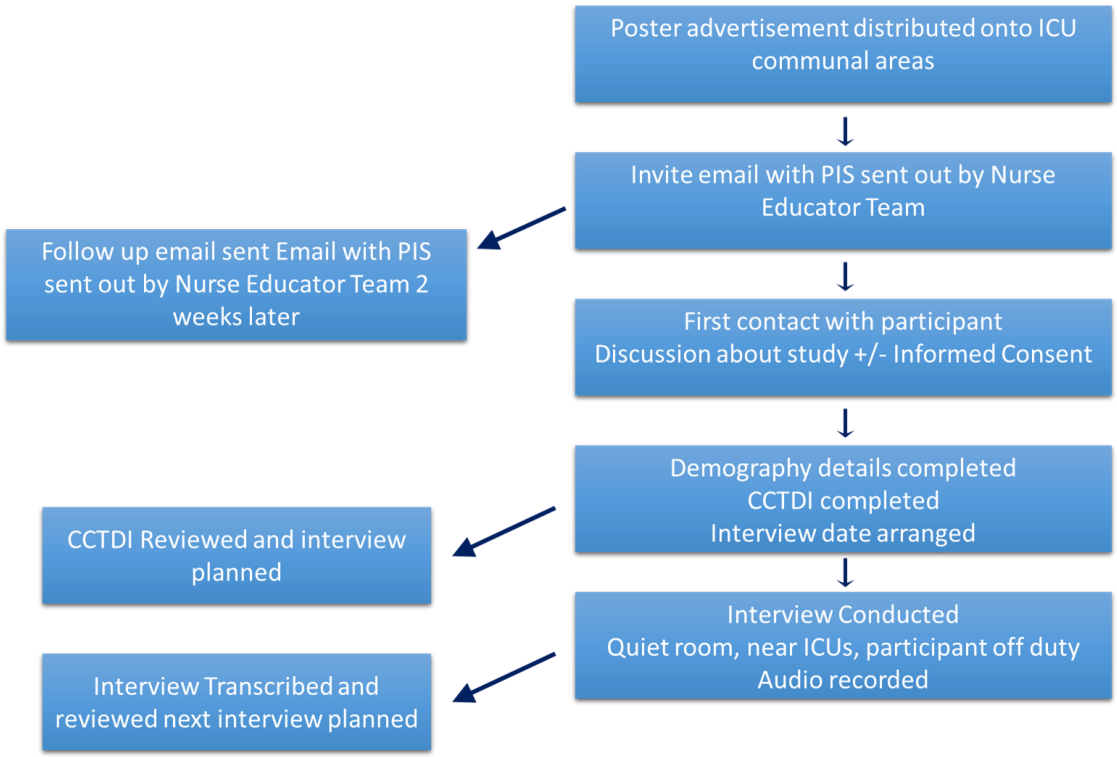

Figure 7 Study Design Chronology

3.13 Data Analysis

All data was generated or collected by the researcher and on a sequential basis, the units of data were transcribed (where appropriate), de-identified and coded by the researcher. Transcribed interviews and the CCTDI results were imported into the latest version of NVivo (QSR International Pty Ltd, Burlington, USA), a qualitative analysis data software package, with versions updated as they were released. NVivo provided the mechanism to enable coding allocations and make comparisons between groups and individuals. In the creation of the

interview transcripts any behavioural elements that had been noted were added, in order to provide any context during the coding process.

These data were analysed thematically based on Braun and Clarke (2006, p87) six phases of thematic analysis; 1) Familiarising yourself with your data, 2) Generating initial codes, 3) Searching for themes, 4) Reviewing themes, 5) Defining and naming themes and 6) Producing the report. The method was adapted as described below to account for the sampling technique, whereby previous interview analysis informed the subsequent interview discussions. However broadly, analysis began as per Braun and Clarke (2006) with the familiarisation of the data by listening to audio recordings and reading the transcripts. Followed by line-by-line coding where distinct concepts and categories were interpreted from the data (inductively) and categorised (phase 2 of 6). This was done through the grouping of quotations into distinct topics with initial simple labels (phase 3 of 6). A good example of this was the topic of experience, where all instances which were felt to relate to experience were categorised.

As new themes developed in the coding of subsequent interviews, previous interviews were reviewed, and additional coding or refinement of the codes already included. At which point subsequently coding occurred where the concepts and categories that had emerged were refined further (phase 4 of 6), for instance from “experience” to “critical care experience” and where possible link relating categories to each other were identified. The use of neutral labelling of codes was adopted as coding progressed based on the high level of alignment seen between participants. In those circumstances where there were discordant views these were highlighted in code annotations in NVivo to ensure all perspectives were addressed during the description of the themes.

Finally, codes were brought together (phase 5 of 6) in similar categories to form a ‘core’ (higher level) category. In producing the report (phase 6 of 6) effort was made to reflect the opinions and perspectives of the participants across these unembellished categories, and in doing so detail a clinically relevant interpretation of these themes. Although latterly these higher-level categories were relabelled to comprised of direct quotations from participants that best conveyed the essence of the themes and some of the nuances and language adopted by participants to tell their stories and experiences. These single quotes would emphasise the authenticity of the data and try and portray the voices of the participants as central to the thesis and the development of the themes. The development of a themes importance was not solely generated through the objective measure of the frequency. Instead, these frequencies (obtained via NVivo) were incorporated with the strength of feeling towards particular topics

and the veracity of opinions on particular codes. The experience theme again provides the perfect example where there was significant volume of discussion but there were also passionate opinions on how long it should be before staff begin to use CRRT. This further accentuated the participants voice throughout the themes.

Examples of codes and coding structure along with the justification and rationale were discussed with supervisors at regular intervals over the course of their construction. This process had a subsequent impact on theme and sub theme generation with numerous refocussing and movement, prior to a completion of a 'final' substantive version of the themes (see Appendix H).

3.13.1 Data Triangulation

Data triangulation refers to the process by which a combination of different methodologies are brought together in the study of the same phenomena (Flick, 2018). The use of multiple sources allows for greater justification in the building of themes and provides greater validity to the study (Creswell, 2014) alongside the mitigation of personal biases associated with particular methodologies. The intention of this study was to use triangulation through the use of interviews and participant observations as a means to assess the concordance of data generated through interviews. The rationale for the lack of participant observation is discussed in section 5.6.1 Participant Observation.

3.14 Ethics

3.14.1 Ethical Approval

Before commencement of the study, formal ethical approval was sought from the researchers educational organisation (University of Hull). In the context of this research, involving National Health Service staff, consideration was made for the requirement for an ethical submission to the National Research Ethics Service/Health Research Authority. However, as this involved NHS staff working in their current role, the governance arrangements for research ethics committees, section 2.3.13, (Health Research Authority, 2011) exempts this type of research from requiring any National Research Ethics Committee approval, as long as there are no other ethical requirements.

In planning the design and delivery of the study, ethical considerations need to be accounted for. In this study there were no physical risks associated to either the researcher or participants during their involvement in this study. There was a small potential psychological risk that might arise to the participant over the course of the interviews. As it was considered that the use of interviews in this study could create a power dynamic which may cause

potential stress to the participants. It was felt that conducting interviews in a location of choice by the participant would ensure that they were not felt to be at any increased pressure, driven by environmental factors. Participants were able to terminate interviews at any point, and as a safeguard, after 90 minutes the opportunity to terminate the interview would be offered to them by the researcher. However, no interview lasted 90 minutes. Inconvenience to the participants was limited as far as possible as their participation took place in their free time, as such mutually convenient interview dates and locations were selected. There was no direct compensation for participants being involved in the study, however they were made aware that the interview opportunity may be suitable as evidence of continued professional development and it also offered them the opportunity to reflect on the interview in a written reflective account, both of which could contribute to requirements set out in the Nursing and Midwifery Council (NMC) process for revalidation (NMC, 2022).

3.14.2 Consent

Interested participants were provided with the ethics committee approved participant information sheet (Appendix G) detailing the study procedures they were asked to participate in. At least 48 hours, from receipt of the PIS, was then given to individuals to consider their participation in the study. The opportunity was made available to discuss the details of the study with the researcher and ask any questions as necessary. Subsequently written informed consent (Appendix I) was sought and obtained from all participants involved in study related procedures (i.e., questionnaires and interviews).

3.15 Researcher Impact

3.15.1 Positionality

The researcher has a long-standing association with the clinical areas where the research was conducted. It was envisaged that this enabled the better facilitation of access to the participants and their environment and provided greater understanding and insight.

To provide clarity the researcher is employed by the same organisation in which the research was conducted, however there is a distinct difference in professional role and relationship with the participants of this study. Whilst in the researcher's usual (paid) role there is an everyday collaborative working relationship with the participants, the researcher's job and employment arrangements fall within a different part of the overall organisational structure, so therefore there was no management responsibilities, clinical oversight, discernible control, or hierarchal influences over participants' employment during the conduct of this research.

Due to the staged data collection approach of this study, it was important that as many participants as possible completed each stage. Participants had the right to withdraw consent at any point in this project, effectively empowering them to control data collection. The deliberate absence of participation incentives also afforded participants a greater degree of control as there is no requirement for them to fulfil the whole study to receive a reward.

It was envisaged that there would be no effect on professional relationships with colleagues. Firstly, for a majority of potential participants, the researcher is known in a professional research-based context rather than a personal or social one. This ameliorated any role conflict. Secondly, individuals who have been deemed competent to provide CRRT by a team of clinical nurse educators, following an education programme. The researcher's professional role does not provide a remit and nor is there an expectation for an assessment of an individuals' ability, there was both a tacit acknowledgment of this and the PIS formalised the notion that the research did not formally assess an individuals' competency in the performance of clinical tasks, and it was purely to understand interactions and behaviours associated with the intervention of CRRT.

3.16 Training

Throughout the conduct of this study, training was undertaken in 'qualitative research methods theory and practice', 'conducting a research interview' and 'research data management'. Aspects of which have been incorporated into the delivery and conduct of this study.

3.17 Summary

This chapter has described the methodology and methods used to conduct the study and the considerations required to deliver useable data. These elements have been addressed in the context of the scientific rigour involved to ensure the highest quality conduct of this study and ensuring that the study can be effectively assessed in regard to the rigours of analysis and the credibility of the findings. Chapters 4 goes on to present the findings from the semi-structured interview data respectively.

Chapter 4 Interview Findings

This chapter details the content of the findings from the semi-structured interviews.

Of the 21 participants who undertook the CCTDI testing, ten participants made themselves available for a single, face to face interview. This group of participants consisted of 8 women and 2 men, with ages ranging from 29 to 56 years. All but one participant (NU004) worked full time, in addition three participants were employed as AfC Band 6 nurses, with the remainder being in AfC Band 5 roles.

Interviews took place between 20th September 2017 and 26th March 2019. Data saturation was reached after interview number 8 (NU012) after which no new or novel codes and resultant themes were demonstrated.

In respect of qualifications and experience, four participants highest qualification was a DipHE, with the remainder having previously attaining a Batchelors degree. Their clinical experience and exposure to CRRT was varied and is detailed in Table 3 Participant Experience.

Table 3 Participant Experience.

Participant ID	Years Qualified	Critical Care Experience	Years Using CRRT	Regularity of Using CRRT
NU001	5-10 years	5-10 years	3-5 years	Monthly
NU002	5-10 years	5-10 years	<1 year	Monthly
NU003	>10 years	>10 years	5-10 years	Less Frequently
NU004	>10 years	>10 years	>10 years	Monthly
NU006	5-10 years	3-5 years	3-5 years	Less Frequently
NU008	>10 years	>10 years	>10 years	Monthly
NU009	>10 years	>10 years	>10 years	Weekly
NU012	5-10 years	5-10 years	5-10 years	Monthly
NU015	5-10 years	5-10 years	3-5 years	Less Frequently
NU018	>10 years	>10 years	>10 years	Every Shift

In terms of Agenda for Change Banding, all Band 6 nurses who completed the CCTDI (NU008, NU009, NU018) made themselves available for interview. Ultimately this provided a disproportionate number of interviews between groups from the population who consented

to participate. However, in view of the maximum variation sampling approach, interviewing these individuals was deliberate in order to seek the broadest possible opinions. The length of interviews ranged from 45 to 86 minutes, with a mean length of 68 minutes. Interviews were digitally audio recorded, transcribed verbatim and interrogated by a single reviewer.

4.1 Interviewees' CCTDI Scores

The mean overall CCTDI score for interviewees was 301.1, with a minimum score of 264 and a maximum of 330. These scores are representative of all participants who took the CCTDI. Likewise, the individual construct scores (Table 4 Interviewees' CCTDI Scores) also align with the overall sample of participants who undertook the CCTDI.

Table 4 Interviewees' CCTDI Scores

ID	CCTDI Overall	Truth-seeking	Open-mindedness	Inquisitiveness	Analyticity	Systematicity	Confidence in Reasoning	Maturity of Judgment	Critical Thinking Disposition Assessment
NU001	276	35	35	43	44	43	38	39	Low
NU002	327	38	39	50	50	55	51	44	High
NU003	289	43	42	44	35	45	33	47	Medium
NU004	311	42	36	46	45	50	46	46	Medium
NU006	267	37	41	38	40	38	33	40	Low
NU008	307	37	44	48	47	37	46	48	Medium
NU009	327	45	48	53	50	48	44	38	High
NU012	313	48	44	47	45	45	38	46	Medium
NU015	264	38	32	42	39	39	34	39	Low
NU018	330	45	46	53	48	49	52	37	High

Assessing the sum of the individual construct scores indicated that some participants were classed as 'inconsistent' or 'ambivalent' critical thinkers (NU006, NU015) whilst the remainder were considered as having a positive disposition to critical thinking disposition. None of the participants were categorised as having a negative disposition to critical thinking in any of the constructs.

As the use of overall score in the CCTDI is not advocated, the following classification was adopted for the purpose of aiding analysis, participants NU015, NU006, NU001 were considered the lowest CCTDI scorers, NU003, NU008, NU004, NU012 were classed as medium scorers and NU002, NU009, NU018 were classed as high CCTDI scorers.

4.2 Major Themes

Four major themes and two overarching themes were identified with corresponding sub-themes providing granularity, these are presented in Figure 8 Themes and Sub Themes.

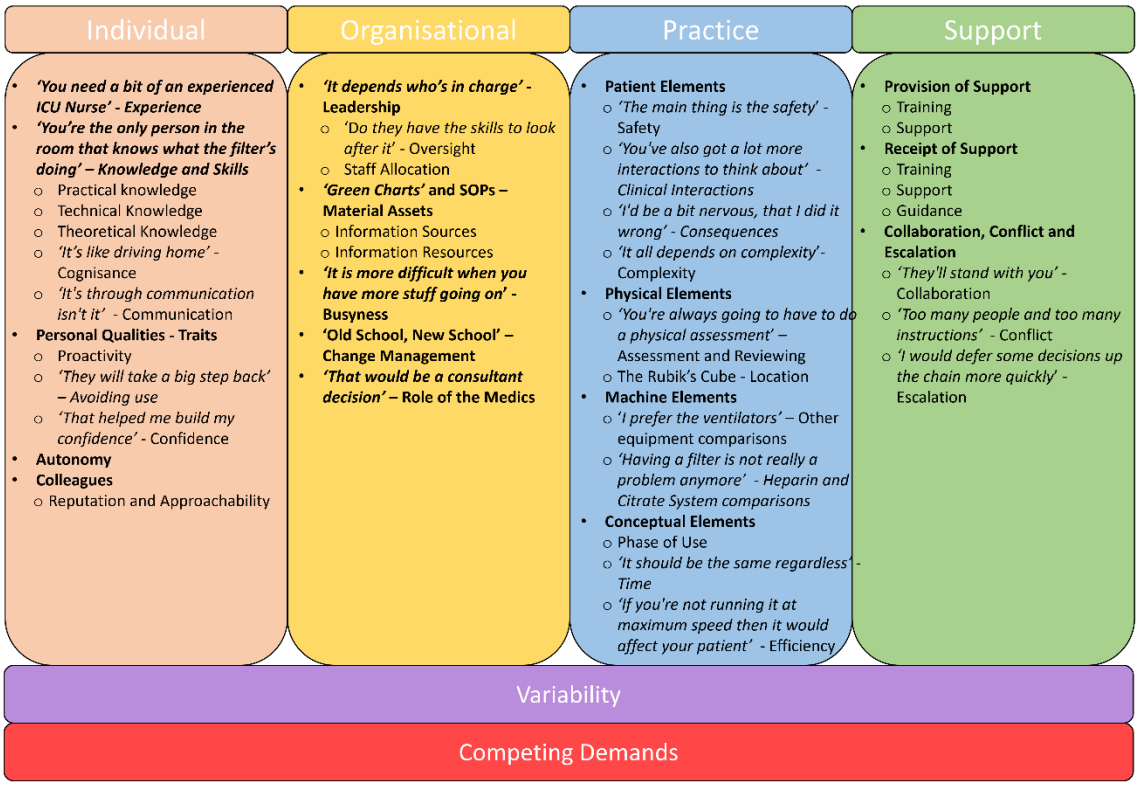

Figure 8 Themes and Sub Themes

4.3 The Individual

The individual theme pertained to the influential elements specifically attributed to the action of participants. The topics in this theme were discussed in the greatest frequency and by all participants. This theme splits between those sub themes that originated from within the individual (Internal) and those sub themes impacting the individual that originated outwith the individual (External).

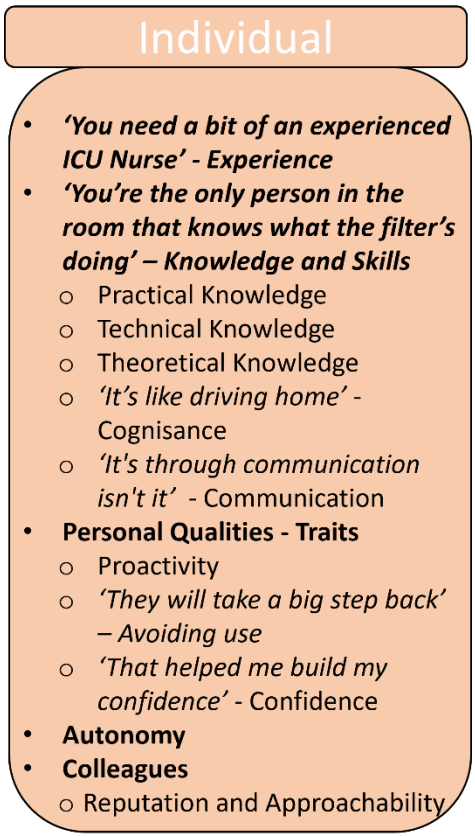

Figure 9 Individual Theme and Sub Themes

- Internal
  - 'You need a bit of an experienced ICU Nurse' - Experience
  - *'You're the only person in the room that knows what the filter's doing'* - Knowledge and Skills
  - Personal Qualities - Traits
  - Autonomy
- External
  - Colleagues

4.3.1 *'You need a bit of an experienced ICU Nurse'* - Experience

Discussions around the impact of experience were the most common throughout the interviews, with all participants considering its role, and examining it in a number of different contexts related to the management of CRRT. Most commonly participants explained that nurses who look after CRRT need to have **Critical Care Experience**.

> *I think you need to be an experienced [nurse].... not only that, you need to be a bit of an experienced ICU nurse, so I wouldn't be comfortable myself with anybody who was brand new to ICU using it, and when I was brand new to ICU, I wouldn't be comfortable using it. (NU001)*

… you need to have been working in critical care for a certain amount of time, I think if you're new it's a bit...it's quite technical and it's a bit you know, and the new people don't really look after them do they. (NU003)

… I think it would help if you had [critical care experience] because you'd understand, what you're doing, rather than just doing it… I think it makes you understand why we're doing [it]. (NU015)

The comments from NU001 address the personal lack of ease an individual had when first starting a role within critical care. They demonstrate reflection and have clear concerns and expectations of colleagues which are based on their own experiences. These feelings are subsequently projected on to colleagues who may also be new to the critical care setting, with a central concern being raised on overseeing colleagues using CRRT if they were new to ICU.

The opinions of NU003 focus on the technical aspects of the provision of care, indicating the challenge for new starters is to understand these elements. These learnable aspects appear to be distinct from any perceived challenges associated with the clinical reasoning involved in providing CRRT care. They also offered further experiential evidence that in a majority of scenarios new starters are not involved in the care of CRRT.

These three participants feel that some duration of critical care experience is important but were not specific on duration. In comparison other participants felt able to identify appropriate timeframes of critical care experience which would make practitioners suitable for beginning to use CRRT.

I think, I think you've got to be in here maybe two years just… because there's such a lot to learn in other fields isn't there (NU004)

…definitely 6 months I would say [before being 'let loose'] (NU006)

So, I think that [practitioners] should be in ICU for at least six months…. we get quite a lot of new starters don't we, so I think six months in ICU just getting used to every day running of the unit and other patients before. I think renal replacement is an extended scope…I don't think somebody with less than six months experience is ready because you are quite autonomous, ... But even when you're not autonomous the problem is, is that some of the band 6's don't have enough experience either. (NU012)

Other participants, like NU018 and NU009 felt unable to specify a timeframe to start using CRRT, though they identified that this was not an early skill to acquire.

…I don't think there's a particular window, but it's certainly not one of the first skills that they're concentrating on. It's like a later additional skill. (NU018)

not all patients are, use the haemofilter or need that intervention of renal replacement, but most of our patients would need some basic support with oxygenation or inotropes or things like that, so it's getting that grounding and that thing in, your basic stuff first, before then you go onto more supportive therapies. (NU009)

Overall, the discussions around critical care experience timeframes felt arbitrary and participants justifications were similar. These justifications being the competing challenge of acquiring 'basic' critical care knowledge and the associated complexity of delivering CRRT. Although a significant gap in duration was noted (18 months). In reviewing the participants, NU004 had significant periods of experience (>10 years) across all experience domains, NU006 had 5-10 years professional experience and 3-5 years' experience within critical care and using CRRT. Whilst NU012 stated they had 5-10 years' experience across all domains. This observation alludes to the fact that practice may have changed over an extended period of time, whereby now there is a unit expectation that new practitioners should begin to start using CRRT at 6 months rather than 2 years. This aspect is anecdotally highlighted by NU018, another participant with over 10 years' experience.

…everyone is [now] trained earlier rather than later, because like I say [it] just used to be an experience thing. (NU018).

These insights from participants with long service durations, within the department, are supportive of evidence regarding a subtle shift towards the earlier use by staff of CRRT. As a 6-month period was identified as an expected timeframe for individuals to start to feel comfortable and thinking about delivering CRRT. It may be that this has been due to a necessity as a result of a lack of sufficiently skilled staff, increased number of patients requiring CRRT or the recognition and rebalancing to ensure staff have the CRRT skill set prior to them having to work independently. Throughout all the discussions there was no talk of a conscious or communicated change by the ICU management to reduce the expected timescale for experience required prior to using CRRT. The consequences of this are evident in the variable expectations of the participants over when their colleagues should be managing CRRT and thus influencing inter-personal and social relationships across the department.

There was minimal discussion regarding more pragmatic ways to initiate CRRT training, such as those which were less centred on stipulating experiential timeframes but rather through identifying existing skills, knowledge, and experience. It was felt that these may be more appropriate indicators to commence training in CRRT, stating that these would be commensurate with the workforce expectations. This lines up with the thoughts of NU002, the only participant that stated that lots of critical care experience is not necessarily vital and that consistent experience using the CRRT equipment played a more important role.

Away from the context of new starters to critical care, nurses that had worked in critical care areas for a long period and who had significant critical care experience were still impacted by aspects that influenced their provision of CRRT.

It was felt that a tranche of staff, those who would be classed as being within a middle tier of experience, on occasions were overlooked for opportunities to manage patients receiving CRRT. It was specifically highlighted that this was due to the senior nurses allocating patients prior to shifts.

> *… and then they'll just kind of like ignore the people in the middle…. and that's sometimes, sometimes not always, it just depends on who's allocating… (NU015)*

This observation feels counterintuitive as the expectation would be that these individuals would have the skills, knowledge, and autonomy to manage CRRT with minimal oversight. NU015 identified as someone who would have fitted into this category, with 5-10 years of critical care experience and 3-5 years CRRT experience and felt they managed CRRT less regularly than monthly.

Again, there was a feeling that there were unwritten, unit specific, cultural positions that resulted in the normalisation of overlooking this particular group of staff for caring for patients on CRRT. Whilst acknowledging that the majority of participants of this study would match the affected demographic.

The importance of **Exposure** and **Practical Experience** with CRRT was discussed by many participants and was felt to be of real benefit when using equipment on an ongoing basis. This was particularly highlighted by individuals who felt exposure helped build confidence.

> *… if it goes right {laughs}, if it works out for you, yeah [it builds confidence]. (NU006)*

This example demonstrates that whilst exposure to new and unique experiences are sought after and beneficial for building confidence there is an associated risk that they may result in negative experiences. However, NU006's ironic laugh talking about this, indicates these scenarios happen and she is happy to assume this risk and is willing to manage any consequences. This suggests that NU006 had already the skill set and confidence to manage the predicted associated risk or a disregard or lack of insight into the consequences. It is possible that others with different personal characteristics or those with less experience may be less resilient to these challenges and in fact ultimately result in a detrimental impact on their confidence. The selection of participants of similar experience makes it difficult to

determine any degree of variation or contradiction to this stance from those staff with a different perspective.

NU008 moved on to talk about the synergy between training and exposure and the impact of this combination when learnt knowledge is applied into practice and how this results in improvement in confidence with CRRT.

> *experience, exposure, definitely so you've got your background training which some people have asked [to have] again you know like {XX}. She actually knew that she wasn't going to be good, so she came to extra training, but until you've had hands on experience… I think you have to have hands on to really compound whatever you've learnt, you know, you need to have that exposure. And having people who are willing, you know to troubleshoot with…. (NU008).*

This insight is extremely valuable and reflective of both NU008's position as a senior staff nurse (AfC Band 6) and their extensive experience (>10 years across all domains). The core implication of this being that experience and exposure are central to building confidence in this situation, in conjunction with and acknowledging the value of the provision of organisational support.

Additionally, NU004 felt that exposure to CRRT whilst on patients was the best way for her to learn, as it provides active learning and enables the granularity of practice to be experienced, this was identified in specific reference to troubleshooting problems.

> *…that's the way I've always done things [hands on experience] you know what I mean and that's the way I can learn better by getting stuck in. (NU004)*

These aspects of building assurances with CRRT are derived from two highly experienced critical care nurses (NU008 and NU004) who have arguably had significant exposure to a breadth of scenarios over their working life which have demonstrated to them the value of exposure on individuals' progression.

Participants also made references that the volume of exposure to CRRT was important, with more exposure deemed better and having a direct impact on the quality of care provided. These ranged from just having seen patients on it beforehand, to the understanding that high volume exposure led to improved capacity to deal with challenging scenarios.

> *I do think there is still and aspect of the newer members of staff will be able to look after the filters, in the managing of the changing of the bags, but probably theory behind the troubleshooting… that comes with experience of using them (NU018)*

And even within challenging scenarios users felt able to convert this exposure to improve subsequent delivery. Perversely however, one participant highlighted, that with the use of the old system (Prismaflex) it was often more challenging to maintain, and frequently needed the recurrent set up and recommencement on another identical machine, due to difficulties maintaining a CRRT circuit. Whilst they found this frustrating and time consuming, in hindsight it enabled them to gain more practical experience improving their ability in troubleshooting and managing therapy.

> *[when the Prismaflex failed] you got more experience, yeah but I'd say once you get up and running with this one I do prefer this one, once you get used to it…it's just experience like with anything isn't it, really the more experience you have with it and exposure then obviously the better you get, quicker (NU006)*

This concept of overexposure to both common experiences and those more unique scenarios, supports a focussed approach to CRRT management, and that repetition was key to confidence and had a perceived cumulative direct result on the speed of decision making and with subsequent actions reinforcing the belief, that quicker decisions and actions were better for the patient and CRRT system.

Aligned with this exposure, one individual highlighted the value of practical experience with previous systems of providing CRRT, which enabled the interviewees to draw on context and perspectives to reconcile the temporal changes in how CRRT has been delivered.

> *if you've used one, like you've used the Prismaflex is what I used, and then I went on to the citrate, the actual mechanics of it are easier to grasp now than it was when I was learning it for the first time, that previous experience was valuable. But obviously heparin and citrate are very different things, so that was more what I found I had to learn, that's the new bit. (NU001)*

> *I mean we've recently changed machines as well, so you need to have some exposure to your equipment beforehand and I think... what's handy [is] what effects, as well, it can have on your patient for particularly renal replacement therapy, if you've seen people on it before that's a big help. (NU001)*

This highlights the importance of ongoing exposure to any forms of CRRT management, irrespective of modality or type, as a means to better inform and equip practitioners for future practice. It is evident from NU001's statements that previous exposure to older forms of technologies has allowed for the easier adoption of new technologies as they evolve.

Fulfilling the concept of exposure, the interviewees discussed the individuals that were badged as 'Superusers' and the impact this had on competency and exposure to CRRT. Superusers

were individuals who had received additional training by the manufacturers in order to provide a higher level of support for the wider staff group.

There were clear concerns that with the implementation of a new system that all staff would be in the same position from a practical perspective. As a Band 6 nurse, NU008 was cognisant that individuals who were labelled superusers would have to act as a dependable resource despite the challenges of potentially not having enough experience and exposure.

> *… competent, because people will go to them because they know they're superusers and they've not really had enough exposure themselves, because it was a brand-new thing wasn't it and that's why I thought it was really important that the people who'd been classed as superusers made sure... that they had the experience and the exposure, because they're the ones people are going to fall back on, so to me that was a priority. (NU008)*

In addition, there was also a culture associated with staff seeking exposure and experience to manage CRRT, and this element is discussed further in 4.4.1.2 Staff Allocation.

4.3.2 *'You're the only person in the room that knows what the filter's doing'* - Knowledge and Skills

The influence of nurses knowledge when dealing with CRRT was split between practical knowledge (knowing how to do something), Technical knowledge (understanding how to do something specifically related to the equipment) and Theoretical knowledge (understanding why).

4.3.2.1 Practical Knowledge

When discussing the use of CRRT outside of the ICU (in an operating theatre) NU001 recognised that as an individual they were central to the delivery of CRRT, reinforcing both the importance of their knowledge and consequently the expectations placed on them in this/these scenarios.

> *cos you were physical[ly] not very far away but practically you're very far away, cos it's a closed environment and you can't just nip out and get someone, and you're acutely aware that you're the only person in the room that knows what the filter's doing… knows how it works. (NU001)*

These scenarios provided evidence of great learning experiences and further practical knowledge acquisition for the individuals; however, it was felt neither to be sustainable for the individual or the organisation and added a burden of stress to both, in the units' current provision of CRRT.

NU006 identified that the importance of practical CRRT knowledge is truly on the understanding of the impact to the patient, like with the physiological parameters.

> *I think you've got to have at least 6 months/ 2 years' experience really and you've got to understand about your gases and your lines and what you're doing really. How it can affect your blood pressure when you put the patient on it, that type of thing, do you need inotropes, you know, you can't just put someone on [a] filter if you're struggling with the blood pressure…. you need to know about your ranges and stuff as well…you can't just be let loose. (NU006)*

This core clinical critical care knowledge was accordingly felt to enable practitioners to better provide CRRT in a safe manner.

Along with the acquired practical knowledge came an expectation that individuals would be able to help successfully resolve problems irrespective of their positioning or role in the department.

> *…there's been superusers on shift and I've heard a little voice down the unit, 'go and get NU001, he knows what he's doing', and so yeah, I think people… there's people with other things like CFAM and stuff like that…it's like go and get them they've seen it before even though you got like teacher trainers or a link trainer, go and get whoever. (NU001)*

Whereas because of their role, there was an expectation that the Band 6 nurses knew how to deliver and support CRRT, but it was felt that their lack of continual exposure to the day-to-day usage of a device hindered this ability. There however, appeared to be a disconnect between the skills and responsibilities the senior nurses have, due to the lack of clinical exposure they have had with the new equipment. Ultimately the support the participant wanted was for clarity or some oversight to ensure that any decisions have the support of the senior nurse.

> *… because they're not us[ing] them are they as much..... which is not their fault is it, it's just the role what [sic] they're in. (NU004)*

Likewise, there was also a similar expectation and outcome for superusers.

> *…they'll [staff] know that they might be a super user or a band 6 or whatever, so yes, they are a superuser, but they wouldn't necessarily go to them. One, because it might be that they feel like oh well they won't know because there are some people who are superusers because of their role, they haven't chosen to do it, do you know who… as a band 6 had I not been a superuser, because to me that is part of my role, a massive part of my role is supporting the other [staff]…we can't know everything about every single piece of equipment, but I'd like to think that I could help them enough. (NU008)*

These observations demonstrate the significance of practical knowledge acquisition, but simultaneously highlight factors that prevent its effective propagation. Validating the vital role that practical knowledge has in the clinical area when staff are seeking and providing support to one another.

4.3.2.2 Technical Knowledge

Participants highlighted their feelings and the impact around gaining the knowledge to use the CRRT equipment.

> *… I'm as comfortable using the citrate ones [now] … I think the steep learning curve about it is learning the new potential risks, which is you know citrate levels and what will happen, and the management of that, and what to do if you're in a crisis. That's the steep learning curve, cos it's a whole different set of risks than it is with some[one] who's over heparinised. (NU001)*

This participant has the opinion that the technical management of equipment is not necessarily the critical issue around delivering CRRT, but rather highlights the ongoing maintenance of the system to keep the patient safe, as being the element that has a steep learning curve.

NU003 also highlights that the knowledge of how to deliver the intervention is one of the first things that comes to mind, indicating its importance.

> *Having a knowledge about how the machine works [is important for decision making] (NU003).*

Separately NU009 corroborates this and also identifies early in their interview the value of the technical knowledge needed to deliver CRRT. Indicating the importance CRRT equipment plays in treatment delivery.

> *…the knowledge base to know what you're doing, what you're treating, what contraindications you could come across and the knowledge of the equipment that you're using. (NU009)*

Supporting this, NU015 underlined the use of support documentation to complement knowledge, particularly in the setting up of CRRT (this is also explored further in 4.4.2.2 Information Resources.

> *So, for setting it up I do [use SOPs] because I forget, so I do it slowly but then I know you can do it on the screen as well… I need to look at it when I'm setting it up… I [use a stepwise approach], cos otherwise if you miss one little thing out then…because… they've just said in there [office] that somebody used three sets! (NU015)*

These statements portray the importance associated with the technical knowledge and skills involved in CRRT delivery. During the interviews it became apparent that technical knowledge and skills were largely seen as the domain of the critical care nurse

> *Interviewer: … do you think that the one thing that would make you go to a medic would be something like …. [a prescription].*
>
> *NU002: and your calcium, yeah. Anything technical - no.*

In one example a participant joked about the medical staffs' perceived lack of technical knowledge with CRRT, and the perceived likely consequences if they got involved with its equipment.

> *(smiling) no, no absolutely not (laughing) [seen any medical staff touching the CRRT machines] … [It is a] good thing. Yeah, cos a lot of them come on and have no idea what, what the whole kit is about as in they obviously know clinically what it's about but technically, they have no idea. (NU002)*

Likewise, NU015 firmly believed that medical staff have no understanding of what buttons to press to deliver the treatment they feel would resolve patient and machine issues.

> *they're just changing settings aren't they, so your doctor's wouldn't know if the machine was loaded wrong or anything like that… they won't have a clue about that I don't think. (NU015)*

These opinions put the remit of the technical delivery aspects of CRRT in the hands of the critical care nurse, there is tacit acknowledgement that medical staff understand the concepts of CRRT, but the nurses effectively implement treatment requests.

4.3.2.3 Theoretical Knowledge

A number of aspects were discussed by participants which focus on the theoretical knowledge surrounding CRRT delivery. Significant discussion points revolved around the value and process attributed to the acquisition of theoretical knowledge of CRRT.

> *…, I think that to be the actual person using, delivering the therapy the person who is actually using the machine at the patient's side you definitely need some theoretical knowledge. (NU001)*

Independently, NU012 agreed.

> *I've changed my mind on it slightly, and I do absolutely think that we need our bedside training and assessments because that's… 99% of what our job is about, but I do think it is beneficial and especially since we… just had recent citrate training in the team meetings we've been doing, you do see like lightbulb moments go off around the room when people are sat thinking about it. (NU012)*

From this statement, NU012 demonstrates here the evolution of her changing perception on the best learning methods. Whilst there appears to be an overwhelming preference for bedside learning (like many other staff), she specifically identifies and provides examples to the value of theoretical training outside the clinical area and the associated benefits. To provide context NU012 is an individual with a moderate amount of both nursing and critical care experience 5-10 years and 29 years of age.

Later in the discussion she also highlights that the value of theoretical knowledge has been under considered by unit management, but recognises the challenges associated with incorporating it into training schedules.

> *I don't think they [unit managers] fully realised until again maybe over the last few months that yes, you do need a bit more theory. You can't just crack on and use the machine… I think with... a couple of the incidents that happened… I think they've realised now actually yeah; we need to get proper theory sessions in, and it needs to be marked down as this person's attended a theory session. (NU0012)*

This concept was reinforced by NU015 who emphasised the sequencing of training for theoretical knowledge acquisition and what actually happened in practice.

> *NU015: I think that the theory [training] should come first…….*
>
> *Interviewer: do you think it always comes first?*
>
> *NU015 No*

The impact of theoretical knowledge on CRRT was stressed by NU018 over a series of discussion points.

> *[theoretical knowledge] it makes a massive difference, I do think there is still an aspect of the newer members of staff [who] will be able to look after the filters, in the managing of the changing of the bags. But probably theory behind the troubleshooting… that comes with experience of using them… I think from a new starter perspective what it is, is another machine, it's another machine to learn how to use. From their understanding as to what that means for the patient, the theoretical training that they have should cover that, to an extent, but I do think from a mindset it's another thing to get your head round. (NU018)*

These discussions highlight that there remains an experiential element to understanding the impact of CRRT on patients outcomes and clinical conditions, but the theoretical knowledge helps build a better understanding. NU018 is a highly experience critical care nurse who states they are involved with CRRT during every shift they work, the opportunity to understand their

perceptions of the impact of theoretical knowledge is fundamental to generating ways to improving staff learning.

In the same way that the value of theoretical knowledge regarding CRRT was highlighted in the interviews by some individuals. Participants also contextualised this with the **Depth** to which this knowledge was required. Very much highlighting that those extremes of detail and knowledge were not required in order to deliver CRRT effectively and safely.

> *I don't think as the person delivering it, that you need to go as what all the individual chemical reactions are and taking up to masters or PhD level and things like that, I just don't think that's necessary…but like I say I don't think you need to be knowing.... you don't need the same level of knowledge as the people who designed the therapy… you need to know the theory behind what you're doing. I don't think you need to know the theory behind the therapy as a whole and where the idea came from and things like that (NU001)*

> *I think it's good to go over the theory again you got to have that base knowledge to see how things work but it's the practical running in it that makes it work. So, there's got to be a balance hasn't there (NU009)*

The participants who provided these perspectives both had over 10 years critical care and CRRT experience. This concept provides a mixed perspective on the expertise required versus the ability to deliver safe CRRT, advocating that there is an optimum amount of training an individual can have to be proficient with CRRT. Identifying this would aid in the targeting of training of individuals.

In addition, staff skills were seen as important contributors to behaviours associated with CRRT, opinions were concentrated to the human skills of **Cognisance**, and **Communication**.

4.3.2.4 *'It's like driving home'* - Cognisance

This theme captured the understanding and subsequent ability to deliver correct and safe CRRT care with a high degree of automaticity, with the specific reference relating to the phenomena of driving home without thinking about the process. There was unambiguous evidence that participants understood what was required and more specifically what was required of them and that they undertook and displayed activities to facilitate good situational awareness. This was portrayed in scenarios articulated by the participants which evidence their behaviours.

NU006 was pragmatic and understated about their knowledge and actions indicating that the checking of equipment and ensuring that there were enough supplies to provide CRRT was second nature.

it's kinda like driving home isn't it, you don't really think about it you just know the way, don't you…(NU006)

Likewise, they highlighted the importance of and how there was an innate feeling of understanding related to patients, which came from extended periods of time caring for them.

yeah, that's all part and parcel [having an insight into how specific patients behave on CRRT] of knowing your patient I suppose and if they're improving every day or it is literally just to take you… to the point of dialysis [IHD]… (NU006)

There was also a similar understanding in senior nurses assessing the readiness of CRRT naïve nurses to begin to utilise the therapy.

Yes, when they are ready… Yeah, but however, sometimes they think they're ready when they're not and I think that's the excitement of it. (NU012)

Conversely there was also the acknowledgement that there was a lack of insight, whilst this was largely focussed on new starters with little experience of CRRT.

… especially with the new ones who were overconfident, and there has been a few examples of the ones that had it too soon… and they focus so much on the filter because it was the thing that was the most new to them, that everything else just got forgotten about. So, the patient isn't then… the priority, the machine was the priority. So, I think patient care suffered without a doubt for those patients… they were so bogged down in the whole process and mechanism of the machine, how it worked, when they needed to do bloods, when the needed to do the obs that it just took over their whole day. On the other hand, though I think those that have got lots of experience getting and get blasé about it in that way that they, things get forgotten about… (NU012)

I didn't think I knew everything but, … [I] came on ICU to see a chart like that and you think oh my god that I didn't realise how interconnected all these systems were…. (NU008)

Here NU008 reflects on her own learning and development and the realisation that critical care units collect and retain information that can be used to enable greater understanding and subsequent decision-making.

These statements identify a gained tacit knowledge in understanding what was felt to be needed to deliver CRRT for both patients and staff members, whilst acknowledging that a process occurs where new starters latterly begin to gain insights and a deeper understanding as well as the integration of CRRT into day-to-day practice. Whilst NU008 indicates an epiphany of sorts, it is not clear from other participants if this is replicated or whether they have a more gradual realisation.

4.3.2.5 *'It's through communication isn't it'*- Communication

A number of segments of the conversation were coded related to communication skills and interactions. With the experienced Band 6 nurses (NU009 and NU018) ardently stressing the importance of communication in the process of decision-making

> *Like I say communication, and whoever's looking after it, or if I'm looking after it, communicating to the Doctors… to the nurse in charge and working within the protocol, I'm a strict believer in using guidelines, if they're there they are there for a reason. (NU009)*

> *Not just through observing, it's through communication isn't it, so I will ask them how they are getting on with the filter and if they know what it's for and how it works usually, I will get time to do that… On shift yeah, so we check on staff, I check on staff regularly particularly the new ones to see if they are happy in what they are doing… (NU018)*

It is understandable, that as the Band 6 nurse provides oversight to the whole critical care unit, communication may be a significantly important element for them. The effective management, timely and key reactions they as individuals provided were all guided by the provision of accurate information. Inefficiencies in these processes were identified as being problematic. In general, however, the content of these discussions during the study usually focussed on the face-to-face element of verbal communication with peers, with one participant stating they felt written communication regarding CRRT was poorly documented and specifically focussed on parameter setting (see Guidance, 4.6.2.3).

> *I actually said to him 'we're all still learning this' and that's just confusing… matters and he was saying 'oh I see what you mean'. I said it wasn't even written in the notes [the] reason why you deviated from the policy or the guidelines…, I think certain people will always document about the fluid, you know about the fluid aim…, but they would have [for] any patient it's not just because they're on the filter…, I actually think most of the time they actually let's [sic] you go along with the guidelines… and occasionally they might come along and say oh right there, we need to up this and why is it that… (NU008)*

NU008 emphasises this issue from a place of nursing seniority as a means to support colleagues and convey their ongoing challenges they were encountering, and it is clear from the language she uses that there is frustration related to the lack of transparency and documentation of rationale, presumably related to recurrent communication problems associated with this scenario. Ultimately indicating there is an over reliance on protocols and guidelines, which cause problems in the event of deviations. In this specific instance it is clearly compounded by the naivety of the staff who are still learning the delivery of CRRT with a new system.

Alternatively, NU006 instead describes positively how there are often huddles to discuss troubleshooting of equipment, with the prevalent use of verbal communication to provide support throughout. Her ability to describe a number of scenarios she has experienced enabled, an understanding of different types of challenges encountered, but also the approaches taken to resolve them. In the non-urgent group settings, she indicates a relaxed collaborative approach.

> *… we kind of all chip in I think… 'This happened, have any of you guys experienced it before?', you know and sometimes people do and they're like 'oh yeah you just need to do this or'… when I have had an issue… everyone wants it to stop bleeping for starters {laughs} (NU006)*

Whereas in the more time critical scenarios there is direct and desperate calls for help to resolve the problem.

> *…or just voice it loudly and hope that someone says I know what to do…. 'DOES ANYONE KNOW WHAT'S GOING ON WITH THIS!' (NU006)*

NU006 also identified ward rounds as situations where there were more formal communication methods, with constructive discussions. Although it was clear from the interviews that the majority of communication touch points were very organic and informal situations, predominantly asking for help, advice, or support. The determinants of these touch points are likely influenced by organisational aspects and are discussed further in section 4.4.

On the contrary, to the largely positive and supportive impact communication had on delivering CRRT, the impact of the absence of communication left participants with feelings of frustrations. NU015 details that when patients are in cubicles the nurses' have significant control of the goings on around the patient. They explain however that when they are nursing a patient in central areas and are covered for breaks by other staff members it is quite a common occurrence for someone to silence an alarm but fail to communicate what has transpired.

> *… because people forget to tell you what they've done and if an alarm gone on [sic], and they're busy with their patient and they're watching while you've gone somewhere, or you've gone for your dinner. When you come back, they've just cancelled it and then forgotten to tell you that why it was alarming and then you've kinda like missed that window then. (NU015)*

The frustration from participants to these types of events was obvious throughout the discussions. These were centred around the standpoints of individuals having ownership and responsibilities of the patients' care over the course of the shift and the discourtesy of failing to properly handover even after a short break.

4.3.3 Personal Qualities -Traits

A wide range of personal qualities were evident from the interviews, however three key qualities identified were Proactivity, Confidence, and Avoiding use.

4.3.3.1 Proactivity

A common theme derived from the interviews was the concept that individuals often demonstrated or talked about the engagement of behaviours that were **proactive** to the management of CRRT.

A central topic of proactivity was seeking out learning opportunities both clinical and theoretical, several participants discussed these.

> *I definitely think that the people who are more proactive asking, they either ask their team leaders, they ask [Band 7s] or the nurse coordinator who's on that shift… 'tomorrow I'm on, could I get a bit of experience'. Now they do get more because they are asking and putting that idea in somebody else's mind… and if somebody has asked you then you feel more obliged to do that…. (NU008)*

In addition, NU012 also highlighted some of her experiences, where individuals had been proactive in their search of CRRT experience.

> *but I think some people are quite, quite good. I know a couple of the girls here have gone to those [band] 6s' and said look, I really need some experience on this and then they'd be really mindful about trying to give them those patients… (NU012)*

These statements highlight that whilst proactivity may have an impact on increasing exposure to learning opportunities, there appeared to still be an element of luck when it came to accessing chances. This luck appeared to focus on the Band 6 in charge of the shift, this then concedes that interpersonal relationships with individuals, with the power to make these decisions, is a huge contributor to accessing learning opportunities. This had the effect of discouraging some staff from asking for opportunities, in the knowledge that others with strong relationships with the nursing leadership, which often continued outside the workplace, would get preferential exposure.

With reference to teaching opportunities, NU008 again had a number of experiences where proactivity was demonstrated with subsequent success.

> *…I think we got quite a lot of … the theory side you know, we had the reps coming in doing teaching, we also had the teacher trainers, and they're still doing it now. Well, they're asking us if there's anything that we want to go over and they're willing to stay, people to stay behind and do a little session after the team meetings …., but we can ask, will you do the filter again and people can stay behind and it's more of hands on. They'll actually start putting the filter together*

and that's really good, …. where there's a few other people who have the same interest because obviously people have asked for that, which I think makes a difference. (NU008)

NU008 further reinforced this by saying.

people have said… 'I want to go to that [teaching]' and this is not a mandatory session. It something that you've chosen to stay behind for, then they will learn what they need to learn because, you know, they've asked for it and that what they actually wanting to do. (NU008)

NU008 was the predominant voice when speaking about colleagues actively seeking learning opportunities, throughout the discussions she appears to speak from the standpoint of her role as a Band 6 nurse coordinator and spoke enthusiastically about scenarios where staff had either put themselves forward or performed contrary to expectations. It is believed, in part, that it is her role which generates the volume of opinions on this topic. Her vast experience and exposure to critical care staff over the 10 years was felt to give significance to her opinions.

Confidence was highlighted as another element that impacted individuals proactivity when seeking out learning opportunities.

but say the {XX} that's more of a can't be bothered and literally just come to do my stuff, 'oh I'm not interested in that'. You've got {YY} on the other hand and it's a confidence thing… she was given that role as a superuser and she embraced it, and she was one of the ones that I made sure that she got experience to it. … I think, it gave her a bit of confidence, I think she fed off that for a while you know, but you thought she was capable of doing it and that other people might be able to come to her and ask her for advice, she actually embraced that and that surprised me a bit, … I was really pleased (NU008)

Other participants also support NU008's opinions that there are some self-driven proactive individuals who wish to learn.

[some] people don't drive to go and learn about stuff. So, I think them [sic] that are more confident have gone away and thought right. What is it that I'm using? what's different and they understand it better, they understand why they're doing certain checks on patients' blood and samples, I think yeah, I think it's just their own understanding of what the machine does and how it works. (NU012)

The relationships and interactions between colleagues and co-workers and the requirement for junior members of staff to demonstrate proactive behaviours in order to access learning opportunities is indicative of a cultural issue within the areas where the participants worked.

Preplanning

Within these proactive behaviours discussed above, every participant referenced some form of consideration to preplanning surrounding care and potential care related interactions. There was significant discussion of preplanning of care delivery across all interviewees. Many evidenced scenarios where they would physically prepare for the management of a CRRT patient at the beginning of a shift, by checking equipment, supplies, and support.

NU004 specifically highlighted, that for them, this thought process occurred at the beginning of a shift.

> *yeah so, I can go, go to them if there is any problems… because they might be somebody, like as senior as you on, a Band 5 I think oh well I could maybe [go to them]. If it's the Band 6 whose quite Junior, do you know what I mean, there's some quite junior ones isn't there, you know [you] could call on (NU004)*

Along with others who also had this approach.

> *I would know at the beginning of the shift, who is my go-to [for support]. (NU002)*

Other participants explained their desire to be prepared in a more general way.

> *when I was newly qualified probably not, but as I'm more senior yeah, you'd sit round and have a look round and think right…. if the shit hits the fan. {laughs} who am I going to, and you do look round and sometimes you think there isn't anybody. (NU012)*

> *[It's] really important cos if you know it's going to clot off you need to know your plan and are we carrying on, are we leaving it… Yeah for me it is then I know, I'm quite OCD {obsessive compulsive disorder} and organised and I think I like a nice, structured approach and I think for me that's important like to sort of know… (NU003).*

> *that's how I work though, quite organised in me {sic}…. I suppose I mean in a way, you know I've always got my trolley stocked up I've always got my little bits on there, there's always something that I can change if it needs changing quickly, but then I wouldn't sit there with another new set on top of my trolley all day either. (NU006)*

There was little surprise in this acknowledgement that preplanning began early in a shift, allowing staff to make provisions for any actions during the shift to ensure that their workday was organised, ran smoothly and was as well managed as possible.

NU015 and NU006 were however dissenting voices on this aspect to preplan and claimed that they did not take part in pre-empting for care events or any requirement of support. NU006

whilst discussing that they wished to be prepared, specifically mentioned they did not check for colleague support before starting a shift.

> *I don't personally do that [check for people for support], I just go on and do and kinda crack on with it really, but then if problems arrived, … It depends who's next you, don't it [sic] have you got any experience with this or and ask anybody really (NU006)*

> *No, it wouldn't cross my mind [pre-empt my support] til it [actually went wrong] (NU015)*

These acknowledgements stand out because as individuals neither of them possess large amounts of critical care or CRRT experience (3-5 years). Understanding the development of their behaviours and actions in the future might indicate that an experience time frame, or a critical event, acts as stimulus for behaviour change. Alternatively, this may demonstrate their confidence in either their ability to identify the right person at the right time, or a confidence that the critical care unit has an abundance of sufficiently skilled and available staff.

Other staff members took time to cognitively prepare, to ensure that they could deliver the target parameters for the shift.

> *this is really hard [planning delivery of parameter] because… this can be to do with a consultant as well and that just sounds awful… they want them negative 5 litres come hell or high water … you come on a night shift, you might suddenly think oh my god we need to get 5 litres off, they've not even got anything off yet or it might be that they're nearly already there, but you know that all these drugs {infusions] and then they've got one [bolus dose] at 10 o'clock that might be 250 ml and another one in the morning, so to me I will do that over the 24 hours. The hours that I've got left, look how much they've got going in how much you've got, how many hours divided by and what have, so you've got it on an even keel. Rather than just suddenly going up and down, some people go up and down on the fluid removal just because they think we need to get more off, I like to have a figure (NU008)*

Likewise, participants also took the time to understand prioritisation of care.

> *…you have to prioritise which is the most important thing do you know… you would have to think, right what are the chances of it packing up, because it might be that we've had problems with it all day. The filter's going to pack up shortly so then you might think oh in that case should we get off as much [fluid] as we can, the blood pressure is fine they'll tolerate [it] and so you'd speed up the fluid removal, because you think we're not going to have many hours of this… (NU008)*

These cognitive elements of preparation were demonstrative of participants and their observation of colleagues ensuring that the care was done properly and with due

consideration. However, similarly to when they discussed the physically preplanning of care, and conversely to all the other participants, NU015 again claimed to take an approach in which she did not prepare, and instead dealt with issues as they arose.

> *I don't write things down like some people do, write everything down, like on a hand over some people write down times of what things need to be done. I don't do that, whereas the filter goes. I'll just mentally remember what time things need doing. It's only the bloods that need doing. At set points and that's quite easy to remember so I don't, and I've never written anything down. I just make sure; I get things ready a long time before they're needed. (NU015)*

The language used across the proactivity theme could be portrayed by NU015 as a blasé approach to managing CRRT in comparison to colleagues. However, the manner in which she talked and discussed this content was with an honest simplicity, with comfort in how she managed the system, with previous experience of working with NU015 this is truly representative of her. This naivety demonstrates that different styles and approaches to CRRT can still provide safe and effective care.

NU018 emphasised the evolution of the approach to preparing for a shift, highlighting after the change in CRRT equipment happened, the demand on the individuals to prepare for eventualities subsequently decreased.

> *you could spend hours and hours playing with your access on the Prismaflex and filter for about 20 minutes. But this Fresenius works so nicely and is very, there's very little to do with it, on a running basis… so, I mean you won't go to your break right before your bags need changing, but some people would, because whoever is watching might not mind changing the bags. It's like we said earlier you're not constantly in that I need to problem solve mentality, because it generally doesn't cause a problem. (NU018)*

Demonstrating an awareness of surrounding behaviours, of colleagues, there was also evidence from participants that they witnessed individuals not demonstrating proactive behaviours.

> *usually, you can think oh they're not as… enthusiastic as they might normally be but then you still know they're going to be safe. If it's somebody who you thought was safe before, even if they're having a bad day, they usually are still pretty safe but they may not be as proactive, but they usually still safe, so you don't have to worry about that… (NU008)*

This lack of proactive behaviours was felt not to be unsafe behaviours, but ones that did not demonstrate best practice. Overall, there was a distinct proclivity for preplanning, from these interviews it is difficult to attribute this as being derivative from clinical experiences and subsequently behaviours developed over years of practice, or down to individuals innate

behaviours. The 'systematicity' domain within the CCTDI is associated with organisation behaviours, and of note was participants who had outlying perspectives on preplanning (NU006 and NU008) scored relatively lower in comparison to the other participants. The observation and recognition that particular individuals were less proactive is again symptomatic of ongoing disparity in the unit culture. This was further magnified by the recognition and subsequent disquiet of participants in staff who looked to avoid using CRRT.

4.3.3.2 *'They will take a big step back'* - Avoiding use

There were repeated discussions around the perception that some critical care nurses attempted to avoid using CRRT. Participants provided a picture of what they felt influenced this behaviour and who was likely to be affected.

There were individuals that were felt not comfortable using the equipment.

> *…I think I've maybe seen a couple of people who've had reservations, who've been around for a while and used different systems for a long time and now this is the new thing… but I don't think I've ever seen anyone take any sort of extreme where they won't [use CRRT]. (NU001)*

> *…there are people who would shy away from anything you know, and it's not that they are not capable of doing it, I think it's 'oh gosh something extra to have to think about'....well sometimes it can be confidence, but I personally and this is just me thinking, some people it's just extra work for them, yeah and I do know people like that, it's extra work you're having to think a bit more… (NU008)*

> *…like a lot of people do when they're managing other people, they will take a big step back especially if they're not as confident with the machines and the renal replacement side of things… and let the experienced band 5 run with it. Whereas I'm still quite hands-on I suppose because I'm new to the Band 6 role even though it's been 2 years (NU009)*

> *…. they don't…put themselves forward… they don't actively say… I haven't had many filters, so even though I've been here [for a long time]. Whereas… if I hadn't done something I'd say (NU004)*

It was indicated that this lack of comfort was related to personal preferences rather than a clinical inability or a lack of skill to deliver CRRT. As a result, the reasons to why these preferences existed were explored further.

The participants identified the types of individuals or perceived reasons of those avoiding CRRT use. They focussed on the type of work it involved, frequent lifting of large bags of fluid, inexperience, and the type of experience, and those 'older nurses'.

> *… it is like oh god look [at] all them bags you've got to shift around... and it is back breaking sometimes, but the new machines you're changing the bags less*

frequently so there's less amount of times you're lifting those big heavy bags so I get why people don't want to use them for, it's hard work… (NU002)

… you feel more comfortable, because you've used one every shift or you've set one up, or I think it takes you a good six months to actually feel comfortable using. And then I have come across people who haven't even set one up yet… and they may be working longer than me… Then they don't know [how to manage it] ... they step back from it. (NU002)

…forward yeah, where us older ones probably wouldn't [push themselves forward… (NU004)

In these comments the participants made comparisons between the different behavioural approaches of nurses. As part of these discussions, NU002 initially coined the phrase **'old school and new school'.** This was initially perceived as being related to generational standpoints or duration associated factors, in part due to the contemporaneous discussion with NU001 who used the analogy 'it's like giving your mum an iPhone', further exploration identified that this platitude was particularly used in reference to people adapting to change.

Old school people, I've seen more reservation in using from old school people. (NU001)

…it is the change [of equipment] …, well you do hear them say well I don't know how to use this, and I'm use to the old Prismaflex… probably old school... not to blanket but there are a lot of old school. (NU002)

The concept was further reinforced by,

I think that some are like old school, do you know what I mean, some don't like changes do they…. (NU004).

In later interviews, whilst the 'old school/new school concept was also corroborated by NU008 and NU012, they believed length of service was not the distinguishing or overarching factor in characterising these groups of individuals.

…because I work with people who've been here longer than me who are open to things, but I also know people [who] have been here longer than me that aren't, and they are very resistant to any change. But it's not always just about resistance to change, you know, it could be something that they're supposed to do, but they've been doing forever… I don't know it's almost like they can't be bothered and that sounds really bad, but it is almost like they can't be bothered especially learning new things (NU008).

In seeking further clarification, they identified the aspects that specifically relate to resistance to change due the individuals underlying disposition.

[it's] just personality (NU008)

…This… Old School nurses New School nurses, now seeing it from a teacher trainer point of view, I find that there's people that are going to be stuck in their ways regardless of how long they've been qualified, whether it's a year or 20 years. (NU012).

From speaking to the other people who was involved. I think it [adoption of citrate CRRT] was it was really difficult to introduce, but the older staff, at least... it did sort of put them all on a level playing field. But then since it's been on, that's changed again because there's people still now that are more confident than others, even though they have exactly the same experience. (NU012)

NU001 and NU015 caveated some of the above responses by stating that whilst people try to avoid looking after patients on CRRT, in reality they have very little control over the allocation. Especially when they are considered competent to care for this patient population.

…I've seen people that was [sic] like, 'I don't like it and if I can avoid [it I will]' … if someone says there's a filter, I'm not going to jump up and go I'll take it, but I've never seen anybody who will actively say look I'm not having anything to do with that. (NU001)

…I don't think there are [groups of people trying to actively avoid using CRRT], some might, because they don't get a choice, do they.... So, in handover you get what you're given, so you can't avoid. So, I don't think they can actively avoid it... then when I think when you go on your break, and somebody covers for you. I don't think anybody has avoided [it], I can't think of anybody avoiding looking after it. (NU015)

These wide-ranging aspects of avoiding CRRT suggest that there are multi-faceted reasons to the avoidance which centre around personal aspects like comfort and ability, cultural aspects associated with staff being characterised in a way that expectations of their behaviours are accepted and sometimes reinforced.

4.3.3.3 *'That helped me build my confidence'* - Confidence

There was considerable discussion on the influence of confidence and its relationship with the other aspects of delivering CRRT. These centred around support, experience, and exposure, alongside both a lack of confidence and fear.

Support was an element impacting on confidence, for example in two of the interviewees, there appeared to be a direct impact on their confidence with the availability of support structures throughout the department.

So, you can actually go to people and say you're going to have to show me this again and that helped me build my confidence, because it was a case of I

wasn't thrown at it until I felt I could use it. It was quite quick but even the first time you use it you've still got a bit of a support network. (NU001)

… I mean working in conjunction, …sort of out of the numbers…working with somebody, to get experience cos that's how it was always done, like, when it was ICU and HDU, it was always..... I remember working with {CC} and going through everything with me, the Prismaflex...and it all made absolute perfect sense and you know sort of every intervention that he did, he explained it and I felt really confident at the end of it. (NU003)

Supplementing this direct impact of support, NU001 also pointed out that a confident delivery of advice and support, helps in both the provider becoming a central resource for offering advice whilst also enabling those seeking support to feel empowered to action any advice provided, irrespective of the potential outcome.

…If the person you've gone to… [is] confident in saying this is going to work, that's going to work, or it is or it's not, then I think that may be rubs off on other people. So then that person gets a bit of a reputation whether they've solved the problem or not, they've got the confidence to say that just seems daft let's talk to someone and see what we're going to do about it. (NU001)

These interpersonal relationships appear to play a large role in the development and maintenance of confidence through effective and supportive communication methods, and behaviours allowing users the opportunity for regular positive reinforcement.

In regard to experience and exposure, this was highly sought after as a means to improve self-perceived confidence.

experience, exposure, definitely [improves ones' confidence]. So, you've got your background training which some people have asked [for], again you know, like {SB} she actually knew that she wasn't going to be good, so she came to extra training, but until you've had hands on experience I don't think, I think you have to have hands on to really compound whatever you've learnt you know, you need to have that exposure… (NU008)

Additionally, NU001 supported the training element of exposure and experience.

what makes me feel more confident about using it? errm I got quite good training session given the time. (NU001)

He was also adamant that an incident which took him out of his comfort zone had a direct impact on his confidence in using CRRT.

In line with this NU006 supports the idea that specific events build confidence, although matter-of-factly makes it clear that this is very much reliant on a positive outcome.

Interviewer: … having that exposure, do things… you've had to almost work through yourself, does that… improve your confidence then…?

NU006: if it goes right {laughs} if it works out for you, yeah!

These unique opportunities and the subsequent feedback appear to have had a significant role in instilling confidence and also allow for individuals to further develop their skillsets.

More broadly, other participants talked about how their day-to-day decision-making improved their confidence, and likewise how their confidence enabled them to make clinical decisions.

you seen [sic] your patient and you can see… if you're getting any improvement or… any change. So, you're... [more confident] yeah… you can see, each day if you know if it's making a difference, if it's helping, if it .... titrating different things. If it's working… on them or not, or you can you get more of a sense for it (NU002)

Other participants supported this concept by suggesting that confidence improved as a result of regular use of CRRT, even when they were new to using it.

I do now that I've, I know more about it and I'm comfortable with it now, but I wouldn't have done probably when we first started using it, so it took, it takes a little while to get used to it… I would say [it takes about a year] to feel comfortable yeah… and then it cos sometimes you go weeks without having anybody anyway on it so it even in a year, maybe [I've] not had many. (NU004)

I just feel I have the confidence and the experience to do that [make decisions] if it was somebody that was, maybe one of the new people, that had maybe just only started looking at them …, you just feel confident and you just do it, just sort of do it automatically and… it's all down to your experience I think that. (NU003)

Similarly in the move from one system of delivering CRRT to another, previous experience played an important role in enabling a faster progression to feeling confident, despite the change in equipment.

I feel quite comfortable with the [change in systems] yeah, I think they're quite easy too, user friendly I think (NU004)

This comfort aligned with elements that NU006 and NU008 identified, in that having pre-existing confidence allowed for individuals to move forward faster.

if they are quite a confident person anyway, they might grab the bull by the horns and be like come on this is… what's wrong, so we've got to learn it, let's crack on, some people maybe oh I'll wait until you lot have a go first (NU006)

there are people who would shy away from anything you know, and it's not that they are not capable of doing it, I think it's 'oh gosh something extra to have to think about, some people.... well sometimes it can be confidence, (NU008)

These individual level experiences, on the contribution confidence plays in managing CRRT, demonstrate that there is clear practical impact on treatment delivery and the ability and opportunity for the wider workforce to be able to look after their patients.

Overarching all these confidence and experience elements was the recognition that if there was perceived confidence on the part of the Band 6, this increased the opportunity that the staff member would be allocated a patient with CRRT.

You'll maybe get someone piping up and if you don't then I will choose someone who I think would benefit from the experience of having a filter. (NU018)

There was a motivation here, demonstrated by NU018, where the portrayal of confidence was as important as the skill, in allocating nurses to look after CRRT.

Contrasting the positive displays of confidence, interviewees also referred to individuals who demonstrated a lack of confidence when managing patients on CRRT.

…I think there's a lot of people that are less confident in their own decision-making and they would always ask, and it doesn't matter how much experience that person's got they will always still come and ask you. I don't know if that's to do with confidence or insecurity in their own knowledge and decision-making. (NU009)

I know that there is the teacher practitioners there. I know that there is the nurse in charge, there are the superusers, there are other people that have used it as well... but just because I just don't feel confident with it really… I don't think I would be able to set one up. Oh yeah. Every time I've looked after one and if I've been a bit, you know like, sort of having to work things out or you know the T:I ratios and things I've always gone to somebody that's been there for a long time, like myself, and just got some advice from them so you know. We've all had a lot of exposure to the machine… It's just, it's with me it's the confidence. (NU003)

You've got {YY} on the other hand and it's a confidence thing… but she was one of the ones who stayed behind and did the extra training, so it's not that she's not interested… She wouldn't want somebody coming to her asking her a question, because she's been here longer than I have, both of them have, but she wouldn't then want to look stupid because she didn't know, you know it would be more of a confidence thing with her (NU008)

These statements demonstrate that individuals possess a lack of confidence at a personal level. This lack of confidence is manifested in a number of ways, namely in the approach they take for seeking out support from colleagues. In the statements of NU009 and NU003 this was

identified as the constant seeking out of support irrespective of the clinical situation. There was also evidence that the lack of confidence results in the absence of support to others (NU008). Recognition that these behaviours exist because of a lack of confidence on the part of individuals could enable a refocus on how best to support providers and receivers of support.

Drawing on the aspect of confidence NU006 identifies that confidence with CRRT goes someway to dispersing any fear of using the equipment and highlights the impact of individual differences on how both confidence and fear affect critical care nurses.

> *… I think it's just about your confidence, when you feel confident with it then obviously you don't fear it anymore, but people are different with their levels… you know, some people are quite confident with things straight away other people it takes them time and that's just because of their confidence really, I mean they are maybe just like that (NU006)*

Validating NU006's points surrounding confidence and fears, other participants spoke about the lack of confidence within the staff group and sometimes themselves and identified a fear as an aspect associated with people using CRRT.

> *I have seen a couple of people who are new to nursing who are afraid of it.... well just because it 'oh my god it's a filter' you know what I mean. 'I've only just seen a ventilator' and that's a filter urghh. (NU001)*

> *Cos they're scared of using it (NU002)*

> *…I think sometimes when you're a new starter and you've got quite a lot going on anyway, the thought of looking after a filter can be a little bit daunting… some people are quite eager and yeah, 'I want to try it' and other people [are] like 'oh I fear it' … (NU006)*

> *So, it's just a big scary machine, that's really critical to someone isn't it. But it's more scary than the ventilators easily…well, it looks a scary thing to use, cos like there's blood pumping around it, I remember being real scared of it when I first came here. I am still a little bit scared of it like when I've said, I don't like to attach it, even though I know it's all right, really to somebody. Just in case there's something wrong with it and does something wrong to somebody, but I think if you're new here it is a scary thing to look after. (NU015)*

There is a clear perception of unease emphasised across all this commentary, and whilst there is a focus on this being evident in new starters it is apparent that this element of fear still pervades those individuals that have worked on ICU for a number of years. The specific reasons for this fear were difficult to elucidate, it would appear however that sufficient

training and CRRT exposure plays a significant role in moderating this fear. The training aspects associated with this are further discussed in section 4.6.

4.3.4 Autonomy

All 10 participants interviewed mentioned the role autonomous practice played in CRRT. There was a distinct perception that a degree of autonomy was required by individuals (nurses) managing CRRT systems and they described their justification for this.

> *I think it's the same, because whatever changes you make you still have to, if you titrate anything up or down you still have to have two people check what you've got up or down… (NU002).*

> *I'm happy to tweak, I'm confident in doing that, cos we work autonomously on intensive care anyway don't we. So …I don't find it a struggle or I'm not like not confident doing it, I will titrate and adjust things as I feel I need to. (NU003).*

> *…I don't think somebody with less than six months experience is ready because you are quite autonomous a lot of the time, again site-to-site dependent. So, I think you need to be on top of things because that they are the things that you'll miss as an autonomous practitioner, because there's so much to think about… So, I think you do need that experience and because you need to be aware of how important things are. But even when you're not autonomous the problem is, is that some of the band 6's don't have enough experience either. (NU012)*

> *…I think the autonomy with it comes from the experience of using it and from if there's any troubleshooting to be done… (NU018)*

From these extracts it is largely perceived that the management of CRRT is a nurse led intervention, with minimal oversight provided by the medical staff (usually reserved for extremis). However, it is also apparent that this autonomy has develop organically through the absence of consistent support structures. Where it has been obligated on staff to both educate and inform themselves on appropriate actions to take, and this has become embedded into practice with guidelines being developed around these skills.

4.3.5 Colleagues

4.3.5.1 Reputation and Approachability

A fundamental related to the influence colleagues have on individuals interactions with CRRT was their **Reputation**. This facet was often associated with a number of the covered concepts identified throughout the interviews and within this thesis.

Colleagues were often singled out for having particular attributes, interests, or knowledge.

.... you know who's got their own little niches... Some of them have got that... ability with certain equipment and you know to go to them. (NU002)

…there are one or two people who tend to be a go to for a particular piece, 'oh go and get X' cos they know what they are doing with it... If I could identify someone who I knew had been running them a lot, then I would probably seek them out regardless of banding or position or anything like that. If there's someone who's actually got their hands on it a lot, then I would probably go to them first cos usually they're the ones that are more available (NU001).

NU004 also agreed that irrespective of any formal or informal training, colleagues were identifiable by their own particular clinical interests. These were often tacit understandings, which developed through regular exchanges between colleagues or word of mouth, alongside directly observed behaviours. The development of interpersonal relationships across the workforce allowed colleagues to learn the characteristics of one another which then became useful at times when assistance was needed and sought.

Separately to this there was also a general feeling that co-workers reputation was built on their ability to deliver an outcome.

then that person gets a bit of a reputation whether they've solved the problem. (NU001)

Well from what I've seen, from people who I know that when we've had an emergency situation they've been there, and they've been on the ball. (NU012)

Positive outcomes in respect of problem solving reinforced the behaviours of staff to seek out support from particular individuals. There was no reference to any negative impacts on reputation associated with a failure to resolve a problem, potentially indicating that any interactions would be seen positively.

However, away from the tangible practical skill and knowledge, participants identified the importance of the more personable aspects associated with interactions.

I think probably if somebody feels like you've been more helpful to them in the past, they'll come to you again and I think if you show that you're open to people coming to you for advice, then they come to you more (NU009)

… or even if it's not the reputation, [it's] how they found them in the past. (NU008)

This leads on to a significant major factor regarding interactions with colleagues, which was their approachability.

my personal experience [is] that she's approachable and you can go to her, and she does [help]... (NU006)

…I have actually asked in the past oh how come you've come? why did you come for me?' and they've said… we didn't think they'd know anyway. And it's like I'd rather come and asked [sic] you cos you would explain it to me properly and even though the other person might know. They might just come and sort it out for them, whereas I wouldn't just come and do it, I would say alright then let's have a look, we'll problem solve this… and even if I know straight away, I might say ok I know what this is, what do you think it might be? (NU008)

…I think probably when…I'd only been here a short length of time, I probably would have asked the same person that I felt was approachable, that I would dare ask…, like maybe when I first started I would of thought I'm not asking them they're real unapproachable and now I wouldn't think anybody was now. I think everybody's fair game to ask now. I think it's because I've been here longer, and I know everybody's personality. (NU015)

This evolution to a change in stance by NU015 was mirrored by another participant who felt they would now approach anyone, irrespective of their approachability.

I tend not to feel that now. I know for a fact as a band 5 that's exactly what I would have gone for, and I know that they will be out there doing that because I think it's human nature to be going to the person that is most approachable (NU012).

However, there were also participants who valued the merit of being approachable, so much so that they wished they were perceived in this manner.

oh, that's an interesting one, I would hope that they would come to me just because they thought I was approachable, regardless of what grade I was… definitely approach-ability…, a massive part of my role is supporting the other people and I'd like to think that anybody would be able to come and ask me…, but I certainly wouldn't want to make them feel stupid that they've come to me… I think yeah so it you're not there to know everything... but I'd like to think that I could help them enough. (NU008)

The importance of these approachability and reputation elements are largely manifested by NU002, who when asked whether she had any problems with colleagues asking her questions said.

Oh no, no, people do tend to ring me up [at home]. (NU002)

Demonstrating the lengths to which staff go to ensure they provide the best support for colleagues and ultimately patients.

4.3.6 The Individual Summary

The individual is a complex interaction of a variety of intertwined tacit characteristics. These relationships appear to be personal to staff members and as a result each producing distinct and variable outcomes and perspectives. These descriptions of approachability and understanding the characteristics of colleagues demonstrates the importance of the development of interpersonal relationships. They act to both garner reliable support from colleagues in order to aid the provision of CRRT and also indicate the importance of non-technical skills like communication, teamwork, and leadership in this area.

4.4 Organisational

The Organisational theme focussed on factors related to the individuals' management of CRRT that were heavily influenced by the hospital, NHS Trust, local department, or other external influences. These fell into a number of domains (see Figure 10).

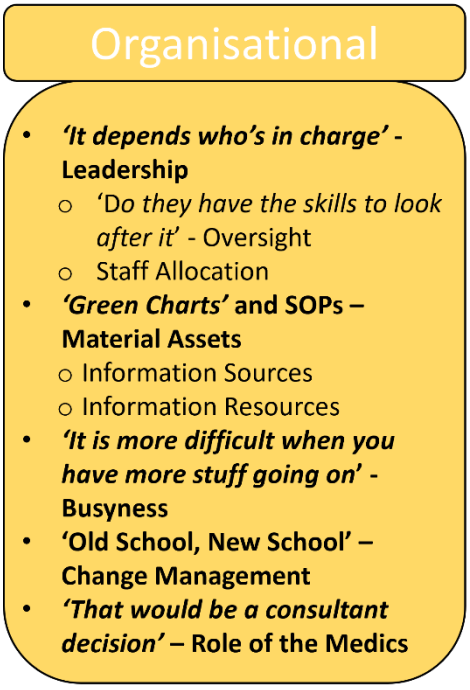

Figure 10 Organisational Theme and Sub Themes

4.4.1 *'It depends who's in charge'* - Leadership

The role of leadership became apparent throughout the interviews, with participants identifying characteristics of behaviours relating to leadership specific to CRRT, and moreover an organisational structure and recognition of those individuals who they felt fulfilled this leadership role.

There was an acceptance of the importance and the role of day-to-day de facto clinical leadership on shifts. With specific reference throughout the discussions on staff groups with a leadership role, namely the consultant body and Band 6 Nurses.

> *…. I think it's a good thing, I think there has to be somebody at the top of the pyramid who is identified as having the training, the knowledge and that to say I know enough about this therapy to know that this is all we can do with that. (NU001)*

> *Then depending on who my 6 was, and again that comes from experience. I might go to my 6, probably should go to my 6 because they're the ones in charge of the shift and I probably would tell them, but I wouldn't necessarily always take their advice depending on where I thought it was appropriate, but again that's coming from having more experience. After that if I was struggling, I would maybe go to the trainers if they were around or even the Medics to a point, some of the senior medics (NU012)*

> *kinda, respect you know I've got massive amount for NU008 and I kind of think oh if she doesn't know it, don't need to know it kind of thing, so that's why I would always go to her you know. Mind you saying that if there's somebody that, who's next door to me where I feel that they would have, I'd have no problem I wouldn't just go out and seek NU008, whoever is around really. 'HELP' {laughs} (NU006)*

There was clear acknowledgement to the importance of the staff in charge, whilst there was also recognition that they may not always have the ability to resolve the problem. The challenges highlighted were that despite these escalations of the problems there was not always a confidence that the problem would be remedied.

Highlighting the right characteristics of a leader was difficult as a number of individuals raised issues whereby these characteristics were seen as lacking.

> *Sometimes you don't get the support that you probably need from the senior ones, because they think that you are [ok], they'll just leave you to it. …some [Band 6's] are better than others, it depends a lot, some haven't got a lot of clinical experience. Only because of the job they're doing at the minute… it's better lately because there has been more than two Band 6's on [duty], one on each side so the other one is usually clinical, but you do find some of them are lacking in clinical skills. (NU004)*

> *[conversations about band 5 nurses getting CRRT experience] do happen in isolation. So, then the other 6s aren't necessarily doing that and then there's some other 6s that maybe their team don't feel like they can go to as easily as this other team might do, so I think it's maybe again hit and miss because I think some people get better [support]. (NU012)*

Mitigating the perception that there was a lack of leadership related to CRRT, a Band 6 Nurse (NU009) felt she demonstrated a hands-on approach, which whilst linked to her relatively new (2 years) position as a Band 6 made a difference in demonstrating leadership characteristics.

> *…I'm still quite hands on, rather than stepping back and letting just other people do it, like a lot of people do when they're managing other people, they will take a big step back. Especially if they're not as confident with the machines and the renal replacement side of things. They would maybe take a step back and let the experienced band 5 run with it. Whereas I'm still quite hands-on I suppose, because I'm new to the Band 6 role even though it's been 2 years (NU009)*

More widely however, there was also the allusion that there was a lack of insight about the delivery of CRRT in the management structure of the critical care units. Whilst acknowledging the ongoing challenges and the wider confounding issues within the department to enable this.

> *I think it's quite difficult really cos, if you haven't done something for a while then you do forget, so you know. When they come and work on the shop floor and stuff, it hard to get back into it cos you're not doing it day in day out. So, I don't really see what benefit that they need to know the ins and outs of it……. I think in an ideal world where we had lots of nurses and we was [sic] able to give that I think we would be, we would be giving it and if them to understand the knowledge of why and that must be protected would be fantastic but.... it's not practical (NU006)*

This subsequently highlights a resource issue for senior management leadership to consider, in order to facilitate what would be deemed as better CRRT support. In identifying this lack of leadership characteristics in some staff, and the inability to provide sufficient leadership structure, there was often an air of pessimism and feeling of frustration towards some of the leadership team. It was felt that whilst there were specific CRRT related issues, a more broader leadership problem existed across the department irrespective of any particular intervention.

4.4.1.1 '*Do they have the skills to look after it*' – Oversight

Following on from the leadership elements discussed, the provision and degree of oversight of staff was another common element examined by participants.

As highlighted above, NU004 felt there was a distinct lack of oversight given to them personally, in particular they felt that some Band 6 nurses did not have sufficient and current skills to provide effective oversight. With the feeling this lack of oversight was exacerbated when they were looking after patients in cubicles.

> *No, they tend to leave you a lot in the cubicles and not come, you know what I mean unless you ask for [help…] and then that's difficult when you're trying*

to change the bags and then you want somebody just to come in and just watch or keep an eye and they'll say 'well will watch from, wherever. (NU004)

This resulted in them having to seek out advice or input themselves as well as a lack of staff coming in and asking questions about the patient's status.

For context NU004 is a highly experienced staff member with over 10 years' experience using CRRT, demonstrating that despite significant clinical experience and insight, there was still a perception that a sufficient degree of oversight was missing. This perception of a lack of oversight generates a mismatch between the expectation of the Band 6 nurse who would fully expect someone with over 10 years' experience to manage a patient on CRRT with a need for limited oversight. Understanding the reasons for, and ultimately resolving this disparity, would likely provide benefits to both staff like NU004 and the Band 6 nurse on shifts. Conversely there were contrasting experiences from others who thought the oversight was satisfactory, specifically, NU006 who believed there was sufficient oversight.

A number of participants also stressed that there was a case-by-case assessment when determining oversight including who, and therefore how much oversight was needed.

NU006 detailed that how the equipment was functioning at the time played a role in oversight.

…I mean like it all depends on how it's running doesn't it I suppose. You don't need to be hovering around someone who's like more newly qualified if it's working ok and there doing the gases and everything's running as it should be. (NU006)

from my point of views as a Band 6 then it would be, has the person who's looking after the equipment, do they have the skills to look after it, because obviously I would need to oversee them more if I thought it was somebody who had less experience. They might, because you can't always just give it to the people who had loads of experience people have to learn as well and I think hands on learning is going to be far more useful to a person developing their role. So that would be real key issue as to the experience the nurse has looking after it and how much I have to input... some of it is because you know that person and you know…they know how to use the machine they can troubleshoot… (NU008)

Those band 6 nurse participating in this study also made commentary on the challenges in providing oversight and why a case-by-case assessment was appropriate.

Again, it depends on your skill mix. Generally, what you'll find is more experienced nurses will just go and help. Not all of them, some of the better more experienced nurses. I mean if there is, if there is an experienced nurse on shift, then I would give that experience nurse less of the workload so that they were available to assist the newer starters with any problems. (NU018)

it's always a balancing act and because we've been quieter recently it's been nice to double people up, to give them that experience of working with a sicker patient with more support therapies… But when it's busier and you're allocating people to look after certain patients you would go probably for the more experienced staff because you don't have to monitor them so closely in working with the renal replacement systems that we have... when it's busier on the unit, it's definitely harder to keep an overview on... (NU009)

The predominate feeling was a case-by-case approach was taken when providing oversight, this demonstrates a pragmatic, risk assessed perspective on the part of the Band 6 nurse in managing both the patient on CRRT, and the nurse caring for the patient.

4.4.1.2 Staff Allocation

The allocation of staff to patients requiring CRRT also provided a Band 5 and Band 6 nurse split in perspective.

The Band 6 nurses discussed their considerations, rationale, and decision-making in their staff allocation, these were largely clustered around the influences of experience and the predominant ICU circumstances at the time of allocation.

Even if somebody has come and asked you 'can I have more experience with a filter?', it might be somebody who has less than 18 months experience and I'm thinking 'Yeah that would be lovely', but 1) there's people who've been here longer who really should get a chance, but also there are lots of basic things that they're not quite [up to speed with] … But also, if I know that I might be busy that day if I'm coordinating and things, I might not be able to give them the 100% support that they might need… the person next to them has to be able to help them out and sometimes you get people who are more than willing to do that and others are a bit more reluctant. (NU008)

Moreover, NU009 alluded to the fact that the level of staff experience and the newness of staff was the overarching day-to-day challenge to their allocation.

Allocation of staff and stuff like that it's always a bit of a challenge, typically with the number of new staff we've got and the experience that we've got, it's always a challenge. (NU009)

This heightened alertness regarding the allocation of lesser experienced staff is reinforced again by NU008 who goes on to identify that this begins at the earliest stage of a shift, in handover.

…usually you can take a look around the coffee room {laugh}… because you don't know who's going to be looking after which patients, somebody else has allocated for you, so you can be sat in the coffee room and you're thinking right and then as the patients names [are allocated] ….you think 'oh you might… have to keep more of an eye on them' and… I don't know whether it's… a preconception of something you formulated in your mind, but it's almost based on experience. (NU008)

However, NU018 felt that whilst staff experience was important, a significant element was personally knowing the staff and understanding their suitability's.

> *Well, again everyone's different… because reputation doesn't necessarily mean anything does it…. Everyone is individual. We will have people more comfortable going to people than not, so it's just a case of, for me, choosing someone as a support mechanism knowing that that person will actually provide that support mechanism. And again, it's knowing the staff. (NU018)*

The influences on the staff allocation by Band 6 nurses revolved around the happenings on the unit, making it difficult to plan allocations for CRRT.

> *From the allocation point of view, it is quite tricky because of the skill mix and not having the extra support there for supernumerary [staff] (NU008).*

There was evidence of a burden on the Band 6 who found it difficult, because of time pressures to do the right thing for staff members.

> *… I think about that [staff allocation] a lot, but I know that sometimes even from an allocation point of view you don't have much time, because it's been so busy on your shift and now it's coming to the next shift… and you haven't allocated, you've got to get the two units together to do it… and then it might be just be a 'ooh my gosh' we haven't got much time, just got to allocate now. So, all of that [staff considerations] would go out the window, then it would be more about the safety of the unit not about whether you're helping somebody to gain skills, that's always the last, later consideration. (NU008)*

This acknowledgement of the prioritisation in staff allocation led to comments about the potential consequences associated with the insensitive allocation of staff.

> *… I know that [Band 7 nurses] do try and encourage that [planning for staff exposure] if they can, because they want to keep, retain staff and obviously if you're not giving people the chance to expand their knowledge and stuff it gets boring, and they'll want to leave. But as much as you do that there's always staff [that need], retaining further down the line, who have all the skills already and they can feel like they're having their noses pushed out because you're trying to you know [give new staff experience], so they still need… exposure because they'll lose their skills, but more than that they become despondent… We don't always get enough filters. (NU008)*

These practicalities of actually allocating were reiterated by NU018.

> *Well, you've just got to pick the best candidate. You generally know where people are up to in confidence particularly, skill based tends not to matter because the skill sets are quite low initially, for quite a lot of people so and it is a learning on the job environment. So, you just pick someone who, I generally ask 'does anyone want a filter?' … You'll maybe get someone piping up, and if you don't*

then I will choose someone who I think would benefit from the experience of having a filter (NU018)

There was obvious deliberation and internalisation happening for Band 6 nurses when making decisions on which staff to best allocate a patient receiving CRRT. This process involved the consideration of the specific situation and applied it to their own personal principles. These examples demonstrate how Band 6 nurses choices of allocation were considered against their own personal values prior to making a decision. They had very little support in this process, usually only another Band 6. The participants in this study clearly evidenced they wanted to do the right thing by both the staff member and the patient, to enable the best outcomes and ensure diligence even if there were time pressures.

The perspectives from the band 5 interviewees raised similar issues to those from the Band 6's. It was apparent there is a disconnect between 'requesting' exposure to care for a patient on CRRT and this actually being realised.

…I think some people are quite, quite good. I know a couple of the girls here have gone to those sixes and said look, I really need some experience on this and then they'd be really mindful about trying to give them those patients, but then….they [conversations] do happen in isolation so then the other 6s aren't necessarily doing that and then there's some other 6s that maybe their team don't feel like they can go to as easily as this other team might do. So, I think it's maybe again hit and miss because I think some people get better. (NU012)

I think yeah [there is opportunity] to ask for it, Yeah, but then the thing is sometimes there's no filter is there, and other times there's quite a few, and then when there's quite a few we're real busy and then there weren't enough people to double up, to help someone that might want to learn. So, I know whenever there is like a lull, like there is now, they often… give two people one patient, they'll give a new starter somebody else so that other person can learn the filter, without having to look after the patient. But then you can go ages without looking after one, months and months and months and months. So, if somebody wants to learn how to use one and they'll ask, they don't even have that chance because it didn't occur on their shift. I know that because that happens with a lot of, not just the filter with lots of things. Like people will 'ask I've never used a filter I want [to] look after a filter' but however they've asked like six months previously when the opportunity comes around it's all been forgotten because loads of people have asked since then (NU015)

In turn there was evidence from participants that they felt that there was conscious thought on the part of Band 6s' about who to allocate CRRT patients to.

… and you know sometimes unfortunately when you have a certain people on a night shift, you know, what staff are going to get what patients. So, I don't think, so that's unhelpful to pick some staff allocation. So that's there's a downside but there is an upside because they get to sit and think right what we got what we got coming in? They're not just doing it rushed in front of people and I found what

the downside is at {elective site} is that although it's great because you can go, I am ready for that challenge. I would really like to have that patient and generally they'll say yeah, that's fine. You have that patient then, but what if you're asking for a patient that they know you're not ready for, you have to say no in front of everybody, and then… that puts down their confidence. (NU012)

NU015 specifically picked out a sub section of staff that they felt had more exposure to CRRT.

…and the filter, sometimes people will automatically give the filter to somebody that's been here a long time and then miss out everybody else and that's the same for ventilators as well. So, people might have even been here a long time and still won't get given the filter because they'll automatically give it sometimes to the person that's been here forever and then they'll just kind of like ignore the people in the middle… it just depends on who's allocating what and because it's something that we don't use a lot you can, it can miss you out anyway… (NU015)

However, both NU012 and NU015 agreed that it was more luck than judgement that enabled both the exposure to, and support for providing CRRT. There was a mutual understanding of the challenges between each of the roles but at the same time a disconnect between what was able to be facilitated and the perceived lack of equity across the allocations. It was this lack of equity that generated the most dissatisfaction across the Band 5 nurses.

4.4.2 *'Green Charts'* and SOPs- Material Assets

The material assets of the organisation to aid in the delivery of CRRT were split into two categories; **Information sources** included existing and tangible data or information which staff used to inform their decision-making and determine current happenings of CRRT. **Information resources** were items that staff could interrogate and refer to aid in their understanding of effective and safe CRRT delivery.

4.4.2.1 Information Sources

The availability and importance of clinical data to improve decision-making was raised by a number of participants. The predominant information source was the 'green chart'. The 'green chart' is the ICU paper documentation chart which staff use to record physiological observations, fluid balance and treatment delivery (including CRRT). These form a significant part of the non-narrative record keeping by staff.

… I think, it goes back to… the more information you have the better, if you can look at trends on charts, trends on the machine and things like that and see what marries up it gives you more insight into what's doing what. (NU001)

Your green charts for your trends… your bloods, your [T:I] ratio is [vital]... (NU002)

NU009 corroborated this use of the 'green charts', but also identified the ease to which there was ongoing use and access to patient observation data. These 'green charts' were fundamental to the minute-by-minute activities in the ICU with constant references made back to them. There was, as a result, a reliance to using them in aiding decision making and treatment changes.

In talking about the acquisition of patient data, NU008 observed that a number of colleagues took comparatively more blood tests than others as a means to aid decision-making.

> *gases as well as {lab test] yeah… in every shift you can see there are some people that take far more bloods than everybody else and that is a confidence thing [and not being able to accurately predict or traject where things are going] (NU008).*

The impact of blood tests was also discussed by participants, in particular their use as a means to escalate concerns or otherwise allow for the continuation of nurse led care was important.

> *…but I mean obviously if your pH isn't shifting or your potassium not moving is there something else, that we need to do cos clearly [it's not working]…, but other people yeah you do you need to go to the doctor maybe and [be] like ' this isn't [working] we've been on X amount of time now and nothing's particularly changing' or is it still continuing to rise (NU006).*

> *I think it's great [not having to send coagulation screens to the lab] I think it allows the user of the filter, it allows you to manage it with less input from the doctors. I think that frees up that resource for everyone else rather than having them tied down with 'oh me [sic] ratio's doing this' (NU001)*

Furthermore, the particular value of Point of Care Testing was raised and was often viewed as central to the whole process of information gathering.

> *…is great yeah, you know what you're doing at the time rather than sat on the clock waiting it's like, is that going to come back in an hour?, and then I'm going to discover there's issues… so yeah you get like your pHs and your lactates back a lot from your gases, but you don't get your U&Es back until 24 hours later. (NU001)*

> *I would say though just from… how we're looking after people on here the things that are the most concerning to the nurses would be the potassium, if it was renal failure. And you can see that on a blood gas, or it would be acidosis and you can see that on a blood gas or fluid overload, and you can see that on the fluid balance. So actually, the things that are the least important to the nursing staff, I don't know about the doctors, but to the nursing staff are the U&E's and BCP. You can get the information, the most important to a nurse… you can actually see those on the [Point of Care] tests that you're doing (NU008)*

… so, if someone comes to you with something, sometimes the first thing that pops into your head is just do a gas, because then I've got something physical to look at, so I think that's what happens. I don't know that a protocol would change that I think even if we said do not do a blood gas on this patient for 6 hours unless there is a clinical indication, they would find a clinical indication… I think 50% of the blood gases we do in ICU is for personal reassurance (NU012)

It was clear that the ability to see blood test results almost immediately after the sample was taken was felt to be beneficial by the participants, both in understanding the patients' status and the performance of the CRRT circuit. This directly led to the ability or impetus to make changes in CRRT treatments.

There was an acknowledgement that whilst data trends from patient's observations were useful, both physical assessment of the patient and the CRRT circuit and equipment, provided invaluable information aiding decision-making and understanding the current situation.

[depending on] what the issue is really you know, if it's continually with the blood flow… where it's obviously the vascath in a different place, have you just turn the patient does the head need moving a little bit… I suppose it depends on what's causing whatever the issue is... (NU006)

More specifically the value of data was reiterated in contrast to physical 'hands on assessment'.

… you can't look at a patient and think oh yeah, their blood flows on 100 you've got to take your numbers into accounts you've got to see what it's running at and is that fast enough are we taking enough off, yeah it is it's more the technical basis of it (NU006)

The presence of data in any form was essential to the staff in aiding the ability to deliver CRRT. There was evidence of expedited treatment plans based on the use of Point of Care testing results, constant refining of treatment, and treatment goals based on data present on the ICU 'green charts' and this presence of physiological data played a significant role in treatment decisions in the absence of clinical assessment.

4.4.2.2 Information Resources

The Information Resources available to staff also became topics of conversation. These were largely divided into a human information resource (see 4.6 Support) or a document resource.

Document Resources

The documentation resources consisted of protocol, clinical guidelines, SOPs, and instructions, with many of the terms often being used interchangeably throughout the discussions.

The use of on screen (CRRT equipment) instructions was deemed helpful by a number of participants, enabling them to ensure what they were doing was correct and safe and allowing a step wise process to be followed, especially in the context where staff had had a hiatus between usage.

> *I think as long as you get past the, {pause} the fear of the unknown and then you just read the instructions clearly and you don't jump ahead of yourself they're quite self-explanatory really… if you hadn't had one for a while you're kind of back to square one [and] you wouldn't be as quick, if you're doing them day in day out then you'd be able to do it with your eyes closed wouldn't you. (NU006).*

> *… I tend to go by the machine setup [on screen instructions]. Just cos the SOP has [a] few little things it misses out but other than that I think it's a … good thing to refer to… but the protocol and your prescription charts are really good tools. (NU002)*

These onscreen directions provided easily accessible and reliable machine specific guidance alongside the reassurance of following the correct procedures. However, having paper copies of these documents was viewed as imperative based on the challenges that were otherwise encountered accessing electronic resources.

> *It just takes too long [to access online versions of paper documents], [you would have to] abandon your patient and have to go to a computer and there isn't one. And then just try [to] get on to wherever you need to be… It would take too long, yeah (NU015)*

These challenges related to simple things like the presence of enough computers on the ICU, on top of access difficulties with having numerous passwords and inconsistencies to where files were stored, resulting in this requirement for physical backup copies of documents.

The organisational constructed support documents of the protocols and SOPs appeared vital to the day-to-day management and delivery of CRRT and were widely well received.

> *The SOPs are good, really helpful, and I think they're quite thorough guidelines… I think they are alright... as I've said earlier on, I don't think there's ever enough training and I think the more you do something and if you don't get to practically do it, refreshing yourself on it is always a good thing… (NU001).*

> *I think they are useful especially in the beginning when we was [sic] all, so I use to go by that a lot you know (NU004).*

> *so, with having the SOPs as well… has been a major thing, people always look for those now, I mean at one point people were like oh SOPs no, but now you do get people coming reading the SOPs. (NU008)*

Despite being well received and used, there was commentary from participants on the limitations of these documents.

> *[the SOP] it's a bit clearer I think than the protocol, but I know that I can't remember what, but something went wrong on it [CRRT equipment] … it wasn't very clear on the SOP or the protocol, so we had to ring the rep in the end. (NU004).*

NU015 also indicated that the protocol is insufficient without appropriate training and experience.

> *… rather than just following a protocol on changing stuff, which we have to do anyway, but then sometimes I think if you've worked here longer, you'd understand why you were doing it rather than just doing it… because it's all like drafted out step by step but then you don't know why you're doing it do you, unless you had the training for it (NU015)*

Others highlighted the rigidity of the protocol and that this enabled them to seek advice if deviation was required.

> *that's what they're there for. If you're working outside of them and then you can often lead to problems, they're there for a reason (NU009)*

> *but we've got all that set out and any deviation [can be addressed] you know, if a patient's weight, body mass [then] these are your flow rates, this is how fast you can run that… you assess how much fluid you can remove by how much the patient can stand and anything outside that has to be consultant led and that's in the SOP. (NU001)*

Separate to the support documents it was apparent throughout the interviews that there was the absence of discussion around record keeping related to CRRT practice. Only NU001, mentioned anything about documentation of events associated with CRRT. This may be in part due to the focus on recording CRRT observations rather than a clinical narrative.

> *… I've never really come across anything where I've had to, to go sort of that far out of my stipulated guidelines you know what I mean. And if I have it's always been a documented conversation anyway cos there's always been someone else immediately involved… (NU001)*

4.4.3 'It is more difficult when you have more stuff going on' - Busyness

A general theme surrounding the influence on how busy the environment was when providing CRRT became apparent. These influences subsequently fell into 4 categories. Firstly, participants NU001, NU009 and NU015 all pointed out that they felt that this impacted on their decision-making.

I mean you might end up at the same decision, but you might make them quicker or slower depending what's going on around you [acuity of the shift]... it is more difficult when you have more stuff going on, when you've got less time to think and process the information as well, but you've also got a lot more interactions to think about. Between body systems so it makes it a lot harder, and I think, I just ask a lot more questions of the consultants if there was more going on. (NU001)

…. but then sometimes on a night shift sometimes we're left to our own devices…., sometimes we've not got anybody senior on and they [doctors] end up in A&E a lot, so we can go for hours and hours without a doctor on the unit or seeing anybody... (NU015)

This influence of busyness appeared to have an impact on increased advice seeking from colleagues. This was alongside a general sense that in despite of a context where speed was of the essence, there was often a slowness to make decisions. This was ultimately a consequence of either seeking advice from others or because of individuals internal deliberations on their next actions.

Another influence of busyness was the impact on training and training opportunities with CRRT.

I had a lot of teaching from NU008… because it was a nice shift, and she was able to come and teach… She was fantastic at Prismaflex. Then when I set it up it was a couple of months ago now when {S} helped me, she was a super user we had time to go through it and it wasn't rushed because she was spare and it just made it, you don't panic as much do you.... you could be full and it's alright day or you can be full and hectic and there's no time, and you just got to kind of plod on which will take longer to set up (NU006)

… if we're having a quiet day or a quieter day… give it to that junior staff and put somebody with them. I do [think opportunities are few and far between] and that's just the nature of the city itself. Because the city is getting bigger and the ICU beds haven't changed, so we're only ever Going to get busier…. so, I think it's the fact that the opportunities are not always there, but I think when they are there, we need to be a bit more mindful of them. (NU012)

I think you'd have to be like competent at your job anyway or you'd be struggling to do your job as well as look after that...filter, on top of that because it's a lot to get your head round and if you were brand new, too busy getting your head around everything else. (NU015)

This lack of opportunity for learning was felt to be problematic as it limited the amount of exposure staff had to CRRT. It was felt to be indicative of the belief from interviewees that the critical care units were getting increasingly busy which meant that opportunities to learn were being reduced.

Thirdly and crucially, Busyness's impact on oversight was also raised by NU009.

> *when its busier on the unit, it's definitely harder to keep an overview on... [the ICU] (NU009)*

This observation from a Band 6 nurse demonstrates a degree of self-reflection with the challenges that a busy critical care units poses for senior staff nurses trying to co-ordinate the unit. This recognition implies that there is a potential risk for insufficient oversight and with possibility adverse consequences.

The fourth element to this was the impression that the band 6 busyness may impact staff members willingness or ability to raise concerns or seek advice.

> *so some of the more experienced band 5's will always come to you with the important things, like patients not clearing or not getting better or, just you know despite what we're doing for them the patient's deteriorating they'll come to you and let you know, give you a little update now and again, 'I know your busy but this is what's happening' and there's the ones that you know won't come to you, that will just bimble along and won't come to you and they're the ones that you would go back and check on. (NU009)*

Overall, there is a clear implication here that busyness of the unit is perceived to affect both the quality of care given, along with the availability of training whilst oversight and effective support may be lacking. This poses questions as to the safety of care given during these periods.

4.4.4 *'Old School, New School'* - Change Management

This theme surrounded the adoption of, and challenges associated with the delivery of new CRRT technologies. In itself areas of focus seemed to be about the types of individuals resistant to change. These again were largely focussed on the concepts of 'Old school, New school' practitioners.

> *So, there's that like quite keenness, but there are some people who will step back, and I don't know how you [get] around that... It's change in't it. It is the change; well, you do hear them say I don't know how to use this, and I'm use to the old Prismaflex and… it's basically…[from] certain groups [it's] probably old school... not to blanket, but there are a lot of old school. (NU002)*

> *I think that some are like old school, do you know what I mean, some don't like changes do they… but we all have to.... (NU004)*

These statements demonstrate the wider implications of the 'Old School, New School' divide and the potential influence it has on the cultural development of the critical care units.

However, there is an inability to accurately identify individuals who fell into these categories. Future exploration into these aspects may help classify these better.

Separately there were practical elements that provoked resistance to adopting citrate CRRT.

> *…they don't [want to] have to learn something new and it's, because for some people it would have taken them absolutely years to start becoming comfortable with the Prismaflex and then you go and change over to a new system, and it is completely different. A new machine, a new way of thinking and they will have to learn that, so they can't, you know they don't necessarily want to be bothered with having to learn something new. But it might just be, there are some people even with the Prismaflex who were not really that interested because it was just more work to do on that shift for them, do you know. And that sounds really awful. (NU008)*

> *… I work with people who have been here longer than me, who are open to things, but I also know people who have been here longer than me that aren't and they are very resistant to any change. But it's not always just about resistance to change you know… I don't know it's almost like they can't be bothered and that sounds really bad, but it is almost like they can't be bothered especially learning new things. (NU008)*

This clear reluctance to engage with the adoption of Citrate CRRT within the critical care units reinforces a cultural barrier that was evident and being propagated by some staff within the units. There was obvious derision of these individuals for both their unwillingness to get involved and their attitudes towards developing the critical care units.

In the specific context of CRRT in cardiac surgery, NU012 believes here that the resistance to change from the cardiac surgeons to adopt citrate therapy was due to their known experiences and comfort from theatre in using heparin.

> *like the cardiac surgeons. They, any, the first opportunity they can possibly have they'll throw somebody on Heparin… and I think it's just that they use heparin in theatre to put patients on bypass and things like that. And I don't know if it's just that they [are] so used to using it and that's the way that they've decided is best because they have it on this big machine… for this certain length of time. That they just want to go back to it as that's what they're comfortable with and that's what they understand. (NU012)*

However, there were episodes where individuals resistant to change altered their perspective on things.

> *I think maybe at the beginning… it was quite… different and it wasn't as clear I don't think as it was [on] the Prismaflex and there's a little bit more fiddly things going on. Some people, well people fear change don't they and like to stick with what they know and that's... And it's just some people are quite eager and yeah, 'I want to try it' and other people like 'oh I fear it'. But I think now I'm not*

exposed to anybody who really does not like taking a filter. Yeah … and then when we all realised, they last for 3 days, generally they loved them {laughs} (NU006).

This evolution of changing attitudes towards delivery of CRRT using the 'new' citrate systems is based upon ongoing experience with devices and the newfound practical understanding of what occurs with patients receiving this therapy.

The interviews occurred in a period on the participants ICUs, when they had recently changed the technology and equipment, they used to provide CRRT. This contemporaneous factor led to issues around these changes and the processes undertaken being at the forefront of specific discussions and ultimately the resistance of change being raised throughout the interviews.

4.4.5 *'That would be a consultant decision'* - Role of the Medics

All 10 interviewees discussed the role of the medics in CRRT. There was a consensus that the senior medical staff were responsible for the overarching decisions related to CRRT which predominately revolved around decisions to start and stop.

I suppose the timing of introducing the renal therapy… if somebody you've seen deteriorate throughout the days, when to start that therapy and starting it in good time and doing it before they deteriorate further and become unstable… So, I suppose in terms of that, that's not our decision, that would be a consultant decision to start the renal replacement therapy (NU009)

I think the main decision… is 'are you going ask the doctor whether they really need it anymore' when you're getting to that point. I think at that point you'd be looking at blood results and looking at things like that and looking at your patient and saying to the doctors 'are we going to give them [a] go without the filter? (NU001)

This assessment was typical across all interviews and was felt to be consistent with other practices on the critical care units, such as weaning patients from mechanical ventilation, or other key patient centred decisions.

As such NU003, NU004 and NU002 all had opinions in which they all felt that these decisions made by the consultant intensivists were the important overarching decisions of the day, where related to the delivery of CRRT. There were also opinions on the seniority of medical staff to engage with.

I would go more senior, I don't think I'd go to a lot of the SHOs for anything like that, purely because of my experience you go to the SHO, and they'll take a look at the filter and then they go and say I'll go and get the Reg[istrar], so I tend to just sort of right I'll just ask the Reg anyway (NU001)

> Your ideal [medic to get advice from] would be our Reg… Actually, the ACCPs are a quite good first port of call to be fair…*they're all [grades of medical staff] … There's some that do and some that don't, but then again that's the same with the nurses there's some that do and some that don't so as long as you have the protocol and you can say this is what rate and ratio we run it at, calculate to the weight that's how you'll prescribe. (NU002)*

> *'… there's no point asking the doctor for advice… you may be would [with] the Registrar but like the other more junior members of staff, medical staff that we've got some of them have no idea what to do (NU009)*

> *After that [seeking advice from a band 6 nurse] if I was struggling it would be maybe go to the [nurse] trainers if they were around or even the Medics to a point, some of the senior medics. (NU012)*

These conversations reflected a concern by the nurses in asking the less senior medical staff for advice or support. There was a clear preference for asking individuals with actual hands-on experience of CRRT, indicated by the positive reference to ACCPs. The attitudes towards the junior medical staff often came across as condescending, indicating a divide between the staff groups and a lack of support to enable a reciprocal learning environment.

The level of seniority also impacted on the availability of the medic, with direct access to consultant level input proving difficult 'out of hours'.

> *Yeah, there's less people around on a night, and weekend and bank holidays sometimes you do feel like a level of support is a bit shaved at the top end {laughs}. (NU001)*

> *me getting support, well I suppose it is always harder at night, and weekend it would always be harder. There is, and even from like from the consultant point of view… (NU008)*

> *[do you have support?] There's a bleep? There's a bleep to the Reg and then a phone call to the consultant should we need it… it's better [variability of support] recently, [compared to] when they weren't covering the Registrar shift you were just getting any doctor that could cover the shift, coming in any consultant [usually a non-intensivist anaesthetist] generally but they're standard [was poor]. (NU018)*

There was an acceptance that Consultant level input was not to be expected out of hours but evident disappointment that this level of input was not always available all the time. This reiterated the perceived importance of the Consultants role in the major decision-making elements surrounding CRRT.

Contrary to these perspectives NU006 felt there was very little difference between unsocial shifts and a typical day shift.

…on a weekend?... I wouldn't say so much on the weekend or really not nights, no I've not seen it be any different really. (NU006)

Despite feelings where medical staffs' input was not required, there were specific scenarios when medics would be approached for advice.

But I would ask them [medical staff] as well if you know if the Band 6 was that busy or if there was anyone else who is so busy, I would say to the Medics what do you think, you not I mean I'm not frightened to…. [if there was no one else] about… I'd grab the doctor. (NU004)

well actually no that, because that troubleshooting, they're just changing settings aren't they so your doctor's wouldn't know if the machine was loaded wrong or anything like that. They don't have a clue about that, I don't think (NU015)

These perspectives on medical staff involvement in CRRT were taken further where participants detailed cognisant approaches to avoid medical staff involvement in particular circumstances.

If it's just day to day running and it keeps alarming and messing about, stuff like that, I think I'd exhaust everything that I could do first as long as the patient was stable you know. If it's just access pressures and things like that you have a tinker with, what you do with your flow rates and things like that to see if you can get it to carry on operating. But if it's just not going to work then you need the doctors to come and say start/stop or they need to do something that only they are trained to do, like a line change or something, so I would exhaust everything that's within my remit (NU001).

But I think I would still go to a nurse before a doctor. (NU003)

No I'd ask the nurses for advice [first]...it [protocol] says you've got to let the doctor know doesn't it, so you do, … they're a bit limited aren't they on what they know now because I think they've been brought up with the old ones, the Prismaflex.... (NU004)

It would appear that attempts are made to avoid the need for medical staff to be involved in CRRT problem solving. This was likely to be for mixed reasons, firstly there was evidence that there were concerns about medical staff workload and the need to see other patients matching the concerns raised about the busyness of critical care units. Additionally, it is likely the concerns relating to certain medical staffs knowledge manifested in this avoidance strategy.

NU002 was particularly vocal about the involvement of medical staff with CRRT.

Interviewer: Is there a particular aspect you would go to a medic for? For advice

NU002: (shakes head to indicate no), Not troubleshooting no… Yeah if your T:I ratio and all that. You would flag that up [to medical staff], I would flag that up and your clotting and all your platelets and things like that and your bloods… Anything technical no…

Interviewer: Yeah, OK. Hands on… have you ever seen any medics touch the machines?

NU002 (smiling) no, no absolutely not (laughing) [that's a] good thing… technically I don't, I wouldn't... I wouldn't want any of them but...(laughs) sorry… Yeah, I feel that the response to that side of it whereas technically I wouldn't go to them for advice (laughs). But clinically I would run things by them.

It is apparent from the content of these conversations that there is a belief that medics do not have the technical skills and understanding of practically delivering CRRT. This leads to scenarios where advice is sought largely from senior medical staff, purely on a non-technical basis and when determined by the protocol and SOPs.

4.4.6 Organisational Summary

The organisational theme is clearly complex and pertains to a diverse range of sub themes with interrelationships. There was a clear separation in the perspectives between Band 5 and 6 nurses, indicating that there were organisational influences based on role hierarchy within the critical care units. The representation of this from the participants indicated that there was clearly a respected clinical leadership role for the senior medics surrounding CRRT which was present despite a perceived lack of insight and understanding to what is involved in delivering CRRT. This was largely based on their role as clinical experts on the critical care unit. This leadership was complemented by organisational resources both on a human and document level that were well utilised if not completely without problems. There was however a lack of respect and confidence in the ability of the junior medical staff in relation to CRRT delivery.

There were clear challenges posed by organisational aspects to effectively delivering CRRT, as presented by the participants. The acuity of the critical care units impacted across a number of factors like decision-making, training, and oversight, whilst at the same time there were pockets of the workforce that were identified as being resistant to change.

4.5 Practice

The practice domain consists of elements that are directly associated to the active provision of CRRT by the practitioners. The themes throughout this domain highlighted Patient, Physical, Machine and Conceptual elements to adequately describe the interviewees perspectives.

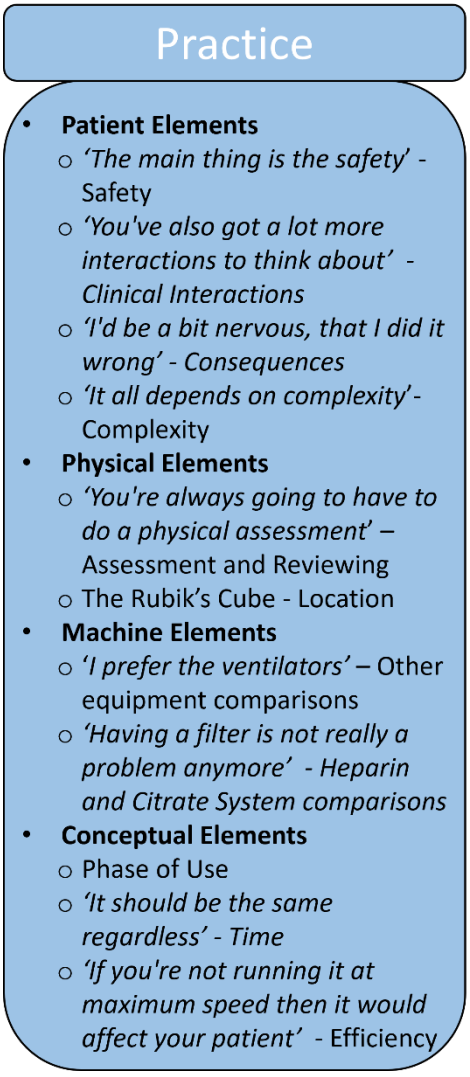

Figure 11 Practice Theme and Sub themes

4.5.1 Patient Elements

The sub themes within the patient elements focussed on the issues that were either directly or derived from the patient undergoing CRRT.

4.5.1.1 *'The main thing is the safety'* - Safety

There was an acknowledgement across a wide range of the participants that the safety of patients undergoing CRRT (and other care) was of paramount importance across all contexts of the issues raised during the interviews.

it shouldn't be an added extra, but the main thing is the safety, but people have to learn from things don't they and feel comfortable and the more they do they gain confidence. So, this is a thing we've got lots of new starters (NU008).

…because then they've [new starters] seen some of the alarms going off and they're seen some of the things happening with the patients and you need to know enough to be able to keep patients safe at the bedside, because when the bloods [are] coming back you need to be able to interpret them, but then to be able to come back and sit in a room and tell well actually I've seen this and now I know why… (NU012)

The implications here are that the staff group are safety conscious across a wide range of issues, whether it be by checking in on staff, or ensuring colleagues are appropriately trained and supported. Exploring deeper into the safety element, there was also an observation by NU008 that demonstrated colleagues more often than not practiced safely but were not necessarily proactive and dynamic.

Yeah, usually you can think oh they're not as enthusiastic as they might normally be but then you still know they're going to be safe if it's somebody who you thought was safe before. Even if they're having a bad day, they usually are still pretty safe, but they may not be as proactive, but they're usually still safe, so you don't have to worry about that… you know that they'll manage it they won't do anything ridiculously stupid, but you also know that they wouldn't necessarily be proactive (NU008)

These statements clearly raise issues about how staff are perceived as being competent and have the ability to maintain patient safety, yet they may not always outwardly demonstrate characteristics associated with dynamic activity. Additionally, this may be contributed to by the impact of unseen influences outside of the work environment, i.e., trouble at home.

Another aspect of the provision of safe CRRT therapy was the concept of the provision of safe levels of staffing on the ICU. Whilst NU006 felt there was always staff available to provide care safely, NU015 particularly raised concerns about safety when patients are cared for in a cubicle.

I've never come across where there's not been people around to fix any situation, or any problem that's gone on with it, to be fair I haven't had that many issues with it once it's up and running… they are quite self-working aren't they. (NU006)

I've been in a cubicle. I've gone somewhere, I've come back, and I can hear it beeping, I think everybody else is zoned out, and I can hear it beeping myself as a comeback.... Yeah, if I was in a cubicle and I wanted this help I'd stick my head out a cubicle and ask for help… I think you would [get help straight away] depending on … who was on, but it'll be the same as if you was [sic] on the main unit wouldn't it. But then if you're on the main unit and it's alarming some people

ignore it anyway and then other people are just press the cancel button because… it's not their patient is it. (NU015)

These location elements are further discussed in 4.5.2.2 but highlight the safety implications and influences of where CRRT is happening. When discussing staff influences on safety, NU008 recognised that as a Band 6 nurse it was an important safety mechanism that they provided oversight to less experienced team members.

So, from my point of views as a Band 6 then it would be, has the person who's looking after the equipment, do they have the skills to look after it, because obviously I would need to oversee them more, if I thought it was somebody who had less experience. They might, because you can't always just give it to the people who had loads of experience people have to learn as well and I think hands on learning is going to be far more useful to a person developing their role. (NU008)

This outlook was felt both to enable the provision of safe care but also support the experiential learning of newer staff members. This identified the Band 6 role a critical safety role, not just in the provision of CRRT but the wider critical care activities.

4.5.1.2 *'You've also got a lot more interactions to think about'* - Clinical Interactions.
The clinical interaction sub theme consists of aspects linked to the interrelationship between critical care therapies and the effect on and by CRRT. There were observations from the participants that there are clinical conflicts between these therapies which ultimately poses challenges in decision-making. NU001 particularly raised a number of examples, like the impact of CRRT fluid management, blood pressure control and inotropic support or the clinical challenges associated with patients with multiple failing physiological systems. NU001 insights were drawn from their extensive years of experience in managing CRRT.

you can be chasing your tail sometimes… you do desperately need to get some fluid off patients but obviously you're going up on your inotropes and things like that… I'm trying to get fluid off a patient but they're hypotensive. (NU001)

it is more difficult when you have more stuff going on, when you've got less time to think and process the information as well, but you've also got a lot more interactions to think about you know, between body systems so it makes it a lot harder, and I think I just ask a lot more questions of the consultants if there was more going on. If that's changing and that's changing is [it] because of this or is it… because of that and…. (NU001)

NU002 agreed that often CRRT is 'blamed' for not turning patients clinical status around, and the impact of the effectiveness of vasoactive drugs is not fully considered and the clinical picture not taken as a whole.

Many of the staff interviewed gave the impression that they enjoyed the challenge of managing these interactions. This may in part reflect the positive critical thinking disposition displayed by the participants in the CCTDI testing. It was particularly demonstrated here by NU003.

> *That's happened before [removing fluid from the patient with a low blood pressure] and say you've increased your inotropes but then… the patient can't tolerate it [fluid removal] so you've had to come down to level where you're removing some fluid but where the patient's not compromised, where the blood pressures' not compromised so it is a bit of a balancing act…Yeah, I do [enjoy that process], yeah, I do (NU003)*

More broadly the patients' presenting clinical condition also interacted with the management and decision-making of the patient on CRRT.

> *Yeah, a septic patient can be more unstable, and they have the septic showers, so their blood pressure is dropping so you, maybe tweaking things more perhaps with them, than somebody who's on it you know somebody whose just acidotic but they're not really septic, they're more unstable and you have to do a lot more tweaking… (NU003)*

> *Well, I just say to the doctor's look, the blood pressure's low, I'll, I reduced the fluid removal and I'll tell them I've done it you know. (NU004)*

This added deeper complexity and variability to the critical care nurses decision making, in respect to the huge variations in presenting and active clinical condition. There was also a recognition by NU006 and others that there was a knowledge base required throughout the workforce in understanding these clinical interactions prior to any staff being allowed to manage of CRRT.

> *…I think you've got to have at least 6 months/ 2 years' experience really and you've got to understand about your gases and your lines and what you're doing really. How it can affect your blood pressure when you put the patient on it that type of thing, do you need inotropes that, you can't just put someone on a filter, if you're struggling with the blood pressure… You need to know about your ranges and stuff as well, you can't just be let loose. (NU006)*

> *I suppose because I've got quite a lot of experience, 22 years in critical care, you've seen things happen previously and you look at other functions you look at how the liver works and how the liver and the kidneys and everything works within the systems. (NU009)*

With NU009 agreeing that often less experienced critical care nurses do not see the whole picture and see organ support as separate entities.

they don't see, oh they've been on the filter, and I've had to put my inotropes up. (NU012)

These observations closely reflect the earlier thoughts and feelings about the length of experience required to undertake CRRT and provide basis for the rationale for a period of time before learning how to manage CRRT.

Unexpectedly, there was an observation by NU001 on the impact that other HCPs had on delivering CRRT.

… you get some of the others like physios and stuff that don't show much appreciation for the fact that everything they're doing with the patient is affecting how well I can deliver that therapy. I think they could do with a little bit [of an insight] .....Yeah, I think they could, if you change the thoracic pressures, it sets your line access [alarm] off, then it's not delivering things like that if they're coughing [or] their blood pressure's up and down and usually someone who's on a filter need some careful inotropic management. They sit them up move them around they pull on lines!!] {laughs}. Yeah, I think a little bit of appreciation of you've done that, you've done that, its alarmed a few times we've pressed mute you've walked away and now it's going to take me ages to get that patient settled and stable again and keep that machine running...{laughs} (NU001)

The tension in this discussion related to the impact that other HCPs can come and perform their role but leave the nurse at the bedside with problems to resolve. This is likely to echo other strains between the members of the multi-disciplinary team that have not been specifically highlighted in these interviews and also represent other facets of the cultural challenges that exist within the critical care department.

On a personal level it was also detailed that when it came to the more complex clinical interactions there was a process by which individuals tended to seek advice.

if [it] was compromising other, other systems… I would seek their [doctors] advice… (NU002)

I think I would seek band 6's acknowledgement in that that they were in agreeance and when the consultant was next around at least say 'look it compromised the blood pressure' we've either reduced it or turned it off. If it was compromising them, I would. (NU002)

This support seeking within this context enabled individuals to divest these more difficult decisions across a broader colleague pool to moderate any responsibilities if there were subsequent issues. It also ensured that the 'best' staff contributed to challenging decision making in order to maximise the chance of the best outcomes.

4.5.1.3 *'I'd be a bit nervous, that I did it wrong'* - Consequences

The consequences sub theme is centred around the aspect that both CRRT treatment and interventions can have a considerable influence on patients and the wider organisation. Interviewees took the time in the discussion to acknowledge the significance of these consequences.

Firstly, NU001 considered financial impact alongside the vulnerability of patients who often require CRRT.

> *I know it's all on screen instructions but it's important to get it right it's an expensive piece of kit, you're attaching it to [a]very sick patient, (NU001)*

> *I think I'd have a go, but I'd be wanting somebody else, that had done it, to be there with me. And if it was that busy on the unit and I had to set one up in a hurry I would be a bit.... I'd be a bit nervous, that I did it wrong and I wasted this set or something.... (NU003)*

The volume and content of discussions indicated that the financial component was not a widespread primary concern. Participants were more focussed on the patient related consequences.

In line with phases of use topic (section 4.5.4.1), NU001 identified that during the set-up phase when the CRRT equipment was not attached to the patient, any consequences were of lesser significance. However, once it was on a patient, this is where any consequence of decision-making could have significant clinical impact.

> *…I think it's all got consequences, the thing is usually if you're taking a patient off the filter that means there in a better position, they're in more of a stable position, so I think there's maybe a slight bit of maybe subconscious comfort that comes from [this] because people have completed, without wanting to sound horrible, people have either completed treatment and are recovering so there in a much better position from their health or the treatment's futile and there's not really a lot more damage that can be done in term of long effect all you've got to do is make sure that you get them off it safely. (NU001)*

A large proportion of the consequences were focussed on the impact to the patients and expressed in potential scenarios or alluded to hypothetical 'what if' situations.

> *because I do think people who require that sort of therapy, are quite possibly at risk of other things going wrong as well... [talking about the advantages of Citrate] I like the fact they've got other massive lines in, or they've had surgery I'm not as worried about immediate massive blood loss every time you have to do something [with the patient] {laughs} (NU001)*

you have to prioritise which is the most important thing, do you know, is the filter going to, you would have to think right what are the chances of it packing up, because it might be that we've have problems with it all day, I think, the filter's going to pack up shortly so then you might think 'oh in that case should we get off as much as we can'. (NU008)

…two of the biggest things are with the patients that are really that sick, so usually it's their coagulopathy, leaking lines and the other way where you get clots and things like that, so there's two different things with the efficiency of the filter and the condition of the patient. And then the big one that I've found with the citrate therapy especially more than the heparin-based therapy is your hypotension and how that affects how empty they are really, and the drag on the catheter from the filter, that effects the efficiency as well and flow (NU009)

… I don't like, still, if I set a filter up actually putting it on the person and pressing go when I'm on my own. I feel like it's just such a major thing to be attaching to a human body and then pressing go. And it's like, I like moral support there, somebody there. When I do it, so that's why I don't like, I wouldn't like to be in the cubicle when I first press go (NU015)

These scenarios were generated based on first hand experiences and represented the fears of participants and situations they were keen to avoid. Acknowledging these consequences supported the reflection of the participants and further reiterated the challenges associated with delivering CRRT. Interviewees also discussed other non-patient specific consequences related to CRRT.

but the consequences of what that [CRRT delivery] means? I think from a new starter perspective what it is, is another machine, it's another machine to learn how to use, from their understanding as to what that means for the patient. The theoretical training that they have should cover that to an extent, but I do think from a mindset it's another thing to get your head round… Yeah. I do think initially that it's generally how most new starters think. Yeah, the theoretical understanding of what it does comes later when, when they've then had the chance to be comfortable with, with their role of it, (NU018)

NU004 was able to identify however that there were circumstances which were not patient specific which had the potential to impact patient care.

…I'll say I need some help because it's like the filter machine, it's difficult to set that up, if you need to set one up and then you've got a really poorly patient. Because I did try that, and it doesn't really work because I took my eye off it, I had a flood. You need somebody there to set it up, who's not, so you're free to look after your patient. (NU004)

This perception displays the concept that many patients in need of CRRT are extremely sick and time taken away from direct bedside care, to set up CRRT could have the potential to impact on the patient.

Despite the acknowledgement of the consequences involved in CRRT, participants did present insights where they felt there was a distinct lack of understanding of the consequences.

> *I actually don't think they fully understand what the potential complications are. If you're not understanding what it is that you are using. So, they're real keen to have this big machine and look after somebody who's on the filter, but they don't understand… I think the SOPs are brilliant for the set up as a machine. So, the SOPs are brilliant for when you've not set one up for a while, and the actual physical setup of it. I think the doctors rely far too much on the fact that they've got a written prescription there for them because I don't think again, they fully understand what it means, and they don't have to do this because it's already there…(NU012)*.

Equivalent non CRRT examples of this lack of understanding of clinical consequences were also presented, these reinforce the importance to understanding the potential consequences of CRRT.

> *{elective site}, it tends to be they do quite a lot of oesphagectomies and stuff like, that they do not understand why a surgeon who was just done an oesphagectomy on a patient might not want an NIV… They don't think about how that affects other parts of the body. (NU012)*

> *I think I think some people can be a little bit overconfident or they don't really understand the importance, especially inotropes you know you've got someone on quad strength norad[renaline] and you haven't got another one setup yet and it's alarming 9 minutes to go and they haven't got a bit of a rush on, you think.... are you understanding what you're on that for, you know. It, some people can but that's just I don't know that's human nature isn't it that some people will be overconfident nothing ever arose from it nothing happened it was dealt with and that was that, but... (NU006)*

The lack of understanding regarding these consequences raised the potential for serious safety concerns. Perhaps this blasé approach highlighted that the ability to provide CRRT represented a professional status cachet and that many staff were keen to obtain this, as sign of their developing critical care competency.

4.5.1.4 *'It depends on Complexity'*- Patient Complexity

A significant element to practice was the bearing that complexity had on individuals. The interviewees described the added challenges they had managing CRRT, when circumstances were complex. Identifying that these were often the sicker high acuity patients, requiring both significant mental and physical effort to ensure both the maintenance of CRRT and optimal care for the patient.

> *…it is more difficult when you have more stuff going on, when you've got less time to think and process the information as well, but you've also got a lot more interactions to think about you know, between body systems, so yeah it*

makes it a lot harder and I think, I think I just ask a lot more questions of the consultants if there was more going on. (NU001)

…nurses who have been here for a year and they've got more basic things to be learning … they need to know the basics before they start trying to take on more complex things and it's not just about, they wouldn't manage that complex thing, it's… you don't want them to go away from the basics, do you know… (NU008)

in the sicker patients definitely, they are always going to end up {in a} more positive balance and deal with it later… it's not just one thing is it, it's the patient not [the equipment] definitely it does [add stress and a burden] (NU009)

so, they come in and think that they're not ready or good enough to look after these patients that are more complex and need that, you know more intensive care. But then there's those that unfortunately feel like they're ready to have the sickest patient in a unit when they're nowhere near ready. (NU012)

These insights come from a broad range of participants all highlighting the need for a specific skill set to maintain the safety of the sicker patients requiring CRRT, portraying a consensus that supports the need for experienced staff to care for higher acuity patients receiving CRRT. Conversations were not about patient complexity being insurmountable, but rather that there was a requirement for additional insights and experience in order ensure both safety and effectiveness.

4.5.2 Physical Elements

4.5.2.1 *'You're always going to have to do a physical assessment'* - Assessment and Reviewing

The assessment sub theme was derived from interview content where participants talked about the need to effectively assess patients receiving CRRT and the challenges associated with doing this.

The discussion depicts a picture of ongoing assessment, this appears consistent with the nature of critical care units.

Yeah, you know you put them on it, and they might be alright but then you might have to maybe increase their inotropes, you wouldn't then wait for the next hour, you just, you [are] constantly assessing everything (NU003)

You're always going to have to do a physical assessment. So, if the machine starts beeping blah, blah, blah, pressure alarms. Whatever the first thing I would look at it and look at my patient, is it the lines? is it Lumens? is the patient position? where are they sat is it in the femoral? Is it in the jugular? What, you know is their head resting in that way. So, from that point of view, you'd be looking at your pain patient assessment, but from the physical running of the machine as an artificial kidney. So, to speak. do I do an assessment of the actual kidneys no [I] probably wouldn't (NU012)

But that's not true [physical assessments are not required] is it (Laughs}, Yeah you can see whether they're deteriorating the patients it always good to see a patient look at them see the oedematous or even things like weight and things like that are big indicator isn't it, if you're successful in fluid management of your patient, so it's a case of looking at everything and not just one thing (NU009)

you can't look at a patient and think oh yeah, their blood flows on 100 you've got to take your numbers into account you've got to see what it's running at and is that fast enough are we taking enough off, yeah it is it's more the technical basis of it (NU006)

This ongoing assessment was deemed key to the management of CRRT, with concerns that the lack of continuous assessment would result in inefficiencies or cause problems that would arise later in the shift.

NU009 as a Band 6 nurse, highlighted a process by which she assesses her shifts.

…each shift I come on I usually go round and eyeball all the patients... I always make a point of doing that, because I like to see, because it might even change coming from handover to coming back onto the unit, so I always like to go round [and] eyeball the patients have a quick look at the charts and see what's occurring at that point… Most [of] us who co-ordinate a shift …usually do that we'd go around, and first thing have a look at all the patients and then take it from there really, so it would be a shift-by-shift assessment of how patients are. So when I go around at the beginning of a shift when I go see the patient, I have a quick look at their obs chart and look from their have a look at the patient see what their like, see what's actually occurring on the screen at the time which you can gauge a lot of information from and you can see the patients change later on in the shift, so it's having that comparison at the beginning of the shift to having that comparison if you have a problem at some point during that shift. (NU009)

This Band 6 insight acknowledges a process at the beginning of a shift whereby familiarisation of patients condition occurred. Enabling them to prepare and predict patient related scenarios over the course of a shift. Another aspect of assessment was that done by the medical staff, on which a number of participants discussed.

I usually say to the doctors in the morning on the ward round… do you want any fluids taking [off], if they're not taking any off, then I'll say do you want us to take any off and then they'll say some will say no or yeah. And they'll usually just say see what you can take off really that's what they you know so. I start about 50 {ml} and then work up (NU004)

I think they'll listen to what we've got to say but then obviously if I was talking something absolutely outrageous, they're not going to just go with it are they. (NU006)

…I think [ongoing assessment] it's hit and miss. I think it's certainly from a nurses point of view. I don't think they do it, probably not. I think they'll just go on

the numbers from Filter. And I think from a medical point of view, I think it's hit and miss on experience. I think some will come in and say actually we're now at a point where the kidneys should be working… (NU012)

The commentary from these interviewees reflects the continuing perspective that medical input on CRRT was variable and that physical assessment, was viewed as the purview of medical staff, and that it occurred infrequently.

The reviewing and the place of biochemical results also appeared to play an important part in the assessment of the patient. Participants demonstrated a clear focus and reliance on the results, and these were often pivotal in decision making. These appeared to provide reassurance for staff and reaffirm treatment plans.

yeah [I look at blood results, to see], is there anything shifting (NU006)

the first thing you'd look at, it depends what you're actually having to change doesn't it because different people are on the filter for different reasons. Some are on for acidosis let's say some are on for just fluid control you know fluid balance and things like that, so I suppose it depends what actually they are on the filter for. If they're on it for the acidosis and things, then I suppose you would look at I suppose you'd always be looking at gases first (NU008)

if we didn't do the blood test, we wouldn't know what the urea and creatinine or anything was would we, and the pH and everything but when…. you look at our obs charts you can see everything getting better. It does make me feel better and it makes me feel more confident that the filters actually yeah doing what it's meant to be doing rather than just running and doing…(NU015)

The evidence within this theme demonstrates both pragmatism and acknowledgements from the nursing staff that a patients' condition changes frequently and as a result there is a burden throughout to assess and review patients' status. This acceptance allows for the timely escalation of issues and supports the autonomy of the practitioners discussed previously.

4.5.2.2 The Rubik's Cube - Location

The location where CRRT occurred played a significant role in its delivery and its associated behaviours. Discussions fell into categories relating to the physical space and differences between the two hospital sites the staff worked at. With participants then also talking about specific bedspaces and why these posed challenges for the delivery of CRRT.

so, when I was a band 5, I had to go to {elective site} and this was when we had the Prismaflex and this patient's been struggling with his blood pressure all night, but they were still taking 300mls off on the filter and they didn't even think to change it. And I just thought, I find it really hard at that point as I wasn't the nurse in charge or and I didn't work there I was just saying just stop your fluid removal… I think all the bed spaces are pretty small, very tight and you are

restricted to wherever you are. There are certain bed spaces that are more restrictive like bed space six on ICU one or less sockets on ICU 2, so you got to know where's the best places to put your patients. Bed 12 on ICU 2 is terrible! (NU009)

I think the difference here {ICU1 Elective site} is you can see everyone from anywhere on the unit everything is visible, whereas over there {acute site} if you've got to a junior member of staff stuck in a room with a filter, that are not too confident in what they're doing, I might not do that. Again, it would depend on the member of staff and how out of the way the room was, you can see and particularly with these you can see the alarms through the windows all the way round. (NU018)

It depends which unit you're on if you're on ICU 2 that can be a bit of a nightmare there's leads and wires everywhere it's not set up the same as the other unit with the pendants and things. (NU003)

I think we do alright with it, I mean, physically it's a compact system and stuff so you can get it to any patient that needs it. I never really found anywhere where it's like 'that patient needs to go on a filter so now I've got to Rubik's cube 7 different patients around'. You know, so mechanically the system you can get in to… I've always seen that, that therapy got to the patient that needs it and its done its job and so if it's done its job, it's been delivered effectively… (NU001)

Participants recognised that small environmental elements had an impact on CRRT delivery and were left frustrated by how these made their lives more difficult. Whilst a greater amount of space was preferred, the setup of the space was more important with easy access to power sockets, space directly around the CRRT equipment, and a lack of obstacles preferred. Whilst these environmental features were different across sites, it was noted that there were differences between sites on the approaches and the manner in which CRRT was performed, indicating a lack of harmonisation between the critical care areas.

Although these physical barriers were identified, distances between areas of the units were not seen as problematic. As NU002 felt that they would seek advice from someone further away than in an adjacent bedspace. Reiterating that proximity was not the most important aspect of advice seeking.

Another environmental specific element discussed at length was the impact that cubicles had on CRRT delivery. With the implication that they played a significant role throughout the whole CRRT process.

… I think with everything though, sometimes in a cubicle you can be quite isolated especially if the rest of the unit is really busy (NU001)

It's... I mean I as a nurse in charge know it is a lot more challenging and I'm, I'm aware that I... you don't always go and look at everybody in the cubicles all the time cos you've got so much going on and you think oh god and you have to physically oh I must remember to go and especially if it is a filter... so a lot of people unfortunately on filters are in cubicles so you feel like you're not allocating people who need to learn as much in those ones because they are out on limb and even if there is somebody nearby it is you're still a bit more isolated, so it tends to be when it's a cubicle somebody who you know has all the key experiences and things that you put in there. (NU008)

I think all the cubicles have a bit more space, so the logistics of looking after the patient on a filter it's easier, but you wouldn't put a junior member of staff in a cubicle with a filter, without some sort of buddy system going on or checking up on them regularly because that would be unacceptable. (NU009)

in a cubicle… it's a bit of out of sight out of mind. (NU012)

But I think people do tend to sort of forget about you when you are in a cubicle… they don't come to you, you would have to go to them, I think. (NU003)

I don't like, I don't like, still, if I set a filter up actually putting it on the person and pressing go when I'm on my own… so that's why I don't like I wouldn't like to be in the cubicle when I first press go (NU015)

The cubicles seemed to thwart social interaction between staff members and implication was that this contact would normally afforded them support and engagement with colleagues during shifts. Ultimately, it appeared that participant balanced the reduced social interaction with the feeling of greater space and control over the equipment whilst in a patient cubicle.

There was specific discussion about the provision of Support in the context of location.

I always try to buddy people up so there would be somebody more senior and a more junior in close proximity, so they have that support system… (NU009)

but I'd go out and I'd get somebody. If I was, if I was struggling and something, I'd go out. And even if I knew there was someone next door, a superuser I'd ring the other unit… I'd ask for some support (NU003)

in the ideal situation it would be better if they were supernumerary to look after a filter but that don't work so it usually, you're in adjacent beds really to look after them (NU004)

I mean that [working in an adjacent bedspace] if ideally, it's better I suppose because you've got the 1:1 but if you are adjacent to someone whose got the experience then I think that would work as well (NU006)

It is clear from these data that whilst proximity plays an important part in support mechanisms it is likely not the sole determinant when seeking advice.

This evidence from a majority of the participants indicates that care location played a role in the CRRT process, and this opinion was largely unanimous, both across hospital sites, specific critical care units and patient bedspaces. There was also an acceptance, in the tone of conversations from participants, that there was very little control over the environmental aspects of providing CRRT, in view of the age and facilities of the critical care units and they merely persisted to delivery CRRT as best as possible, wherever it was needed.

4.5.3 Machine Elements

The theme of machine elements refers directly to practice related elements associated with the CRRT equipment. These specifically focussed on comparisons with CRRT associated behaviours to that of other medical devices along with comparisons between different forms of CRRT delivery.

4.5.3.1 *'I prefer the ventilators'* - Other Equipment Comparisons

It was common for participants to make direct comparisons between other equipment to aid treatments in critical care, enabling them to contextualise and relate to (mostly) more commonplace interventions.

> *not all patients… use the haemofilter or need that intervention of renal replacement, but most of our patients would need some basic support with oxygenation or inotropes or things like that, so it's getting that grounding and that thing in, your basic stuff first, before then you go onto more supportive therapies. (NU009)*

> *Yeah, like say it comes in that sort of later set of skills. like a balloon pump or a Swan [Ganz catheter], it's not, it's something that is not used as often as the ventilators and your inotropes and things, so it's not your basic ICU skill. So, it comes in that sort of subset of extra skills. Which is something that we develop a bit later with the staff than everything else. (NU018)*

The reference to most uncommon interventions like pulmonary artery catheters or intra-aortic balloon pumps was noteworthy, due to the commonality of CRRT throughout critical care. The association here was largely related to complexity of the treatment rather than the frequency of occurrence. As a result, further focus on the elements of confidence and competency were also compared between types of treatments. In particular NU012 alluded to aspects where there was a feeling that competency to look after CRRT was gauged by the ability to look after other patients.

> *depends on sites again and what specialities they've got. So yeah, I think if you're in you're in neuro ICU or neuro trauma, when you get your first trauma patient. It's like ooh I've got a trauma patient now and I must have hit that level where they thought I'm good enough to have a trauma patient…, and I do think that the same as the filter that they think the same way. (NU012)*

I mean that's the ideal, what would tend to happen if, if you've got pretty poor skill mix on a shift Then it's the 6, the 6 will be the support mechanism for the new member of staff that is using a machine that they're not particularly familiar with regardless of what that is. (NU018)

Ventilators were the most compared to treatment modality, throughout the study, presumably due to their high usage and relatability in critical care areas. This allowed for participants to easily illustrate their comparisons against a more common intervention.

I'd feel more comfortable, well I do feel yeah, I prefer the ventilators. (NU015)

I see what you mean, is it, is she someone maybe that I would go to about everything or just... yeah [I would go to her because she resolved some issues with a ventilator] (NU006)

[the equivalent to chest auscultation when patients are on ventilators doesn't happen on the filter], no that would be more if it was just bleeping, is the vascath touching the vessel or you know anything like that. But yeah, the actual, I suppose all the info that you need is on that screen. To go with this and if it's not running fast enough then you're not going to shift your pH or it's not it's going to take a lot longer isn't it, can we crank it up a bit, to go with the numbers of the patient what's happening at that time I suppose (NU006)

if the ventilators play up, which sometimes they do, it's easy to see straight away because you can see on the monitor. You can see on the ventilator, and you can see on the monitor that they're not breathing properly… and then you've got like a backup you can just whip it off (NU015)

This evidence suggests there is less of a role for nurses when physically assessing the patient in respect to the filter, compared to other practices like mechanical ventilation. This corroborates the thoughts of participants as discussed in Assessment and Reviewing (section 4.5.2.1).

The utility of comparisons to other critical care treatments allows for the contextualisation of problems and concerns with CRRT against everyday practice and the application of learnings across a wide range of critical care interventions.

4.5.3.2 *'Having a filter is not really a problem anymore'* - Heparin and Citrate System comparisions

Another key comparator was between heparin and citrate systems. There was the overwhelming appearance that participants felt that despite some of the complexities associated with setting up and managing citrate CRRT, they caused very little trouble once they were up and running and its introduction had largely been beneficial. Resulting in part for individuals not having to plan their days around citrate therapy.

I think once they're up and running, and when there's no troubleshooting involved and they're [patients] not really septic, they are, the citrate ones are definitely more, are easier to look after than the Prismaflexes (NU003)

I think they are [more user-friendly] but that's [personal experience] ... they don't break down or go wrong.... not wrong, but not changing many sets and things (NU004)

I find this one [citrate] a bit easier and once it's on, then you're kind of up and running if you like. (NU006)

Yeah, I think this one [Citrate] is more, more robust, you can bash it about a bit more and it dun't...bother, whereas Prismaflex was a little bit twitc[hy].... you know you had to go near it, and it was alarming. (NU002)

Oh yeah, God yeah, [citrate has helped] a few years ago, they'd say turn the filter off, leave them for 24 hours, throw loads of bicarb at them so they don't get too acidotic and then run off to theatres {laughs} but now you can actually carry-on therapy and I think it's great and you don't have to interrupt it cos stop/starting therapy reduces their effectiveness. (NU001)

The concept of experience was again raised with participants detailing opinions on its bearing on their perceived differences between the two systems. With accumulation of CRRT experience paying dividends with the newer system.

you got more experience, yeah but I'd say once you get up and running with this one, I do prefer this one [Citrate], once you get used to it… it's just experience like with anything isn't it really, the more experience you have with it and exposure then obviously the better you get, quicker (NU006)

It's not a bother… having a filter is not really a problem anymore… historically you would need to allocate a reasonably experienced member of staff to deal with the Prismaflex (NU018)

… the actual mechanics of it [citrate] are easier to grasp now than it was when I was learning it for the first time, that previous experience was valuable. (NU001)

The conversion to citrate has resolved a lot of the decision-making problems about anti-coagulation that once existed with heparin systems.

I think the subject [clotting] comes up less, it just doesn't come up now, with the citrate stuff people tend to be quite happy that its either working or... I mean mechanically it's either switched on or switched off. You don't tend to get a lot of... problem with it clotting and things like that. You've substituted the clotting problem with citrate accumulation so... (NU001)

Also, whilst there was the improvement in usability demonstrated in the comments above, the safety processes for citrate were no different than that of heparin and no different than any other intervention like ventilation or drug infusion changes.

> *… if you titrate anything up or down you still have to have two people check what you've got up or down. Which your heparin you had to go up or down on your ratio with whatever your ratio was. (NU002)*

However, there was, in hindsight a recognition that individuals were more cautious with heparin systems.

> *I absolutely think we're more cautious with [heparin] … Just cos of the coagulation and... that I do actually believe we were more cautious with that. I think maybe blasé [isn't] quite a word to use... a bit more comfortable maybe [using citrate] (NU002)*

This concept is surprising given the teams relative inexperience with citrate and underlines the previous experiences with heparin if the indication is that citrate is perceived as less risky than those systems.

Despite the challenges NU003 felt confident and provided a more complete picture managing Prismaflexes and detailed how they were happy to instigate interventions to troubleshoot, but feels available knowledge was quickly exhausted with citrate. This may have been down to the relatively short time the system was in use locally.

> *…it would be like the troubleshooting side of it even with the Prismaflexes, even though I looked after them and I was really experienced with them, there were certain things when they just didn't work and they just alarmed all the time and you troubleshoot it, and you'd get a colleague to look at it, I'd go to a doctor if there was just no way of solving that problem...with the Prismaflexes ones, not the citrate ones (NU003)*

The recurrent failure of heparin-based systems allowed for more practice at setting up and troubleshooting, where there was more nurse led contributions required in the management of CRRT which helped build experience. Conversely with the reduction in these events with citrate, there was a risk that oversight was not sufficient, and problems or optimisation could not occur.

> *there could have been [variability] yeah, if you haven't got much experience on the Prismaflex… and where that you know to up your blood flow and your rate and all that lot to shift [solutes], to work harder basically, so then hopefully to make a change in the patient's gases… And if you didn't have a Band 6 that picked up on it and it's a night shift and the doctors haven't picked up on it on the Night Round and on the morning round. Then they had a full 12 hours of not*

optimising then that's not good is it… whereas this one [citrate] no [less variability] (NU006)

maybe we've become a bit more complacent because they don't seem to go wrong. But then I don't get a spare set out or anything. I just, all I get out is fluids and citrate and calcium bags. (NU015)

The unpredictable nature of heparin systems meant that individuals planned for failure eventualities, with the introduction of citrate, behaviours have changed due to their reliability.

So, in the heparin because it happened so often, the machine was always clotting off, or your APTT would be out, so you know you'd be changing things all the time. So, … if I was on heparin I'd be thinking right. Let's have a look at the TMP (Trans Membrane Pressure), how long have I got left on this filter, whereas I think with the citrate you expect it to be alright, because mostly it is and when it goes wrong, you're a bit like arghh! (NU012)

However, whilst the feeling was generally the citrate systems were easier to manage, there was also the perception that the citrate system was not as efficient as the previous heparin one.

in the honest opinion with the Prismaflex you can turn them around and shift a massive metabolic acidosis to a normal pH within a shift. Because there's no filtration, I guess is the difference on these ones, it does take a lot longer, but it's just I don't think that the knowledge of you can filter harder is available to the more junior members of staff, so they wouldn't particularly recognize that we're not clearing very quickly, there is an option to do it better, because we start with standard settings (NU018)

It is evident from these discussions that the equipment plays an important role in the delivery of CRRT, with staff providing clear preferences and details of what they require. An integrated approach with the CRRT equipment was seen as necessary. Moreover, as there is a worldwide movement towards citrate CRRT due to evidence and perceptions of the benefits associated with citrate-based systems, this integration will be vital to ensure the removal of the significant burdens detailed throughout this section by the nursing staff.

4.5.4 Conceptual Elements

4.5.4.1 Phase of Usage

The concept of 'Phases of Usage' refers to the acknowledgement of interviewees, throughout the discussions, that there are a number of different phases which occur when managing CRRT that engage and elicit different mindsets and approaches from the individuals involved. These are, a pre-patient connection phase, an ongoing management phase and a disconnection phase.

> *First time I took a patient off it, it just seemed to make sense what was going where and what was doing. Whereas you're setting that up there, and now that I'm getting it onto a patient, I think those are three distinct phases and I think if you don't understand all three then, all three are equally [important], you've got to be retrained in all of them*. (NU001)

The impact of these phases on the day-to-day working was highlighted by NU008, who felt that the setting up phase happened less frequently due to the nature and duration of the treatment and as a result for staff extended periods of time might pass between having to set up and connect CRRT, as a consequence they felt more support was needed for this phase, however the utility of the SOPs was valuable in this.

> *usually when they are setting it up, say they haven't set it up for a long time, because it might be absolutely months and months before you've done it. And they may think 'oh I've forgotten, right I'll just get the SOP out' and they'll be working along with [the] SOP, but then might actually come and get somebody else and say come and have a look and see what you think. So, it's both, some people do it just on their own and it's just as an aide memoir, some people are actually using it as a proper 'I have to follow this step by step'. (NU008)*

This was also raised by NU015, where they observed that they were often asked to look after patients during the ongoing management phase of CRRT without significant training opportunities. Whilst at the same time noting that the combination of obtaining the complete skills and knowledge to manage a CRRT system took time.

> *in hindsight, like now, we seem to get more training. So… initially when I first came here, I don't think before I actually got a patient with a filter, I don't think I'd had any official training with the patient, and it was just learnt on the job kind of, on my own and muddle my way through it. So, like I think as long as you've had some training because I mean, we can come on and they're already set up on the filter. There's so many bits to it to get your head around. I think it takes quite a long time to learn how to use it properly. (NU015)*

None of these phases were seen as less important than another, all were viewed as having potential impacts to the patient.

> *I think it's [phases] all got consequences. (NU001)*

However, there were feelings of pressure and time constraints when the patient was connected to the CRRT circuit.

> *Sometimes I feel a bit pressured when it's actually going and things start to go wrong, but it's not as if you can sit there for hours messing around with it. (NU015)*

if it started alarming and I didn't know what it was and I was at work and the patient was attached to it, my initial response would be like does anybody know what that is? Maybe that's wrong, but that's what I'd do and then I'll get the instructions out as well. But I would always, I would ask. If they weren't attached to it I probably wouldn't, but if I feel like you're under pressure then [when it's running on a patient] (NU015)

However, there was an observation that the context of the disconnection phase was important. In so much as for improving patients, rather than the time the decision to stop CRRT being based on a clinical reason, it was associated with the natural lifespan of the CRRT circuit.

the thing is, usually if you're taking a patient off the filter that means there in a better position, they're in more of a stable position, so I think there's maybe a slight bit of maybe subconscious comfort that comes from because… people have either completed treatment and are recovering, so there in a much better position from their health or the treatments futile. (NU001)

yeah, probably yeah, they would wait for the life of the filter and then [stop], unless it's been a quick turnaround (NU009)

The predictability of the impact on the patient during these phases also differed.

Putting someone on, you don't know how they are going to react, taking someone off is a bit more predictable they are either better or they are not getting better… So, they are either going to stand it better or they're not going to stand it.... when you're starting them up there's a lot more things that can go wrong, because it's something new you've introduced. (NU001)

This identification and delineation of the different phases of use is novel and will allow for a future focus, bespoke learning, and training applications, such as prioritising training that addresses ongoing management, as patients spend the longest time in this phase.

4.5.4.2 *'It should be the same regardless'* -Time

The role of time and timing was also a significant consideration in CRRT behaviours and practice. Specifically, discussion revolved around unsocial working hours i.e., night shifts, weekends, and public holidays.

There were some generic references to how time or timing was perceived to be important CRRT delivery and the implications it had on practice.

so, when I go around at the beginning of a shift when I go see the patient, I have a quick look at their obs chart and from there have a look at the patient, see what they're like, see what's actually occurring on the screen at the time, which you can gauge a lot of information from, and you can see the patients change, later on in the shift. So, it's having that comparison at the beginning of the shift to

having that comparison if you have a problem at some point during that shift (NU009)

I think probably on a night it would be, I get quite tired, so I think it will be more difficult to make decisions rather than during the day, weekends don't bother me cuz I'm used to work[ing those] (NU004)

at the start of the shift and the fluid balance has been done, you know you've got your 12 hours and you… can work out how much fluid you need to take off. So, you'll be increasing it to achieve that target and if you get to say 6 o'clock in the morning and you know they're coming on the round at 9 and your still you would adjust the figures I think to try and meet the balance (NU003)

Alongside these generic comments there were also significant references to changes in support in relation to aspects of time.

If anything, on a night shift, you would get better support. Because there is a little bit more time on a night shift for a bit of teaching, same with weekends, without so many doctors kicking about and without so many demands on time with electives coming out from theatre, then there is that extra bit [of] time to support (NU018)

obviously, there's less input on a night... like doctor input so the consultants not there, the registrar won't always know… you know problems that may occur and troubleshooting and things like that so, so you've got less of that [support] on nights. Not so much on a weekend day but weekend nights as well… [weekend nights and weekday nights] yeah, they're both the same (NU009)

well, it's [support] not readily available is it and then you kind of hoping on a night shift that the doctors have got a Handover about absolutely every little thing because we asked them and sometimes, they don't know… but then sometimes on a night shift sometimes we're left to our own devices. Yeah well, we are because the doctors sometimes we've got anybody senior on and they end up in A&E a lot, so we can go for hours and hours without a doctor on the unit you know or seeing anybody (NU015)

These concerns depict two perspectives from participants, some identifying that the quality of support would be better due to the reduced workload, others suggesting that the lack of staff means that there is a lack of support. This in itself pinpoints that the same support was not consistently available, reaffirmed the belief that variability existed and that there were potential impacts on patient care. However, some participants also stated that in many instances there were largely no differences between the impacts of the times of day or dates. This was caveated by the fact that staff are used to working shift patterns that cover 24 hours across 7 days.

most people do nights, days, weekends, do all of those sort of things, so technically it should be the same regardless, but there are people who just work

nights or tend to just work nights and people who just tend [to] work weekends or whatever. I'd like to think that they would get the support regardless of what the shift was, whatever time of day if I'm nights, day, weekends to me I'm not going to give them any less or any more support on any of those shifts. (NU008)

I feel comfortable to make changes but whether that's at the end of the shift or the beginning of a shift, I feel like, I like to think I would do the same thing. (NU002)

I don't think it really makes a difference as far as day shift night shift, but I've always been a shift worker. So, I always been day shift night shift weekend bank holidays (NU001)

Overall, there were evidently wide differences in the opinion of the role the time of day played on CRRT activities, these could have been due to support related or intervention issues. It was felt the time elements influenced individuals on a very personal level and these standpoints were highly shaped by previous experiences and may be transient depending on the clinical situation.

There were also observations from participants related to the impact of time/timings with specific context to patients.

because you're busy, busier in those few days because there can be a lot going on you know there might be a nitric, they might be on this they might be on that, do you know what I mean, there might be a lot of machines around. Whereas seven days down the line well you would hope they would be getting better not so much going on (NU004)

you could be full and it's alright day or you can be full and hectic and there's no time and you just got to kind of plod on which will take longer to set up (NU006)

Importantly these alluded to a wider sense of prioritisation of care and the wider influence of the workload pressures associated with the critical care environment. This then fed into an associated concept of speed, and the importance of delivering care in a timely manner. Familiarity resulted in faster practice, but the participants implied that speed is secondary to getting it right first time. With repetition, fostering learning and the ability to perform interventions all sped up performance.

[looking after CRRT regularly] … absolutely it helps if it, if you hadn't had one for a while, you're kind of back to square one you wouldn't be as quick, if you're doing them day in day out then you, you'd be able to do it with your eyes closed wouldn't you. But if you don't have one that needs setting [up], cos they do run for three days don't they, and 9 times out of 10… they're kind of up and running (NU006)

… it certainly helps me, it's not that if I go a long time between doing it that I can't do it, it's just that if I go a long time between doing something I find that I need to make sure that I've done it right and that's a process that takes me a little bit longer. Cos, if I've not done something in a while then I tend to take a slower approach to it because I want to make sure that I thought about it because... but if you're doing something every day you do tend to be a lot quicker at it and like I say that's me personally. (NU001)

It was felt the importance of speed depends on the context of the intervention, life or limb saving actions versus less urgent changes or recording of therapy, but there was an acknowledgement that in many cases speed is of the essence.

[The promptness of dealing with issues is] Really important cos if you know if it going to clot off you need to know your plan and are we carrying on, are we leaving it? Cos, if they clot in the middle of the night and things… and your doctor's down in A and E you'd speak to your nurse in charge and… they might say on the ward round you know if the filter clots leave it, and we'll see what happens. (NU003)

Yeah, I would say they are [aware of time critical nature of delivering CRRT], the decision is made to set a filter up, then it's done, it is done immediately because that's the treatment that's been asked for and what should be happening. There will still be members of staff that will um and arr about it because they're not confident at setting them up, and it is those members of staff that I make set them up with a bit of assistance., I would say that the urgency of it, is known. However, it does depend on the patient. (NU018)

The role of time was very much based on personal perspectives and interpretations and whilst it was difficult to control, the presence of support on night shifts or the condition of a patient all contributed to the actions of staff irrespective of the clinical context.

4.5.4.3 *'If you're not running it at maximum speed then it would affect your patient'* - Efficiency

The concept of efficiency in CRRT was introduced by participants throughout the interviews and they talked through the importance and processes of ensuring CRRT was being delivered in an efficacious manner and the challenges determining this.

absolutely, yeah and obviously, if you're not running it at maximum speed then it would affect your patient… I find this one a bit easier and once it's on, then you're kind of up and running if you like. (NU006)

… you get the doctor's, they'll say we'll change this, so that we can filter them harder…(NU004)

I think it would give a lot of people piece of mind but it's like putting a happy face or a sad face on the screen isn't it. It's like 'your filter is happy' or your filter [has a] sad face. I think that would just make other people feel better but the people who need to know whether it's working or not need to know cos they've

got the knowledge base to look at your patients responding. It might be nicer for the family you know. (NU001)

This recognition indicates that participants were keen to ensure that the treatment was delivered as prescribed and to ensure that CRRT had an impact on the patients, whilst highlighting the challenges of assessing maximum efficiency. It was also observed by some participants that maximising CRRT was often difficult and multifactorial.

and maximise treatment, so you would have to go and see them [staff] anyway just to encourage them to maximise treatment. (NU008)

I was 'arrgghhh' that's one thing I didn't check on the machine that the settings was set as they should be, and I suppose looking back I should have, it was obviously affecting the way the efficiency of the filter, and the patient was ok (NU009)

I think like when we do with the bloods, that to me, that's the only thing that makes me feel like it's working. And even when I've use the filter before and you've had to always keep adjusting the doses, in my mind, I start to doubt whether it's, if it's actually working properly. So, if we do a gas and nothing needs adjusting, not that it's any effort to adjust it because it isn't, is it, but it makes me feel better that it's all running smoothly. So, it makes me feel more comfortable when everything is within its little limits, and nothing needs adjusting (NU015)

These opinions demonstrate that staff are looking for simple sources of feedback to enable them to determine that the CRRT is running effectively. The requirement to interpret data sources to understand and act accordingly was highlighted in these comments as something that can be done better.

4.6 Support

The Support theme was a highly discussed topic and every participant engaged in some discussion about the impact of support in the delivery of CRRT. The theme encompasses both the provision of support by individuals and the features associated with the receipt of support. It also addresses the elements of collaboration, conflict, and processes of escalating issues within the teams which were raised. Both the provision and receipt of support consisted of the components: training and support, with the Provision of support sub theme also examining the role of guidance.

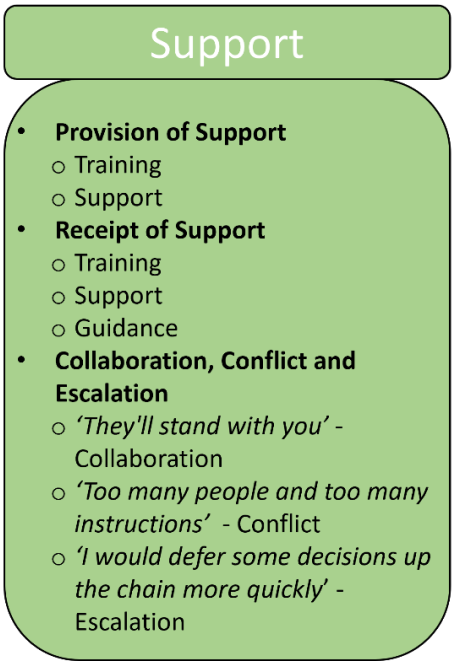

Figure 12 Support Theme and Sub themes

4.6.1 Provision of Support

There was input from all participants about the provision of support, however a majority of the insights were largely obtained from the Band 6 nurses interviewed (NU008, NU009, NU018).

4.6.1.1 Training

A major element of the provision of support was the experience, availability, and access of training for CRRT.

> *As a team leader… making sure people have had the appropriate training was important because… there are people who used the other system you know, used to Prisma… so there was a lot of people being scared about using the new system… that would be excellent [pair people up]…. But unfortunately, we never have enough staff for that to happen… (NU008)*

> *It's always a balancing act [training staff up and providing bedside care] and because we've been quieter recently it's been nice to double people up, to give them that experience of working with a sicker patient with more support therapies like the renal replacement… But when its busier and you're allocating people to look after certain patients you would go probably for the more experienced staff because you don't have to monitor them so closely in working with the renal replacement systems that we have (NU009)*

> *Yeah, but then the thing is sometimes there's no filter is there, and other times there's quite a few and then when there's quite a few we're real busy but there weren't enough people [spare] to double up, to help someone that might want to learn... I know whenever there is like a lull like there is now, they often give two people one patient, they'll give a new starter somebody else so that other person can learn the filter, without having to look after the patient. But then you can go ages without looking after one. Months and months and months and months so if somebody wants to learn how to use one and they'll ask, they don't*

even have that chance because it didn't occur on their shift. I know that because that happens with a lot, not just the filter, with lots of things. Like people will ask I've never used a filter I want to look after a filter, however they've asked like six months previously, when the opportunity comes around it's all been forgotten because loads of people have asked since then (NU015)

…thankfully we're quite well staffed here aren't we, and we tend to have an opportunity whereby we can have a member of staff that is not experienced will be buddied up with someone so they can get the experience of just the hands on running of the machine... So, the teacher trainers seem to catch people earlier…. everyone is trained earlier rather than later because like I say just used to be an experience thing. You weren't trained on it at all like a lot of the stuff you weren't trained on it were you..... (NU018)

These components and experiences all linked to the ability to pair inexperienced members of staff up with a more experienced colleague. There was a clear acceptance that these opportunities were based on factors associated with staffing levels or the busyness of the unit, with opportunities needed to be taken when presented. In relation to obtaining exposure and practical experience participants identified a preference for hands on training in smaller groups.

… I concentrate more if it's just me… if I'm actually physically doing it…I prefer it if there's a smaller group here where we can feel more comfortable. I do feel more comfortable asking questions if there isn't too many people, if there's a group, I won't ask anything in front of the rep, I'll wait and I'll keep it in my brain for another day. [I] like physically doing it]. (NU015)

Likewise, a number of participants reiterated these comments, whilst they valued the theoretical content, they stated a preference for hands on learning.

I like to do things, I think if the formal [theoretical] bit first and then, but I do think you'll learn more doing it rather than watch[ing] people, but you need to get your hands on them. (NU004)

I think it's better now, but I do think sometimes, I think it's better that you get the theory first, but I don't think it always happens that way, but then sometimes people here are given a filter and they'll say that they've never looked after a filter before, sometimes they get somebody to work with if we've got enough staff. They do that recently, they'll put two people together so they can have experience of working with the filter. (NU0015)

…I've had a session where the rep came in and showed us what the machine was, how you interact with the machine and how you put the sets on, the things like that, which was fantastic (NU001)

This evidence all indicates an overwhelming support for the provision of hands-on training and experience with CRRT, whilst acknowledging a desire for theoretical training too. The in-situ opportunity for this emerged as the barrier to obtaining such training.

4.6.1.2 Support

As support providers the participants discussed the levels and depth of support and the circumstances encountered when trying to deliver this to learners and inexperienced CRRT users.

> *… I find myself to be the one that people are running to get when something's gone wrong with their filters… like I say I've had them a lot now, so usually I find that people are running to me to find out… but now I've found myself in situations, like I've been on like ICU1 and someone has come round from ICU 2 and said my filter is playing up I can't stop it alarming have you got a minute to come round and have a look (NU001)*

> *…. there are quite a few [staff] that are willing to say, 'if I set it up will you watch me do it' (NU002)*

> *there are other people that [help]. Somebody was setting one up the other night and there was a nurse and she.... she's not a superuser but she's set one up a lot and she was sort of helping this person to set it up and sort of giving her some advice (NU003)*

> *I thought it was really important that the people who'd been classed as superusers made sure... that they had the experience and the exposure because they're the ones people are going to fall back on, so to me that was a priority. (NU008)*

The support provided by colleagues took many forms, and from many individuals revealing a subculture within the unit that was able and willing to provide support for inexperienced staff, these interviewees would appear to positively represent this subculture. As demonstrated by NU002 who also explained that they felt really comfortable using CRRT to the point where she would be happy for people to ask her questions throughout the phases of use and specified examples where she had provided advice over the telephone.

Distinctively, this general attitude by all the participants indicated that they felt they were key support providers. However, some participants did identify challenges to one's own workload in delivering this role.

> *… sometimes when you know they're asking you questions, I've just said look we'll just wait and we'll just get this sorted out first because the patient is more... the patient is really important you've got to make sure that patient's safe and... they've been asking me questions about things and you just have to sort of*

delay it because the most important thing is that patient and when their having that septic shower you can't be then doing a little teaching session you've got to focus on [the] patient. (NU003)

So, there's some (Band 6's) that'll go I don't really care, they need to experience if it means that we just have to help them out a bit more then that's what we'll do. And some that I'll go, oh no It's too much hard work. (NU012)

The support providers made direct reference to the use of a buddy system in supporting colleagues and there was clear recognition of its value and reception.

I always try to buddy people up so there would be somebody more senior and a more junior in close proximity, so they have that support system… and I think that definitely started out at the beginning and now they've got that level of experience because they've used more filters, you would try and buddy them up more, so they'd be supported [by] somebody else who has got this experience but they're there, so you do try and do that (NU009)

I would ideally keep someone else who has the experience of it available? So whatever capacity, to whatever capacity you could do [as] It's just providing that support. (NU018)

There was an undercurrent from the participants that they felt their approachability was significant too, with them valuing the perception of being approachable by colleagues.

I would hope myself, that I'm quite approachable in that way, but it will depend on how busy the unit is, but I think most people are quite confident coming forward if they've got a problem or want more advice (NU009)

I would hope that they would come to me just because they thought I was approachable, regardless of what grade I was. (NU008)

As senior support providers the Band 6 nurses had particular perspectives on their role in supporting staff.

On shift yeah, so we check on staff, I check on staff regularly particularly the new ones to see if they are happy in what they are doing, so the filter would come under that, cos it's a safety issue and particularly if I've allocated someone that is just about ready to take the filter for the first time then… that would be my first port of call, to make sure that on the start of their shift they know what they're doing and they're happy with what they're doing and I would point them in the direction for support, either from me or from any other experienced members of Staff (NU018)

So, from my point of views as a Band 6 then…, do they have the skills to look after it because obviously I would need to oversee them more… you can't always just give it to the people who had loads of experience, people have to learn as well and I think hands on learning is going to be far more useful to a person developing their role. So that would be [a] real key issue as to the experience the

nurse has looking after it and how much I have to input…. if I know that I might be busy that day… I might not be able to give them the 100% support that they might need, so you have to look at the other skill mix on the floor…I mean as a nurse in charge know it is a lot more challenging and I'm aware that I... you don't always go and look at everybody in the cubicles all the time cos you've got so much going So, when that comes to allocating then you definitely start thinking more about you need somebody experienced in there, somebody who you know has all the key experiences and things that you put in there. (NU008)

The cumulation of these various aspects, like the desire to provide support in a time pressured role, the range of and fluidity of staff and patients all appear to pose difficulties for Band 6 nurses to adequately reconcile their own workload, whilst coordinating a busy critical care unit. The effect of this was that sufficient support was not always provided directly and sometimes delegated to others to support the more inexperienced team members.

There were observations that the amount of support provided differed dependent on the context and as a result there was a degree of gauging the support required between colleagues.

… there's no point in just doing it for them is there…They have to learn from it (NU008)

not really because… I'm still quite hands on rather than stepping back and letting just other people do it like a lot of people do when they're managing other people, they will take a big step back especially if they're not as confident with the machines and the renal replacement side of things… and let the experienced band 5 run with it. Whereas I'm still quite hands-on, I suppose because I'm new to the Band 6 role even though it's been 2 years (NU009)

no, you can't treat people the same, I know you have to have certain rules and standards and things, but you don't treat everybody the same, I wouldn't, … But at the end of the day my main things I have to make sure the shift is safe and that they're doing things that aren't going to harm the patient, if in the meantime you can teach them and give them lots of support and things that's brilliant you know (NU008)

This evidence suggests a pragmatic approach by critical care nurses with the provision of support. In doing so they undoubtedly consider the individual nurse they are supporting by establishing the level of support needed in a manner that provide safety and effective care for the patient but also learning opportunities for the nurses. Despite these challenges and returning to NU008's comments in Time 4.5.4.2, there was the feeling that staff would get the support they required irrespective of the shift type.

It was felt that this assessment of the support required allowed the senior nurses to prioritise and focus efforts where support is needed most.

Through the training and support described it is clear the Band 6 nurses are geared to offer and facilitate supportive processes to the junior members of staff wishing and requiring CRRT experience, the perceptions of this are detailed in 4.6.2 Receipt of Support.

4.6.2 Receipt of Support

The receipt of support theme focussed on the feelings and perspectives of individuals receiving support from their peers and colleagues. A significant portion of the discussing revolved around however participants sought or observed other seeking support and is contextualised again into Training, Support and specific to the receipt of support Guidance.

4.6.2.1 Training

The training aspects of CRRT highlighted the challenges in getting the opportunities to train. Initially with some irony from NU006 who raised the notion that formal training was always received, before using the equipment. This indicates that it is common for users of CRRT not to have had any formal training on CRRT prior to using it for the first time and the uncomfortable reality and discontent that this occurs, all whilst accepting it is a necessity.

> *If you've been actually trained on them for starters {laughs} you know because some people might be you get a filter, but you haven't had the correct training you don't know what you're looking for or your gases and things (NU006)*

In the process of these discussions the constituents of good training sessions and non-formal training occurrences were also raised.

> *But I do think it's really important… when the companies come round, especially when it's new pieces of equipment that if they come round and show you how to set it up. And they provide then that fall back… I found that recently really useful, that they were hanging around, that you could go and ask questions you know on a new piece of equipment rather than (asking) staff, cos staff weren't aware. [The] more you use it, the more you get to know about it, of the answers to the questions you needed… I got really great education on it, and I got it in team meetings…and that's how [I] learnt how to use it, cos it was just reinforced and reinforced (NU002)*

> *… I mean working in conjunction… so, sort of out of the numbers working with somebody, cos that's how it was always done, like, when it was ICU and HDU, it was always... (NU003)*

> *… the training with people actually on the shift, so the experienced nurse, can step back and let you kinda take the patient and then they can come to you, cos I think you learn better on the job really…I mean that [buddying up] if ideally, it's better I suppose because you've got the 1:1 but if you are adjacent to someone whose got the experience then I think that would work as well (NU006)*

Separately, NU006 also expressed a desire to get repetitive practice on real patients rather than in setup training scenarios.

> *I think to start off with it's really difficult isn't it, cos sometimes you might be having the training, the theory side of things [first], and if you haven't had a [practical] session with a teacher trainer, but then obviously you've got the opportunity from the staff point of view that you can go and shadow somebody for the day. I would think that was more beneficial then [sic] someone just coming in and setting it up because you can't really do that, can you, without it going on a live patient, so… I think you learn more on the job working with somebody* (NU006)

And ultimately NU001 described the outcomes of the receipt of good training.

> *What makes me feel more confident about using it, errm, I got quite good training session given the time (NU001)*

These formed a mixture of approaches like information being disseminated by someone seen as legitimate, in a supernumerary and hands on context with some degree of regularity. The application of these methods would potentially be viewed favourably.

4.6.2.2 Support

The receipt of, and access to support for colleagues was a highly considered topic by all participants. The content largely focussed on who was the best person to approach for support and the factors involved in making this decision.

> *Yeah, I think you do tend to eyeball somebody you would go to in general. It's like, right if it hits the fan I think I'll shout for them first but I think that's almost a subconscious thing, sometimes you're sort of walking down to get your allocation and you're like you look left and look right and you think I've got a bit of back up if something [goes wrong] or you look left and look right and think I'll get the nurse in charge if something goes wrong {laughs}. (NU001)*

> *all levels, so I think as a band 5… first, I'd look around and think right whom are my senior band fives, or I was a senior band 5 myself when I was using it, but I'd look around say right, whose got the most experience to… who I'd be confident would tell me the right thing to do. (NU012)*

> *if it started alarming and I didn't know what it was and I was at work and the patient was attached to it, my initial response would be like does anybody know what that is? … Maybe that's wrong, but that's what I'd do and then if and then I'll get the Instructions out as well. (NU015)*

> *I know that there is the teacher practitioners there. I know that there is the nurse in charge, there are the superusers, there are other people that have used it as well, you know [for support] ... I'd go for the nearest person first and then, and then if I knew who was a superuser next door as well but.... initially I'd go for the nearest person… it depends with who is on shift, you know when you are*

in the coffee room.... you can tell when people are coming in and sitting down you... you just know whether it's going to be a good shift or not (NU003)

Yeah, or even if it's not the reputation, how they found them in the past… There's a helpline there that you could ring if you needed to you know, actually we have rung helplines in the past especially at the beginning when [using new equipment]. Mind, at the beginning they [representatives] were available, they had a support team that actually worked with us for so long, didn't they, on shifts and were available if you needed any support when it very first started. But we have had to ring in the past for information but also, we have, when it's come to running out of fluids and things like that. (NU008)

I might go and have a chat and say this is what's happening. What do you think about, and I don't think I would ever go and ask somebody from the other side to come round… potentially I'd have a little look and see who was next door. (NU012)

I'd ask somebody that had been here a long time… And, as we've got some citrate link people, but chances of them being on are quite slim, [I] just ask people that had been here a long time. I know would have had a lot of experience with it (NU015)

This wide range of support appeared vital in providing consistent support, availability and covered everything from ad hoc questions to emergency scenarios. Taken as a whole these opinions felt representative of a supportive staff group culture. However, despite all the routes for support, NU004 felt that they were opportunities for them to be supported better. Although, they did not expand on specific details.

I think we could be better supported but it doesn't always go like that. Cos you come on duty and there can be like there's the band 6, you and then a lot of new staff, so you have to support them you know you'll end up supporting them (NU004)

More specifically there was direct reference to seeking support from a Band 6, in part due to their role and being seen as a proxy for experience, expertise, and ability with certain equipment.

if they're [Band 6] busy with something else, yeah it is, would be hands on experience [sought]. Some of them you know have got that... ability with certain equipment and you know to go to them. (NU002)

they're [Band 6's] usually great. There are a couple that I probably wouldn't go to it just depends… they [Band 6] do look after them cos they are clinical as well, I mean one of the band 6's the other day was clinical and I'm sure she had the filter so they do, they do look after it, but I know that there are a couple of them... that I probably would not go to. The old HDU nurses shall we say (laugh) (NU003)

sometimes you don't get the support that you probably need from the senior ones because they think that you are, they'll just leave you to it. I don't mind

I don't mind being left and I will ask if I get stuck and I need more help you know if I'm getting bogged down with things too busy. (NU004)

This evidence demonstrates that whilst there was an overwhelming focus on using the band 6 nurse as a support mechanism, there was an awareness of the challenges this brought both to the difficulty on occasions accessing them and an acknowledgement that they might not always be the best individual to gain support from.

This was stance was further supported by NU006 who felt there were also scenarios whereby those with significant critical care experience were overlooked for advice in place of more junior members of staff.

…. because some people have been here 20 odd years, haven't they, you know, but they might still come to me even if {CP} next to me … She's got miles more experience than I have but on the filter…. (NU006).

The general feeling was that there was a consensus that a support structure existed within the department, and no one was felt left without access to support, however it was apparent that individuals went through a variety of processes to determine who was the best person to provide them with support and often this individual was not the most obvious choice.

4.6.2.3 Guidance

The receipt of guidance was focussed on the use of clinical parameter setting and patient targets for the delivery of care, and also information gained from CRRT protocols and SOPs.

The use of parameters appeared widespread and integral to the delivery of CRRT. They were largely sought after and well received, as demonstrated by their reference throughout the interviews by a significant number of participants. Participants referenced both their utility in the delivery of treatment aims and the fact it allowed for scrutiny if treatment aims were not met.

Yeah, I do [find parameters useful], I like to establish at what point the clinicians think there's a problem, cos I can then compare that to what point I think there's a problem {Laughs}… you can get some days where you've been given no parameters whatsoever, so you do have to go back and say right I want targets for this, this, this, this and this and after that you can let me get on and I'll tell you if there is a problem…we're quite good at prompting clinicians to provide those [parameters] (NU001)

As long as you've got you parameters and you're working within your parameters and you're making the changes to keep within them parameters or achieve them parameters, I find that it goes smoother… (NU002)

they'll set a target of you know they want this balance, and they want this fluid removing but then we manage the, the sort of you know you'll achieve them figures or you'll try and achieve what they set. But then blood gases wise and things I think we are quite autonomous in that and we that's not like consultant led not in my experience. (NU003)

I always say to them do you want any fluid taking off and they'll say... yeah take some off, they don't actually tell you what, you know. Some will say we'll I want them in a negative balance or something and then you know what to do but some will just say yeah take and you just do it by your own judgement really. (NU004)

I'd ask the consultant… because they seem the ones in the morning well, they're the ones that know exactly what they want doing with the filter (NU015)

This clear direction enabled critical care staff to work towards a mutual treatment aim sand resulted in feedback both from colleagues and a personal response to their execution of practice allowing for reflection and subsequent personal development.

4.6.3 Collaboration, Conflict and Escalation

The content of the Support theme was further underwritten by the conversations with participants which centred around how staff engage with each other.

4.6.3.1 *'They'll stand with you'* - Collaboration

Collaboration was seen as pivotal to facilitating support throughout CRRT practice, through knowledge sharing and the provision of mutual aid.

You've got that little bit of thing where you've got people, who if you run into a little bit of trouble with it, you can go and get the help with. It's not like you're the only person on shift who knows anything about them and to everybody else it's a totally alien machine, so it's nice to be in that, that's confidence building to know that there's other people with a similar knowledge base with that device. (NU001)

[asking for support], it's more, this is going on I don't know what to do with it, to be fair [it is more like] can you show me what to do. It's not like you fix it I'm just going to go do me obs or I'm going to do this. They'll stand with you, cos otherwise what's the point really, you can't be there all the time can you. (NU006)

… then often when we act, if you do get stuck on anything and you are one person. It's kinda like a group decision anyway because everybody starts sharing [advice] don't they (NU015)

There was also specific reference to collaboration with other healthcare professionals and individuals thoughts on this.

Maybe we don't actually, yeah. Maybe we don't maximise them [other HCPs] enough (NU002)

A portion of the conversations pertained specifically to the collaboration with medical staff and the intricacies this involved, some of these were previously discussed in section 4.4.5.

On ICU you're quite lucky you've always got the consultants about as well, so you generally you know if you see one walking past as a target of opportunity would just 'while you're on your way by can you have a look at this' 'are we happy?'(NU001)

from our doctors, I don't think one of the renal consultants would come and say you know, they do when the, the haemodialysis but not the type of hemofiltration that we do. I think it's more consultant intensive care doctor that lead that. I don't think it makes any difference really [if the renal consultants are not involved] (NU003)

… if we do need input from them [nephrologists] then you wait, you can wait a few, two or three days to come do you know what I mean yeah. (NU004)

I would say so yeah, [ward round conversations are constructive] I've never felt like you never doing your job properly, cos you're not getting a filter working. (NU006)

Demonstrating in the event that medical staff input was required it was usually constructive and a mixture between opportunistic conversations and formal ward rounds or clinical referrals.

Overall, a constructive collaborative working approach was sought and there appeared to be a consensus that the more insights that were available the better, with NU001 summing this up nicely by saying.

Well yeah, the more brains you have working on it, is for the better, as long as they don't start arguing {laughs} (NU001)

As mentioned throughout this chapter, these findings again represent a culture of engagement and cooperation between colleagues, as a means to seek appropriate support, with what appears to be a continual opportunity for a back and forth of information sharing.

4.6.3.2 *'Too many people and too many instructions'* - Conflict

The discussion around collaborative working were somewhat balanced by observations where distinct episodes of conflict arose. The origin of these reported conflicts was predominately focussed between nursing and medical staff.

I like to establish at what point the clinicians think there's a problem, cos I can then compare that to what point I think there's a problem {Laughs} ... (NU001)

... there's too many people and too many instructions and some sometimes they might all conflict one another (NU002)

[when there's conflict] you have to prioritise which is the most important thing, do you know, … (NU008)

… I think they'll [medics] come in and they'll say… we're not getting the clearance blah, blah, blah but they don't fully understand how that clearance is happening. It does not happen in the same way that it used to on the old filters. You know, we're not bashing them with high rates to try and clear, its diffusion it's only going to happen at this rate, we can't change that. I don't, but I don't think they understand that, that's how it's working. (NU012)

There were further instances however where there was particularly conflict solely between medical staff on the management of CRRT.

I have seen it at {Cardiothoracic Site} where it's the [surgeons]... trying to out rule another… Whereas if it's coming from the intensivist it's their area and it's their decision…Always go to your anaesthetists, listen to your anaesthetist cos they're the one that are on all the time, whereas your cardiacs' they will come and they would ultimately turn it all around, 'why you doing this, why you doing that?' and swap it all around again and disappear and then come back and you would literally change it back again when they'd gone always conflict and question why you'd done. (NU002)

4.6.3.3 *'I would defer some decisions up the chain more quickly*' - Escalation

The final aspect of this theme was the escalation of problems to others. A variety of aspects were highlighted as to when and how this might occur. Some comments drew parallels with the approachability concept discussed in 4.3.5.1.

I think sometimes stress levels and things like that, and sometimes if you're aware that you're quite stressed or your patients on renal replacement therapy but there's also a lot else going on I think maybe I would defer some decisions up the chain more quickly, if I had a larger workload or a more critical workload [sicker patients] … there's the human factor like I said so I suppose it depends on how you're doing that day (NU001)

I think it's to do with approachability, I think if you go to them, and you'll say oh Yeah you happy with how this is going… you'll look and see what the patient weighs what their gases are and things and then just say oh right well we could maybe up that or so you don't always wait for them to come to you… (NU008)

so some of the more experienced band 5's will always come to you, you know with the important things, like patients not clearing or not getting better or, just you know, despite what we're doing for them the patient's deteriorating they'll come to you and let you know, give you a little update now and again, ' I

know your busy but..' this is what's happening and there's the ones that you know won't come to you, that will just bimble along and won't come to you and they're the ones that you would go back and check on. (NU009)

now I think I'd go for the really knowledgeable one. So, if it was like the consultant that loves the filter, that's not particularly approachable I would still ask him at the risk of being, I don't know, talked down to, because I'd know I'd get the right answer. Whereas in previous years I would have avoided asking anybody anything like that. I would have asked I would have gone for the in-between them knowledgeable person that was approachable. (NU015)

Individuals demonstrated and justified processes for when to escalate challenging scenarios, as well as self-identified gaps in knowledge, they also consisted of episodes when they felt confounding factors were influencing their ability to make decisions.

4.7 Variability

An overarching observation from the discussions was the aspect of variability involved around all aspects of the provision of CRRT. Throughout the previously identified themes there have been points raised about variability in the Individual, Organisational, Practice and Support themes.

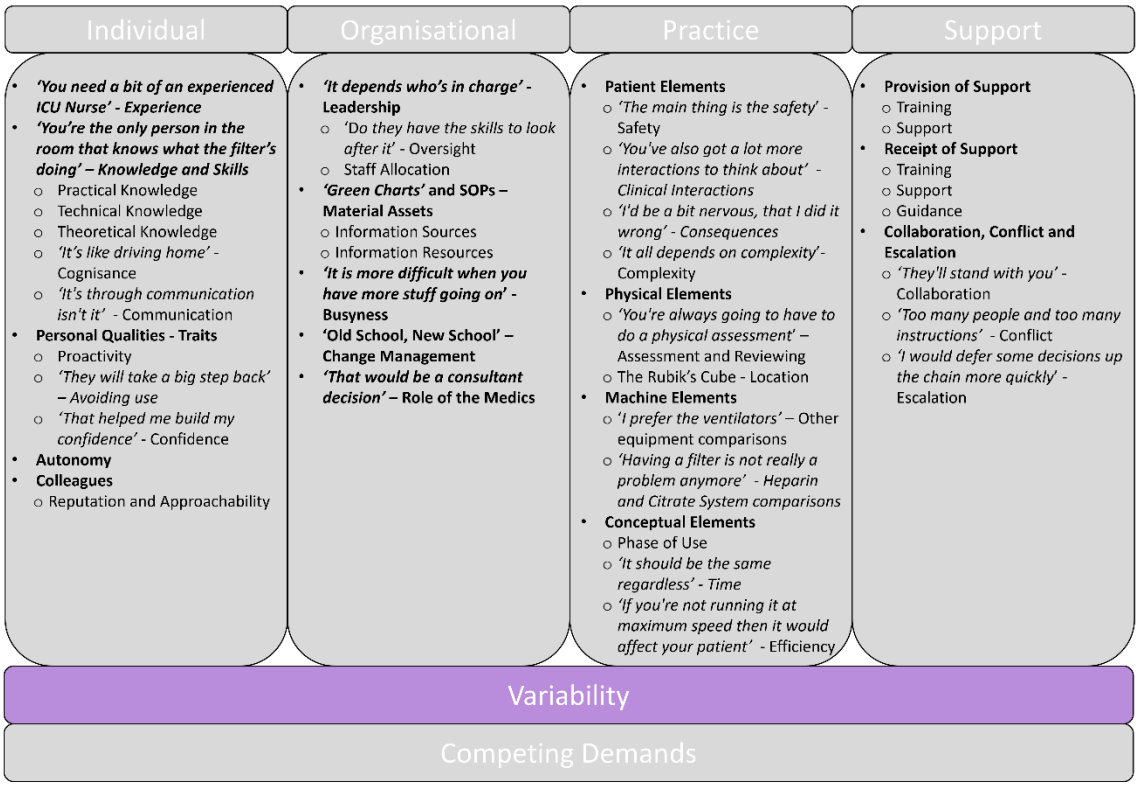

Figure 13 Variability Theme

NU001 implied in conversations that there was variability in colleagues abilities to manage CRRT, and these were not necessarily linear alongside the duration of experience in ICU.

I think it does differ Yeah, Yeah, I think some people pick things up very quickly and some people may need a bit of extra time a bit of extra training doesn't mean to say they can't be equally qualified at the end. (NU001)

Moreover, this human element of variability was repeatedly raised and acknowledged as a contributing factor to CRRT delivery.

Well, you'd like to think not [there is no variability], but we're all humans (NU001)

…sometimes it depends on the consultant and sometimes it depends on the patient obviously. (NU002)

He's like really good on the filter he hasn't been here for ages, and I think {XX} is as well so if {YY} she goes and fiddles with the filter… but she's and she can look at all the… obs and everything not even look at the filter and just know exactly what's going on and then tweak with it… but then not everybody's the same are they (NU015)

Yeah, they're usually great. There are a couple [of nurses] that I probably wouldn't go to… You know it just depends who it was but most of them are really good and really supportive and there's always the teacher trainers that are always around… Some of the consultants are really good. …. But I think you know like the consultants, like {ZZ} for instance... he's very good and he would be very supportive, and I would maybe go and ask him something about it. (NU003)

The significance of these human elements was vital in view of the other conversations highlighting the importance of individuals and the cultural support provided by the workforce. However, more specifically than the broad influences in variability from the staff group as a whole, the variation associated within the Band 6 nurses was raised.

It's the same with the band 6s it depends which 6 is on (NU002)

[support] some are better than others it depends a lot, some haven't got a lot of clinical experience. Only because of the job they're doing at the minute and some, it's better lately because there has been more than two Band 6's on, one on each side so the other one is usually clinical, but you do find some of them are lacking in clinical skills (NU004)

Across these opinions it was well-defined that variability is viewed as a sub-standard concept and that a more consistent approach is beneficial to both stakeholders and subsequently patients.

4.8 Competing Demands

Similarly, another cross-cutting theme was that of the competing demands highlighted by staff.

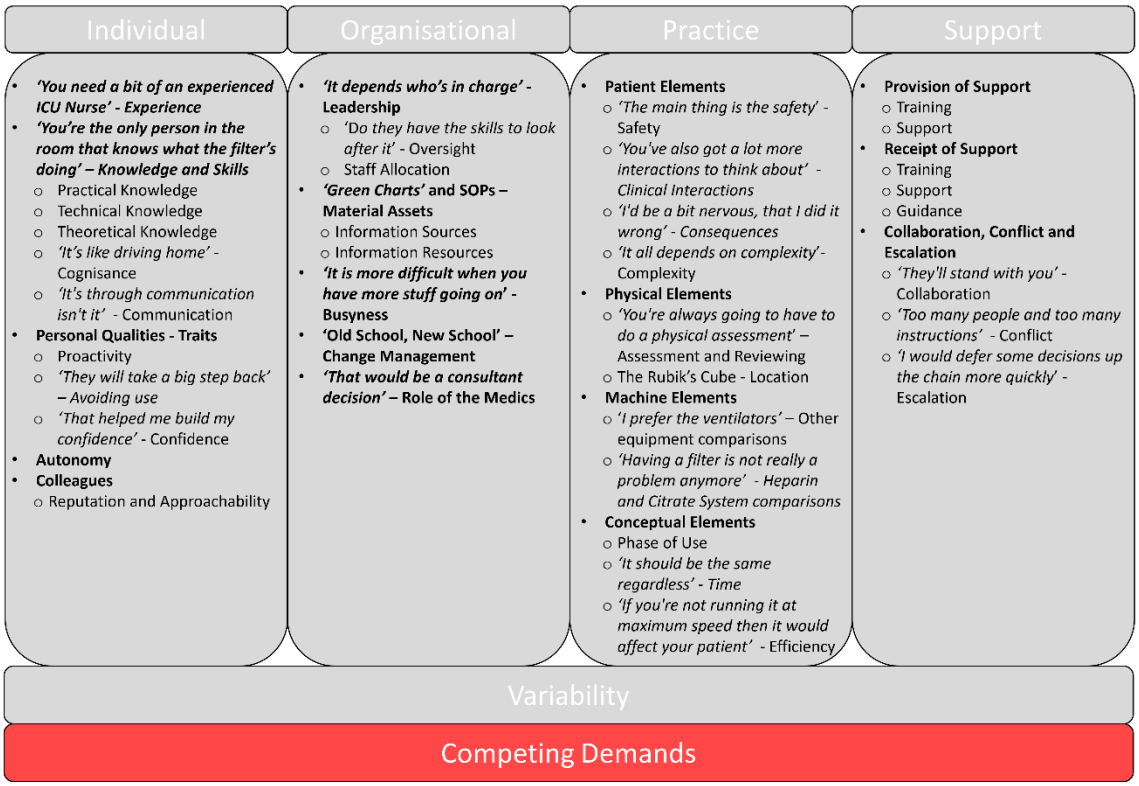

Figure 14 Competing Demand Theme

These were burdens on staff preventing them delivering CRRT in a manner that they desired to.

> *it's quite important, it's because it's about your time management and the things, and your organisation of the rest, because you got to try and fit it in with what else you've got to do, haven't you, and you might have other machines that need looking after and things, so it's... I think it's quite important. (NU004)*

> *I think sometimes when you're a new starter and you've got quite a lot going on anyway the thought of looking after a filter can be a little bit daunting, I think you've got to find your feet a little bit first and then cos you're learning about your ventilators and all, you know (NU006)*

> *but also, there are lots of basic things that there not quite, have got you know ventilation and things like that and there not quite totally ofay with it, so to me it's like don't take on a new challenge and learn loads of new stuff when you've still got other stuff that you need to do... yeah. but also if I know that I might be busy that day if I'm coordinating and things I might not be able to give them the 100% support that they might need, so you have to look at the other skill mix on the floor and the person next to them has to be able to help them out and sometimes you get people who are more than willing to do that and then you have others that are a bit more reluctant to be involved with other people so you have to look at that as well. And that sounds awful but.... (NU008)*

4.9 Chapter Summary

From the content of the interviews undertaken it is clear the influences of critical care nurses behaviours are complex intertwined and multifaceted. A number of themes and sub themes have relationships demonstrating their impact on one another. Chapter 6 will discuss how these findings fit with the existing literature and suggest recommendations for the future.

Chapter 5 Discussion

5.1 Introduction

The original aims of this thesis were to determine what were the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy. In doing so it was to develop an understanding of these factors in order to highlight areas where improvements in practices can be made, to improve both patient and organisational related quality indicators of CRRT. These aims and objectives were deemed important through literature which highlighted the need for exploration of the role the human element plays in CRRT. Alongside research agendas identifying need for clinical decision making and judgement research in nursing research (Thompson et al, 2013) and the broader research priority of determining factors that influence nursing staffs' behaviours in critical care (Blackwood et al, 2011). These findings generate new knowledge and contextualise these understandings of individuals, the organisations, the wider interactions, and relationships between colleagues, and the CRRT technology, and provide insights to enable a holistic approach to understanding the provision of CRRT and potentially enable improvements in treatment delivery.

This thesis has identified a broad range of influences, across six domains, (Individual, organisational, practice, support, variability and competing demands) on critical care nurses decision making during the management of continuous renal replacement therapy. The exploration of these influences with a group of critical care nurses has allowed for a greater understanding of their impact. In understanding this impact, it has elucidated improvements in practice which should enable improvements in both patient and organisational related quality indicators for continuous renal replacement therapy. These practical improvements are demonstrated and discussed throughout the remainder of this chapter.

The findings presented are important as the provision of CRRT is complex and involves a highly specialised nursing workload (Langford et al, 2008) and occurs in 5-61% of critical care patients (Baduashvili, et al, 2020). Whilst there is extensive work focussing on the physiological and technical factors of optimising outcomes for patients on CRRT, the available literature fails to address any focus on the human influence which may impact on patient outcomes of CRRT.

The findings from these interviews, undertaken with 10 experienced critical care nurses, demonstrate a complex, interwoven range of elements focussed on the following factors: Individual, Organisational, Practice and Support. All of these have influence the behaviours of critical care nurses in the delivery of CRRT. The foundations of these themes were associated with experience, knowledge and skills, and personal traits for the individual theme. The features of leadership and information sources contributed principally to the make-up of the

organisational theme. A diverse range of practical aspects like patient safety, patient complexity and location of CRRT delivery formed the practice theme, and details of support received and provided by critical care staff and the manner of the encounters with colleagues in trying to deliver CRRT were key in the generating the support theme. Two other overarching themes of Variability and competing demands completed the determined influences on critical care nurses delivering CRRT from this study.

This Chapter discusses the findings in the context of 4 aspects:

- Synthesis of the findings against the discoveries from the literature review and other sources.
- The findings relationship to the concept of the ideal CRRT Machine.
- Conceptualisation of the individual in the delivery of optimal CRRT.
- Implications to practice

Given the objective of this study was to use the findings to both support optimal practice and ways to improve CRRT delivery, this chapter section has a focus on the implications of these findings for practice. The discussion is underpinned by the relevant wider literature and realistic, practical evidence-based suggestions for implementation are examined. These aspects are contextualised through the discussion around the strengths and limitations associated with this work. Additionally, ideas for future research in these areas are also discussed.

5.2 Synthesis of findings against literature review data and others.

The empirical evidence within the findings demonstrates a new contribution into the thoughts and perspectives of individuals delivering CRRT. The proposal of this Individual, Organisation, Practice and Support model, whilst specific to the context of CRRT delivery, shares similarities with the Who?, Where?, How? proposal of influences highlighted in the synthesis of the literature review surrounding decision-making in critical care nurses in section 2.5. There is a general alignment between the major themes generated across the two processes (theme generation from the literature and theme generation from interviews). There are also wider alignments between sub themes.

5.2.1 Who?

The Who domain, which picked up the themes of **Experience**, **Individual Clinician Factors,** and **Collaboration**, and was driven by the personal elements of influence and is clearly represented across the Individual and Support themes generated in these interview findings. The constructs of the themes like experience and collaboration were similar, in that the topics that comprised

the themes were directly comparable. Within experience, the existing literature detailed the influences of the number of years' experience on elements of practice (Wøien et al, 2013; Sørensen et al, 2013; Lavelle et al, 2011) whereas the focus in this study was on the perception of the duration and type of experiences needed to begin to manage CRRT systems. Moreover, some of these existing studies provided granularity on what the output of experience provided, with Wøien et al, (2013) particularly indicating that more intuition was used in those with greater experience. Additionally, Lavelle et al, (2011) and Marshall et al (2011, 2013) also highlighted that educational credentials were used as a proxy for experience. Whilst specific credentials were not mentioned in this study it was perceived that 'superusers' were largely viewed as the most experienced CRRT users and there was recognition that these individuals were often sought after for advice because of their status. Likewise, the concept that staff members in Lavelle et al (2011) and Marshall et al (2013) sought out individuals with the most appropriate clinical experience was supported in this current study. This is evidenced throughout by the interviewees mentioning that they would frequently seek out specific support from individuals, this often included where there were tacit insights into their ability to problem solve with CRRT rather than formal recognition of knowledge. Finally, in regard to experience these data also reinforce the postulation in both Lavelle et al (2011) and Marshall et al (2013) that both proximity and availability of staff plays as important a role in support seeking as the perceived or documented knowledge held and imparted by individuals.

Regarding the individual clinician factors, there were again similarities between the data gathered in this study and studies by Cranley et al, 2012 and Tingsvik et al, 2015, exploring other areas of critical care. Personal traits were a theme in common, with Cranley (2012) and Tingsvik et al (2015) pinpointing confidence, professional approach, attitude, and interest, as significant contributing factors in decision-making. Some of these themes were replicated identically, such as the sub theme of confidence where the content was largely identical Whereas others were categorised indirectly, such as in scenarios when interviewees referenced the behaviours associated with the elements of proactivity and avoiding use in this study which were reflecting in the traits of attitudes and interests.

Participants in this study talked about the impact of fatigue and working unsocial shifts, they consistently identified that they felt their decision-making regarding CRRT was not affected by these factors and suggested their fatigue and sleep deprivation, associated with a 24-hour shift pattern, had little to no impact on their ability to make decisions and function appropriately. This contradicts evidence identified within the literature search by Scott et al (2014) who demonstrated performance effects associated with sleep deprivation and fatigue as a result of with lack of sleep. In trying to explain this outlook there is potential that this discrepancy is

influenced by a number of issues. In particular, Scott et al (2014) had no specific critical care clinical focus and the study looked at any decision regret during a worked shift over the past 7 days, whereas in this present study the focus is purely on CRRT, therefore making it more difficult for participants to identify and pinpoint any specific effect of fatigue on their CRRT practice. Additionally, the respondents in the Scott et al study (2014) had the benefit of preconceptions for the questions on fatigue and decision-making via a cover letter and the provision of questionnaires, whilst interviewees in this study were not prepared specifically for these types of questions. Further underlining these aspects, there is also evidence to suggest that patient outcomes influence individuals' self-assessment of performance and ability (Orest, 1995). The importance of this element is that, as highlighted throughout by the interviewees, CRRT provides very little real-time feedback. Its success (efficiency) was largely measured daily via blood tests often with little recognition of performance, whereas failure of CRRT was clear and demonstrated in the need to restart a CRRT circuit and its associated attributable workload. Future specific research in the CRRT staff population may aid better insights.

These data obtained through the interviews with the nurses also mirrors the mixed desire for autonomy demonstrated by Kydonaki et al (2014) and Subramanian et al (2012). Analysis of data in this study shows significant evidence supporting the belief that CRRT was managed autonomously by the nursing staff. Alongside this there was a self-awareness of autonomous working practices which was complimented by an understanding of role and remits of the medical staff and the appropriate times to seek medical input. There was clear evidence where interviewees detailed the referring back to CRRT protocols or seeking to escalate to the medical staff, when they felt uncomfortable or unwilling to act autonomously.

The lack of proactive CRRT behaviours and the recognition that the individuals sought to avoid the use of CRRT draws parallels with the themes of 'Attitudes' in Tingsvik et al (2015) where positive attitudes were demonstrated to optimise patient weaning from mechanical ventilation. There was observation by staff that they felt the consequences of this were that whilst staff were safe delivering CRRT, treatment was also not being delivered according to 'best practice'.

These manifestations of traits identify that despite the geographical differences between this study (UK based) and the existing published literature (Canada; Cranley (2012), Greece; Kydonaki et al (2014), Sweden; Tingsvik et al (2015)) critical care nurses behaviours align across these boundaries.

5.2.2 Where?

The themes of **Culture** and **Organisation** were identified in the existing critical care literature and when compared to the findings of this study, highlight a number of similarities, but also a number of differences.

There was evidence from Egerod et al (2013) indicating a collaborative approach for sedation decision-making, and Villa et al (2012) indicating a dominant medical role in weaning from mechanical ventilation. Whilst conversely, Evans et al (2010) determined from their study that clinical decision-making by nurses was both 'normative and integral' to the delivery of care. The perspective of Evans et al (2010) is supported by the evidence generated from the participants of this study in relation to CRRT. As this thesis found that there was clear opinion in all 10 interviews that the expectation was that CRRT was predominately a nurse delivered intervention, representative of a 'normative and integral' delivery of care, with collaborative working with medical staff input only being required in the cases of extremis or when problems were unresolvable.

From these data it is conceivable that this autonomous approach to delivering CRRT is specifically related to two aspects: geography and its associated cultural norms or a specific clinical intervention, in particular comparing studies by Evans et al (2013) investigating Canadian nurses confidence; Egerod et al (2013) who undertook a mixed nationality study (predominately a Nordic population) exploring sedation, and Villa et al (2012) studying weaning from mechanical ventilation in Italy. With this United Kingdom study looking at CRRT it is challenging to tease out any transferability due to the cultural and topic matters. Further exploration and understanding to distinguish factors associated with critical cares nurses' autonomy may be warranted.

The support aspect is significant in this present study and was placed in the Culture theme in the Where? domain. Within these themes Lin et al (2013) identified that senior ICU staff supported inexperienced team members both inside and outside the clinical area. However, in context of the Lin et al study (2013) this was considered partly due to the need to ensure the efficiency of the discharge process and further specifics are not explored. The information gained in this study surrounding the extensive support structures and mechanisms largely replicates the evidence in Lin et al (2013) as there was both significant provision of support by the majority of the experienced staff, both AfC Band 5 & 6 nurses. The indications for this however were similarly to confirm patient safety, whilst there were occasions where support was offered to ensure the effectiveness of the CRRT systems were optimised and episodes of checking in with staff.

From a hierarchy perspective, Tingsvik et al (2015) determined that unit mangers and medical leadership was important in influencing the prevailing culture of weaning from mechanical ventilation. In this present study there were clear opinions that there were some of the Band 6 nurses who were neither approachable nor clinically savvy with CRRT. This was further identified that from a unit management perspective that there were views from participants reflecting what they felt was a distinct lack of oversight focussed on CRRT across the critical care units. There was however acknowledgement from one interviewee (NU006) that it was difficult for managers to come in and have day to day exposure to CRRT and ultimately there was little value in it, and that they should prioritise the management and training side of CRRT.

With reference to the medical staff oversight, this was highlighted as variable, there were senior individuals who were felt to be well engaged, but otherwise the impression given was that there was no medical leadership with CRRT locally and the involvement of junior medical staff was frequently derided.

5.2.3 How?

The How? theme was divided into the sub themes; Decision Processes and Context. In addressing the similarities between the findings in this study and the existing literature, there is extensive support for the premise set up by Lundgren-Laine et al (2013) that real-time information is vital. This was demonstrated in particular when participants talked about the utility of the Point of Care Testing technology in the instances of arterial blood gases. Whether this is a by-product of information hungry critical care staff, or the improved accessibility of reliable and actionable test results, it was clear throughout that the participants felt information acquisition benefitted patients.

The access to information in the decision processes theme was highlighted throughout the literature (Aitken et al, 2011; Cranley et al, 2012; Haslam et al, 2012; Kydonaki et al, 2012; Subramanian et al, 2012; Tingsvik et al, 2015; Villa et al, 2012 and Wøien et al, 2013) identifying the importance of acquiring information for clinical assessments. This was no different in this study where individuals sought out clinical information from both paper and electronic records to aid in the clinical assessment of patients.

In other aspects of information acquisition there were strong desires to seek out other, sometimes specific colleagues as information or advice sources, often when they were not readily accessible, due to them working on adjacent units or because of their own patient commitments. It was also explicitly pointed out that obtaining print and electronic information was often challenging and cumbersome, primarily due to lack of IT resources. These findings align with Marshall et al (2011) who demonstrated nurses preferentially choose colleagues as

information sources to support clinical decisions. This reinforces the view that future research in understanding how nursing colleagues act as information resources may aid in improvements in the decision-making process. Whilst further accessibility and availability to information technology in the future may mitigate the burdens on individuals.

The Context sub theme was associated with other sub themes in the Practice domain generated from these findings. The was direct reference to the temporal association between staff behaviours and clinical conditions. Whilst Tingsvik et al (2015) identified 24 hours as a key timepoint for mechanical ventilation weaning, the commonly discussed timepoints associated with this study was 72 hours or 7 days. These are associated with the manufacturers filter life guidance (72 hours), and in a more subjective assessment, when staff appeared to consider that the CRRT was moving from an acute provision, with time critical interventions, to a longer-term requirement for patients where CRRT was considered in a maintenance phase, pending decisions regarding longer term RRT. Accordingly, participants identified less urgency associated with the patient at 7 days, whereas 72-hour intervals were deemed important junctures in the decision-making processes for patients, such as for trials without CRRT.

5.2.4 Elements absent from the Who?, Where? and How? Model.

Despite significant alignment between the themes in this study and the literature in the Individual, Organisational, Practice and Support model and the Who? Where? How? model, there were other themes from these findings that were not evident in the existing literature. A majority of these sub themes were in the Practice domain. The Practice domain encompassed specific reference to the delivery of CRRT throughout. Two of the patient elements fell into this category, clinical interactions, and consequences (of CRRT). Likewise, the machine element theme was not discussed elsewhere, where the focus was on the CRRT equipment to provide delivery.

5.2.5 Summary

Overall, the findings from these interviews highlight common themes and topics surrounding the delivery and influences on decision-making with CRRT which are comparable to the existing literature focussed on non CRRT critical care interventions and staff behaviours. This study however provides specific new findings and insights into the delivery of CRRT, for example the perception that nurse autonomy is more integrated into CRRT delivery than other similar clinical interventions, the critical role of Point of Care Testing, the specific time focussed nature of CRRT, and the observation that CRRT decisions are not perceived to be influenced by fatigue or sleep deprivation. These elements can be used to explore approaches and interventions designed to improve CRRT delivery.

5.3 Relationships with the concepts of the Ideal CRRT Machine

The models Ronco et al (2015) and Cerdá et al (2016) both propose that the ideal future CRRT system is based on the premise that information input, algorithms, feedback, and automation are central to an ideal system. Currently it is the staff member(s) at the bedside who process this information and provide a feedback loop for intervention. These findings demonstrate, specifically in relation to CRRT, critical care nurses are impacted by significant variables which they perceive influences their practice and ultimately the feedback loop. The use of automated CRRT models would circumvent many of the influences highlighted in these themes. However, the adoption of automated models is not without risk (Ricci et al, 2017), as different sets of knowledge, training and expertise are required to avoid the passive acceptance of systems performance or its interpretation of data which facilitates automation. The lack of these provisions may impact patient safety or a failure to maximise treatment efficiency, because many datapoints may have two interpretations, for example in a fluid balance feedback loop if an oliguric patient spontaneously had 100ml urine output recorded the, amount of fluid being removed from a patient may be automatically adjusted to compensate in order to reach a predetermined fluid balance target, without due consideration that this may be after a bladder washout.

Many authors have predicted that the future of CRRT includes biofeedback models (See et al, 2021; Clark et al, 2017 and Ronco et al, 2000). However few examples exist in the literature of its practice application in CRRT. The technology is present in mechanical ventilation where if patients become apnoeic or trigger a low respiratory rate alarm the ventilator automatically enforces a change in the mode of ventilation to deliver pre-set respirations (Chatburn et al, 2014). There are also examples in Intermittent Haemodialysis (Hueso et al, 2018; Leung et al, 2017 and Santoro et al, 2013), across a wide range of management including, blood flow, temperature, ultra-filtration rate, however their adoption and integration into clinical practice in a single system is not widespread. The various methods of feedback; Fully Automatic, Nurse Authorised and Nurse Manual, all pose solutions and challenges to delivering CRRT. The application of the findings from this research are explored below. Using a combination of the models proposed (Ronco et al, 2015 and Cerda et al, 2016), and these data derived from this study, will help understand the important impact on critical care nurses delivering CRRT.

5.3.1 Nurse Manual Biofeedback

Currently the use of manual feedback is the current default method facilitating changes in CRRT usage throughout ICUs. The interpretation and actions based on physiological

assessments has been demonstrated in this study to be influenced by 4 major themes – Individual, Organisational, Practice and Support.

5.3.2 Nurse Authorised Biofeedback

This middle ground approach sits between a completely automated system and a manual system. It implies the existence of algorithm approaches in which nurses would acknowledge and action a biofeedback process. The model reduces exposure to the influences described in these findings, as any actions would be algorithm based, however the evaluation and assessment of patients and data would still be influenced by the theme detailed in the findings such as busyness, traits, autonomy, and support structures.

5.3.3 Fully Automatic Biofeedback

Fully automatic biofeedback presents itself as the future for CRRT delivery, with ability to strictly adhere to prescription, reducing downtime, whilst maximising patient tolerance (Cerdá et al, 2016). The premise is that a fully automated system should be able to integrate with electronic medical records, physiological data and achieve the following: adequate ultrafiltration rate, adequate dose delivery, thermal and energy balance, circuit pressure control and acid base and electrolyte control.

The implementation of a whole system automatic biofeedback loop for CRRT removes a large proportion of the influences from the domains highlighted here. The ability to provide a whole CRRT fully automated biofeedback system approach however, is not yet available. Although, some of the technological requirements do already exist to deliver biofeedback systems, but in order to ensure proper functionality there needs to be CRRT connectivity with existing systems such as electronical medical records including clinical observations and risk scoring, biochemistry, patient monitors and syringe drivers (Cerdá et al, 2016). It is the large-scale integration of these systems and devices and the subsequent generation of algorithms or institution of machine learning that poses the next challenges for true CRRT automation.

When considering the impact of this study's themes on fully automated biofeedback in the Individual domain the predominate themes modified would be traits and autonomy. Specific experience, knowledge and skill would be required; however, these elements will be adapted to the changes to task orientated models and removal of the requirement for any clinical interpretation and critical thinking. Influences of colleagues would largely remain unchanged, new types of problems will arise associated with automatic systems, but it is unlikely individuals reputations and approachability will change when there is the requirement for interactions.

The impact on the organisational influences would be huge, based on the predefined task focussed role delivering CRRT, in addition the challenges associated with staff allocation would be simplified to the point where it would be conceivable for non-nursing staff to carry out any physical manipulation required. This could consequently reduce the influence of busyness associated with CRRT. In a fully functioning automated feedback system the influences of a number of the themes associated with the Practice domain would be impacted, whilst a subjective theme like patient complexity, clinical interactions and consequences would become moot points as the characteristics (multiple organ failure, clinical presentation. intense monitoring or multiple medication infusions) defining a complex patient are converted into data for the application of an algorithm(s).

It is likely that with change in automation status of CRRT some of new themes generated by this study would look very different than what has been described in the findings. Those output orientated themes like efficiency and safety whereby clinician satisfaction of performance of the Practice themes like assessing, and the type of CRRT system, would consist of different focusses and detailed description of the challenges and work around adopted would tell a different story of the influencing factors affecting nurses ability to make decision regarding CRRT. Likewise, the constituents of those input focussed themes like assessment and reviewing which require as a data input in order to contextualise care and provide a basis from which algorithms work from would also look very different in a fully automated CRRT environment. As for the remainder of the themes, location, time, phases of use and comparisons with other equipment it is conceivable that these would be unlikely to be impacted by the progression into more automated systems.

In a future heading towards the automation/semi automation of CRRT delivery, there is a clear requirement for the validation of processes and decision support systems to provide assurances around safety and efficacy. It is hoped the insights provided in this thesis will help in understanding the human element of CRRT delivery and therefore contribute to the future of automated systems.

5.4 Conceptualisation of the individual in delivering CRRT

This thesis' theoretical contribution is that it identifies the central role that the individual has on delivery of CRRT, enabling the recognition of the needs of the individual to support best practice.

In the interviews and across the majority of the themes and sub themes, the critical care nurse is the focal point of CRRT, through interactions with colleagues and patients, acquisition of

information, the delivery of clinical practice across a broad context of scenarios all accentuates their critical role in the delivery of the treatment. With consideration to the nature of critical care units and critically ill patients and the role of the critical care nurse these aspects are unsurprising, however this study highlights the reasons and details and the specifics of this element to the role.

This centric role in critical care units, in the context of these data, describes a burden to critical care nurses delivering CRRT whilst also having wider clinical delivery responsibilities for patients under their care. With that in mind an alternative approach to arranging the themes could result in a reconfiguration of the model presented in the findings to one where the 'Individual' theme was placed centrally with the influences from 'Organisational', 'Practice' and 'Support' elements impacted onto this (see Figure 15 Individual centric model of influence).

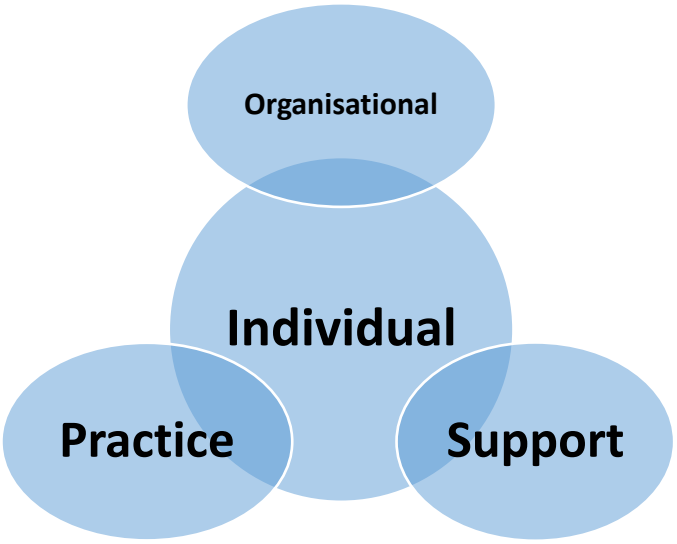

Figure 15 Individual centric model of influence

Though this burden exists it puts the critical care nurse in the position where they as individuals can mitigate against these external influences. Therefore, obtaining practical local insights and engaging individuals and groups in delivery and quality improvement of CRRT will create a critical mass for change.

5.5 Implications for practice

5.5.1 Introduction

The focus of this study was 'Developing an understanding of the factors that influence critical care nurses' decision-making in the management of patients receiving Continuous Renal Replacement Therapy', and the rationale underpinning this was to guide future interventions, innovations, and approaches in this subject area to better improve CRRT delivery. Typically,

recommendations to improve practice concentrate on educational approaches to support knowledge and skills deficits, however the results of this study demonstrate a complex mix of determinants to optimal practice. Therefore, this section will discuss in detail the specific implications and the myriad of potential options to address and improve the highlighted aspects, considering each within the context of strategies to support practitioners according to the relevant empirical improvement studies.

5.5.2 Experience

It was evident from the discussions, that the critical care nurses interviewed looked both back in hindsight over their own experiences as well as with a forward-facing desire to enable newer colleagues the opportunity to gain experience with CRRT. The topics surrounding lack of access to adequate experience and exposure to CRRT, draw parallels with other critical care nursing topics like interhospital transfers (Dabija et al, 2021), and assisting with intubations (Williams and Parry, 2018). Whilst CRRT is a common occurrence on critical care units, ensuring the workforce has the adequate exposure and consequently experience in delivering CRRT, is important. For staff new to critical care units facilitating approaches for exposure and experience with CRRT might include ensuring there is the availability of programmes to ensure this exposure happens. Within the UK, frameworks to enable the standardised assessment of competencies exist (Step Competency Framework (cc3n.org.uk)) Step 1 identifies core competencies aimed at those critical care nurses under supervision prior to the commencement of an academic critical care programme. With specific reference to RRT competencies, these are focussed on the discussive elements and application to supervised practice. Whereas in Step 2, competency attainment is achieved through the application of clinical delivery. These programmes are widely adopted across the UK ICUs (Cutler et al, 2021), however there is little data evidencing their impact on either staff (retention, confidence, knowledge) or patient-based metrics (adverse events, satisfaction, or outcome).

Whilst this formal critical care competency assessment is available, there also remains the opportunity to standardise in house training for CRRT, with this element identified as having a lack of standardisation (Schell-Chaple, 2017). There is however no specific UK focussed data to substantiate this variability, although evidence from the United States (Przybyl et al, 2017), Italy (Ricci et al, 2015) and Canada (Bourbonnais et al, 2016), all indicate variability, and that nurse training was an area to address. In particular, Przybyl et al (2017) detailed the development of a harmonised and thorough training and educational maintenance program to reduce variability. Whilst the outcome data they provide on CRRT usage and incidents does not report statistically significant changes, over a four-year period, there are trends to indicate a

reduction in reported incidents and machines being sent for repair, in the context of a greater number of patient CRRT days.

The identification of the importance of approachability as being as critical as the knowledge imparted, indicates there is potentially added value of preceptorship and buddy systems for critical care staff related to CRRT. The utilisation of preceptorship programmes and the formalisation of a buddy system when managing CRRT is likely to address some of the interviewee issues about support provisions, whilst maximising and engaging input from a wider staff group. The use of preceptors usually offers a medium length fixed term period to help support nurses new to the clinical practice area. Preceptorship periods offer the preceptee the tailored opportunities of experiential learning and participation in clinical activities in the context of both the pastoral and clinical support to enable development and the achievement of the desired outcomes. In additional a successful preceptor-preceptee relationship has the potential to improve the quality of care (Quek and Shorey, 2018). There is clear relevance to how a well delivered preceptorship programme in the context of CRRT is. Likewise for preceptors these programmes allow them to fulfil personal professional development possibilities and facilitate organisational improvement (Macey et al, 2021). These additional activities also have the potential to unlock opportunities related to the development of CRRT practices.

The use of a buddy system directly references short term episodes (shifts) where time is spent supporting the individual in the delivery of patient care and learning the ropes. The implication from the interviewees was that these ad hoc occurrences were sought after, with a focus shift driven approach to expand novices experiences in a supportive manner. Whilst the ad hoc nature of buddying someone up enables the shifts leaders the ability to flexibly use the workforce, it was clear there was inconsistency in delivery. Widescale and consistent implementation of a buddy system would require a larger workforce and an organisational commitment to support the process. The use of this type of support system aligns with some of the behaviour change techniques and the associated clusters identified by Michie et al (2013). Specifically, these are ‘Modeling of the behavior’ technique and those cluster of techniques labelled as ‘Social support’. The ‘Modeling of behavior’ advocates the ability to observe both directly and indirectly the performance of the behaviour, the buddy system provides an abundance of opportunities for this to occur, where the learner can imitate the desired actions in supportive environment. Additionally, the value of the social support cluster behaviour change techniques (Social support, General; Practical, emotional) ensures there is a route to provide non contingent praise or reward for behaviours alongside encouragement and advice when colleagues discuss practice and their learning (behaviour). Practical help in

the form of working with, and alongside colleagues with CRRT systems together with sharing tasks also aids in the development of these behaviour and learning changes. Likewise, a buddy system provides emotional support for colleagues in the event that something does not go to plan or if things go well, providing both immediate and delayed access to positive and negative reinforcement opportunities. These behaviour change techniques and approaches offer a bottom-up approach to support learning from peers which should, in the environment and context described, be practical and deliverable. The buddy system does however require access to colleagues willing to share skills and insights in a manner deemed appropriate both at an organisational (critical care unit) and personal level. The addition of buddy matching processes, ensuring that buddies can work together well, based on their personal and work characteristics may also extend the utility of this provision.

Finally, the use of an effective appraisal system whereby the line management structure can advocate and communicate the needs of the individual would benefit and tackle the concept that opportunities to manage CRRT in the newer staff was largely down to being by luck, despite effort being made by individuals to plan and request the opportunities. For the more experienced members of staff with an existing background of practical experience managing CRRT, more bespoke and novel approaches to gaining experience need to be sought. Opportunities like, becoming superusers, teaching junior members of staff, auditing CRRT all offer staff the chance to spend more time dealing and engaging with CRRT, increasing their exposure and experience.

5.5.3 Knowledge and Skills

The acquisition and maintenance of knowledge and skills was considered important. Interviewees detailed didactic approaches for the practical, technical, and theoretical knowledge acquisition of CRRT. Whilst many valued the role this played, there was certainly a preference for a more hands on approach, which was learner centric and performed at the bedside. The provision for the more experienced staff to having exposure or access to company representatives may enable a higher level and focussed understandings of concerns. A number of more novel approaches to CRRT teaching have been tried and tested.

The historic practice model for learning CRRT is that of practice on a patient, lectures, or off patient hybrid demonstrations with the equipment. The constituents of a learning approach by Przybyl et al (2017) detail online pre-learning modules, didactic lectures, computer training, hands on training, bedside orientation, intermediate CRRT Courses, advanced CRRT courses and an annual competency assessment. Some of these aspects are evident in the discussions with the interviewees, particularly the use of superusers didactic sessions, and hands on

sessions. However, there were a number of aspects where there was no formalised learning like the use of follow up training courses at 6 months and 1 year later, simulation training and an annual competency assessment. The opportunity to institute some of these measures into teaching programmes may optimise learning and improve knowledge and skills.

The use of simulation training in intensive care units has grown exponentially in the past 20 years (Eisold et al, 2015). Its utility has been demonstrated to improve nurses knowledge and confidence across a number of studies in intensive care units (Boling and Hardin-Pierce, 2016). With CRRT (and other extracorporeal circuits) there are challenges to replicate the effects of clinical conditions (Mencía et al, 2014), as a result a degree of fidelity is lost. However, the use of High-Fidelity Simulation training with CRRT has been demonstrated. In Przybyl et al (2015) there were reported increases in self-assessed skill level (10%) delivering CRRT and personal perception of trouble shooting skills of CRRT increased by 15%, at 3 months post training. Additionally, there was a mean score of 8 out of 10 for nurse satisfaction associated with this training. Mottes et al (2013) conducted an observational study as their department moved through the transition from a collaborative provision of CRRT to a critical care provision model of CRRT, with the subsequent addition of simulation based CRRT training. Their data indicated an increased filter life during the period post the additional simulation training versus that of the purely didactic sessions (59.4 vs 42.5 hrs p=0.008). Lemaire et al (2019) went further and established, through a randomised trial, patient related impact of high-fidelity simulation training. They took CRRT naïve nurses and provided additional high-fidelity training and found the CRRT sessions they managed had less unplanned interruptions (RR 0.67, (0.51-0.88), P=.002) and requirements for assistance episodes reduced (RR-2.6 (-3.5 to -1.6), p=<.0001).

Future potential ways to maximise learning from simulation would the use of In Situ Simulation, whereby simulation takes place in the clinical area. Whilst the effectiveness of this form of simulation has not been established (Baxendale et al, 2022), in view of the contextual sub themes brought out in this study like ‘Location’ the use of in situ simulation may increase the level of fidelity.

This evidence appears to support the commentary from the participants in this study that hands on simulation training is beneficial to staff members and potential influences on patient outcomes.

5.5.4 Traits

The evidence from these interviews identified that there were individual traits associated with influencing the delivery of CRRT Confidence, Avoiding use and Proactivity. It could be contended that an ideal staff member might possess particular qualities that make them

perfect for the delivery of CRRT (and other critical care work) and an understanding of these qualities might enable better people management. Within this work, both the CCTDI and the interviews have elucidated potential characteristics of interest.

In regard to the CCTDI, its intention within this study was to demonstrate participants had a broad range of critical thinking disposition and provide context to the discussion, however it inadvertently demonstrated CCTDI data with a positive skew towards a critical thinking disposition. These data however were in the context of recruitment arguably from an engaged staff population with CRRT, with more than 2 years critical care experience. Its potential therefore is that the CCTDI may be indicative of predicting the retention of critical care nurses.

The ability to recruit and retain critical care nurses has been exacerbated by the COVID 19 pandemic, with approximately 8.8% of registered nursing vacancies across critical care units in the UK and a staff turnover of around 10.1%-11.1% (CC3N, 2020). Accordingly, ensuring staff are able to build relationships and develop themselves whilst working on the critical care units is important. Whilst the provision of CRRT is only a small proportion of critical care nursing, it is clear from the content of these interviews that it is identified as a stressor for some individuals, whereby some disengage from providing CRRT.

Whilst Khan et al (2019) conceptualised a number of themes that influenced critical care nurses intentions to leave, quality of work environment, nature of working relationships, and traumatic and stressful workplace experiences. It is conceivable there may be some individual and measurable psychological predictors which can prospectively determine those recruits who may be better suited to critical care working environments.

However, approaches to the recruitment and selection processes for new staff which have improved turnover have involved a number of strategies, shadowing experiences prior to interviewing, staff led tours and recruitment fairs to help identify strong candidates (Kester et al, 2020). The use of numeracy and literacy testing has been used in nursing interviews in order to assess competency in these core skills, with many staff not reaching organisational requirements (Dean, 2016) and therefore not progressing into the role. At undergraduate level there has been work undertaken to identify students willing to pursue mental health nursing careers (Wilbourn et al, 2018). These precedents open the door for other (psychometric) testing during the interview process to ensure the right candidates are appointed for critical care nursing posts, and the CCTDI may be of utility in this process.

Whilst pre-emptive approaches can be employed for new starters to maximise their stay in critical care units, considerable focus needs to be directed at existing staff to ensure they feel

supported in a critical care environment and also in the delivery of CRRT. As a result, supportive approaches for existing critical care staff are essential to maximise retention.

A potential source of support for critical care nurses is the use of clinical supervision. Recently, and given impetus by the COVID 19 pandemic, the UK has advanced a programme to ensure that all nurses receive clinical supervision through the adoption of Professional Nurse Advocate (PNA) roles (NHS England, 2021). This programme for clinical supervision adopts an AEQUIP (Advocating and Educating for Quality Improvement) model of restorative clinical supervision. The method works in four ways:

- Advocating for the patient, the nurse and healthcare staff.
- Providing clinical supervision using a restorative approach.
- Enabling nurses to undertake personal action for quality improvement.
- Promoting the education and development of nurses.

These four approaches coupled with the support of trained PNAs are the ideal opportunities for staff to highlight and acknowledge any issues related to CRRT (and other topics) that may be encompassed in the themes derived from these interviews. In particular restorative clinical supervision also addresses the emotional needs of staff by enabling '*capacity to reflect and cope with their workplace experiences*' (Wallbank, 2010, p69). Accordingly, the AEQUIP model allows for a bespoke approach by nurses for facilitating specific outcomes, in view of the wide-ranging conversation and opinions throughout these interviews this approach may bring added depth and value to addressing issues.

5.5.5 Organisation

Throughout the discussions it became evident that a number of the themes were directly impacted by the organisational structures and facilities, namely the constituents of the organisational theme; leadership, material assets, busyness, change management, and the role of the medics. In addition to this, both the provision and receipt of support on the delivery of CRRT and the collaboration, conflict, and escalation with colleagues. Conversations often identified a lack of teamwork, respect, and engagement across the clinical role i.e., between medics and nurses.

This identifies that improving teamwork and engagement in CRRT (and other critical care provision) would be of benefit to both staff and patients. This is builds on work by Reader et al (2009) who identified effective teamwork was crucial in providing optimal care for critical care patients and that team communication, team leadership, team co-ordination and team decision-making were the key constituents to delivering this optimal care. In turn, they

propose a specific ICU framework by which team performance can be evaluated consisting of three phases: Input, Team processes and Output. Importantly in regard to this research, the task is identified with the input domain therefore using this model would allow for a bespoke evaluation of team performance regarding CRRT.

Building on this work Reader and Cuthbertson (2011) highlight a number of key stages in the design and implementation of a team training program (Figure 16 Key Stages in the design and implementation of a team training program (Taken from Reader and Cuthbertson 2011, p3). The adoption of a training program aligned with this may offer the best opportunities to maximise learning.

Stage	
1. Conducting a needs assessment	An assessment of the team behaviors associated with effective and safe performance in the task domain must be made along with an evaluation of the gap between actual and optimal performance. From this assessment, a team training curriculum can be devised.
2. Developing training objectives	The objectives of team training should be explicitly stated (for example, to influence attitudes and behavior) in order for measures to be developed to assess training efficacy.
3. Selecting training methods	Common methods include instructional, demonstrative, or practice-based training, and their usage will depend on the training objectives. The setting used for team training should be considered carefully along with teaching resources (for example, availability of high-fidelity simulators and training staff).
4. Designing a training strategy	The training strategy should be designed to meet the stated training objectives. This might include (a) introducing participants to teamwork theory, (b) providing them with opportunities to practice and receive feedback on teamwork skills, and (c) providing recurrent training to reinforce teamwork skills.
5. Implementing the team training	The purpose of a team training program should be clearly articulated and communicated to participants and tutors prior to implementation. Team training should be blended into practitioner training, and managerial staff must display a commitment to the importance of team training. The quality of the curriculum and teaching should be constantly monitored, assessed, and adapted where necessary.
6. Evaluating the training	Measures should be devised to regularly test the impact of the training upon (a) individuals (for example, attitudes, knowledge, and observations of practice) and (b) the organization (for example, error rates and safety climate).

Figure 16 Key Stages in the design and implementation of a team training program (Taken from Reader and Cuthbertson 2011, p3)

5.5.6 Summary

The implications identified across these generated themes encompass the key points identified by the interviewees. In future work looking at a holistic systems approach to delivering CRRT, Opgenorth et al (2019) plan to implement a standardised CRRT programme and a multifaceted intervention and knowledge implementation strategy, and measure changes to a number of key performance indicators including: average filter lifespan, downtime, delivered dose ultrafiltration achieved and alarms recorded. The Opgenorth et al (2019) study will offer insight into both the impact of standardised CRRT but also the influence that human elements have with the ongoing provision of education, coaching and audit and feedback.

5.6 Strengths and Limitations

This study consists of a particular approach to elicit and subsequently interpret information to better understand the influences on critical care nurses in the process of delivering CRRT. With an absence of data on the influences on critical care nurses decision-making with CRRT the

methodological approach taken was grounded in methods and findings of other critical care research on associated topics.

Contextualising the findings in the approaches taken to generate them enables an understanding as to the validity of these results and ultimately their Credibility, Transferability, Dependability, Confirmability (Lincoln and Guba, 1985) and Authenticity (Guba and Lincoln, 1989).

Credibility - The concept of credibility relates to the ability to create an agreement between the participants statements and the subsequent interpretations of these by the researcher across a particular methodological approach. Measures to increase credibility include establishing sufficient contact with both participants and the context in order to gain enough information; to gain insights from different perspectives to obtain a complete picture of the setting; to use individuals with insights on the area to assess and evaluate findings and interpretations; by triangulating, the process of using other sources of data to enlighten each other, and through member checks by asking participants to check the data analysis to ensure it is an accurate reflection of their opinions. This study addresses the challenge of credibility through several approaches. Firstly, participants words are used throughout the findings in this thesis to reiterate and reflect their opinions and perspectives, the interviews took place over across an 18-month period during this time and whilst not embedded in participants everyday practice understanding and engaging with developments and evolving perspectives enabled ensured that the content of the interviews is an honest and reflective account of their points of view.

Transferability is the ability to show that findings have applicability in other contexts, this is largely achievable via appropriate sampling and context, where the subject matter under discussion can be related to other scenarios to a greater or lesser degree. Aiding transferability can also be achieved via thick description. This is the process by which rather than recording detail there is a process by which information begins to be interpreted and 'circumstances, meanings, intentions, strategies, motivations and so on characterize a particular episode' (Schwandt, 2001, p.255). In this study transferability was targeted through the specific sampling of staff whose opinions were current, applied, and relevant to the contemporary CRRT practice. In interviewing these participants and exploring the intricacies of their opinions whilst contextualising these to the clinical and personal circumstances rich thick description was obtained and is usable for the reader to interpret.

Dependability relates to the stability of data over time. Due to the emergent nature of qualitative research opportunities to use fixed standardisation process are limited compared

with that in quantitative approaches, like imposing strict controls on variables. Ensuring dependability is essential to drive broad changes in practice. Qualitative researchers provide an audit of the methods, decisions and interpretations made in a study, so that these and the logic underpinning them may be tracked and appraised. Within this study, a number of approaches were taken to strengthen its 'dependability', throughout this thesis there are details of the process of how the research was performed (See section 3.1.2), the use and inclusion of an interview guide (Appendix E) also enables oversight of the leading topics and questions for the semi-structured interviews. The study whilst incorporating the perspective of supervisors does however lack further broader inclusion of peer input in the analysis process. However, Appendix H details the iterative process of developing themes based on feedback from supervisors and feedback and input from peers at scientific conferences.

Confirmability is associated with reliability of the findings, are interpretations consistent both within the study and in the wider context? Confirmability does however acknowledge the perspective of the researcher but ensures that methodological biases are accounted for (Given, 2008) but not exclusively 'figments of the researchers' imagination' (Guba and Lincoln 1989 p243). Efforts to ensure confirmability aspects were addressed and measures adopted throughout the interview process with participants asked to provide clarification on statements and the generation of the thick description noted in the findings seeks to detail where the assertions from participants generated from for the findings and subsequently lead to the conclusions of this study.

Authenticity was advocated to the complement the principles of trustworthiness to address the positivist stance of the existing Lincoln and Guba (1985) criteria. Authenticity rather than focussing on the validity and reliability of qualitative research it addresses the influence of the investigation on the community being researched and whether it is worthwhile. The criteria for establishing authenticity are fairness – do researchers ensure that participants have equal access to contribute to the development of the findings and do the researcher and participants develop relationships past the typical questioning and answering scenario. Ontological authenticity – does the research raise the levels of awareness surrounding the topic under investigation. Educative authenticity - The research should demonstrate that participants understand the opinions and stances of others. Catalytic authenticity relates to the extent to which the research has stimulated some form of action of the research participants and Tactical authenticity refers to the empowerment of participants to engage in action as a group in order to change circumstances.

This section attempts address these concepts in relation to the study and where measures have been adopted to both improve Trustworthiness and Authenticity.

5.6.1 Participant Observation

The initial ethics committee approved submission and design of this research sought to include the conduct of participant observation during clinical practice and specifically the management of CRRT. Participant observation (PO) is a naturalistic data collection method, which is concerned with the reliable depiction of the research participants' point of view. Murphy and Dingwall (2007) believe that observation is the gold standard for exploring processes. It allows researchers to learn about the activities of the participants through the observation and participation in their activities. It provides data on the physical environment and its patterns, the behaviour of people and the interactions between them. The rationale for its proposed use was the perceived value of carrying out PO to enable triangulation of data obtained during the semi-structured interviews and explore concordance with the opinions and perspectives of the interviewees and their physical behaviours and actions during clinical practice.

This assumption was supported by Blanford et al (2015) who identified a number of studies, which examine the use of technology in a hospital setting many of which used observational or interviews methods. Highlighting that whilst it is possible to conduct studies in laboratories or simulated environments, in situ studies are essential for examining the detail of interaction.

Using PO would have allowed a focus on individuals' behaviours within their usual environment and their interactions with colleagues, a particular strength of PO (Mulhall, 2003), enabling an approach sensitive to non-verbal expressions of staff; and ascertaining who interacts with whom and how this is performed, alongside understanding how much time is spent on various activities related to CRRT.

Two approaches to observation exist – structured and unstructured. Mulhall (2003) suggests that structured observations take the form of using predetermined taxonomies from known theory to attach observation to. Whereas unstructured observations enable an interpretivist relationship between the observation, researcher, and context. Consequently, as clinical decisions are made related to CRRT often take place in dynamic, unpredictable and stressful environments often without any predefined notice the choice of an unstructured PO approach was considered appropriate in order to best facilitate data collection.

This is reaffirmed by Mulhall (2003) who identifies that observers using an unstructured method have no predetermined conceptions (as with GT), but some idea of what to observe

but this may evolve over time. This study from the outset was interested in the interaction between individual, CRRT technology and patient and generating an encompassing theory.

Despite the planning and preparation for PO, alongside obtaining the necessary approvals to conduct the PO, no observations were undertaken for this study. The reason for this was three-fold.

During the initial phase of recruitment in Autumn 2017, there was a desire to conduct the CCTDI testing, semi-structured interviews, and the participant observation for individual participants in relatively quick succession. As the ability to conduct the CCTDI and the interviews were only reliant on the availability of the researcher and participants these were straightforward to mutually organise and conduct. The conducting of the PO was however reliant on the alignment of patients on the critical care units receiving CRRT, the participant being on duty and allocated to the care of these patients and the availability of the researcher to be able to conduct the PO at the time. It became apparent that there was a lack of opportunities to undertake these periods of observation in part because what appeared to be the lack of patients receiving CRRT on the accessible critical care units at this timepoint. Consequently, the decision was made to remove the focus from this element of the study and be more opportunistic when appropriate occasions for observations arose. Subsequently focus on the delivery of the CCTDI and interview elements of the study was chosen. Participants were made aware of this approach during the consent process and after the interviews. Ultimately this approach failed to yield any observations and was further hampered by the need for the researcher to take a 12-month period of intercalation from June 2019 to June 2020, by which time the environment on the critical care units was not suitable to enable to the conduct of the PO due to the continued impact of the Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic. At this point a difficult decision was taken to abandon the PO component of the study. Based on the findings of the interviews of this study there is still value in the PO element in this study and consideration for its inclusion in future research is being assessed, as discussed in section 6.7.

5.6.2 Positionality

My credibility in exploring this topic is as a previous critical care nurse and co-worker of a number of the individuals interviewed for this study. And also, as someone who has engaged in the supervision, teaching and support of other healthcare workers using CRRT, along with the auditing of its use established my credibility in exploring this topic. My positionality, largely my experience and existing relationship in regard to the participants has the potential

to influence both the context and interpretation of these data gathered throughout this study in both positive and negative manner. I expand on this next.

Firstly, this insight and existing relationships with participants enabled what I believe to be frank and honest conversations around the conduct of CRRT locally. This postulation is partially borne out by the use of the phrase 'you know' used throughout the discussion indicating my pre-existing understanding and relatability to the participants and also the relaxed manner of the interviews, which contained laughter both ironic and genuine. Whilst laughter may be used as a defence mechanism to avoid further questioning (Nairn et al, 2005) on reflection I do not believe this to be the case throughout these interviews. The relationship between interviewer and interviewee is an important one and due to pre-existing relationships, rapport was quickly built during the data collection stage of the study, there was clear respect throughout from the questions being asked and the opinions offered back from the critical care nurse. However, it is acknowledged that according to Kvale (2002) that qualitative interviews generate an asymmetrical power relationship between the interviewer and interviewee whereby research interviews are a one-way dialogue in part because the interviewer defines the interview situation and conversations, the interview is instrumental in nature to serve the purpose of data collection. Assessing the equality in an interview is difficult however mitigations of these elements existed and align with Kvale (2002) suggestions in avoiding a consensus-seeking interview dialogue. In the Participant Information Sheet (see Appendix G) it is transparent that the participant can use this interview for their own means by reflecting on their own practice with CRRT. This was evident as a number of participants took time to consider their answers and in observing their behaviours. At points there appeared to be realisation of a number of factors (the influence of POCT, variations in support) that they could then reflect on. The opportunity also allowed them to potentially use the discussions as part of their NMC revalidation process (there was evidence of a participant using their interviews in such as fashion). These features and relationships I hoped made participating in the interviews more like every day clinical conversations between equal partners.

I believe these aspects and these relationships led to the rich, thick, and nuanced descriptions provided by participants and enabled the level of insight obtained in this study. These characteristics of this data enables readers to determine the concepts of transferability to their setting. This is partly due to the interviewer-interviewee power dynamic which was clear and comprised of a mutual understanding, trust, and respect for across both parties and that despite pre-existing relationship any interview content would be managed sensitively.

5.6.3 Sample

This study sought healthcare workers, with exposure to CRRT working permanently on one of the four critical care units across the study setting, in order to provide perspectives and insights into the study phenomenon. Participants were invited to be involved in the study by posters in rest areas along with an invite email sent from a clinical nurse educator to all the permanently employed Band 5 and 6 nurses working within critical care. Whilst a purposive sampling approach was employed, in order to maximise the elucidation of any insights, ultimately it was uncovered through ad hoc conversations with participants that that those who were asked to participate agreed because it was recommended to them by a colleague. Participants were neither asked nor asked not to refer potential participants for the study.

There were a limited number of willing participants who wished to be interviewed who had a smaller duration of CRRT and Professional experience. Consequently, a majority of the participants interviewed had 5 years or greater experience. This limits the contribution to this model from those with lesser experience.

A large proportion of the interview content focussed on staff new to CRRT and what was viewed as appropriate ways to train or educate them on CRRT. This study misses the input of those new starters where their perceptions may have been able to add a specific beneficial perspective on CRRT. However, the research does capture the perspectives from individuals who have been through the process of learning about CRRT, albeit many of them a number of years previously, or who have guided others through learning CRRT more recently.

The individuals participating in this study had the experience (both critical care and CRRT) to offer valuable and credible opinion on the influences on CRRT delivery. The attempt to differentiate them using the CCTDI was not effective. Accessing staff with a broader critical thinking disposition, if they exist in a critical care environment, may improve transferability.

5.7 Implications for future research

The primary focus for this study was ‘Developing an understanding of the factors that influence critical care nurses’ decision-making in the management of patients receiving Continuous Renal Replacement Therapy’ and the conduct of this research took place in the absence of any CRRT specific exploration on this topic. Whilst this evidence demonstrates a number of contributory factors for the sample interviewed, it highlights the possibility for future exploration on this topic.

5.7.1 Replication in other staff

This study was conducted with a group of critical care nursing staff in one NHS Hospital Trust across four intensive care units. With variability across healthcare highlighted and moreover CRRT (Bellomo & Schneider, 2014; Intensive Care Society, 2009), there would be value in the wider exploration of these issues with staff in other critical care areas both nationally and internationally. This would enable the corroboration of the proposed model of influences and enable a bespoke understanding of local influences and ways to address resolvable issues.

This study sought individuals with experience and excluded individuals without experience of CRRT as the participating sample of interviewees in this study, whilst this sample was appropriately reflective of the nurses delivering CRRT in these specific clinical areas, there are likely other cohorts of staff whose opinions are not represented. These may include critical care nurses just beginning their experiences with CRRT, medical staff using CRRT, nurse educators or the senior critical care leadership. Future exploration of these groups may add value or continue to help further contextualise the content of these findings.

A broad range of themes were identified throughout this study, the content of opinions of these themes sit along a continuum without a harmonised stance across all these themes. A number of approaches to address the influencing factors have been proposed within the implications section, such as employing evidence based educational approaches, or utilising Professional Nurse Advocates to better support clinical supervision. However real world understanding of the perceived relevance and preferences toward these approaches may aid implementation and engagement. The use of Q-methodology or Discrete Choice Experiment (DCE) whereby scenarios of dichotomous questions based on the themes, identified within this study, can be asked to understand staff preferences on approaches or provide wider support for the themes. Based on some of the discourse raised, questions could include whether critical care nurses would prefer approachable or knowledgeable staff, hands on versus didactic teaching, heparin or citrate systems, caring for a patient in a cubicle or main unit, seeking advice from a protocol or person, commencing CRRT training at 6 months or yearly training. The approach of a DCE or Q-methodology allows for insight for a greater number of staff across potentially wider geographical contexts in a standardised manner, focussed on prioritised questions. In contextualising individuals' attributes (i.e., age, AfC Banding and clinical experience) results would allow a customised understanding of preferences. The potential of this approach would allow access to a larger and broader group of staff, enable uptake from those staff who would have avoided interviews and ultimately further hone implications and resolutions for practice, however they fail to generate the rich, granular insights provided by the approach taken in this thesis.

5.7.2 Eye tracking studies on CRRT

The potential of (in situ) high fidelity simulation to maximise learning opportunities regarding CRRT has been raised. Whilst some of the value of high-fidelity training is on the realism to scenarios faced in everyday work. Simulation allows for the opportunity to both allow pre-briefing, the simulation task and subsequent debriefing in order to prepare, act and reflect on learning.

It has been postulated that the use of eye tracking technology during clinical simulations offers the potential to gain new insights into the individuals' visual attention and latent cognitive processes governing their performance, that may not otherwise be gleaned from observation or interview (Henneman et al, 2017). The concept of eye tracking is that the measuring and recording of an individual's eye movement and the duration they spend fixated on an item is indicative of the cognitive process related to those items along with any subsequent actions (Brunyé et al, 2019).

Previous exploration of the use of eye tracking in extracorporeal circulation in a cardiac surgery context has occurred (Tomizawa et al, 2012) demonstrating a successful proof of concept. This enabled the researchers to identify Areas of interest (AOI), the number of fixations towards an AOI and transitions between information sources. Its application to a critical care CRRT scenario would therefore be potentially technically feasible, however there would be significant ethical barriers to overcome in the video recording of incapacitated adults within critical care, however these have been overcome in previous critical care studies. (Grundgeiger et al, 2010)

5.7.3 Does the CCTDI (and others) predict retention of critical care nursing staff, would this enable support for simulation training.

Whilst the majority of the evidence associated with the CCTDI is derived from studies of undergraduates, predominantly nurses, the inclusion of the CCTDI in this study was to aid in the sampling process of what was expected to be a heterogenous sample, in relation to their individual characteristics associated with decision-making. As an aside the results however demonstrate that there is largely a positive skew in critical care nurses critical thinking disposition. As the sample size was small in this study, in the future readministering the CCTDI in a larger sample of critical care nurses, may provide more confidence towards the direction of any skew associated with critical care nurses critical thinking disposition.

When these results are viewed in the context of the nurses taking part in this study having greater than 5 years professional and critical care experience, it raises the question as to whether working in critical care areas positively influences critical thinking disposition (and

other critical thinking measures) or whether individuals with positive critical thinking attributes are attracted to critical care areas and remain for the medium to long term.

Understanding the relationship of these characteristics would enable both the introduction of a recruitment process for critical care nurses that had more depth and substance and potentially be more successful in ensuring that critical care units mitigate attrition of nurses, but also develop more personalised induction programmes in order that staff are supported appropriately when they start.

This use of the CCTDI has been use in quasi experimental studies in education settings for pre-service teachers Temel (2014). No evidence was apparent detailing its use in the nursing recruitment process making it an ideal opportunity for future research.

5.8 Summary

This chapter has discussed the findings of this thesis and examined them against the existing literature in critical care nurses decision-making regarding therapeutic interventions, where there was sizeable alignment with the constituents from the Who?, Where?, and How? model generated as part of the preceding literature review. With specific themes being represented such as individual clinician factors, experience, and support. This theme alignment did not always represent the findings in the literature, such as contrary perceptions on the influence of fatigue and the differences in perceptions in autonomy in comparison to other interventions.

The chapter further explored the impact these findings have on the future of CRRT delivery with the development of automatic biofeedback systems and the importance these findings have on maturing these systems and the resultant impact these systems will have on critical care nurses decision-making.

Next, an alternate approach to conceptualising these data was offered, where the critical care nurse was centric to the influences of the organisational, practice and support themes and how this both burdens the critical care nurse but makes them vitally important in mitigating the wider influences on the delivery of CRRT. With an important aim of the study being the opportunity to highlight areas where improvements in practices can be made to improve both patient and organisational related quality indicators of CRRT. These strategies were significant, evidence based, with a focus placed on approaches to address some of the modifiable themes raised throughout the findings, such as measures like the Professional Nurse Advocates and optimised training programmes.

Using Lincoln and Guba (1985) and Guba and Lincoln (1989) discussion is then detailed on the strengths and weaknesses of the study and ability to demonstrate its Trustworthiness and Authenticity. Finally, the implication for future research is discussed with approaches to replicate this study in other critical care staff groups, the use of eye tracking technology to enable greater understanding of critical care nurses real time relationship working with CRRT and the value of using the CCTDI as a means to determine whether psychometric testing plays a role in the recruitment and retention of critical care nurses. The following conclusion chapter will draw together the significance of these findings and the new knowledge and contribution this makes to the existing literature.

Chapter 6 Conclusions

This thesis set out to answer the question of 'what are the influences on critical care nurses' decision-making in the management of Continuous Renal Replacement Therapy', in doing so to develop an understanding of these factors and highlight where improvement in practices can be made for the benefit of both patients and organisations. The thesis identified that there was a lack of research literature specifically focussed on decision-making in CRRT (section 2.2.2) but there was literature associated with decision-making in critical care (section 2.2.3). This literature was interpreted to contain key themes associated with decision-making in critical care to Who?, Where? and How? which in themselves contained sub themes associated with experience, individual clinician aspects, collaborative approach (Who?) culture and organisation (Where?), and decision processes (How?).

These themes were taken and used to guide 10 semi structured interviews in an Interpretive Description aligned study to explore critical care nurses opinions on the topic. In order to provide a rich data set, participants were also asked to complete the California Critical Thinking Disposition Inventory to contextualise their attitude to decision-making.

The findings presented identified four major themes from the interviews; Individual, Organisational, Practice and Support, which were associated as having the influences on decision-making and the delivery of CRRT. Several of these themes aligned with the wider critical care literature, but this study provided new and specific insights into the role of nurses autonomy in CRRT and the perceived value of Point of Care Testing. In addressing the future of CRRT provision these findings were related to the concept of the 'ideal CRRT machine'. This study has highlighted areas where improvements in practices can be made to improve both patient and organisational related quality indicators of CRRT, through intervention focussed on staff.

This study concludes that these aspects have not been investigated before and that this thesis has created new knowledge on this topic and interpreted in such a way that has been able to generate new ideas which can be applied in practice to improve the quality of CRRT. In doing so this thesis attempts to address the agendas highlighted by Thompson et al (2013) to strengthen the evidence in fostering effective clinical reasoning at the point of care, and also fulfil one of the research priorities in intensive care raised by (Blackwood et al, 2011) to which 'factors influencing nursing staff behaviours' was highlighted as an issue. This focus on the individual worker and examination of their decision-making in relation to CRRT has generated an understanding of behaviour and will now enable improvements in learning and teaching,

alongside the usability of CRRT technologies, all of which can be utilised to subsequently improve patient and staff outcomes.

6.1 Reflections

This thesis represents the product of my commitment and enjoyment to delivering the research process over the past eight years. As someone who is passionate about understanding research, irrespective of the topic area, or delivering it as part of a professional role, completing this thesis has brought me the satisfaction of many 'aha moments' and the often-daily challenges of overcoming the interpretation of data or 'writers block'. Despite the initial excitement of this journey like many, it has not been the easiest. I have had the challenges of integrating this PhD with full time employment in healthcare, with limited support from my employer, this alongside the daily trials and tribulations of what are now teenage children. These personal challenges culminated with a terminal diagnosis and ultimately the death of my father with the end of this project in site, leading to me taking a year out of my studies to focus on mine and my family's needs.

Over the course of the eight years in delivering this research, academically I have dealt with the challenges of changing supervisors for retirement and ill health reasons, which incrementally resulted in a completely different set of supervisors from where I started. Finally, like many, the SARS-CoV-2 pandemic played a significant role in the ability of me being able to deliver this study as I initially envisaged and influence the direction of this research as elements were not able to be fulfilled.

These challenges have empowered me to reflect on this PhD programme and recognise that 'life happens' and dealing with circumstances is part of the learning process. As a consequence, I now recognise in myself a number of traits that have been instrumental in completing this thesis. Firstly, my ability to adapt throughout, from the understanding of the many obstructions in delivering this research and accounting for these through redesign processes; through to my adaptability shown in the capability of working with others and acknowledging different approaches and styles and appropriately managing these changes. Simultaneously, whilst having the open-mindedness to listen to new ideas, suggestions, and approaches to improve the qualities of the work and avoiding preconceived approaches, all with the ends of producing the highest quality work possible. Despite all these challenges I realised my personal resilience to deliver when I have been personally, professionally, and academically challenged which has resulted in my commitment to finishing the thesis to a standard of which I am pleased with. These personal qualities I have learnt about myself over the course of the years, alongside the knowledge, skills and experience that undertaking this

PhD has given me, I believe will help me further develop my ability, and desire, to continue and progress in a career focussed on research.

Accordingly, my post-doctoral ambitions lie in the continuation of some of the future work highlighted in this thesis, specifically I would be keen to look at designing strategies that could be used to support staff managing CRRT and their impact on improving quality, additionally my interest has been piqued by the potential utility of the CCTDI in the recruitment process of nurses and whether it can be used to identify nurses more suited for working in critical care environments and consequently aid in the increase of staff retention rates. More broadly however, my research interests are focussed on understanding the influences of healthcare professionals behaviours, and the approaches available to either optimise or mitigate improved outcomes for staff, patients, and organisation. These, however sit alongside a longstanding desire to conceptualise, deliver, and interpret clinical research focused on critical care areas.

6.2 Final Statement

This work has demonstrated the absence of data on the influences on critical care nurses when managing and making decisions on CRRT. This study went on to address this lack of evidence and provide new knowledge and insights on the topic. It used data gained from interviews with critical care nurses, to propose that the influences situate in four key themes: Individual, Organisational, Practice and Support. In turn recommendations are then provided to aid the mitigation of some of these influences to improve the quality in the delivery of CRRT.

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Wong, S., Vanderspank-Wright, B., Bourbonnais, F. F., Tousignant, K. & Wright, D. K. (2020) Intensive care nurses providing end-of-life care in a community hospital. *Canadian Journal of Critical Care Nursing*, 31(3), 23-30.

Wright, S. E., Bodenham, A., Short, A. I. K. & Turney, J. H. (2003) The provision and practice of renal replacement therapy on adult intensive care units in the United Kingdom. *Anaesthesia*, 58(11), 1063-1069.

Yura, H. & Walsh, M. B. (1978) *The nursing process: assessing, planning, implementing, evaluating*. Appleton-Century-Crofts.

Appendix A – Literature Review Matrix (Example)

Author & Year	**Purpose of Study**	**Type of study & Data Collection Methods**	**Setting & Participants**	**Major Finding**	**Recommendations**	**Comments**
Subramanian et al. (2012)	Explore nurses challenges in managing pain in critically ill patients.	Qualitative. Purposive Semi Structured 1-1 "in depth" interviews using Critical Incident Techniques. Data analysis using a framework developed by the National Centre for Social Research.	21 nurses from a single UK Institution.	Identified 4 main challenges. Lack of Clinical guidelines, lack of structured assessment tool, limited autonomy and patients' condition.	As the nurses perceived it is a role that they can perform the use of guidelines and training might go some way to improve the challenges identified.	Appears that there are simple approaches that can be adopted to address this issue. No justification for sampling or discussion around saturation. No details provided regarding the relationships between participants and researcher.

Appendix B – Critical Appraisal Skill Programme Checklist (Example)

CASP
Critical Appraisal Skills Programme

Paper for appraisal and reference: Subramanian et al (2012)

Section A: Are the results valid?

1. Was there a clear statement of the aims of the research?

Yes ✔ | Can't Tell | No

HINT: Consider
- what was the goal of the research
- why it was thought important
- its relevance

Comments: Sound rationale and supporting context, identifies the space where this research sits. Contributes to the factors that affect Critical Care nurses decison making

2. Is a qualitative methodology appropriate?

Yes ✔ | Can't Tell | No

HINT: Consider
- If the research seeks to interpret or illuminate the actions and/or subjective experiences of research participants
- Is qualitative research the right methodology for addressing the research goal

Comments: Looking for intrepretaion of and meaning to pariticpants to seek clarification and understanding of their experiences.

Is it worth continuing?

3. Was the research design appropriate to address the aims of the research?

Yes ✔ | Can't Tell | No

HINT: Consider
- if the researcher has justified the research design (e.g. have they discussed how they decided which method to use)

Comments: Discuss role of interpretive designs. Approaches appropriate to ellict nurses' descriptions of challenges. Adopts a Critical incident Techniques references and justifies

CASP
Critical Appraisal Skills Programme

6. Has the relationship between researcher and participants been adequately considered?

Yes	
Can't Tell	
No	✔

HINT: Consider
- If the researcher critically examined their own role, potential bias and influence during (a) formulation of the research questions (b) data collection, including sample recruitment and choice of location
- How the researcher responded to events during the study and whether they considered the implications of any changes in the research design

Comments: No details provided regarding the relationships between participants and researcher. No obvious between lead author and site

Section B: What are the results?

7. Have ethical issues been taken into consideration?

Yes	
Can't Tell	✔
No	

HINT: Consider
- If there are sufficient details of how the research was explained to participants for the reader to assess whether ethical standards were maintained
- If the researcher has discussed issues raised by the study (e.g. issues around informed consent or confidentiality or how they have handled the effects of the study on the participants during and after the study)
- If approval has been sought from the ethics committee

Comments: Ethical approval sought and gained but no direct reference to the ethical challenges/risks posed in the study.

CASP
Critical Appraisal Skills Programme

8. Was the data analysis sufficiently rigorous?

Yes	✔
Can't Tell	
No	

HINT: Consider
- If there is an in-depth description of the analysis process
- If thematic analysis is used. If so, is it clear how the categories/themes were derived from the data
- Whether the researcher explains how the data presented were selected from the original sample to demonstrate the analysis process
- If sufficient data are presented to support the findings
- To what extent contradictory data are taken into account
- Whether the researcher critically examined their own role, potential bias and influence during analysis and selection of data for presentation

Comments: Absence of study specfic details around the analysis framework. Overarching approach discussed. Good level of supporting evidence for the themes provided. Not a great deal of contray evidence presented. No personal biases or influences discussed

9. Is there a clear statement of findings?

Yes	✔
Can't Tell	
No	

HINT: Consider whether
- If the findings are explicit
- If there is adequate discussion of the evidence both for and against the researcher's arguments
- If the researcher has discussed the credibility of their findings (e.g. triangulation, respondent validation, more than one analyst)
- If the findings are discussed in relation to the original research question

Comments: Findings are clearly displayed and intrepreted. However discussion focuses on findings with no commentary on methodological approach

CASP
Critical Appraisal Skills Programme

Section C: Will the results help locally?	
10. How valuable is the research?	HINT: Consider • If the researcher discusses the contribution the study makes to existing knowledge or understanding (e.g. do they consider the findings in relation to current practice or policy, or relevant research-based literature • If they identify new areas where research is necessary • If the researchers have discussed whether or how the findings can be transferred to other populations or considered other ways the research may be used
Comments:	Paper identifes its contribution in the wider context of pain management research and suggests recommendations and contextualises the ability for it to be generalised whilst adovicating local approaches. Provides a useful example for the context of this literature review

Appendix C - CCTDI Pre completion questions

Personal Details

Unique Identifier.....

Age ☐ **Gender** Male ☐ Female ☐

Employment Status Part Time ☐ Full Time ☐

Professsion Nurse ☐ Doctor ☐ AHP ☐ Anaesthesia ☐ Intensive Care Medicine ☐

Grade (Nursing Band/.....) ☐

Speciality Qualificatic .....

Highest Qualification

- **Doctoral** ☐
- **Masters** ☐
- **Degree** ☐
- **Diploma** ☐

Professional Experinece (years) ☐

Critical Care Experience (years) ☐

CRRT Experience (years) ☐

Frequency of using CRRT

- **Per Shift** ☐
- **Weekly** ☐
- **Monthly** ☐
- **Less Frequently** ☐

Appendix D - California Critical Thinking Disposition Inventory (CCTDI)

Due to rights restrictions, the content of the CCTDI cannot be included within the Thesis. However, the instrument manual can be accessed from the link below.

CCTDI User Manual 2017.pdf

CCTDI User Manual and Resource Guide (Insight Assessment/ California Academic Press, 2017)

After consultation with the chair of the University of Hull Faculty of Health and Social Care ethics committee access to the instrument access was provided to an independent peer reviewer (Dr Peter Draper) this adheres to the publisher's terms and conditions and licensing agreements.

Editing or deleting items from the instrument is prohibited due the effects this will have on the instruments validity and reliability; the instrument must be accepted in its entirety.

Appendix E - Decision-making in CRRT Semi- Structured Interview guide.

Introduction

- Start to build rapport.
- Ensure they are happy with it being audio recorded. I'll be taking occasional notes.
- Reiterate that participation is completely voluntary, and all data is completely confidential.
- Explanation of the research project.

Experience

Can you tell me what experience you think is important when you make decisions in CRRT?

Prompts Educational and Clinical and in house training or external.

Probes Why do you think this is?

Individual Clinician Factors

Do you feel that anything directly affects you and your decision making about CRRT?

Prompt Type of shift, Professional Role, Fatigue, Degree of Autonomy

Collaboration

Tell me about how you think the relationship works between you and your colleagues when making decisions about CRRT.

Prompts Differing professional relationships, experience of other colleagues, support structure, effectiveness of communication, conflict.

Organisation and Culture

How do you think the department is set up for managing CRRT?

Prompts Support (Critical care vs Nephrology), Guidelines.

Decision Processes

Can you talk me through how you make decisions in relation to CRRT?

Probe What do you look out for

Prompts Assessment, Data Availability, Forward planning.

Context

What type of circumstances do you think circumstances affect your decision making?

Prompts Types of Patients (Sepsis/AKI), Longer term CRRT. Your knowledge and experience of the patient. If the decisions are based on your assessments or somebody else's.

Close Out

Any questions you would like to ask me?

Arrangements for observation stage of the study.

Thank Participant.

Appendix F – Invite Poster

Appendix G - Participant Information Sheet

Hull and East Yorkshire Hospitals NHS Trust

University of Hull
Faculty of Health and Social Care

Participant Information Sheet

Study Title

Exploration of critical care nurse's decision making in the daily management of Continuous Renal Replacement Therapy.

I would like to invite you to take part in a research study. Before you decide if you want to participate, you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything is not clear or if you would like more information. Take time to decide whether or not to take part.

What is the purpose of the study?
This study aims to explore the factors that influence the decision making of nurses in Critical Care during the clinical management of Continuous Renal Replacement Therapy (CRRT). Decision making in other clinical aspects of Critical Care provision have already been explored, for example in areas such as weaning patients from mechanical ventilation, extubation and the titration of sedation and analgesia. However, there is a limited insight into this process during the management of CRRT.
It is hoped that this research will provide these insights which will help practice educators focus on specific aspects during training and consequently aid improvements in patients' outcomes.

This research is being conducted as part of a PhD at the University of Hull.

Why have I been invited?
You have been asked to participate in this research as you are a registered nurse working within Critical Care, with experience of making clinical decisions whilst managing patients receiving CRRT. For this reason, I am keen to get your thoughts on providing CRRT.

Do I have to take part?
No. It is up to you to decide. We will describe the study to you and go through this information sheet with you. You can take as much time as you like to consider participation. You do not need to provide a reason if you do not wish to participate.

What will happen to me if I take part?
If you wish to take part and have had any questions answered suitably, you will be asked to sign a consent form to indicate that you are happy to participate. You will still be free to withdraw your consent at any time, without having to give a reason.

Study Events

- After consent, you will be asked to complete a short questionnaire regarding your professional history and information about your experiences with CRRT. Along with a 20-minute online questionnaire looking at how you make decisions. These will be used to guide future discussion.
- Arrangements will be made to interview you to discuss what influences your decision making when you manage CRRT.
- This interview should last a maximum of 90 minutes and will be conducted in a meeting room away from the clinical area ensuring there are no interruptions and that your privacy is maintained. All interviews will be audio recorded to enable detailed analysis later.
- At the end of your interview, arrangements will be made to observe you in practice to see how the issues raised during the interview become apparent in clinical practice or if other issues become noticeable whilst managing a patient undergoing CRRT.
- During observation stage, hand written notes will be made to help determine any links in practice, observations of behaviour and clinical interactions. This observation will last a maximum of 6 hours but can be adjusted to suit your wishes. After this period of observation, a further ten-minute follow up interview will be held to allow the researcher to clarify any issues that may have arisen and allow you the opportunity to ask any questions.

All the information collected from these episodes will be anonymised and you will not be able to be identified from the data collected.

Expenses and payments?
You will not receive any payments for participating in this research.

What will I have to do?
You will be expected to be available for interview and observation at mutually acceptable times and honestly discuss your thoughts on a number of topics related to providing CRRT.

What are the possible disadvantages and risks of taking part?
Participating will involve you providing about 90 minutes of your free time. The study will involve discussions around aspects of care related to providing CRRT. These discussions are to gain any insight into practice rather than look at your ability or technical understanding. It is not envisaged that discussions will explore any issues that would be considered sensitive.
This research is not design to assess individuals' competence at providing CRRT and no formal assessment or feedback on performance will occur.
If after participation you feel you would like more feedback on how you provide CRRT, arrangements can be made for you to discuss your needs with the Critical Care Clinical Nurse Educators or a Consultant Intensivist.

What are the possible benefits of taking part?
There is no expected direct benefit to you taking part in this research. However, participating in this research may help you facilitate reflective practice, contributing to part of your professional revalidation process.

What if there is a problem?
If you have a concern about any aspect of this study, you should ask to speak to the lead researcher (Neil Smith 01482 674457), who will address your problem.

If you remain unhappy and wish to complain formally about the study, you can do this by speaking to
Dean of Faculty of Health and Social Care, University of Hull.
Professor Julie Jomeen. j.jomeen@hull.ac.uk (01482) 464581
or
Hull and East Yorkshire NHS Trust Research and Development Manager.
Mr James Illingworth. James.illingworth@hey.nhs.uk (01482) 461903.

Will my taking part in the study be kept confidential?
All research information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the hospital will have your name and address removed so that you cannot be recognised.

Once you have signed a consent for your personal details will be allocated against a randomly assigned code. Only the Chief Investigator will have a record linking you to this code.

Data in this this study will be collecting in both handwritten and audio form, of which some will be subsequently transferred into electronic format to aid in analysis.

- Individual participant research data, such as the questionnaire and interviews will be anonymous and identified by a code, only known to the researchers.
- Direct quotations from interviews may be used in publications but these will be anonymised.
- A master list identifying participants to the research codes data will be held on a password protected computer accessed only by the researcher.
- Hard paper data will be stored in a locked cabinet, within locked office, accessed only by researchers.
- Electronic data will be stored on a password protected folder on secure NHS data server, which is only accessible to the researchers.

- With your consent, the anonymised data generated from your participation in this research will be used in future suitably approved research, investigating Critical Care practice.
- The Chief Investigator (Neil Smith) will have access to view identifiable data, this will only be shared with supervisors if deemed necessary.
- Data will be retained until 10 years' post completion of the PhD (Expected to be 2030) and written transcripts will be destroyed using confidential waste procedures, electronic data will be destroyed using data wiping software.

If during the observation period a patient is put at risk the observer will intervene to help prevent the patient coming from harm. In this scenario, the incident will be reported to your line manager for further follow up.

It is necessary to store data relating to the California Critical Thinking Disposition Inventory (CCTDI) outside the European Economic Area. This data will be securely stored on servers controlled by California Academic Press but therefore may not be subject to the same protections afforded by the Data Protection Act (1998)

All other procedures for handling, processing, storage and destruction of data comply with the Data Protection Act 1998.

Who has reviewed this study?
This research has been reviewed by the University of Hull Faculty of Health and Social Care Research Ethics committee to ensure the rights, safety, dignity, well-being of potential research participants are protected.
If you have a complaint about the ethical aspects of this study you can contact the Chairperson for the committee via shsw-ethicssubmissions@hull.ac.uk

What will happen if I don't carry on with the study?
If you withdraw from the study we will destroy all your identifiable data/ tape recorded interviews, but data already collected up to your withdrawal will be used.

What will happen to the results of the research study?
The results of this study will form a major part of my thesis of decision making in Critical Care. The results will also be written up for presentation at healthcare conferences and for publication in peer reviews journals. If you wish to see the results of this result this can be requested. In any report/publication you will not be identifiable from your data.

Who is organising or sponsoring the research?
This research is being sponsored by Hull and East Yorkshire NHS Trust and being supervised by the University of Hull. In order to conduct this research, I have received a research grant from the Intensive Care Foundation.

Further information and contact details:
If you require any further information, please contact.

Mr Neil Smith
Neil.Smith@hey.nhs.uk
01482 674457

Appendix H – Iterative Theme Development

What influences Critical Care nurses behaviours (decision making) when managing CRRT.

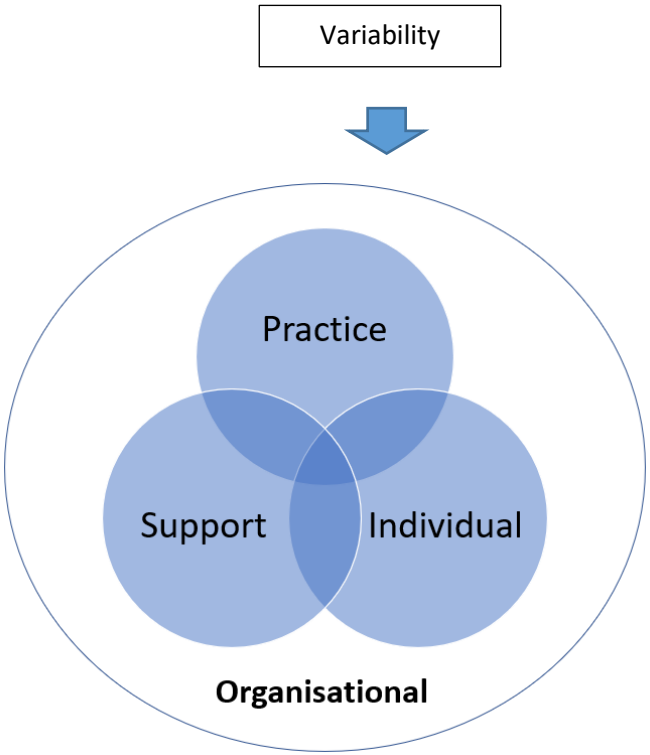
Literature

- Who?
  - Individual Clinician
  - Experience
  - Collaborative Approach
- How?
  - Decision Making Process
    - Information Acquisition
    - Assessment
    - Nursing Process
- Where?
  - Context
  - Local and Organisation Culture

First Iteration from Data (after Coding 7 interviews)

- Support
- Individual
- Organisation
- Practice

Oct 2020 Iteration



Practice	Support	Individual	Organisational
Context • Time • Location • Patient • Competing demands	Providing • Knowledge • Practical	Experience • Critical Care • Practical Experience/Exposure • Old School vs New School	Leadership • Oversight • Staff Allocation
Safety • Clinical Interactions • Consequences	Receiving • Seeking	Learning • Providing • Receiving	Documentation • Information Sources • Information Resources
	Role of Medics	Traits • Confidence • Reputation • Approachability • Knowledge – Theoretical/Technical	

December 2020 Iteration

Influences on management of CRRT practice.

Practice	Support	Individual	Organisational

Patient Element
• Safety
• Clinical Interaction
• Clinical Consequences
• Futility
• Patient Complexity
	Providing
	• Training
	• Support
	• Guidance
		Internal
		• Experience
		  ○ Critical care Exp
		  ○ Practical Experience
		  ○ Exposure
		• Knowledge and Skills
		  ○ Practical
		  ○ Technical
		  ○ Theoretical
		  ○ Communication
		  ○ Cognizance
		• Traits
		  ○ Avoiding use
		  ○ Confidence
		  ○ Proactive Behaviours
			Leadership
			• Oversight
			• Staff Allocation

Physical Element • Context • Assessment • Location	Receiving • Training • Support • Guidance	External • Colleagues • Organisational	Documentation • Information Sources • Information Resources

Machine Element • CRRT Component • Other Equipment comparisons • Heparin and Citrate systems	Collaboration, Conflict and Escalation		Busyness
Conceptual Elements • Speed • Covert Impact • Conflict • Efficiency • Time • Phases of Use			Change Management
			Role of the Medics

December 2021 Iteration

Practice	Support	Individual	Organisational

Patient Element
 	
• Safety
• Clinical Interaction
• Clinical Consequences
• Patient Complexity
	Providing
	
	• Training
	• Support
	• Guidance
		Internal
		
		• Experience
		  ○ Critical care Exp
		  ○ Practical Experience
		  ○ Exposure
		• Knowledge and Skills
		  ○ Practical
		  ○ Technical
		  ○ Theoretical
		  ○ Communication
		  ○ Cognizance
		• Traits
		  ○ Avoiding use
		  ○ Confidence
		  ○ Proactivity
		• Autonomy
			Leadership
			
			• Oversight
			• Staff Allocation

Physical Element
 	
• Context
• Assessment
• Location
	Receiving
	
	• Training
	• Support
	• Guidance
		External
		
		• Colleagues
		  ○ Approachability
		  ○ Availability
		  ○ Reputation
			Material Assets
			
			• Information Sources
			• Information Resources

Machine Element • Other Equipment comparisons • Heparin and Citrate systems	Collaboration, Conflict and Escalation		Busyness
Conceptual Elements • Speed • Covert Impact • Efficiency • Time • Phases of Use			Change Management
			Role of The Medics

January 2022 Iteration

Practice	Support	Individual	Organisational

Patient Element
 	
• Safety
• Clinical Interaction
• Clinical Consequences
• Patient Complexity
	Providing
	
	• Training
	• Support
	• Guidance
		Internal
		
		• Experience
		  ○ Critical care Exp
		  ○ Practical Experience
		  ○ Exposure
		• Knowledge and Skills
		  ○ Practical
		  ○ Technical
		  ○ Theoretical
		  ○ Communication
		  ○ Cognizance
		• Traits
		  ○ Avoiding use
		  ○ Confidence
		  ○ Proactivity
		• Autonomy
			Leadership
			
			• Oversight
			• Staff Allocation

Physical Element
 	
• Context
• Assessment
• Location
	Receiving
	
	• Training
	• Support
	• Guidance
		External
		
		• Colleagues
		  ○ Approachability
		  ○ Reputation
			Material Assets
			
			• Information Sources
			• Information Resources

Machine Element • Other Equipment comparisons • Heparin and Citrate systems	Collaboration, Conflict and Escalation		Busyness
Conceptual Elements • Speed • Covert Impact • Efficiency • Time • Phases of Use			Change Management
			Role of The Medics

May 2023 Iteration

Practice	Support	Individual	Organisational

Patient Element
 	
• *'The main thing is the safety'*
	Providing
	
	• Training
	• Support
		Internal
		
		• Experience
		  ○ Critical care Exp
		  ○ Practical Experience
		  ○ Exposure
			• **'It depends who's in charge'**
			
			• 'D*o they have the skills to look after it*'
			• Staff Allocation

• *'You've also got a lot more interactions to think about'*
• *'I'd be a bit nervous, that I did it wrong'*
• 'It all depends on complexity'
		• Knowledge and Skills
		  ○ Practical
		  ○ Technical
		  ○ Theoretical
		  ○ Communication
		  ○ Cognizance
		• Traits
		  ○ Avoiding use
		  ○ Confidence
		  ○ Proactivity
		• Autonomy	

Physical Element
• You're always going to have to do a physical assessment'
• The Rubik's Cube
	Receiving
	• Training
	• Support
	• Guidance
		External
		• Colleagues
		  ○ Approachability
		  ○ Reputation
			• **'Green Charts' and SOPs**
			• Information Sources
			• Information Resources

Machine Element • 'I prefer the ventilators' • *'Having a filter is not really a problem anymore'*	Collaboration, Conflict and Escalation • *'They'll stand with you'* • *'Too many people and too many instructions'*		• ***'It is more difficult when you have more stuff going on'***

	• *'I would defer some decisions up the chain more quickly*'		
Conceptual Elements • Phase of Use • 'It should be the same regardless' • *'If you're not running it at maximum speed then it would affect your patient'*			• **Old School, New School'**
			• ***'That would be a consultant decision'***

Appendix I – Consent Form

Hull and East Yorkshire Hospitals NHS Trust

University of Hull Faculty of Health and Social Care

Research and Development Number: ……..

Participant Unique Identifier for this trial:……..

CONSENT FORM

Title of Project: Exploration of critical care professionals' decision making in the daily management of Continuous Renal Replacement Therapy.

Name of Researcher: Mr Neil Smith

Please initial box

1. I confirm that I have read the information sheet dated 03 April 2017 (V4) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐
3. I understand that interviews will be audio recorded and that direct anonymised quotes may be used in publications. ☐
4. I understand that relevant sections of data collected about me during the study, may be looked at by individuals from University of Hull, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access this data. ☐
5. I agree that the data collected as part of this process can be used for future ethically approved research. ☐
6. In the event that during the contact observation a patient is put at risk, I am aware that the observer will intervene to prevent the patient coming to harm and subsequently this will be reported to my line manager. ☐
7. I understand and consent to having my data relating the California Critical Thinking Disposition Inventory (CCTDI) held outside of the European Economic Area (EEA). I am aware that it may not be afforded the same protection as data held within the EEA. ☐
8. I agree to take part in the above study. ☐

(Please Turn Over)

When completed: 1 copy for participant, Original for the researcher.

Decision making in CRRT Consent Form V4 03/04/2017. IRAS ID 112829

Name of Participant	Date	Signature
Name of Person taking consent	Date	Signature

When completed: 1 copy for participant, Original for the researcher.