

Acute Kidney Injury and Renal Replacement Therapy (RRT) in ICU: The Nephrology or Intensive Care Nurse Role

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ABSTRACT

INTRODUCTION: Acute kidney injury (AKI) has become a known complication of individuals admitted to the intensive care unit (ICU). The increase in AKI occurrence in ICU translates to increasing use of Renal Replacement Therapies (RRT), hence the need for more defined roles among the critical care and nephrology trained nurses.

The paper aimed to critically analyze the role of intensive care and nephrology trained nurses regarding the management of AKI patients in ICU requiring RRT.

METHODS: A review of published literature was done using the appropriate search words. The following databases were used to identify articles for the review: MEDLINE, CINAHL, PubMed, EBSCO Host and the search engine Google-scholar and Google. The criteria included reviewing literature published from 2000 to 2020. An in-depth analysis of documents and studies were done using descriptive qualitative content analysis.

RESULTS: Regarding training, entry requirements for both specialties (nephrology and intensive care nursing) include a diploma or a degree in nursing. The post-basic training for the two specialties is offered at varying levels ranging from certificate, diploma, bachelors and master's programs. In practice, three care models used by nurses when performing renal replacement therapies in ICU were identified by relevant literature. These models were the nephrology nurse-led, ICU nurse-led and the collaborative (nephrology and ICU trained).

CONCLUSION: There is a wide variation in the management of AKI patients requiring renal replacement therapy (RRT) in ICU. However, the need for nephrology nurses is evident as they will meet the current and future challenges of delivering high-quality care to patients with AKI in ICU settings.

Keywords: Acute Renal Injury, Renal Dialysis, Renal Nursing, Critical Care Nursing

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INTRODUCTION

Acute kidney injury (AKI) is a known complication of patients admitted in the intensive care unit (ICU), causing significant morbidity and mortality [1,2]. Literature reveals that 50% of ICU patients experience an episode of acute kidney injury (AKI) [3]. We define AKI as a rise in creatinine of $\geq 50\%$ from its baseline value and/or a fall in the glomerular filtration rate (GFR) by $\geq 25\%$, and/or a decrease in urine output below 0.5 ml/kg/h for six hours or more [4]. In intensive care unit (ICU) settings, an estimated 8–12% of patients need renal replacement therapy (RRT) for severe acute kidney injury (AKI) [5]. Fortunately, there have been improved use of new renal replacement therapy (RRT) methods which partially replace the level of renal function and metabolic demands for hemodynamically unstable patients with AKI in the intensive care unit (ICU) setting [1,6].

Dialysis is defined as a procedure that cleans the blood when the kidneys cannot get rid of extra water and waste products as a result of injury or diseases [7]. Literature highlights three main types of RRT modalities for AKI predominantly used in ICU. These are Intermittent Haemodialysis (IHD), Prolonged renal replacement therapy (PIRRT) [including Sustained low-efficiency dialysis (SLED)], Peritoneal Dialysis (PD) and Continuous Renal Replacement Therapies (CRRT) [7, 8, 9]. IHD results in 65 to 70 per cent reduction of blood urea nitrogen concentration in a three to four-hour treatment session [10]. PD uses catheters implanted in the peritoneal cavity per 4-hour, 6 hour or 8-hour cycles, whilst CRRT provides slower solute clearance per unit time for 24 hours a day compared with intermittent therapies.

The increased incidence and prevalence of AKI among patients admitted in ICU translate to the increased use of the aforementioned dialysis types [11]. An increase in AKI requiring RRT is now a major concern in ICU settings [12]; hence knowledge on renal pathophysiology, sophisticated resources both material and personnel to perform progressive toxin and fluid removal for the procedure are required to reduce damage and adverse effects events to the patient [13]. The successful implementation of RRT depends on the effectiveness of the entire health care team, including trained nurses. It is important to know the essential elements to be implemented in the ICU to ensure optimal RRT [14] to enhance

positive patient outcomes. On the other hand, AKI requiring dialysis is associated with high mortality, especially in limited-resource countries [15]. CRRT is widely used in developed countries to dialyze hemodynamically unstable patients, whereas developing countries rarely use this option due to lack of finances, human resources and materials [9].

RRT requires good knowledge of the technique's principles, regular basic training of health care team clear and well-followed protocols and good communication between the various stakeholders [14]. The continual increase in AKI cases necessitates the need for dialysis to become part of daily activity for nurses working in ICU, hence the need for more defined roles. All nurses (general nurses, Intensive care and nephrology trained) should take it as a shared responsibility to care for patients requiring RRT in ICU. However, there is still a lack of consensus on its role in performing RRT in ICU settings. Is it the Role of Intensive care or nephrology trained nurse or a combination of both? As controversy remains, further critical analysis is still warranted, hence the need for this review.

METHODOLOGY

A review of articles was done to analyze the training, scope of practice and role of intensive care and nephrology trained nurses in caring for patients in ICU requiring RRT. MEDLINE, CINAHL, PubMed, EBSCO Host and the search engines Google-scholar and Google were used. Professional organizations and WHO websites discussing the training and scope of practice and the roles for nephrology and ICU nurses were identified. The relevant search words were as follows: Acute Kidney Injury AND Renal Replacement therapy AND Intensive care unit/settings AND Training AND Scope of practice AND Role AND nephrology trained nurses AND IC trained nurses.

The criteria included articles and documents from 2000 till the present. Quantitative, qualitative and mixed methods, review papers, reports, texts and opinion papers were considered. Only articles published in English were used. The search was done using the online data basis, namely MEDLINE, CINAHL, PubMed, EBSCO Host, as well as Google-scholar and google search engines. Moreover, a search of social websites and professional nursing boards that talk to the training, scope of

practice, including the roles for Intensive Care and nephrology trained nurses regarding the management of patients in ICU requiring RRT.

RESULTS

In our review, twenty-eighty (28) articles were included to describe the training and the scope of practice of nephrology and critical nurses (Table 1). Regarding training, both specialties are trained after they have obtained either the diploma or the degree in Nursing. The post-basic training of intensive care and nephrology nurses varies from certificate, diploma, bachelors and master's degree. In other settings, they consider the clinical hours spent in the area coupled to in-service training; a certification exam is given to acquire either the certified intensive care or nephrology nurse status. While Nephrology Nursing's scope of practice deals with individuals with kidney disease from primary to tertiary levels, critical care nurse treats patients with acute conditions, life-threatening illnesses, and injuries.

Twenty-three (23) articles were used in elaborating the roles of critical care and nephrology nurse in the management of RRT in the ICU setting (Table 2). Three models of care used by nurses performing renal therapies in ICU, namely nephrology nurse-led, IC nurse-led and collaborative (nephrology and ICU trained), were identified by relevant literature. Mixed results regarding the roles of the two specialties in the care of AKI patients requiring RRT were revealed.

DISCUSSION

Globally, the first step toward becoming a nephrology or ICU nurse is to become a registered nurse (RN) either at degree or diploma level. According to the American Association of Nephrology nurses, the licensed Registered Nurse needs to be attached in a clinical nephrology setting for 3000 hours and 30 hours of approved continuing education in nephrology to acquire nephrology nursing certification [16]. After that, the nurse can sit for the Certified Nephrology Nurse Certification, which the Nephrology Nursing Certification Commission offers. Recently, the successful development and implementation of a comprehensive Nephrology Nurse Residency Program was realized [17]. In addition, the American Association of Nephrology Nurses

has a number of modules and webinars on nephrology-related topics that nurses can access for educational purposes [18]. Other countries like Australia offer the Advanced Nephrology Nursing Program (ANNP) to registered nurses, which provides theory and practical instruction in renal patients' care and treatment [19].

For intensive care nurses, at least 2 years of nursing experience in a position specializing in intensive care nursing is needed to obtain the Certification for Adult Critical Care Nurses (CCRN) awarded by the American Association of Critical Care Nurses [20]. The WHO European Strategy for Nursing and Midwifery education states that the admission criteria in critical care nursing includes at least 2 year post-basic nursing qualification, and then takes 1200 hours in both evidence-based theories and practice [21]. For those within Australia and New Zealand, most tertiary institutions currently offer postgraduate critical care nursing education at a Graduate Certificate or Graduate Diploma level as preparation for specialty practice. However, this is often provided as a Master's degree [22].

In few African countries, nephrology and critical care nurses' training varies regarding certificate, diploma, degree and master's level. In South Africa and Zimbabwe, Intensive care and nephrology nursing training is offered to registered nurses in colleges and universities to obtain a certificate, diploma or degree after a period of one or two years, respectively [23,24,25]. In Kenya, Kenyatta National Hospital/school of nursing provides both critical care nursing and nephrology nursing through its higher diploma course program [26]. In Tanzania, a sustainable critical care nursing orientation program that provides essential critical care nursing competencies was developed for critical care nurses [27]. Nephrology nurses receive a further 2-3 months training course in hemodialysis either in the local hospital, India or Pakistan [28]. In Rwanda, both critical care and nephrology nurses are trained at the master's level with at least a bachelor degree as a prerequisite for enrolment into the program [29,30,31].

In most situations, academic and professional training to either ICU trained or nurses working in ICU do not provide them with enough clinical competencies to manage continuous hemodialysis [32]. Hence the implementation of in-service and on the job training, including clinical rotation, provides these nurses with the required clinical skills. Moreover, the majority of the registered

Table 1: Articles relating to the scope and training of nephrology and critical care nurses

Author and year of publication	Title of article
Training of nephrology and critical care nurses	
American Nephrology Nurses Association (2017)	Nephrology Nursing Scope and Standards of Practice
Hudson-Weires et al. (2020).	The development and implementation of a new graduate registered nurse nephrology nurse residency program in acute hemodialysis.
Counts (2020).	Core curriculum for nephrology nursing. American Nephrology Nurses Association.
Douglas and Bonner (2017)	Nephrology specific clinical performance indicators for nurse practitioner education in Australia.
American association of critical care nurses (Accessed January 2021).	American association of critical care nurses
WHO European Regional Office (2003).	WHO Europe Critical Care Nursing Curriculum.
Leanne Aitken et al. (2020)	Essential scope of care practice.
Beer et al. (2011).	Intensive care nursing in South Africa Current challenges to ICN in SA.
South African Nursing Council (2013).	Competencies for Nephrology Nurse Specialist'
Nurses Council of Zimbabwe (Accessed February 2021).	Nurses Council of Zimbabwe
Kenyatta National Hospital (2019)	Higher Diploma Courses in Specialized Nursing
Seed Global Health (Accessed March 2021).	Commitment to Care: Training Critical Care Nurses in Tanzania.
Furia, F. F. et al. (2019)	Developing nephrology services in low-income countries: A case of Tanzania
Mukamana et al. (2016).	Nephrology nursing in Rwanda: Creating the future through education and organizational partnership.
Chironda et al. (2019)	Renal replacement therapy (RRT) in Rwanda: benefits, challenges and recommendations.
Munyiginya et al. (2016)	Critical care nursing practice and education in Rwanda.
Celestino (2019).	Training of intensive care nurses to handle continuous hemodialysis: a latent condition for safety.
Ellis (2007).	Nephrology Nurses Are Better Prepared to Provide CRRT.
Clapp et al. (2020)	Nephrology in the Academic Intensive Care Unit: A Qualitative Study of Interdisciplinary Collaboration.
De Becker (2007).	Starting up a continuous renal replacement therapy program in ICU.
Zuber et al. (2019)	Nephrology Advanced Practitioners in the United States, 2010-2018.
Hassen et al. (2020).	Human resources for nephrology in South Africa: A mixed-methods study.
Scope of practice	
Gomez (2017).	Nephrology nursing scope and standards of practice. American Nephrology Nurses Association.
South African Nursing Council (2020).	Competencies for Nephrology Nurse Specialist.
Gomez et al. (2017).	Nephrology Nursing Scope and Standards of Practice: Integration into Clinical Practice.
Forni et al. (2017).	Renal recovery after acute kidney injury.
South African Nursing Council (Under the provisions of the Nursing Act, 2005) (2014).	Competencies for Critical Care Nurse Specialist (Adult).
American Nephrology Nurses Association (2017)	Nephrology Nursing Scope and Standards of Practice
South African Nursing Council (2013).	Competencies for Nephrology Nurse Specialist'
Beer et al. (2011)	Intensive care nursing in South Africa Current challenges to ICN in SA.

nurses are trained in chronic hemodialysis and CAPD, leaving a deficit in the skills and competencies required in the management of AKI in ICU settings. Whilst critical care nurses and other registered nurses receive basic learning in kidney physiology and kidney diseases; nephrology

trained nurses have a much higher level of knowledge and training to manage RRT for patients with kidney failure. When proficiently trained nephrology nurses provide CRRT, an impression is created that this modality is simple [33]. On the other hand, ICU nurses may feel less motivated

Table 2: Articles used in analyzing the role of nephrology and critical care nurses regarding RRT in ICU settings

Authors and years of publication	Title of the article
Boyle & Baldwin (2010).	Understanding the continuous renal replacement therapy circuit for acute renal failure support: a quality issue in the intensive care unit.
Ellis (2007).	Nephrology Nurses Are Better Prepared to Provide CRRT.
Furia et al. (2019)	Developing nephrology services in low-income countries: A case of Tanzania
Annigeri et al. (2016)	Impact of dialysis practice patterns on outcomes in acute kidney injury in Intensive Care Unit
Melo et al., 2018	Aspects of interest and preparation of intensive therapy nurses to act in the care of acute kidney injury.
Beer et al. (2011).	Intensive care nursing in South Africa Current challenges to ICN in SA
De Becker (2007).	Starting up a continuous renal replacement therapy program in ICU.
Andrade et al., (2019)	Training of intensive care nurses to handle continuous hemodialysis: a latent condition for safety.
Gallagher et al. 2014	Long-term survival and dialysis dependency following acute kidney injury in intensive care: extended follow-up of a randomized controlled trial.
Coelho et al. 2017	Nursing activities score and acute kidney injury.
Graham & Lischer, 2011.	Nursing issues in renal replacement therapy: organization, manpower assessment, competency evaluation and quality improvement processes.
Ricci et al. (2015).	Nursing procedures during continuous renal replacement therapies: a national survey.
Liu et al., 2017	Research regarding the relationship among intensive care nurses' self-esteem, job satisfaction and subjective well-being.
Baldwin, I. (2007).	Is there a need for a nurse emergency team for continuous renal replacement therapy?
Martin, R. K. (2002).	Who should manage continuous renal replacement in the intensive care setting?
Bellomo & Ronco (2000).	Continuous hemofiltration in the intensive care unit.
Endre (2017).	The role of nephrologist in the intensive care unit.
Rizo-Topete & Ronco (2017).	Critical care nephrology: a multi-disciplinary approach.
Harvey et al. (2002)	A renal critical care educator: the interface between paediatric intensive care and nephrology.
Bennett et al. (2019).	The International Society of Nephrology Nurse Working Group: Engaging Nephrology Nurses Globally.
Echeverri et al. (2018)	Continuous Renal Replacement Therapy Specialized Teams: A Challenge to Improve Quality Performance.
Charytan et al., 2001.	Role of the nephrologist in the intensive care unit.
Donovan et al., 2018.	Interprofessional Care and Teamwork in the ICU.

to take full responsibility in the provision of CRRT. However, the current ICN training on RRT is critical because they are expected to prepare the circuit of the machine, connect it to the vascular catheter of the patient, and perform treatment maintenance tasks while nephrology nurses may act as a reference in clarifying doubt and problem solving [34]. Nurses' minimum qualifications to efficiently and effectively manage the continuous renal replacement therapy (CRRT) device are part of an ongoing debate between nephrologists, intensivists and nurses of the renal ward and the ICU [35].

Predictions on the increase of population with kidney diseases that will require RRT have been highlighted, hence the need to train nephrology nurses with enough knowledge and skills to manage, provide, and coordinate such patients' overall care [17,36,37]. Nephrology nursing practice encompasses individuals' primary, secondary, and tertiary care, including patients at risk for AKI, suffering from AKI and other healthcare conditions requiring nephrological intervention [38, 39]. Nephrology nurses manage individual' care across the lifespan as a direct health provider to patients in renal and kidney transplant units [24,40]. The American Nephrology Nurses Association highlights the scope of practice of its members from primary, secondary and tertiary care as care of people with possible and progressive chronic kidney diseases, end-stage renal disease, acute kidney diseases, and other health-related issues demanding nephrology interventions [16].

Whilst Nephrology Nursing deals with individuals with kidney disease, Intensive care nurses treat patients with acute conditions, life-threatening illnesses, and injuries resulting in manifest or potential disturbance of vital organ functions, including ensuring support to patient's family members [23]. As such, Acute kidney injury (AKI) requires urgent RRT to prevent post-AKI short- and long-term mortality, chronic kidney disease (CKD) and cardiovascular complications [41]. Currently, the scope of practice for critical care nurses is limited when it comes to RRT. Hence the continuous debate on whether to avail a permanent nephrology nurse for acute dialysis in ICU or equip the ICNs with the skill required for acute dialysis. Currently, in many ICU units, AKI patients in need of RRT are connected and disconnected from the nephrology unit. Yet, the

best solution is for the nephrology nurse to be stationed in the ICU to initiate and stop the dialysis session while remaining in the background for eventual technical problems. Such a cooperative and integrated working scheme allows the ICU nurse to remain responsible for the overall care of the AKI patients even during dialysis. In such an "ideal "setting, the indication for starting dialysis should become a combined decision of both nephrologist and intensivist. Although there is a recommendation for considering in-depth coverage for renal replacement therapy as one of the critical care nurse competencies [42], the authors feel differently as Acute RRT in the ICU is rarely needed every day. Moreover, involving the ICU nurse in managing RRT will result in loss of critical care skills since she/he is only occasionally for acute dialysis.

Delivery of renal replacement therapy requires expertise and sufficient knowledge [43] and the choice of a given method of dialysis is also determined by the local circumstances and resource availabilities. Acute kidney injury (AKI) often occurs in the intensive care environment [44], with greater than 40 % among these cases requiring Renal Replacement therapy [45]. Acute Kidney Injury (AKI) is treated not only with HD but also with peritoneal dialysis. These renal replacement types are executed by nurses working in an intensive care unit (ICU) or the Dialysis unit. Therefore, this condition incurs a greater need for intensive clinical support, which, in turn, is characterized by a greater amount of nursing staff to these patients [46]. The decision to initiate a continuous renal replacement modality depends not only on the physician, nephrologist or intensivist but also on the availability of specially trained nursing resources [47].

However, currently, the respective roles of intensive care and nephrology trained nurses in the management of critically ill patients needing continuous renal replacement therapies are unclear. Studies identified three nurses performing renal therapies in the ICU, namely nephrology, ICU and collaborative (nephrology and ICU trained) care model. A study done in Italy revealed that ICU patients requiring CRRT are managed under shared responsibility between the critical care and nephrology nurses, even though their specific duties can vary across the country [48]. The nephrology nurses' model suggests that these

nurses are responsible for conducting the RRT in ICU settings because of their technical and specialized knowledge on kidney diseases [44]. In some settings, especially the developing nations, patients with AKI requiring RRT are moved to the renal unit, thus automatically becoming the nephrology nurse's responsibility. In situations where the movement of the patient who requires RRT into the renal unit is not possible, some nephrology nurses will have to visit and attend to patients who are admitted to the ICU. While the second model, whereby intensive care nurses can conduct early renal treatment, provides the hemodynamic evaluation of the patient and eliminates role conflicts, the collaborative model that involves the nephrology and the ICU nurse in providing care allows the exchange of knowledge [44,49]. In resource constraints settings, it is advantageous for critical care nurses to acquire full responsibility for continuous renal replacement therapies (CRRT) to eliminate either the high cost of contracted nephrology nurses or reduce time paid to hospital-employed nephrology nurses [33]. However, Critical care nurses in ICU are faced with many challenges, including the management of many critical care patients. They lack special technical skills required to manage patients on RRT, hence the need for specialized nephrology nurses to conduct RRT in ICU settings.

Melo et al. (2018) indicated the need for healthcare institutions to provide more intensive training to intensive care nurses who manage patients with AKI [13]. Baldwin advocated for the use of a collaborative approach between ICU and nephrology trained nurses in RRT provision in ICU settings [50], thus promoting the highest level of nursing expertise to the bedside and research skills [51]. Bellomo & Ronco also concurred that either the ICU or hemodialysis nurses could manage CRRT as long as there is appropriate continuing education and nursing staff training to achieve expertise within a given ICU [52]. A multicentre study done in Italy revealed mixed views on who should care for RRT patients in ICU settings. Twenty-three percent (23%) of participants view it as the dialysis staff's responsibility only, 39% said the critical care nurse and 38% highlighted it as a shared responsibility of ICU and nephrology trained nurses [48]. However, De Becker expressed confidence in intensive care nurses to manage RRT without the nephrology nurses [35]. He argued that they only need intensive training on special

skills needed to manage patients in ICU who require RRT.

AKI in ICU carries the risks of multiple complex organizational dysfunctions hence the need for interdisciplinary specialty collaboration. Great strides have been made through ongoing collaborations between critical care and nephrology to improve the care for patients in the ICU, educate multi-disciplinary team members, and build programs designed to maximize care delivery [53]. Tanzania gives a good example of the nephrology workforce situation. It makes all of the effort to have nurses, doctors, and pathologists by local and international training and capacity building through pairing to manage hemodialysis, peritoneal dialysis and kidney transplant care [28]. Moreover, the implementation of the multi-disciplinary approach supports the concept of critical care Nephrology [54]. Hence, Harvey et al. emphasized the renal critical care educator's use as a catalyst that instils confidence in practicing nurses, further serving as a model for developing and maintaining nephrology skills in other regions [55].

In low- and middle-income countries, nephrology trained nurses should focus more on chronic hemodialysis (HD) and chronic peritoneal dialysis (PD) [56] whilst intensive nurses care for patients with life-threatening conditions [23], including AKI. Additionally, clinicians face challenges due to limited resources, reduced availability of trained staff and equipment, cultural and socioeconomic aspects, administrative and governmental barriers [9]. Therefore, many centers have applied a collaborative approach, where the nephrology nurse intervenes during the RRT session to take care of the dialytic treatment's technical aspects [48]. However, the collaborative approach does not solve nephrology nurses' shortage, especially in low-(LICs) and lower-middle-income countries (LMICs). This explains why the ISN proposed educational sessions for both nurses and allied health professionals caring for patients with kidney problems [56].

Moreover, literature revealed the ICU nurse's inability to identify clinical manifestations of AKI in ICU settings due to insufficient training on AKI and limited scope of practice [13]. Therefore, the successful RRT in ICU depends on the availability of highly trained nurses that complement the procedure's advanced technology. Specialized personnel like nephrology trained nurses enhance

the highest quality safety on the critical AKI population, thus encouraging quick decision-making and individualized management [57]. The involvement of a specialist in critical nephrology and a highly trained group of hemodialysis nurses have been shown to help in priority establishment, implementation of standardized actions, and quality control processes [58].

CONCLUSION

There is wide variation in the nursing management of acute kidney injury (AKI) in ICU settings, including the practice of renal replacement therapy (RRT)

around the world. Despite this ongoing debate, the need for advanced nephrology nurse practitioners is evident. This will meet the current and future challenges of delivering high-quality care to patients with kidney disease. The insufficient number of qualified nephrology nurses is faced by an increasing number of chronic cases undergoing intermittent hemodialysis and PD regularly, leaving a gap in the management of AKI patients requiring advanced RRT modalities in ICU settings. Hence, more qualified expert nephrology nurses must provide significant contributions to nursing quality, nursing care, and patient quality outcomes for patients with AKI in ICU settings.

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