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An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

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BN (UNDA), GradCert (Nurse Education)

Submitted in fulfilment of the requirements for the degree of Master of
Philosophy



School of Nursing, Midwifery, Health Sciences and Physiotherapy

University of Notre Dame Australia, Fremantle

May 2022

Declaration

To the best of the candidate's knowledge, this thesis contains no material previously published by another person, except where due acknowledgement has been made.

This thesis is the candidate's own work and contains no material which has been accepted for the award of any other degree or diploma in any institution.

Megan Alice Westphalen

Date: 20th May 2022

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“All you need to do research is an idea and enthusiasm. The rest we can figure out later.” These were the words that kick started my research journey. From my family who wouldn’t let me give up, old friends who stood by me and new friends I made along the way, your contributions were invaluable to see this project through to completion.

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Glossary

ADDS: Adult deterioration detection score

AIHW: Australian Institute of Health and Welfare

APN: Advanced Practice Nurse (also known as Nurse Practitioner)

Bloom's Taxonomy: a hierarchal structure used to categorise different levels of cognition

CJM: Clinical Judgment Model

CN: Clinical Nurse

DAFNE: Dose Adjustment For Normal Eating program

DBKT: Diabetes Basic Knowledge Test

Decision making: a cognitive process for choosing a course of action from a number of options to achieve a desired outcome

Dehydration: potentially harmful loss of body fluid from illness, sweating or insufficient oral intake

DKA: Diabetic ketoacidosis

DKT: Diabetes Knowledge Test

DM: Diabetes mellitus

DMKAT: Diabetes Management Knowledge Assessment Tool

DSRT: Diabetes Self Report Tool

ED: Emergency Department

Electrolytes: charged ions that help the body maintain chemical reactions and fluid balance

Glucose: a sugar that serves as an energy source for cellular function

HbA_{1c}: Glycosylated haemoglobin

HREC: Human Research Ethics Committee

Hyperglycaemia: abnormally high blood glucose level

Hypoglycaemia: abnormally low blood glucose level

ICU: Intensive Care Unit

IDDM: Insulin dependent diabetes mellitus (Type I diabetes mellitus)

JBDS: Joint British Diabetes Societies

Ketones: an alternative energy source when glucose levels are abnormal

Knowledge: information perceived, believed or justified to be true

MAU: Medical Admissions Unit

Metabolic acidosis: abnormally high acid levels in body fluids that can result in organ dysfunction

NHMRC: National Health and Medical Research Council

NIDDM: Non-insulin dependent diabetes mellitus (Type II diabetes mellitus)

NMBA: Nursing and Midwifery Board of Australia

NSQHS: National Safety and Quality Healthcare Standards

OzDAFNE: Australian Dose Adjustment For Normal Eating program

Potassium: an electrolyte with an important role in nerve function, muscle movement, heart rhythm and transport of nutrients and waste products

Protocol: a procedure to be followed in a specific clinical context according to an organisation's policy

RN: Registered Nurse

SGLT2 inhibitors: sodium-glucose co-transporter 2 inhibitors, a type of oral hypoglycaemic medication

UNDA: University of Notre Dame, Australia

VBG: Venous blood gas

WA: Western Australia

Abstract

An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis.

Introduction: Diabetic ketoacidosis (DKA) is an acute complication of diabetes. Registered nurses (RNs) knowledge with regard to DKA has never been investigated in any depth, nor has their decision making ever been examined in this specific context.

Research Significance: Nursing research literature acknowledges that nurses have an important role in the management of patient with DKA. However, there is very little empirical evidence available to support this claim. The purpose of this study is to provide evidence of the level of knowledge, the decision-making processes and the factors that influence nurses' decision making whilst managing patients with DKA.

Methodology: A sequential mixed methods design in four phases was used. An online survey was developed and tested for clarity, internal consistency, content validity and reliability. The survey was administered to nurses who were likely to have been involved in the care of patients with DKA in their clinical practice and the data analysed using descriptive statistics. Semi-structured interviews were then conducted based on the results of the survey. Finally, both data sets were amalgamated in a mixed methods analysis to develop recommendations for future research and clinical practice.

Results: The survey results indicate that RNs had varying levels of knowledge in relation to DKA and strengths and weaknesses at different stages of their decision-making process. Some of the knowledge deficits related to policy, pharmacology and psychosocial issues. Four themes emerged from the qualitative data relating to the factors that influence RNs decision making whilst managing patients with DKA including policy, staffing, patients and confidence. The mixed methods analysis resulted in a number of recommendations for

organisational and education strategies to enables RNs to provide holistic and evidence-based care to patients with DKA.

Conclusion: This study found that RNs were generally able to demonstrate adequate levels of knowledge to manage patients with DKA and utilised all the stages of the Clinical Judgment Model when making decisions. It was found that the most significant knowledge gaps related to information directly out of the hospital policy, which nurses found served as both an enabler and a barrier to their decision making. There were a number of limitations in this study, many relating to the COVID-19 pandemic. The participants requested a flow chart be developed to aid their knowledge application and decision-making practices whilst managing these acutely unwell and complex patients.

Chapter 1

Background and Context

Introduction

The first chapter of this thesis provides an overview of the background and context relating to the nursing management of adults with diabetic ketoacidosis (DKA). It discusses the nursing process in terms of the key concepts of knowledge and decision-making. An analysis of the current literature showed that no study to date has linked these concepts to the management of adult patients with DKA. Therefore, the purpose of the study will be described, including its significance for patient care and nursing research. Additional contextual information will be provided regarding the site where the study took place and the researcher's position within the study. This chapter will conclude with an outline of the thesis chapters content.

Nursing process, knowledge and decision-making

Fundamentally, nursing is a cyclical problem-solving process that considers the assessment of a patient from both objective and subjective perspectives, diagnosing the nursing problem, planning their care and implementing that plan appropriately. The final component of the process is evaluating the outcome of that care. Should the outcome be less than satisfactory and require adjustment, then the process recommences with assessment. Although the nursing process facilitates basic problem solving, in reality nursing practice involves multidimensional reasoning at each phase of the process (Hoffman, 2007; Lauri & Salantera, 2002).

Furthermore, whilst the nursing process model serves a purpose for nursing students at a beginning level of practice during their studies, registered nurses (RNs) synthesise their

knowledge and move beyond this stepwise process as their reasoning ability develops (Johnson, & Webber, 2010). The act of making a choice in the clinical setting requires clinical judgment and decision-making. Clinical judgment involves making a diagnosis, while decision making involves implementing a plan of action. In essence clinical reasoning is the thought process that guides decision making. It includes identifying options that most suit individual needs, cross-referencing options with evidence and choosing the most justifiable option (Levett-Jones et al. 2010).

Nurses require background knowledge of disease processes, diagnostic criteria and clinical presentations to use clinical judgment to make decisions (Schmitz, 2000; Tanner, 2006). This empirical knowledge is often coupled with aesthetic knowledge such as the impact of illness on family dynamics, social context and emotional wellbeing (Tanner, 2006). Nurses are patient advocates who make decisions every day with the primary goal of meeting the complex, individual needs of patients in their care. Some decisions are challenging and require complex cognitive skills (Levett-Jones, 2018). The management of patients with DKA is one example of a situation that can manifest in multiple problems, where the clinical reasoning process should be applied to achieve an optimal patient outcome. In the overextended work environment of the nurse, particularly when multiple points of data exist, errors of judgment can be made (Hoffman, 2007). These situations have been implicated in adverse reactions such as a failure to respond to a patients' clinical deterioration (Institute of Medicine, 2010; Levett-Jones, 2018).

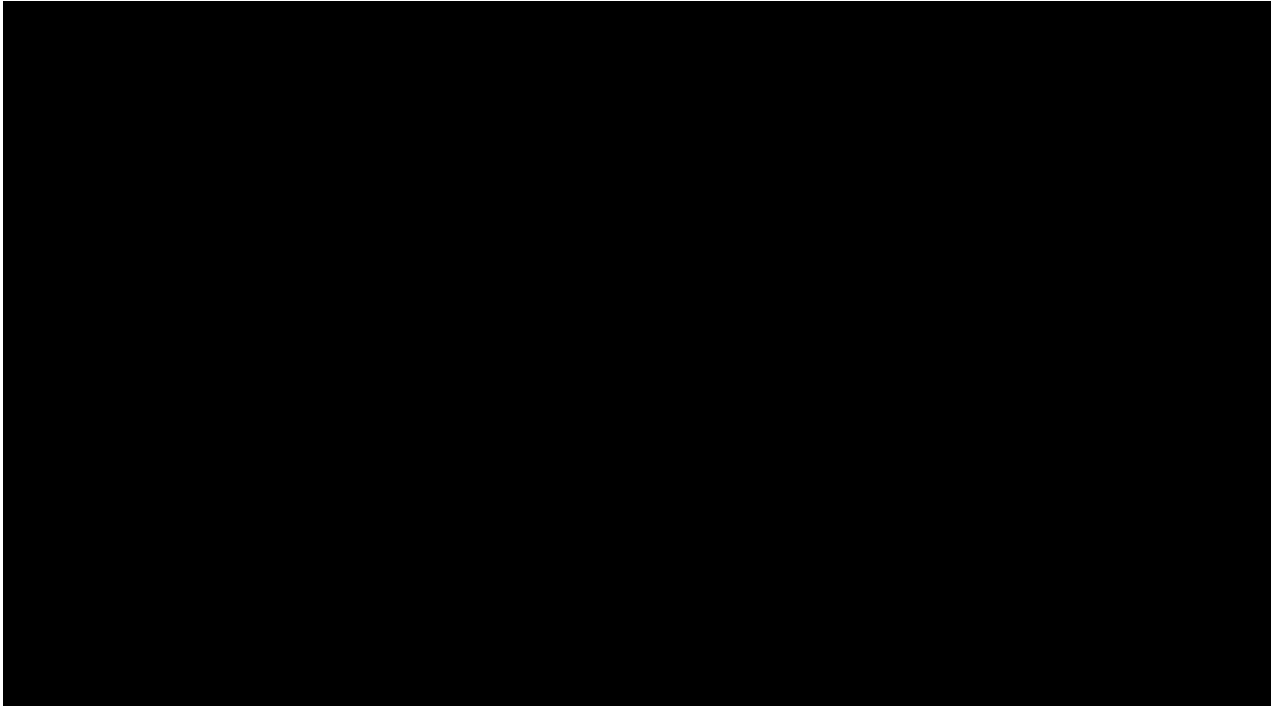
Nursing standards of practice

In an effort to guide nursing practice in a holistic and person-centred manner, standards have been set by the Nurses and Midwifery Board Australia (NMBA). "Standards represent to the profession, government and the public, a level of quality or attainment of

actual practice that can be expected” (Cashin et al., 2017, p.256). The standards for practice of registered nurses are shown in Figure 1.

Figure 1

Standards for Practice for Registered Nurses (NMBA, 2016)



Although these standards are applicable to all areas of nursing practice, several are specifically applicable to clinical reasoning. These include the ability to:

- comprehensively conduct assessments,
- think critically,
- develop a plan for action, and
- to evaluate outcomes to inform nursing practice (NMBA, 2016).

These standards resonate with the nursing process as a means of measuring levels of knowledge and skills.

Competency standards were developed in the 1980s to provide accountability for nursing practice (Cashin et al., 2017). Issues around the competency standards led RNs to be selectively accountable based on the competency standards they were most familiar with, or

those for which RNs were required to be competent but not required to think critically in relation to some tasks. In contrast, the practice standards aim to describe the baseline professional behaviour expected of all RNs (Cashin et al., 2017). Sufficient baseline knowledge of DKA would enable RNs to make clinical decisions in the context of patient care and in accordance with professional standards.

Pathophysiology of diabetic ketoacidosis

The foundation of nursing clinical decision making is knowledge of pathophysiology (Levett-Jones, 2018). It is important for RNs to know the common clinical manifestations of DKA, to anticipate and assist in reducing patient morbidity and mortality and to evaluate treatment effectiveness (Schmitz, 2000). This knowledge also forms the rationalisation for decisions made throughout the aforementioned nursing process.

Diabetic ketoacidosis is a metabolic emergency associated with diabetes mellitus (DM) (Dhatariya, 2019). It has been defined according to a biochemical triad of hyperglycaemia, ketonaemia and metabolic acidosis (Brooke et al., 2016; Dhatariya, 2019). There are two types of DM. Insulin dependent diabetes mellitus (IDDM), also known as Type I DM, results from reduced insulin production. Non-insulin dependent diabetes mellitus (NIDDM), also known as Type II DM, occurs when cells are resistant to insulin. Although DKA occurs most often in patients with IDDM, it can also develop in NIDDM (Kitabchi et al., 2006). In DKA, circulating insulin deficiency leads to the hydrolysis of triglycerides (found in adipose tissue), which are transported to the liver, causing lipolysis and the release of free fatty acids. Although this process serves as an alternative energy source, it also forms ketones as a by-product, leading to ketonaemia and metabolic acidosis (Nyenwe & Kitabchi, 2011).

Studies have also reported another form of DKA with slightly different pathophysiology. Euglycaemic DKA has been reported in NIDDM patients who were prescribed sodium-glucose co-transporter 2 (SGLT2) inhibitors (Dhatariya et al., 2020). A study reported that SGLT2 inhibitors enabled patients to excrete glucose via the kidneys and were usually able to produce small amounts of insulin (Peters et al., 2015). Hence, they developed the ketosis, but not the hyperglycaemic component of DKA. Consequently, it was reported in the literature that patients with euglycaemic DKA were delayed in their treatment because their ketone levels were not being checked because they were euglycaemic (Peters et al., 2015). Therefore, it was recommended that euglycaemic DKA be suspected in patients who are known to have taken SGLT2 inhibitors (Muneer & Akbar, 2020). Other factors such as low carbohydrate diets, poor glycogen reserve secondary to alcoholism and reduction, rather than omission, of insulin are also possible causes of euglycaemic DKA (Muneer & Akbar, 2020). Even so, in terms of the diagnostic criteria and clinical presentation of patients with DKA and euglycaemic DKA, are essentially the same.

The signs and symptoms associated with DKA are polyuria, polydipsia, nausea and weight loss (Kitabchi et al., 2006). Of these, dehydration is perhaps the most significant complication, as hyperglycaemia causes water and electrolytes to shift from the intracellular to the extracellular compartments, resulting in hyperosmolality and osmotic diuresis (Porth & Gaspard, 2015). Other factors that contribute to dehydration in DKA include vomiting, diarrhoea and fever (Nyenwe & Kitabchi, 2011). As a result of these symptoms, the patient is likely to be tachycardic, hypotensive and exhibit Kussmaul breathing, in an attempt to compensate for their metabolic acidosis (Kitabchi et al., 2006; Schmitz, 2000). Severe metabolic acidosis, however, causes depression of the central nervous system, leading to a fall in conscious levels (Kitabchi et al, 2006).

The severity of these signs and symptoms on presentation, cross-referenced with specific diagnostic criteria, are determining factors for how and where these patients are managed. Patients will often present to the Emergency Department (ED) with these signs and symptoms, where they are assessed and commenced on treatment. However, depending on the severity of their DKA, they are typically admitted to either a medical ward or critical care unit for ongoing management. Therefore, RNs in any of these clinical areas are most likely to have been involved in the care of patients with DKA.

Diabetic ketoacidosis diagnosis and classification of severity

There are numerous guidelines that define the DKA diagnostic criteria, which differ slightly, depending on the unit of measurement for specific biochemical markers. The Joint British Diabetes Societies (JBDS, 2013) guidelines state the following diagnostic criteria for DKA:

- blood glucose $>11\text{mmol/L}$ with known DM,
- ketonaemia $>3\text{mmol/L}$ or significant ketonuria, and
- venous pH <7.3 and/ or bicarbonate $<15\text{mEq/L}$.

To date, there are no Australian national guidelines for diagnosing or classifying severity of DKA. Therefore, the JBDS guidelines (2013) were used for the study as they underpin the policy used at the specific hospital site.

As previously mentioned, the severity of a patient's DKA is a determining factor for the location, duration and risk of complications throughout their hospital admission. Table 1 shows the values of biochemical markers used to classify the severity of DKA according the JBDS guidelines (2013).

Table 1*Diagnostic criteria according to severity (JBDS, 2013)*

	Normal	Mild/ Moderate	Severe
pH	7.35-7.45	>7.00	<7.00
Bicarbonate (mEq/L)	22-28	>5	<5
Blood ketone (mmol/L)	<0.6	<6	>6
Potassium (mEq/L)	3.5-5.5	>3.5	<3.5
Anion gap (mEq/L)	6-12	<16	>16
Oxygen saturation (%)	>94	>92	<92
Systolic blood pressure (mmHg)	100-160	>90	<90
Pulse (bpm)	60-100	60-100	>100 or <60
Mental state	15	GCS >12 normal AVPU	GCS <12 abnormal AVPU

According to the JBDS guidelines (2013), patients diagnosed and classified as having severe DKA, should be considered for admission to an intensive care or high dependency unit. The guidelines also advised that nurses who are specifically trained to work in these areas should take the lead on the provision of care for these patients (JBDS, 2013).

Vulnerable patients such as those who are young, pregnant, elderly, have heart failure, renal failure or other comorbidities should also be considered for critical care admission (JBDS, 2013). These patients are at risk of haemodynamic instability requiring cautious but timely interventions to prevent complications.

Potential complications of diabetic ketoacidosis

It is important for RNs to know the common clinical manifestations of DKA so they can anticipate and assist with preventing complications and to evaluate the effectiveness of medical treatment (Schmitz, 2000). They are also responsible for informing physicians of changes to the patient's condition to enable remedial treatment such as early fluid resuscitation and insulin therapy. The role of RNs in the management of DKA is critical

since the patients' condition can deteriorate rapidly into an acute emergency (Kisiel & Marsons, 2009).

Patients who present to acute hospitals with DKA are at risk of a number of complications. The most important are hypoglycaemia, hypokalaemia, venous thromboembolism and cerebral oedema (Muneer & Akbar, 2020). All of these complications are potentially life threatening.

Hypoglycaemia, defined as a lower than normal blood glucose level, is a common and often transient DM complication (Porth & Gaspard, 2015). It often occurs due to their medication for the management of their diabetes, i.e. insulin or oral hypoglycaemic agents (Porth & Gaspard, 2015). Patient's with DKA are treated with high dose insulin which increases their risk of hypoglycaemia which may lead to cardiac arrhythmias, acute brain injuries and death (JBDS, 2013). Therefore, it is vitally important that nurses monitor these patients blood glucose levels closely.

Another potential complication is hypokalaemia, usually defined as a serum potassium level of $<3.5\text{mEq/L}$ (Dhatariya et al., 2020). Patients with DKA often present with hyperkalaemia, due to pre renal injury from dehydration, but can develop hypokalaemia once they are started on treatment (JBDS, 2013). Insulin causes potassium ions to diffuse with glucose into the cells, resulting in a lower serum potassium level (Porth & Gaspard, 2015). Hypokalaemia can cause cardiac arrhythmias, muscle cramps and weakness, confusion and exacerbate gastrointestinal symptoms (Porth & Gaspard, 2015). Therefore, strict guidelines exist to facilitate the safe administration of potassium replacement to prevent these complications (JBDS, 2013).

Patients with DKA are also at risk of venous or arterial thromboembolism (Muneer & Akbar, 2020). Patients with DKA are usually hyperglycaemic, which causes platelet hyperactivity, coagulation activation and hypofibrinolysis (Langevin, 2015). These patients

are at risk of thrombotic events such as myocardial infarction, stroke and disseminated intravascular coagulation (Porth & Gaspard, 2015). It is therefore recommended that patients with DKA be given prophylactic low molecular weight heparin (Muneer & Akbar, 2020).

The last important complication associated with DKA is cerebral oedema which refers to an excess of fluid in brain tissue that increases mortality (Dhatariya et al., 2020). Patients may develop changes in their mental state, headaches, pupillary changes, lethargy and seizures (Muneer & Akbar, 2020). It is therefore recommended that fluid is cautiously replaced, while the patient is monitored closely for changes in their neurological status, especially in young people (JBDS, 2013).

Having defined the potential complications in patients with DKA, it is evident that managing these patients can be highly complex. They require close monitoring and multiple concurrent interventions, which are tasks that reflect the nursing scope of practice.

Therefore, nurses require a specific knowledge set and skill base to safely and holistically care for these patients. Although the literature acknowledges the importance of the RN role in managing patients with DKA, their level of knowledge and the process they use for decision making, has yet to be reported. As the prevalence of DM is predicted to increase in the near future, research into DKA management from the nursing perspective may contribute to health promotion and alleviating some of the burden to the Australian healthcare system.

Prevalence of diabetes mellitus in Australia

In 2017, the International Diabetes Federation reported that Australia had 1.325 million people with DM, and was predicted to increase to 1.503 million people (8.4% of the national population), by 2030 (Shaw et al., 2010). The Australian Institute of Health and Welfare (AIHW) reported in 2017-18 that 1.2 million hospital admissions were associated with diabetes. It was also reported that based on self-report data, for every four patients who

are aware that they have DM, there is one who was unaware of their diagnosis (AIHW, 2020). Moreover, it could be assumed that, with an increase in the prevalence of DM, including the speculated portion of the population who are currently undiagnosed with the condition, the incidence of DKA in Australia may also increase.

Following a review of the literature, it would appear that there are few statistics available regarding the overall incidence of DKA in Australia. However, one study reported that the incidence of DKA admissions to intensive care units (ICU) in Australia and New Zealand had increased 0.97/100 000 to 5.3/100 000 from 2000 to 2013 (Venkatesh et al., 2015). It was suggested the reason for this increase was associated with patients who were not prescribed insulin prior to their presentation with DKA; suggesting a progression in the pathophysiology of the disease (Venkatesh et al., 2015). However, this study had some limitations as it did not take into consideration less severe cases of DKA that did not warrant admission to ICU.

Overall, there is a lack of research that focuses specifically on DKA management in Australia despite the severity and complexity of the condition. Very little research exists on the nursing management of patients with DKA. Nurses are reported to have an important role in this context, though their knowledge and decision making have not been investigated. In light of the increasing prevalence of DM in Australia and risk of complications associated with DKA and its' treatment, there is a need for further research in this field to meet the needs of this at-risk population.

Study purpose

This study has three purposes. The first is to identify the RNs' level of knowledge regarding the management of DKA. The second is to explore how this knowledge impacts the RN's decision-making in the provision of care to the patient with DKA in the clinical

setting. Finally, the study will seek to identify factors that influence the RN's decision making when managing patients with DKA.

Research questions

- What level of knowledge do RNs have regarding the management of adults diagnosed with DKA?
- What are the decision-making processes of RNs when managing a patient diagnosed with DKA?
- What are the factors that influence the decision-making processes of RNs with respect to managing adults with DKA?

Objectives

- To examine the knowledge level of RNs in managing adults with DKA using a case study-based scenario.
- To identify the decision-making process of RNs when managing adults with DKA.
- To explore the influences on RNs in their decision making when nursing a patient with DKA.

Study significance

There appears to be little evidence in the literature of the role of RNs in the management of patients diagnosed with DKA. Although many studies have investigated nurses' knowledge of DM, there has been little consideration of such knowledge for DKA. Moreover, there appears to be no contemporary studies that specifically focus upon the RNs' use of decision-making with respect to DKA. This deficit within the literature, which will be

discussed in detail in the following chapter, provides a clear justification for undertaking this study.

It is not currently known if experience, clinical setting, background knowledge or other factors influence RNs' decision making in the specific context of managing adults with DKA. By encouraging RNs to reflect on their knowledge and decision-making processes in managing these patients, recommendations may be made to improve decision making and, consequently, patient care. These recommendations may also be used to foster RNs' active role in policy development. This study may help to target appropriate education and training for RNs and identify areas for further research.

Context of the study

According to the NMBA (2022), 43 473 nurses were registered in Western Australia (WA). Excluding those with dual, provisional or non-practising registrations, there were 35 367 RNs eligible to practice in WA (NMBA, 2022), of which 30 558 work in the WA public and private sectors. This population consisted of 91% female and 9% male RNs with an average age of 44.3 years (Chief Nursing and Midwifery Office, 2021). These RNs work in areas such as aged care, rehabilitation, education, health promotion, health policy, research, management, community health, primary care and the school systems (Chief Nursing and Midwifery Office, 2021).

The study was conducted at a general public hospital in the south east metropolitan area of Perth, the capital city of WA. The WA population has approximately 2.68 million people, or 10.4% of the Australian population, in 2021 (AIHW, 2022). In the same year, approximately 229 000 people lived in the catchment area of the hospital where the study was conducted (Australian Bureau of Statistics, 2020). The hospital managed over 64 000 ED presentations in 2020-21 and admitted approximately 30 000 patients in 2019-20 (AIHW,

2022). This hospital provides important health services to 8.5% of the states' population. The quality of its services depends on the knowledge and skills of the healthcare professionals who practice at the site.

Role of the researcher

As an RN with an equal passion for high quality patient care and nurse education, I have an interest in empowering nurses with knowledge to help them to look after patients better. I studied nurse education in the hope that it would help me achieve this goal. As my experience in critical care grew and I obtained my first position as a nurse educator, I began to notice trends in my colleague's behaviour. They were asking the same questions and highlighting the same issues with the management of their patient with DKA over and over again, without enduring resolution to the problems.

I audited the protocol we were expected to follow and found it complicated, confusing and rarely applied accurately in practice. I noticed the same patients re-presenting on a regular basis with the same potentially life-threatening issue, and I could not understand why. Ultimately, I observed several patients who died as a result of their DKA which compelled me to investigate further.

Diabetic ketoacidosis is not a condition to be taken lightly, but it also has a clear pathophysiology and reversible causes with the right treatment plan. It is my belief that by examining what nurses know about DKA and how they make decisions, we can shed light on how to better address the issues associated with managing patients with DKA.

Plan for thesis chapters

The following section describes the themes for each of the thesis chapters.

Chapter 2. Literature review: a comprehensive analysis of the literature relating to the concepts of DKA presentations, nurses' knowledge and decision-making. A discussion of the theoretical framework that underpinned the present study was presented as a means of examining how knowledge is used as part of a decision making process. This chapter emphasises the importance of these concepts in order for nurses to fulfill their role in the management of patients with DKA.

Chapter 3. Methodology: provides a synopsis of mixed methods research, underpinned by the philosophy of pragmatism. The application of the sequential explanatory four-phase design that was used for this study is described in detail.

Chapter 4. Phase 1 Development and validation of an online survey: describes the process used to develop the online survey and test it for validity and reliability. The characteristics of the panel of experts and the statistical results of their feedback is provided.

Chapter 5. Phase 2 Administration of online survey and statistical analysis: details the quantitative data collection used in phase 2 of the study. An analysis of the results is presented as a series of tables and graphs to demonstrate statistical trends.

Chapter 6. Phase 3 Semi-structured interviews and thematic analysis: outlines the qualitative data collection as phase 3 of the study. Thematic analysis was conducted and results portrayed through diagrams and verbatim quotes.

Chapter 7. Phase 4 Mixed methods analysis, discussion and recommendations: discusses the integration of the data from phases 2 and 3 as phase 4. Both data sets will demonstrate how they address each of the research questions. Finally, a series of limitations and recommendations will reveal how this study contributes to nursing research in this field.

Conclusion

This chapter introduced the background and context of this thesis. Foundation information on the key principles of the nursing process, knowledge and decision making was provided. The pathophysiology, diagnosis and classification of DKA was discussed to outline the complexity and role of nurses in the management of these patients. To date, there are no current studies that link the concepts of RNs knowledge and decision making in the context of managing patients with DKA.

The purpose, research questions, objectives and significance of the study are therefore presented as a means of contributing to nursing research literature. Contextual information on the location of the study and the role of the researcher were also described, followed by an outline of the layout of this thesis. The next chapter will offer an overview of the literature on the key concepts of RNs knowledge and decision making in the context of managing adult patients with DKA.

Chapter 2

Literature Review

Introduction

The previous chapter outlined the background and context to this study. This chapter provides a review of the relevant literature to identify the gap this study will address. This chapter will provide a summary of the prevalence of DM, the frequency of DKA admissions, and cost to the Australian healthcare system. There will be a discussion on the precipitating factors that cause DKA presentations. A critique of medical management protocols for DKA will be provided, with particular emphasis on the omission of nursing-specific interventions. This will lead to an in-depth discussion of the types of knowledge nurses use in clinical practice to provide holistic patient care.

It is evident in the literature that nurses' knowledge forms the foundation for their decision-making (Hoffman et al., 2004). Decision making is a dynamic and complex phenomenon in nursing practice, with different processes for making decisions and a number of factors that influence those decisions. Therefore, an examination of the concept of nurses' decision making will highlight the lack of current research on nurses' decision making with respect to the management of patients with DKA. The Clinical Judgment Model (CJM), outlined by Tanner (2006), will be suggested as the theoretical framework for the present study because of its correlations with both nursing and decision-making processes. The outcome of this literature review will be to justify the present study into nurses' knowledge and decision-making processes with the overall outcome of assisting nurses in the provision of holistic patient care.

A literature search was conducted via MEDLINE, PubMed and CrossRef databases. The search included Australian and worldwide studies, published in English. Search terms

such as “diabetic ketoacidosis”, “adult management”, “evidence-based protocols”, “nurses’ role”, “decision making” and “nurses’ knowledge” were used.

The literature review included an examination of current medical management protocols and the issues associated with their clinical application in Australia and overseas as they differ between hospital sites. Some studies mentioned the importance of the role of RNs in managing patients with DKA, with vague references as to what that role entails. These claims, however, were often made by non-nursing health professionals, and lacked empirical evidence from RNs themselves. A review of studies that examined RNs’ knowledge found that DM knowledge had been tested extensively, while DKA knowledge has been largely overlooked (Mohamed et al., 2018). Thus, it is clear there is a need for further investigation into RNs’ knowledge and decision making with respect to DKA management.

Incidence of diabetic ketoacidosis admissions

As discussed in the previous chapter, there is an increasing prevalence of DM in Australia. A portion of these cases may have been previously unaware of their DM diagnosis if they had not presented to hospital with DKA. A report from the AIHW stated that in 2014-15, 7132 hospital admissions were associated with the principal diagnosis of DKA. Of those admissions, 3245 (or 45.5%) were IDDM patients aged under 25 years with an average length of stay of 2.9 days (AIHW, 2016). Unfortunately, the study did not provide information regarding the severity of DKA on admission or whether patients had multiple admissions. However, it was reported that DKA hospitalisations were 1.4 times higher for women than men, 1.5 times higher in rural areas in comparison to major cities and 2.4 times higher for people in lower socioeconomic groups (AIHW, 2016). This data suggests that there is a young, isolated and vulnerable population of Australians who are at risk of requiring hospitalisation for DKA during their lifetime. The duration and cost of each hospitalisation

to the individual and organisation will likely follow a similar trend to the prevalence of DM; contributing to an increasing burden to the healthcare system (Lee et al., 2018).

One method to measure the burden of DKA presentations on the Australian healthcare system is to consider length of hospital stay. An Australian study on the factors that influence the time to the resolution of DKA suggested that severity of the condition was an important consideration. An audit of 71 patients found that a lower pH, higher potassium level and concurrent infections were independent predictors of prolonged hospital stay (Lee et al., 2018). It was reported that although it took an average of 11 hours to treat the patient's DKA, the average length of stay was three days (Lee et al., 2018). The delays identified in this study were attributed to time taken to involve specialist teams, multidisciplinary reviews and complex discharge planning (Lee et al., 2018). It is not known if delays in treatment or inappropriate decision making had any impact on length of stay. Therefore, more research may be needed to ascertain the impact of length of hospital stay for DKA admissions on the healthcare system.

An alternative measure of the burden of the disease on the Australian healthcare system is an examination of the financial costs associated with diabetes. The Baker Heart and Diabetes Institute reported on the annual costs of managing the different types of DM in Australia. For patients with IDDM, the average total cost was \$570 million, with an average of \$4669 per person, assuming that they have no associated disease complications. For patients with NIDDM, the average cost was \$6 billion, with an average of \$4025 per person, which again assumed that their disease is uncomplicated (Baker Heart and Diabetes Institute, 2012). Even without considering the increased costs of individuals who develop complications, these figures represent a significant financial burden for the Australian healthcare system.

There is a significant cost associated with admission to hospital for complications associated with chronic diseases. A study that examined the cost of diabetes complications in Australia, described the expenses in terms of healthcare costs (direct and indirect) and government subsidies. Diabetic patients with micro- and macrovascular complications incurred healthcare costs of 2.5 times higher than those with no complications (Lee et al., 2013). Similarly, the cost of government subsidies for diabetic patients with micro- and macrovascular complications was 1.3 times higher than those patients without (Lee et al., 2013). As micro- and macrovascular complications are often considered chronic conditions, they do not necessarily represent the costs associated with an acute complication such as DKA.

Approximately 20% of Australians who are newly diagnosed with IDDM only learn of their diagnosis by being admitted to hospital with DKA (Department of Health, 2015). In the same study, 191 patients were considered to have “new diabetes” and incurred a direct healthcare cost of \$2081 per person (Lee et al., 2013). It may be inferred that a portion of those patients presented to hospital with DKA, so it may be speculated that the cost of a DKA admission may approximate to this amount. If that assumption is true, then the total healthcare cost for a patient presenting with DKA may be estimated at \$2699 with government subsidies of around \$4648 (Lee et al., 2013).

In response to the financial implications of DM, the government developed the Australian National Diabetes Strategy 2016-2020, which was aimed at reducing the socioeconomic burden on the healthcare system. The first of these goals was the prevention of NIDDM which can be achieved through healthy diet and lifestyle choices (Department of Health, 2015). The second goal was to promote awareness for the early detection of DM, and this includes the signs and symptoms of DKA (Department of Health, 2015). The third goal was to reduce complications associated with DM through education and upskilling the

workforce among other strategies (Department of Health, 2015). In order to achieve this goal, further research into the knowledge of key stakeholders, such as nurses, is highly pertinent as they are at the forefront of health promotion.

In light of the increasing prevalence of DM in Australia, the frequency and cost of DKA admissions and the healthcare burden associated with managing DM, there is evidently a socioeconomic need for further research into DKA presentations. These presentations often involve young people with a chronic condition who will be at lifelong risk of complications and recurrent hospitalisations. Each DKA presentation is potentially life threatening, which is a significant problem for the patient, the healthcare professionals who care for them, and the cost to the healthcare system. The Australian National Diabetes Strategy firmly acknowledges that prevention, early detection and reducing complications are high priorities to reduce the healthcare burden caused by DM (Department of Health, 2015). The aim of the present study is to assist in achieving these goals through promoting awareness of DKA as an acute complication of DM within a workforce that plays a significant role in managing this disease. To achieve this aim, the next section will examine the underlying causes that lead to DKA presentations in the interest of preventing their recurrence.

Precipitating factors underlying diabetic ketoacidosis

The causes of DKA have been associated with numerous factors including medical conditions, socioeconomics and psychological issues. As aforementioned, approximately 20% of DKA presentations to hospitals are as a result of a previously unknown diagnosis of diabetes (Department of Health, 2015). Deliberate insulin omission, or non-compliance has been reported as the most common precipitating factor (Nyenwe & Kitabchi, 2011; Sola et al., 2006). Other medical conditions such as: infection, pancreatitis, myocardial infarction, and stroke have also been associated with a diagnosis of DKA (Kitabchi et al., 2006; Nyenwe

& Kitabchi, 2011). In 15-30% of cases of DKA, however, the cause remains unknown (Bell & Alele, 1997; Sola et al., 2006).

Identifying the precipitating factors associated with patient's developing DKA is an important part of the treatment plan, as well as preventing a recurrence. A recent national study in the USA revealed that up to 40.8% of patients who were admitted with DKA were readmitted with the same condition within 30 days (Hurtado et al., 2019). A multivariate analysis showed that end-stage renal disease, discharge against medical advice and drug use were the most significant predictors for recurrent DKA. Less significant predictors included women, patients with IDDM, and patients who experienced complications such as bleeding, hypoglycaemia and encephalopathy (Hurtado et al., 2019). Certain comorbidities such as depression, coronary artery disease, atrial fibrillation, heart failure, peripheral vascular disease, cerebrovascular disease, hypertension, discharge to a nursing home, smoking and liver disease were also predictors for readmission to hospital with DKA (Hurtado et al., 2019). The researchers also found that 25% of patients were readmitted with DKA within the first week post discharge, and 50% were readmitted within 2 weeks.

These readmission statistics clearly indicate a significant burden to the healthcare system, especially when some of the predictors for readmission with DKA are potentially modifiable, such as drug use and discharge against medical advice (Hurtado et al., 2019). While this study reports exclusively on the US healthcare system, it acknowledges that readmission rates in other countries may be different. Regardless, a recent study showed that patients with recurrent DKA were at risk of mortality 10 years younger than in cases of isolated DKA (Del Degan et al., 2019). Even so, the prevention of recurrent DKA should be a priority for healthcare professionals.

The issue of recurrent DKA has been associated with a number of risk factors with insulin non-compliance being the most prevalent in the research literature (Cooper et al.,

2016; Simmons et al., 2015; Randall et al., 2011). Furthermore, studies reported that low socioeconomic status, poverty and drug use were also contributing factors for insulin non-compliance and subsequent recurrent DKA (Bradford et al., 2017; Del Degan et al., 2019; Randall et al., 2011). A study of an inner-city minority population in the USA reported that socioeconomic factors such as financial hardship and homelessness were associated with recurrent DKA (Randall et al., 2011). It was suggested that these people were at higher risk of non-compliance which was related to not having sufficient cash, their insulin supply being lost, stolen or taken away, stretching their supply to last as long as possible, or feeling sick (Randall et al., 2011). There is evidence to suggest that faults in continuous insulin infusion pumps have also caused DKA, but improvements in technology and patient education make this a less common cause (Kitabchi et al., 2006; Nyenwe & Kitabchi, 2011).

Other precipitating factors recognised as underlying DKA are psychological. Mental health issues account for approximately 20% of DKA presentations, and are particularly common for young, female patients with IDDM (Kitabchi et al., 2006; Nyenwe & Kitabchi, 2011). These factors include depression, eating disorders, schizophrenia and bipolar disorders (Nyenwe & Kitabchi, 2011). It is suggested that the cause of these psychological disorders is often due to fear of weight gain or hypoglycaemia, rebellion against authority and the stress of chronic disease, leading to insulin non-compliance (Kitabchi et al., 2006). The identification of the aforementioned precipitating factors associated with DKA is often referenced in clinical management protocols that underpin the care of these patients.

Clinical management protocols for diabetic ketoacidosis

Standardised evidence-based protocols, sometimes referred to as care pathways, are sequential management plans that guide clinicians towards treatment goals for patients (Waller et al., 2007). The purpose of such protocols is to reduce variation in treatments,

promote evidence-based care, decrease hospital cost and length of stay, and optimise patient outcomes (Ilag et al., 2003). Protocols for managing DKA are often developed by a team of experts in the field, such as endocrinologists, internal physicians, pharmacists and nurses (De Beer et al., 2008; Ilag et al., 2003; Evans et al., 2014; Mohamed et al., 2018). However, clinical protocols can be medically focused and may not be designed to facilitate the nurses' role or decision making. There is little discussion within the literature of the contribution provided by RNs in the development of clinical protocols for the management of DKA patients. Therefore, it may be argued that the protocols may lack the holistic approach to patient care that is unique to the nursing profession.

An Australian systematic review examined 85 articles for evidence to support DKA management protocols. This review found a lack of randomised control trials and addressed controversial medical management issues such as fluid replacement rates, potassium doses and insulin administration (Tran et al., 2017). However, more importantly, this review shed light on the absence of consistency across DKA protocols. In a practical sense, this means that current clinical DKA protocols only standardise medical management within individual organisations, not the healthcare system as a whole. This lack of consistency means that healthcare professionals may draw on other forms of evidence to facilitate and support their decision making for these patients. One study suggested that despite nurses having confidence to access and use evidence in practice, they chose to use their personal experience and social interactions with colleagues to guide their practice (Gerrish et al., 2007).

The systematic review focused upon evidence-based practice in terms of medical management and outcomes, thereby suggesting that there was a vast scope for future randomised control trials on all aspects of DKA management (Tran et al., 2017). Performing further randomised control trials would add evidence to address some of the medical management issues that are currently present in DKA management protocols. The impact of

randomised control trials on the nursing management of DKA is open to speculation as there is currently a lack of evidence for nurses' involvement in the development of DKA protocols.

Compliance with diabetic ketoacidosis protocols

Unlike Australia, the UK have a widely distributed document of national guidelines for the management of adults with DKA, published by the JBDS (2013). The aim of these guidelines is to standardise the evidence-based care of these patients to optimise outcomes (JBDS, 2013). However, an audit of the implementation of the JBDS guidelines in the UK reported poor compliance by medical practitioners and nurses, as well as associated complications (Dhatariya et al., 2016). Another UK study found that their evidence-based DKA protocol was only utilised in 43% of cases (Evans et al., 2014). The researchers reported this suboptimal compliance rate was due to lack of education of the staff on its utility and other priorities in the hospital (specifically the introduction of an electronic medical records system) at the time of implementation of the protocol (Evans et al., 2014). Therefore, this study implies that education is the key to compliance with overarching guidelines for the management of patients with DKA.

A Canadian study undertaken in 2018 designed a standardised DKA management protocol with a more multidisciplinary approach to its' implementation. The study referenced a team of experts in the development phase, including RNs. The team achieved a high compliance rate of 87% in their implementation phase through medical and nursing staff education, ongoing feedback and frequent analysis of barriers to implementation (Mohamed et al., 2018). Improvement in patient care was attributed to the large portion of medical (100%) and nursing staff (85%) involved in the study at a specific tertiary hospital (Mohamed et al., 2018). This study argues that a DKA management protocol is only as good as its' implementation strategy for clinical practice, which should ideally involve staff education. It

was also one of the few studies to acknowledge the role that nurses' play in managing patients with DKA.

Furthermore, an audit in the UK audit of the implementation of the JBDS guidelines reported some protocol non-compliance issues being attributed to nursing tasks. These tasks included the frequency of glucose, ketone and urine output monitoring. The audit found 27% of patients did not have hourly haemodynamic monitoring (Dhatariya et al., 2016). This low percentage was attributed by the researchers to be related to the RNs workload without further elaboration. It could be argued that as the JBDS guidelines were not designed with nursing scope of practice in mind. Therefore, it is not surprising that their role, according to the JBDS, in the management of DKA is unclear.

A number of studies have offered other rationales for poor compliance with DKA management protocols. In Denmark, researchers identified 24 different insulin protocols and 21 fluid replacement regimes nationwide (Henriksen et al., 2007). Not surprisingly, they concluded that this significant variation in DKA management protocols likely influenced their application in practice (Henriksen et al., 2007). Another study found that compliance with the protocol was impacted by poor handover (Devalia, 2010). Finally, poor documentation and a lack of supporting charts have also been suggested as possible reason for poor compliance with DKA management protocols (Jervis et al., 2013). This final study may have underpinned the Evans et al. (2014) study by inferring that inadequate staff education also contributed to poor compliance (Jervis et al., 2013). Together, these studies highlight that poor compliance with DKA management protocols is compounded by multiple factors and warrants further discussion about the risks associated with this issue.

Complications from poor compliance

Poor compliance with clinical management protocols has been associated with an increase in morbidity and mortality for patients with DKA (JBDS, 2013). A recent

Australian study reported that of 34% of DKA patients developed hypokalaemia during their admission (Lee et al., 2018). The researchers postulated that non-adherence with potassium replacement protocols led to these cases of hypokalaemia (Lee et al., 2018). Another study reported that hypoglycaemia was the most common complication that patients developed whilst receiving treatment for DKA (Gosmanov et al., 2014). The causes for hypoglycaemia during DKA treatment may include medication issues (for example, steroid doses, timing of insulin administration and oral hypoglycaemic agents), comorbidities (specifically dementia, sepsis and changes in renal or hepatic function) and dietary habits such as changes in oral, parenteral or enteral nutritional intake (Umpierrez & Korytkowski, 2016).

The previously mentioned UK audit of compliance with the JBDS guidelines used at 72 UK hospitals reported that 27% of patients with DKA developed hypoglycaemia during their admission, and 55% developed either hypo- or hyperkalaemia (Dhatariya et al., 2016). It concluded that these complications were the result of either infrequent monitoring or adaptations of the standardised guidelines for potassium replacement (Dhatariya et al., 2016). Nonetheless, these complications can have a range of consequences from nausea, vomiting and muscle cramps, to cardiac dysrhythmias, seizures and cardiac arrest (Porth & Gaspard, 2015). Hence, it is important to address issues related to the implementation of standardise protocols in order to prevent patient morbidity and mortality.

Challenges relating to diabetic ketoacidosis protocols

Implementing standardised DKA protocols has been reported as problematic due to a number of organisational issues. Unclear or incomplete documentation, lack of supporting bedside charts and inadequate staff education have been suggested as rationales for poor compliance with DKA protocols (Jervis et al., 2013). These issues suggest that health professionals did not have the resources or training to carry out evidence-based care and make justifiable clinical decisions. The study reported that as a result of these omissions,

professionals resorted to ad hoc adaptations of the guidelines, which could account for the aforementioned patient morbidity and mortality (Jervis et al., 2013). It is evident that the risks associated with poor compliance with standardised protocols has the potential to adversely impact patient outcomes.

The effectiveness of an evidence-based DKA protocol has been measured in terms of staff and patient satisfaction in the UK. In the study, nurses indicated that a DKA protocol allowed them more autonomy in their clinical reasoning by not having to wait for the medical plan (Evans et al., 2014). No further details on what this autonomy entailed was provided. Autonomy is important for decision making in nursing practice because it empowers nurses to be independent when progressing patients towards their normal level of functioning (Nibbelink & Brewer, 2018). A US study by De Beer et al. (2008), looked at the creation of a clinical resource file for junior physicians and nurses to promote best practice in the management of DKA. It was found that this initiative was particularly useful for RNs and autonomous practice, as they could continue to monitor and titrate patients' progress towards the treatment goals in the absence of medical staff. Nurses value their autonomy because it allows them to apply their knowledge and enables their decision making (Skar, 2009).

The ethical principle of autonomy states that an individual should be permitted the liberty of choosing their own course of action (Fry & Johnstone, 2008). Nurses bring their own combination of values, life experiences, cognitive abilities, moral sensitivity, reasoning abilities and personal motivations to decision making (Fry & Johnstone, 2008). By enabling their autonomy, nurses are able to make sound clinical decisions for patient care (Nibbelink & Brewer, 2017). A study reported on patient's views of how advanced practice nurses (APNs), also known as nurse practitioners, managed their diabetes. The researchers stated the despite advanced practice nurses with prescribing rights being relatively new, patients reported a high level of satisfaction with their care (Eriksson et al., 2018). Patients said that

the care provided by the APN was “effective, fast and easy” and believed they were seen as a complete person, rather than isolated to their disease (Eriksson, et al., 2018). Therefore, nurses who practice autonomously, are enabled in their ability to provide holistic care and patients acknowledge the benefits of this approach.

As part of nurses’ holistic approach to patient care, they have an important role in facilitating patients to manage their DM independently to prevent hospital admissions (Coonfare & Miller, 2020). While patients often value this independence and are capable of making their own decisions, they become easily disempowered when admitted to hospital (Levett-Jones, 2018). Nurses therefore have an important role in enabling the autonomy of their patients, while practicing autonomously themselves as health professionals. However, current DKA protocols arguably overlook the autonomy of nurses and their scope of practice, and do not detail the scope of their decision making, despite it being an important principle within the profession.

Protocols for the management of patients diagnosed with DKA have generally been designed for medical clinicians to follow, with little reference to the scope of practice for nurses. Some management protocols cater for a degree of autonomy, for example the titration of intravenous insulin according to a blood glucose level (Kinney et al., 2021). Generally, the full scope of nursing practice with respect to DKA management is by enlarge omitted in the research literature. This demonstrates that there is scope and a clinical need to investigate what nurses know about DKA and the decisions they make when managing these patients.

Nurses’ knowledge of diabetes mellitus and diabetic ketoacidosis

McPherson and Wendler (2020) postulated that nursing knowledge is the hallmark for safe clinical practice. Knowledge is the key characteristic that nurses, ranging from the least

experienced student to the most seasoned leader, seek to develop and apply in the holistic care of patients. Knowledge has been defined as a means of perceiving the world in a way that can be shared with others (Chinn & Kramer, 2018). In nursing, knowledge is demonstrated through critical thinking, decision making and professional accountability (McPherson & Wendler, 2020). The primary goal of acquiring and utilising knowledge is to ensure patient safety. When a knowledge deficit is identified, there is a potential risk to that safety. The consequences of nurses' lack of knowledge may include failure to identify interventions, failure to provide rationales and failure to solve problems (McPherson & Wendler, 2020). This section will discuss types of knowledge and the theory of knowing as they relate to nursing practice. This will lead to a synopsis of research into nurses' knowledge, and subsequent deficits, with specific reference to diabetes.

Types of knowledge

Epistemological research is the philosophical study of knowledge. Carper (1978), a nursing theorist, identified five types of knowledge, or 'ways of knowing', that underpin nursing practice, namely; empirical, aesthetic, ethical, personal and emancipatory. The purpose of Carper's theory was to achieve praxis: the idea of nurses' moving beyond practical knowledge for task orientation to deeper cognitive processes in a broader social context (Campbell et al., 2018; Chinn & Kramer, 2018). Praxis is important because nurses need to recognise the limits of their ability and experiences and reflect on these situations in order to bring about change in health care (Chinn & Kramer, 2018). One way of measuring nursing competency is through an examination of the types of knowledge nurses' use in practice when making decisions.

Nurses' decision making is often measured according to the depth of nurses' empirical knowledge. Empirical nursing knowledge is considered the 'science of nursing', where nurses' knowledge is established through the senses (Chinn & Kramer, 2018). By

hearing, seeing and touching, nurses are able to observe and record objective data about patients that is considered truth and can be used to make decisions (Chinn & Kramer, 2018). Empirical knowledge is important and forms a large part of nurses' training by offering scientific justification for nursing actions (Campbell et al., 2018). With respect to the management of patients with DKA, empirical knowledge would include hard scientific facts such as the pathophysiology of DKA and rationale for the treatment regime. This scientific knowledge also forms the foundation for many decision-making models, in conjunction with other types of knowledge.

Aesthetic nursing knowledge is also referred to as the 'art of nursing' and involves the cognitive and technical skills nurses' require to carry out their role (Chinn & Kramer, 2018). Nurses are artistic and creative, in the sense that they can differentiate between what is 'expected', and what is 'normal'. Nurses' can engage with patients on a deeper emotional level and comprehend that those emotions and experiences are portrayed in different ways by different people (Campbell et al., 2018). An example of this phenomenon is the prevalence of psychological issues among patients with chronic illnesses, including diabetes. As previously discussed, there is overwhelming evidence to suggest that insulin non-compliance leads to DKA. However, it is less reported in the literature, and consequently in clinical management protocols, of the emotional impact of managing chronic disease has on patients. Feelings of sadness and embarrassment have been associated with DKA presentations, and it is the responsibility of the nurse looking after these patients to detect and address these emotions (Jerreat, 2010). To achieve this, nurses require creative ways of developing trust with patients to disclose information that may influence their care and outcomes (Chinn & Kramer, 2018). This artistic approach to nursing requires rehearsal and experience to develop, in the same way as the other types of knowledge.

Ethical nursing knowledge, or the morality of nursing, is based on the key ethical principles of autonomy, beneficence, non-maleficence, veracity, fidelity and justice (Fry & Johnstone, 2008). Nurses learn these principles through formal education and their individual moral development with the overall aim of doing what is good, desired or right (Campbell et al., 2018). Nurses have a desire to do what is right, for the patient, for the organisation and for their own moral compass. However, ethical dilemmas occur frequently in nursing practice such that nurses are required to take multiple factors into consideration in order to arrive at a decision. Nurses' application of ethical principles, contextual factors, legislative obligations and their individual values are all demonstrative of moral conduct in nursing practice (Chinn & Kramer, 2018). Ethical knowledge with respect to managing patients with DKA may take the form of alleviating symptoms such as pain or nausea, and full disclosure of the treatment plan prior to the intervention. A recent Australian study acknowledges that a lot of current nursing literature has overlooked the impact of ethical expertise on decision making (Hutchinson et al., 2016). This appears to be the case as no study to date has been found that investigates nurses' ethical knowledge with respect to managing patients with DKA.

It is not widely reported if aspects of personal knowledge contribute to nurses' decision-making processes when managing patients with DKA. Personal knowledge refers to how nurses involve aspects of themselves in their nursing care of others. This integration of self into practice is vital for nurses to reflect on their thoughts and actions, and how they communicate with patients in their care (Campbell et al., 2018). The developing of therapeutic relationships is not necessarily a cognitive process, but is demonstrated through acts of empowerment, a sense of community and a mutual exchange of values (Chinn & Kramer, 2018). Nurses are in the unique position to utilise their personal knowledge as part of patient care, but this is not a type of knowledge that is often referred to in research

literature. However, it is possible for nurses to use their personal knowledge with respect to managing patients with DKA by reflecting not only on the patient's progress towards their treatment goals, but also on their own response to the patient's progress. This form of reflection is described in more detail later.

Carper's original theory of knowing outlined empirical, aesthetic, ethical and personal knowledge as vital for nursing practice (Campbell et al., 2018). However, as the nursing profession has developed as a result of social change, emancipatory knowledge is also required to bring about praxis (Campbell et al., 2018; Chinn & Kramer, 2018). Emancipatory knowledge forms the groundwork for future changes to the profession; a way of knowing that examines the current flaws in the system, and works to rectify them. Essentially, emancipatory knowing is a rebellion against the status quo, or 'the way things are', on a quest towards 'the way things should be' for all (Chinn & Kramer, 2018). Research itself is a form of praxis, as it focuses on "developing knowledge that can contribute to social, political and economic changes in the structures of society that affect health and illness" (Thorne & Hayes, 1997, p.275). Research into nurses' knowledge with respect to managing patients with DKA, has the potential to offer new knowledge for the future by examining each type, and how it is applied in a specific clinical context. Nurses themselves have the power to shape the future of the profession, by identifying current gaps in the research literature and designing studies to fill those gaps.

Each type of knowledge is unique and is demonstrated on a daily basis in different ways. All of the types of knowledge are integrated by nurses and lead them to make decisions. Whilst every effort may be made in a situation to make the 'best' decision at that moment in time, it is acknowledged that the 'right' decision may never be clear (Chinn & Kramer, 2018). Therefore, it is important to investigate all the types of knowledge nurses use in their decision making as the foundation for the process they use to arrive at a decision.

Nurses' knowledge and diabetes

To date, there are no studies that investigate all the types of knowledge nurses use to manage patients with DKA. Many studies on nursing knowledge seem to focus on empirical knowledge in isolation, with little to no reference to the other types (Chinn & Kramer, 2018). Studies that examine nurses' knowledge and DM do not go so far as to examine nurses' knowledge of DKA in any depth, thus forming the foundation for the present study.

Seminal research that examined nurses' knowledge of DM concluded that nurses' knowledge was suboptimal (Scheiderich et al., 1983). This study paved the way for further research into what nurses knew about DM, what they thought they knew and, eventually, what they should know (Baxley et al., 1997; Chan & Zang, 2006; Drass et al., 1989; El-Deirawi & Zuraikat, 2001; Findlow & McDowell, 2002; Gossain et al., 1993). This early work also formed the foundation for the development of a number of quantitative tools used to measure the concepts surrounding DM knowledge. The first of these measurement tools was the Diabetes Knowledge Test (DKT) that was used in a 1983 seminal study on a sample of medical and surgical nurses. The researchers reported a mean score of 74% correct answers, with the medical nurses scoring higher than the surgical nurses (Scheiderich et al., 1983). Although the researchers suggested that the DKT could be adapted to explore the in-depth knowledge of nurses in a specific area of DM, no study so far has implemented this recommendation with respect to DKA as an acute complication of DM.

The DKT was adapted in 1989 into the Diabetes Self Report Tool (DSRT), to measure confidence, and the Diabetes Basic Knowledge Test (DBKT), to measure knowledge (Drass et al., 1989). These tools were designed to ascertain what nurses thought they knew and what they actually knew about managing patients with DM (Drass et al., 1989). Both tools were reviewed by six experts for reliability testing and resulted in a Cronbach's α of 0.91 for the DSRT and 0.79 for the DBKT (Drass et al., 1989). Interestingly, no baseline

score for the DBKT was proposed in this study. However, later work by El-Deirawi and Zuraikat (2001) advised that, as 70% accuracy is insufficient for nurses to provide quality care to DM patients, a baseline score of 80% on the DBKT would be appropriate. The following six studies that used the DBKT reported mean scores ranging from 64% to 75.3%, thus not achieving the suggested baseline score (Baxley et al., 1997; Chan & Zang, 2006; Drass et al., 1989; El-Deirawi & Zuraikat, 2001; Findlow & McDowell, 2002; Gossain et al., 1993)

The findings in the 1989 study using these tools indicated an inverse relationship whereby the more confident nurses were about their knowledge of DM, the less they actually knew regarding their clinical practice (Drass et al., 1989). This study was replicated in Scotland, using an updated DBKT and similar results were found (Findlow & McDowell, 2002). However, when Gossain et al. (1993) and, El-Deirawi and Zuraikat, (2001) used the same measurement tools in their respective studies, they reported contrary findings: a direct relationship whereby nurses who were confident in their knowledge of DM actually had more knowledge. A further two studies replicated the Drass et al. (1989) to produce a third set of varied results that suggested no relationship between what nurses thought they knew and what they actually know about DM (Baxley et al., 1997; Chan & Zang, 2006).

The aforementioned studies had response rates of 35% to 80%, with sample sizes of 32 to 245 participants and this variation in population numbers may account for some of the variations in the findings. Four of the these seven studies were conducted in different states of the USA (Baxley et al., 1997; Drass et al., 1989; Gossain et al., 1993; Scheiderich et al., 1983), and all were older than 15 years. The DBKT has two questions relating to DKA; one that asked for symptoms of DKA, and the other about the causes of DKA in known IDDM (Findlow & McDowell, 2002). Therefore, there is currently no stand-alone tool to examine nurses' knowledge of the management of DKA. The discrepancy in the findings suggests

that further studies, with either an adaptation of the DBKT or development of a new measurement tool, should be undertaken to investigate nurses' knowledge of DM and DKA.

A large rigorously designed study that utilised an adaptation of the DSRT and DBKT was conducted in Saudi Arabia. A response rate of 60% (n 423) nurses was obtained with the results showing equivalent scores of 78.2% for perceived knowledge, compared to actual knowledge of 52.3% (Alotaibi et al., 2017). The researchers concluded that a training needs assessment should be conducted in order to bridge the theory-practice gap that was raised by researchers 15 years earlier (Alotaibi et al., 2017; Findlow & McDowell, 2002). This study was larger than those previously mentioned, and conducted outside the US, but it still utilised a form of the DBKT and DSRT. The following study introduced a new measurement tool for assessing nurses' actual and perceived knowledge of DM; the Diabetes Management Knowledge Assessment Tool (DMKAT).

In a large study in the US, 2250 nurses participated in an exploration of their DM knowledge in relation to comfort and familiarity, before and after a four-hour training program (Modic et al., 2014). The nurse researchers developed the DMKAT to measure comfort, familiarity and knowledge. The study found that nurses had higher scores for comfort and familiarity as opposed to knowledge (Modic et al., 2014). This suggests that the new measurement tool found not only a knowledge deficit, but a potential lack of insight into that deficit. Two questions that referred to hyperglycaemia and DKA were highlighted as particularly challenging for the participants (Modic et al., 2014). The results also indicated that nurses' knowledge did improve following the training program (Modic et al., 2014). This study demonstrated that an intervention to bridge the theory-practice gap for nurses acquiring knowledge of DM is possible. However, it did not investigate DKA in detail.

An integrative review conducted by Australian nurses to critically analyse nurses' knowledge of DM aimed to identify the barriers associated with nurses' acquisition of such

knowledge. The review examined a total of 25 studies, six of which related to DM complications (Alotaibi et al., 2016). All six studies reported that nurses had a knowledge deficit with respect to DM complications, but noted the importance of such knowledge for patient education (Daly et al., 2014; Livingston & Dunning, 2010; Nash, 2009; Oyetunde & Famakinwa, 2014; Unadike & Etukumana, 2010; Shiu & Wong, 2011). Interestingly, three of the six studies did not refer to DKA as a complication of DM (Shiu & Wong, 2011; Oyetunde & Famakinwa, 2014; Nash, 2009). One study from New Zealand did not refer to DKA specifically, but reported on nurses' knowledge of hyperglycaemia or high HbA_{1c} (Daly et al., 2014).

The remaining two Nigerian studies from the aforementioned integrative review concluded that nurses' lack of knowledge contributed to patients being inadequately prepared to manage their condition. One reported that 50.9% of the surveyed nurses could identify one clinical feature of DKA, but only 12% could identify four features (Unadike & Etukumana, 2010). The other supported these results by reporting that 27.7% of their sample were able to identify the signs and symptoms of DKA (Odili & Eke, 2010). In the same study, however, 43.5% incorrectly identified diaphoresis as a sign of DKA (Odili & Eke, 2010). No other studies were identified within the integrative review that tested the RNs' knowledge of DKA.

Only one Australian study was included within the Alotaibi et al, (2016) integrative review that referred to DKA knowledge in nurses and this related specifically to practice nurses. Half of their sample knew that hyperglycaemia was a short-term complication of DM. However, DKA seemed less important as it was referenced in the "Other" category along with urinary tract infections and cellulitis (Livingston & Dunning, 2010). The review also examined barriers to nurses acquiring knowledge of DM (Alotaibi et al., 2016). These barriers were identified as lack of education, access to resources, nursing shortages, high workloads, and low job morale (Alotaibi et al., 2016). Based on these studies, it is apparent

that RNs have knowledge deficit with respect to DKA as a major complication of DM, and one that needs further investigation.

Nurses' decision making

Extensive research has been conducted to examine nurses and decision making in a range of contexts. A study conducted by Bakalis and Watson (2005) examined nurses' decision making in medical, surgical and critical care contexts and how decisions differed between these areas. It was found that all nurses had scope for making autonomous decisions regarding patient care. There were limitations in decision making with respect to extended practice roles such as leadership and management, but this was consistent with the trend that more experienced nurses made more leadership decisions. Specialist critical care nurses made more decisions in emergency situations and were able to carry out their role as mentors, more so than medical or surgical nurses (Bakalis & Watson, 2005). This was attributed to more time and specialist training in critical care, but overall education level did not impact nurses' abilities to make decisions.

The Bakalis and Watson 2005 study hints at the range of decisions nurses make based on their clinical area. This concept is interesting with respect to the management of patients with DKA because the patient's hospital journey often begins in the ED, a critical care area, and depending on the severity of the patient's DKA, they may be admitted to either a medical or high dependency unit. According to Bakalis and Watson (2005), the decisions that nurses make in a medical unit, may not be the same and as their colleagues who work in critical care. For example, if a patient with DKA were to deteriorate on a medical ward, the nurses have the option of escalating the patient's care to involve input from critical care specialists. If a patient were to deteriorate whilst already in that critical care unit, the nurses would be expected to make decisions to manage the patient from colleagues and resources within the

unit. The potential impact on patients is consequently different depending on the severity of the DKA they presented with, and their journey through their hospital stay (Griffey et al., 2019; Henriksen et al., 2007). Examining the similarities and differences in decision-making amongst nurses from different clinical areas who manage the same acute condition is therefore important and relevant for optimising the outcomes for patients with DKA.

Decision making in the context of nursing practice is defined as choosing the best of alternative options that influence the care of patients (Krishnan, 2018). There is a growing body of literature around nurses' decision making. The national registration agency underpins nurses' decision making in the interest of public safety and professional accountability (NMBA, 2007).

Principles for decision making

The principles for decision making in nursing have been outlined by the NMBA, similarly to the previous chapter's reference to nursing scope of practice. The four principles used to develop tools that measure nursing decision-making are as follows:

1. The motivation for nursing decisions must be to meet healthcare needs of patients;
2. Nurses are accountable for their decision to consult other members of the multidisciplinary team;
3. Nurses are accountable for the delegation of nursing tasks; and,
4. Nurses' decisions should be in collaboration with planning, risk management and evaluation strategies (NMBA, 2007).

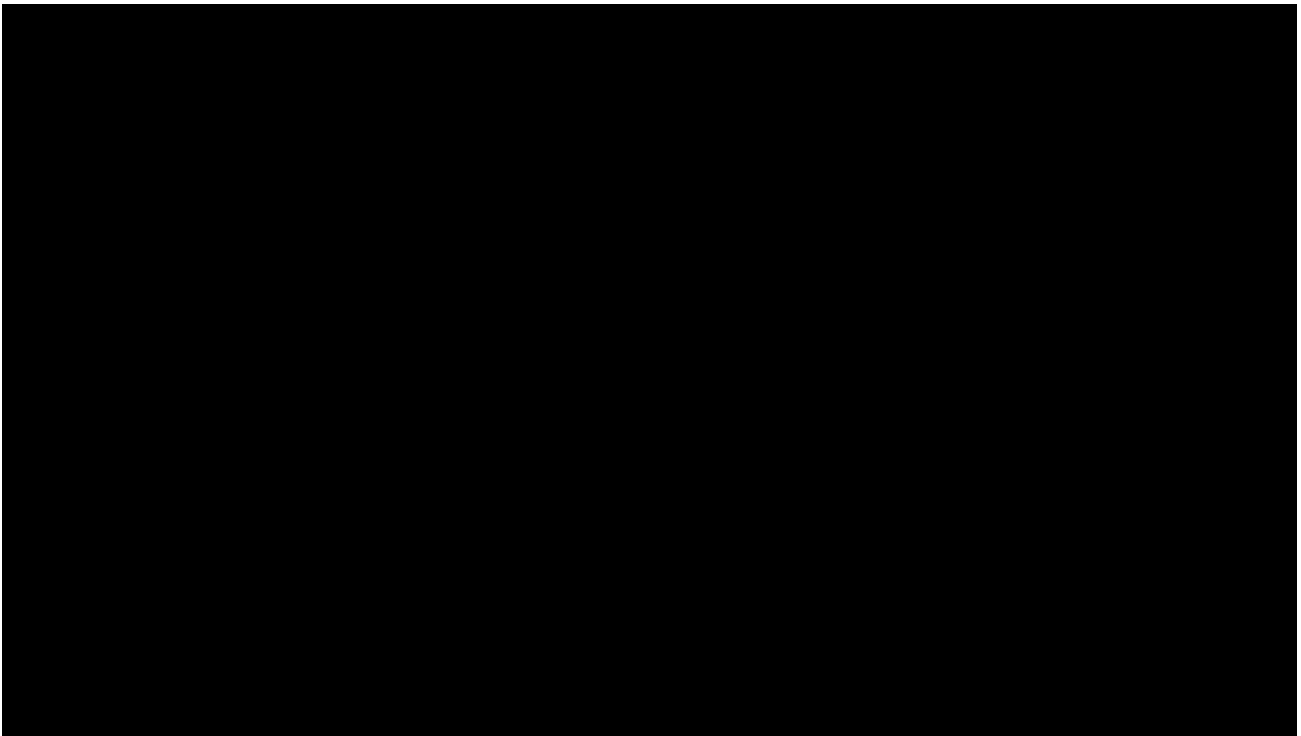
These principles were primarily designed for application in a clinical context, though they can be modified for use in nursing research, education and management (NMBA, 2007).

The NMBA principles are generic and there are a range of factors that influence decision-making processes. The CJM appears to represent an all-encompassing decision-making framework as it closely resembles the nursing process. This model was developed

from a synthesis of over 200 nursing studies focusing on the nurse's role in decision making and clinical judgment (Tanner, 2006). The CJM has four components that are related to each other in a cyclical process as shown in Figure 2.

Figure 2

Clinical Judgment Model (Tanner, 2006)



The first component in the CJM is termed *noticing*. This is a cognitive process related to the identification of nursing problems and is based on the education and experience of the nurse along with the clinical context and patient history (Tanner, 2006). The identification of the nursing problems associated with DKA is crucial to the decision-making process and the timely management of the patient.

The second component of the model is termed *interpreting*. In this stage, nurses start to develop reasoning patterns based on analysis and intuition (Tanner, 2006). In terms of DKA, *interpreting* may include reviewing trends in vital signs to determine the patient's clinical status, alongside biochemical trends in blood glucose and ketone levels. In addition,

interpreting would include the analysis of further objective and subjective clinical data to plan a course of action (Tanner, 2006).

The third component is termed *responding*, where plans are made and implemented. It is recognised that nurses may approach this stage in two different ways. Firstly, they may be able to plan and implement care immediately, based on their tacit knowledge. Secondly, nurses may resort to utilising a deductive reasoning process to ascertain the most likely explanation for the data and plan action based on the best fitting hypothesis (Tanner, 2006).

The fourth component in the CJM is termed *reflecting*. This component also has two elements: reflection-in-action and reflection-on-action (Tanner, 2006). Reflection-in-action refers to an evaluation of the patients' response to the nursing intervention. Conversely, reflection-on-action relates to the nurse reflecting on themselves and their response to a clinical situation for the purpose of learning through experience (Tanner, 2006).

The CJM is arguably underpinned by Hammond's cognitive continuum theory. This theory proposes an alternative to the dichotomy of intuition and analysis, by suggesting that these two concepts form opposing ends of a cognitive scale (Hammond, 1996). Analysis, in this context, refers to a stepwise and logically justifiable cognitive process (Lauri & Salantera, 2002), whereas intuition is considered the polar-opposite, a central construct of expertise and performance (Hutchinson et al., 2016). The continuum allows for the full range of permutations of analysis and intuition, including the often-elusive concept of 'common sense' (Hammond, 1996). Hammond's cognitive continuum theory formed the foundation for their study on the development of a measurement tool to test clinical decision making in nursing. The researchers acknowledged that Hammond's theory was particularly relevant for nursing research as nurses' decision-making processes differ according to different nursing fields (Lauri & Salantera, 2002). Therefore, Hammond's cognitive continuum theory has precedence for nursing research that examines decision making.

A study conducted in the Netherlands used the CJM to develop and validate a rubric to assess nursing students clinical reasoning whilst they were on clinical placement. The researchers utilised the four components of the CJM to develop 11 items. Each item had four levels of behaviour on a scale from novice to expert (beginning, developing, accomplished and exemplary) (Vreugdenhil & Spek, 2018). The rubric was psychometrically tested on nursing students and found to be both a valid and reliable measurement tool of deductive decision making. There is currently a gap in the literature relating to how or if the CJM reflects the decision-making processes of more experienced nurses who have been reported to use a more intuitive approach to decision making.

Factors influencing decision making

A recently published literature review identified important factors that influence decision-making in nursing practice. Nurses' professional experience in their clinical area was the most common themes (Hutchinson et al., 2016; Nibbelink & Brewer, 2017). Interestingly, 'experience' is often referred to as a measurement of time in clinical practice (Nibbelink & Brewer, 2017), rather than breadth or depth of knowledge and skills. Furthermore, the duration of nurses' experience in a clinical role does not guarantee that they make sound and justifiable decisions (Cappelletti et al., 2014; Hutchinson et al., 2016). However, it was acknowledged that nurses who have developed their knowledge and skills over time, are able to utilise more confident, intuitive and collaborative decision-making process (Nibbelink & Brewer, 2017).

A synthesis of 17 studies found that experienced nurses do not necessarily follow a prescribed decision-making process like their junior colleagues (Oliver & Butler, 2004; Radwin, 1998). Instead, they are confident enough to ask questions, identify their options and intervene because they believe they are competent to do so (Oliver & Butler, 2004; Radwin, 1998). These nurses have also developed intuition to the point where they are able

to make decisions based on instinct and contextual reasoning, rather than objective evidence (Hutchinson et al., 2016; Rycroft-Malone et al., 2009). Experienced nurses also tended to utilise a social element to their decision making, where they collaborate with colleagues to justify their decisions. At times, this was even preferred over the use of protocols and other sources of information because it was more time efficient in emergency situations and more patient-focused (Seright, 2011).

Collaboration superseding the use of protocols is a possible explanation for the issues associated with integrating DKA management protocols into nursing practice. The literature acknowledges that the concept of experience in relation to decision making requires further investigation (Cappelletti et al., 2014). Therefore, it is not yet known if the theme of experience, and its' associated sub-themes of confidence, intuition and collaboration, are factors that influence nurses' decision-making processes in the context of managing patients with DKA.

However, there are potential flaws in using a nurses' experience as the sole foundation for their decision making. Nibbelink and Brewer (2017) suggested that experience is not the same as evidence, therefore decision-making processes should encourage nurses to make decisions based on evidence. They also suggested that cultural factors can influence decision making. Nurses need to feel safe and supported by their team when they make decisions, irrespective of their level of experience (Vifladt et al., 2016). Nurses also need to have foundational knowledge of the patient's clinical status, the trends in their response to interventions and a concept of timing; where rapid changes require quick decisions and gradual changes allow time for more information to be gathered (Tower et al., 2012).

As discussed in the previous section, there are no studies as yet that have examined nurses' knowledge of DKA in any depth, such that it is not yet known if nurses possess the

aforementioned foundational knowledge. Research to provide evidence to demonstrate nurses' decision-making whilst managing these patients also did not exist. Furthermore, without the opportunity to demonstrate decision-making in this specific clinical context, it is not known what decisions nurses make or how they those decisions may or may not be rationalised. The literature cited above seems to suggest that junior nurses rely on a more deductive decision-making process, in comparison to experienced nurses who have developed intuition over time. It is arguable that both may be used while managing patients with DKA. Workplace culture has been suggested as a factor that influences decision making (Vifladt et al., 2016), while other factors such as environmental, personal or organisational have yet to be tested among nurses who manage patients with DKA. An emerging theme in nursing research into decision making is situational awareness which may also be relevant in the context of patients with DKA.

The most rudimentary definition of situational awareness is knowing what is going on. It is "the perception of the elements in the environment..., the comprehension of their meaning and the projection of their status in the near future" (Endsley, 1995, p. 36).

Situational awareness is comprised of three hierarchal components: a perception of the current situation, comprehension of that situation and the ability to predict what may happen in the future (Stubbings et al., 2012).

Nurses demonstrate situational awareness when they examine the patient's situation based on their symptoms and diagnosis and try to predict the outcomes (Tower et al., 2012). Situational awareness also includes nurses reflecting on themselves and how their confidence and assertiveness influences the decisions they make (Stubbings et al., 2012). Situational awareness allows nurses to identify patterns and predict outcomes for patients (Nibbelink & Brewer, 2017). This is useful for planning patient care and justifying clinical decisions. However, a nurses' ability to be situationally aware can be influenced by interpersonal

behaviours, team dynamics and authority figures (Stubbings et al., 2012). Research has shown that lapses in situational awareness as a result of these factors, can have a detrimental impact on nurses' decision making and in turn, this may negatively impact patients (Stubbings et al., 2012).

The other key factor that influenced decision making in clinical practice related to the acute care environment. In an observational study over 30 hours, researchers witnessed 85 interruptions in the form of other people and technology (Hedberg & Larsson, 2004). People interrupted nurses' decision-making process by asking questions and requesting help regardless of where the nurse was situated on the ward. Technical interruptions took the form of phone calls and emergency alarms, which was observed to occur as many as five times an hour (Hedberg & Larsson, 2004). It was reported that during these interruptions, nurses were often performing direct patient care 62% of the time, 32% of the time they were doing indirect care such as documentation and the other 6% they were either on a break or in transit between tasks.

With so many interruptions, it is not surprising that nurses may struggle to follow a decision-making process through to conclusion by having to stop and restart the process multiple times before acting on the decision they make. It was concluded that nurses need decision-making strategies to ensure the safety of their patients and the quality of the care they receive (Hedberg & Larsson, 2004). The consequences for delayed decision making were not reported in detail. However, it is reasonable to suggest a risk of adverse events for patients who require timely interventions, as is the case for patients who present with DKA.

The other environmental factor that influenced nurses' decision making was work procedures. Task allocation between team members, time pressures or being 'at hand' were themes that disturbed nurses' when they were making decisions (Hedberg & Larsson, 2004). The researchers concluded that interruptions and work procedures were present in every

decision-making phase, and therefore adds to the complexity of this phenomenon in clinical practice. Interestingly, they noted that many of the interruptions occurred between the *interpreting* and *responding* phase, which is a critical point in the decision-making process, as it caused delays in implementing the decided intervention (Hedberg & Larsson, 2004). It was suggested that this had the potential to influence outcomes for patients, but did not elaborate further. Regardless of this omission, it is evident that there are environmental, cultural and professional factors that influence decision-making in clinical practice.

Based on the examination of the literature, it is evident that there are several processes and influencing factors that nurses use to make clinical decisions. The NMBA provide the basic principles for nurses' decision making in terms of motivation, accountability and collaboration. The CJM is a fundamental framework that is applicable across a variety of clinical contexts because it closely resembles the nursing process. A meta-analysis of literature indicated that experience, cultural and environmental factors all influence decision making in the acute care setting (Hedberg & Larsson, 2004). However, as yet, there is no published literature on the decision-making processes or influencing factors with specific reference to the management of patients with DKA. The evidence presented thus far suggests that nurses' have a key role in the team of healthcare professionals that manage patients with DKA.

The RNs' role within the multidisciplinary team may include observation, education, prevention of complications and advocacy. To fulfill this role, RNs can make and justify decisions anywhere on a continuum. That continuum ranges from analysis of empirical knowledge of DKA pathophysiology at one end and intuitively with aesthetic knowledge of the patient's experience with illness at the other end (Carnago & Mast, 2015). Personal, ethical and emancipatory knowledge of DKA management theoretically fills the gap in the middle of the spectrum. Research evidence that links these two concepts of knowledge and

decision making with reference to the management of adults with DKA is currently lacking, but evidently required in order for RNs to fulfill their role.

Nursing role in managing diabetic ketoacidosis

The literature suggests that nurses have four components to their role when managing patients with DKA. These components were observation, education, prevention of complications and advocacy (Jerreat, 2010; Kisiel & Marsons, 2009; Kreider, 2018; Modic et al., 2009; Moore, 2004; Seley & Weinger, 2007; Schmitz, 2000). An example of the RNs' role in observation was frequent monitoring of the patients' haemodynamic status, blood glucose and ketone levels, urine output and neurological status (Schmitz, 2000). These observations were indicative of hyperglycaemia, dehydration, electrolyte imbalance and decreased level of consciousness (Kisiel & Marsons, 2009). Nurses are also responsible for utilising their clinical judgment in response to these observations.

The nurses' role with respect to monitoring patients with DKA is under reported in the literature; most often it is only implied. The JBDS guidelines (2013) refer to monitoring vital signs, ketone and glucose levels and electrolytes as nursing specific tasks. The guidelines are not prescriptive in terms of frequency, therefore there is scope for nurses to use their clinical judgment to decide. Haemodynamic monitoring, or vital signs, are important for any acutely unwell patient, including patients with suspected DKA. These patients often present tachycardic, hypotensive and tachypnoeic with usually normal oxygen saturations and temperature (Addison et al., 2017). Hourly blood glucose and ketone measurements and at least two-hourly serum potassium and bicarbonate monitoring are recommended by the JBDS (2013). All of this objective data, predominantly empirical knowledge, forms part of the initial assessment, or *noticing* stage, that clinical decisions would be based on. As the CJM demonstrates, *noticing* a patient is not enough. Nurses are responsible for translating that

data into actions and it is those actions that the research literature fails to report in detail with respect to the management of DKA.

At this point, the literature describes medical treatment regimes in great detail including specific fluid, insulin, potassium and glucose infusion doses (Gosmanov et al., 2014; Misra & Oliver, 2015; Savage & Kilvert, 2006; Umpierrez & Korytkowski, 2016). There is rarely any reference to the actions that nurses take in this acute phase. According to the literature, patients with DKA at this point are managed according to a checklist that is divided into phase according to their progression toward the resolution of DKA (Gosmanov et al., 2014). These lists include more information gathering such as a complete history, fluid bolus, insulin therapy, booking tests and arranging consults (Gosmanov et al., 2014). It is implied that tasks such as “continue biochemical and clinical monitoring” is the nurses’ role (Gosmanov et al., 2014). It is not reported what or if there are other tasks, decisions or processes nurses are using to contribute to the multidisciplinary management of patients with DKA.

Misra and Oliver (2015) ask the question “how should patients be monitored?” Their response was with reference to the prevention of complications, which is another implied role of nurses. Nurses are tasked with monitoring patients for signs of thromboembolism, cardiac arrhythmias, hypo- or hyperkalaemia and hypoglycaemia (Misra & Oliver, 2015). If it is assumed that this is part of the nursing role, then it implies that nurses require not only a working knowledge of DKA pathophysiology, but also risks associated with the medical management of DKA (Kreider, 2018; Tanner, 2006). Savage and Kilvert (2006) stated that many complications associated with the treatment of DKA are predictable and preventable with adequate knowledge of biochemistry. There was particular reference to hypokalaemia and hypoglycaemia, with the corresponding action of “monitor carefully to anticipate and

prevent” (Savage & Kilvert, 2006, p. 230). This action fails to specify how or by whom, once again implying that nurses have systems in place to achieve this goal.

What is not yet clear is whether nurses possess adequate knowledge, are confident and competent to make decisions or if systems are in place that enable nurses to prevent complications associated with managing patients with DKA. Furthermore, with little or no reference to nurses in the literature on DKA management, there is no evidence to clarify these concepts in this specific context. And in the interest of a multidisciplinary approach to patient care and the overall goal of optimising patient outcomes, there is clearly a clinical need to define the role of nurses with respect to monitoring patients with DKA and the prevention of associated complications.

It is evident from the literature that nurses have a significant amount of contact with patients and are often the first point of education (Modic et al., 2009; Seley & Weinger, 2007). A US study reported that DKA presentations are a result of failure to educate patients, particularly those with known DM (Bell & Alele, 1997). It is noteworthy that patient education for self-management of DM and compliance with treatment regimens, are often the responsibility of nurses (Seley & Weinger, 2007). A study of nurses working in cardiology demonstrated that nurses may be either unprepared, or uncomfortable to educate patients on DM (Modic et al., 2009). The reason offered for this discrepancy was a knowledge deficit among the nurses (Modic et al, 2009). To undertake this task effectively, however, nurses require knowledge of the precipitating factors that lead to DKA so they can manage and competently educate patients to prevent recurrence (Schmitz, 2000).

There is a close link between the nurses’ role in patient education and prevention of recurrent DKA. In the UK, a 12-month comparative study was conducted to investigate the incidence of DKA on 28 000 IDDM patients who participated in a program called Dose Adjustment for Normal Eating (DAFNE). A diabetes nurse specialist and a dietitian provided

the structured education to participants, then examined key indicators for DM management prior to and following the DAFNE program. The researchers found a 64% reduction in DKA admissions after patients attended DAFNE. They also found that the most likely indicators for patients developing DKA were previous episodes or a high glycosylated haemoglobin (HbA_{1c}) (Elliott et al, 2014). In Australia a 70% reduction in DKA admissions was also reported in a similar program: the OzDAFNE (Speight et al., 2016). An audit of the OzDAFNE program by a team of diabetes specialists including an endocrinologist, two dietitians and diabetes nurse educators, demonstrated better quality of life for diabetic patients after receiving this structured education (McIntyre et al., 2010). The above evidence suggests that the nurses' role of education and prevention can have positive outcomes for patients.

One of the primary roles of nurses across all practice settings is advocacy (Seley & Weinger, 2007). With respect to DKA management, nurses advocate for their patients by developing relationships through listening and coaching (Seley & Weinger, 2007). In a UK study it was reported that patients may have been embarrassed or believed that they did not "follow the rules" which resulted in an admission for DKA (Jerreat, 2010). The "rules" may refer to insulin non-compliance, which is a well-documented cause of DKA (Randall et al., 2011). To address this issue, it was argued that RNs need to listen and respond to patients in a non-judgmental way in an effort to identify the underlying cause of insulin non-compliance (Jerreat, 2010). One of the causes of non-compliance with regimens of insulin dependent patients, is the burden of strict adherence to self-management behaviour (Snoek et al., 2011). Thus, this stress could be disclosed to RNs as they fulfill their role as patient advocates.

There is little doubt that nurses have an important role in the management of DKA as described in various studies (Ingersoll et al., 2005; Kisiel & Marsons, 2009; Moore, 2004; Renders et al., 2001, Schmitz, 2000). These studies, however, appear to provide little clarity

in describing the specific role in the clinical setting. Moreover, there is a scarcity of qualitative data in the current literature to describe what RNs believe their role to be with respect to DKA management. The contemporary literature and professional bodies, as described in the previous chapter, provide little guidance as to a requisite level of knowledge required by RNs in the management of DKA.

Conclusion

This literature review was conducted to identify gaps in literature relating to RNs knowledge and decision-making processes with respect to managing adults with DKA. Firstly, research into nurses' knowledge of DM has been tested and retested for several decades, yet there are no studies that examine RN knowledge of DKA in any depth. Secondly, the governing body for the nursing profession in Australia has outlined the principles for nurses' motivation, responsibilities and accountability for the decisions they make. However, these principles have never been tested in the context of managing patients with DKA. Finally, the literature is clear that nurses have an important role in managing these acutely unwell patients; in particular for observation, education, prevention of complications and advocacy. Unfortunately, there was very little evidence to describe what this actually entails. The purpose of the present study is to attempt to fill some of these gaps.

As the DKA presentations increase in frequency and severity, the role of nurses is of increasing importance to prevent patient morbidity and mortality. In order for nurses to fulfill every aspect of their role, they need sufficient knowledge to make timely and effective clinical decisions. Research that examines what nurses know about DKA, what decisions they make and the factors that influence their decision making is important for several reasons. Firstly, this research may be a positive step towards achieving the goals specified in the Australia National Diabetes Strategy. Secondly, it may promote reflective practice

amongst nurses by giving them insight into processes that guide their practice. And thirdly, it will contribute to alleviating some of the burden on the healthcare system through patient education, optimising their outcomes and prevent the recurrence of DKA.

The significance of this ongoing research and methodology used in the present study to fill the gaps in the literature will be described in more detail in the following chapter.

Chapter 3

Methodology

Introduction

The previous chapter analysed the current gap in the research literature in the field of RNs knowledge and decision-making processes regarding the management of adults with DKA. This chapter will provide an outline of the methodology of this study which is designed to address the aforementioned gap and to help answer both guiding research questions. It will begin with an explanation of mixed methods research and the philosophy of pragmatism. The four phases of the study will be described in detail, according to the specifications of sequential explanatory mixed methods design. The sampling and recruitment strategies utilised in the study will also be discussed. Finally, there will be a synopsis of the ethical considerations and processes that were followed to obtain approval to carry out the study.

Mixed methods research

This study employed a sequential explanatory, mixed methods design in four phases. This type of mixed methods design involved obtaining quantitative data in the first stage of data collection and used those findings to inform the second qualitative stage (Leech & Onwuegbuzie, 2009). The defining principle of mixed methods research is the integration of both quantitative and qualitative data for the purpose of answering complex research questions (Johnson et al., 2007).

Mixed methods research is often used in nursing research because they resemble actual nursing practice (Fawcett, 2015). As demonstrated in *noticing* and *interpreting* stages of the CJM, nurses collect both objective and subjective information when assessing a patient

(Fielding, 2010). Nurses then integrate the data in the *responding* stage, as they make decisions and plan patient care. Therefore, there is a close correlation between the nursing process and mixed methods research (Fawcett, 2015).

Secondly, mixed methods allow researchers to utilise whatever data collection method is required to answer the research question (Doyle et al., 2009). For this study, the rationale for using the sequential explanatory design was to use the qualitative data to explain the quantitative results. Knowledge and decision making could be considered complex phenomena requiring both quantitative and qualitative data to fully investigate both concepts in nursing practice. The purpose of the design was to answer the research question using an online survey for objective data related to knowledge and decision making, and semi-structured interviews to provide narrative, clarification and identify key factors that influence decision making by RNs in the management of DKA.

There is precedent in the nursing literature for mixed methods design for studies that investigate nurses' knowledge and decision making. Flemming (2007) argued that in order for nurses to integrate the latest research evidence into their practice, they require a synthesis of qualitative and quantitative data. Nursing decisions are made with the evaluation of both types of information. Nurses use quantitative research, such as an evaluation of randomised controlled trials to decide on the effectiveness of an intervention, in accordance with a medical model for evidence-based practice (Flemming, 2007). They also value knowledge obtained from qualitative research, including studies on decision making based on prior experience and social interactions (Flemming, 2007). Therefore, mixed methods research has been reported as being both valid and feasible for studies that examine knowledge and decision making in nursing practice.

As far as is known, there is currently no research literature relating to nurses' knowledge and decision making in the context of managing patients with DKA and very few

studies that employed a mixed methods design in this field. The nearest is an Australian doctoral thesis that used a concurrent mixed methods design to investigate nurses' knowledge of diabetes (Alotaibi, 2019). Once again however, this research focused primarily on the context of nurses' enabling patient's self-management of their diabetes, leaving the context of patients with DKA still unexplored. Therefore, utilising a mixed methods design for a study on the nursing management of DKA is an innovative approach to research and may pave the way for future work in this field. A mixed methods and pragmatic approach also assisted in answering all of the research questions in the study.

Mixed methods research and pragmatism

There is debate in the literature as to the philosophical underpinnings of mixed method research (Tashakkori & Teddlie, 2010). Pragmatism has been called the “third research paradigm”, after positivism and interpretivism, with its' own innate strengths and weaknesses (Johnson & Onwuegbuzie, 2004). Pragmatism has been defined as “a method of using scientific logic to clarify the meaning of concepts or ideas through investigating their potential relationship with the real world” (Nowell, 2015, p.143). Positivists maintain that research should be quantitative, objective, generalisable and the researcher should remain neutral. Meanwhile, interpretivists reject this impartiality, by promoting the value of the human experience in the context of qualitative data which negates the need for cause and effect (Johnson & Onwuegbuzie, 2004). However, pragmatism is a practical and humanistic approach to problem solving that positivist and interpretivist paradigms are unable to accomplish in isolation (Tashakkori & Teddlie, 2010).

Opponents to the philosophy of pragmatism suggest an incompatibility thesis that states that positivist and interpretivist paradigms cannot be mixed because of their vast differences (Johnson & Onwuegbuzie, 2004). However, just as the previous chapter refers to

the Cognitive Continuum Theory with intuition and analysis at opposing ends of a scale, a similar model can be applied to pragmatism. Positivist and interpretivist paradigms form polar opposites on a continuum, and pragmatism lies in the middle (Johnson & Onwuegbuzie, 2004). Pragmatism is the amalgamation of both quantitative and qualitative approaches to answer a range of complex research questions and solve real world problems (Kelly et al., 2018). This flexibility of this research methodology is often utilised in nursing research as a means of using scientific knowledge and contextual factors to enable nurses to make clinical decisions (Krishnan, 2018).

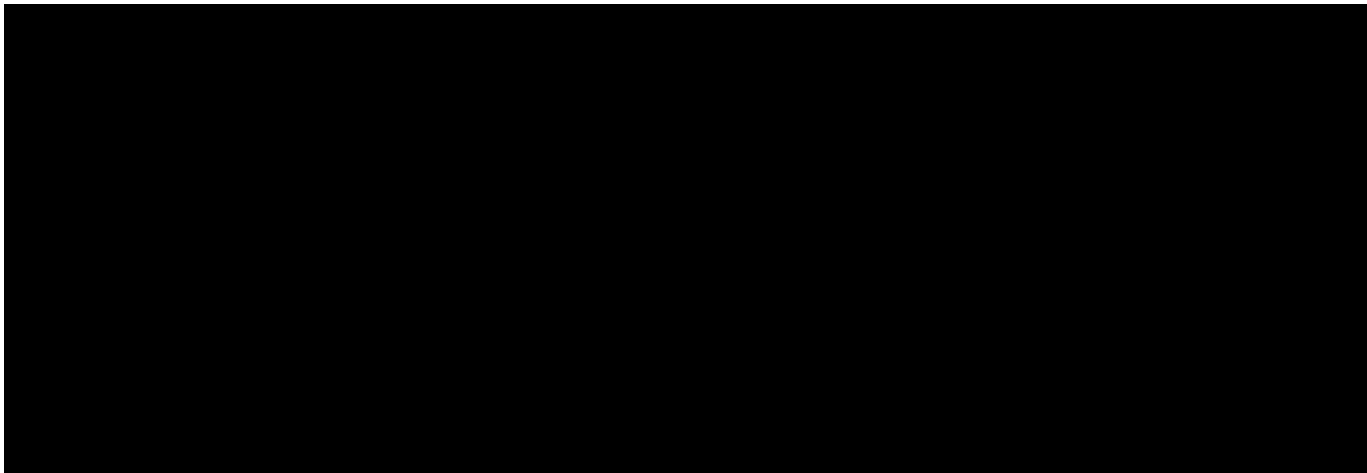
Pragmatist philosophy has been shown to have implications for nursing research. Pragmatism allows for flexible and dynamic research designs to generate knowledge that can be used in nursing practice (Nowell, 2015). If knowledge is not deemed useful, then it is refined until it is deemed useful, which is consistent with pragmatism. Pragmatism allows for research to be critiqued for errors or barriers to the practical application of knowledge for nurses (Hannes & Lockwood, 2011). With the practicality of research at the forefront of nurses' minds, there is argument for mixed methods research, underpinned by the philosophy of pragmatism, for the design of the present study.

Study design

This sequential explanatory, mixed methods study was conducted in four phases, with quantitative data collection being utilised to inform the qualitative interview questions as outlined in Figure 3 (Lamont et al., 2015).

Figure 3

Phases of Study



Phase 1 involved the development of an online quantitative survey tool using Survey Monkey™. This cloud-based software enables user to develop, distribute and analyse surveys through an online company (www.surveymonkey.com). The survey consisted of multiple-choice questions posed from a clinical case study. The survey was validated by a panel of expert nurses and pilot tested. Phase 2 involved administering the survey and analysing the quantitative data using descriptive statistics. Phase 3 used the findings from phase 2 to form questions for semi-structured interviews with participants. Phase 4 utilised a synthesis of the quantitative and qualitative findings to make meta-inferences regarding the research questions. The next section describes each of these phases in further detail.

Phase 1: Development of an online survey

In phase 1 of this study, an online quantitative survey tool was developed to address the research question relating to the level of knowledge and decision-making processes of RNs who manage patients with DKA. An online survey was considered to be advantageous for this study due to its low cost, flexibility of design, and convenience for participants (Safdar et al., 2016). The survey was developed following an extensive literature review to enable the capture of relevant data from participants. It consisted of a clinical case study of a

patient with DKA, questions structured according to the CJM (as discussed in chapter two) and answers scaffolded against Bloom's Cognitive Taxonomy. Each of these components will be discussed in this section.

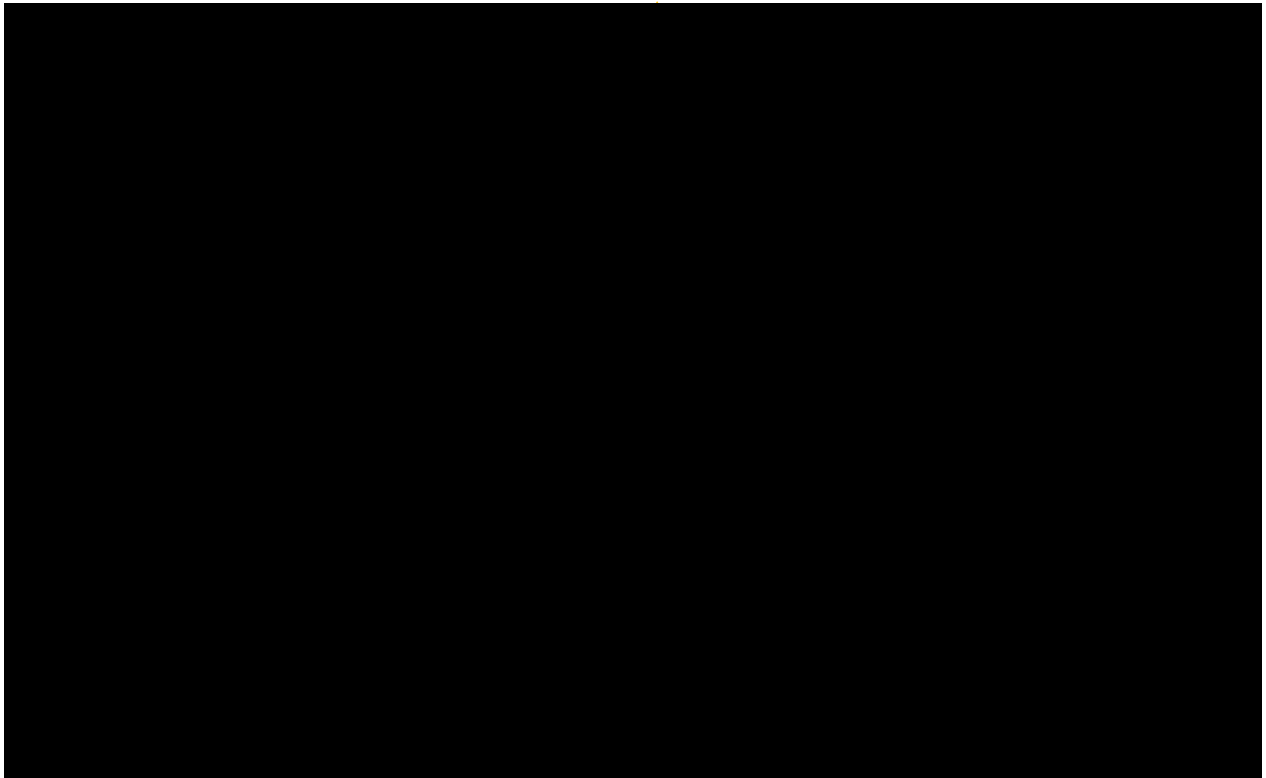
Clinical case studies provide context-rich information, and have shown to be a valid strategy for testing clinical reasoning (Kiessling et al., 2016; Wong & Chung, 2002). This type of data collection method has previously been shown to achieve good levels of predictive validity in studies that examine knowledge and decision making (Kiessling et al., 2016). Therefore, the case study was presented as vignettes where participants were asked to respond from a list of predetermined responses designed by experts in the field.

The corresponding questions relating to the aforementioned case study in the survey were arranged according to the CJM (Tanner, 2006). To examine the nurses' decision-making process, the case study evolved as they progressed through the survey according to the CJM (Tanner, 2006). The case study began with objective and subjective data that nurses would require in the *noticing* phase. As they progressed through the case study, nurses were asked to *interpret* that data to formulate a plan for the patient's care. They were then asked a series of questions to examine how they would implement the plan and *respond* to the patient's progress. Finally, they were questions and statements that prompted nurses to *reflect* on the patient's condition and their professional practice. The purpose of this layout was to examine if nurses had strengths or weaknesses at particular stages of the decision-making process, based on the case study of a patient with DKA.

The answers to the multiple-choice questions were scaffolded according to Bloom's Cognitive Taxonomy as shown in Figure 4 (Hughes & Quinn, 2013). This taxonomy provided a hierarchical structure for testing levels of cognition knowledge ranging from simple knowledge and comprehension, to application, analysis, synthesis and evaluation (Hughes & Quinn, 2013).

Figure 4

Bloom's Cognitive Taxonomy



Bloom's Cognitive Taxonomy served to help structure the survey answers into basic, intermediate and advanced knowledge. The knowledge topics related to physiology, pathophysiology, pharmacology and psychosocial factors for a patient with DKA. An examination of previous tools used to measure nurses' knowledge of DM showed that a four-item multiple-choice format is highly prevalent (Francisco, 2013). The knowledge level categories would formulate the answer to the research question on the level of knowledge that RNs may have in association with managing patients with DKA.

Many of the existing measurement tools examined basic DM knowledge, without detailed reference to DKA. Hence, for the purpose of this study, a new tool was developed and tested for rigour because no existing validated tool focused exclusively on DKA knowledge. The case study, corresponding questions and multiple-choice answers were adapted from a case study in a well-known nursing textbook on the Clinical Reasoning Cycle

(Levett-Jones, 2018). This published work is a highly praised resource for nursing students. A recent blog post stated “the skill of clinical reasoning itself is a key nursing theme required by the Australian Nursing and Midwifery Council, and Levett-Jones’ framework delivers this in spades” (Using case studies to help nursing students overcome the struggle of learning bioscience, 2021). Therefore, it is a useful resource for research into nurses’ knowledge and decisions, hence why it formed the foundation for the development of the survey. The next step was to validate the survey using a panel of expert reviewers.

To ensure rigour, a panel of expert nurses were invited to review and evaluate the quantitative survey tool for clarity, internal consistency and construct validity. Further details on the panel of experts and process for validating the survey will be provided in the next chapter. Once feedback from reviewers reached 80% agreement, the survey was pilot tested for timing and reliability (Kelley-Quon, 2018; Safdar et al., 2016). This testing was undertaken by a small sample of the target population who did not participate in the formal study. Once the draft survey met the validation criteria (details of which will be discussed in the following chapter), it was emailed to potential participants using the WA Health Global email network. This network is used by all employees in the WA Health system for professional correspondence. Groups within the network have been set up to enable emails to be sent to the target population of nurses in specific clinical areas at the hospital site.

Phase 2: Administration of the survey and statistical analysis

In phase 2 of this study, participants were recruited to the study through a series of emails that included information about the study and a link to access the online survey (see Appendices A, B and C). Opening the survey implied consent to participate in this phase of the study, which is recognised by the National Statement on Conduct in Human Research (Hoffman et al., 2004; National Health and Medical Research Council [NHMRC] et al., 2011). The first page of the survey provided a synopsis of the survey instructions and a

specific question to obtain consent. The participants were then asked to supply demographic information to ensure that they met the inclusion criteria for the study of RNs from the ICU, ED and MAU of the hospital site. More details will be provided in chapter five of this thesis.

Participants were asked to respond to the multiple-choice questions with the aim of completing the survey in approximately 30 minutes. At the end of the survey, participants were invited to attend a follow up interview with the researcher in phase 3 of the study. Irrespective of participant's consent to be interviewed, they were thanked for their participation in the survey. Participants were also provided with the contact details of the researcher to access this resource at a later date and clarify any issues in the future.

The data from the online survey was analysed using descriptive statistics in SPSS (Version 27). The purpose of this analysis was to categorise participants knowledge of managing patients with DKA on a four-point scale: inadequate, basic, intermediate or advanced. Their decision making was categorised on a three-point scale of inadequate, marginal and adequate according to each stage of the CJM. The results of this analysis informed the development of interview questions for phase 3.

Phase 3: Semi-structured interviews and thematic analysis

In accordance with the sequential explanatory design, phase 3 consisted of semi-structured interviews to answer the research question on the factors that influence nurses' decision-making whilst managing patient's with DKA. As mentioned previously, the interview guide was developed based on the findings from phase 2 (see Appendix D). The quantitative results indicated that knowledge and experience were key factors in that influenced RNs decision making and were therefore explored during the interviews. The format of the type of interview style used, also facilitated discussion about the factors that helped or hindered decision making in the context of managing patients with DKA.

Semi-structured interviews, as opposed to other types of interviews, allow for a degree of flexibility as the participants responses to the pre-determined set of questions can lead to further spontaneous questions and answers (Kallio et al., 2016). This allowed for deeper discussion on the human and organisation factors that participants believed influenced their decision making. Participants were also asked about barriers and enablers to decision making in the context of managing patient's with DKA.

Participants were invited to consent to an interview on completion of the survey. Contact details including their name, phone number and email address were requested for the researcher to arrange one-on-one interviews. However, when these volunteers could not be interviewed, their information was destroyed. Consequently, a convenience sample of nurses were recruited between 19th October and 1st November 2021. Convenience sampling is often used in qualitative research to find participants who are willing and able to participate in research. Due to time constraints to complete the data collection by a deadline, convenience sampling was a viable option to recruit participants for the interviews (Liamputtong, 2013). Whilst these participants may not have participated in the survey, as all survey responses were anonymous, they did meet the inclusion criteria of RNs who work in the same clinical areas that were consistent with a patient's journey after presenting to hospital with DKA.

Two audio recorders were used throughout the interviews and the resulting recordings were transcribed verbatim using Otter.ai™ software (2021). Interviews were conducted until data saturation was reached (Safdar et al., 2016). Thematic analysis of the transcripts was performed according to the Braun and Clark (2006) model. The resulting themes were synthesised with the findings from phase 2 in the final phase.

Phase 4: Synthesis of analyses

Phase 4 of the study consisted of the mixed methods analysis by synthesising both the quantitative data and the qualitative data from phases 2 and 3 and making meta-inferences.

Integration of the data in mixed methods research serves two purposes: to justify the choice of study design, and to form stronger conclusions (Bazeley, 2009; Bryman, 2006). The process for integrating the data involved using inductive reasoning from the qualitative results and deductive reasoning from the quantitative results to derive conclusions. These conclusions are referred to as meta-inferences (Ivankova, 2014). Meta-inferences were then used for synthesis of data in relation to addressing specific research questions.

The process for synthesis of results in mixed methods research involved relating the meta-inferences from the integration of data to the research questions of the study (Ivankova, 2014). As the study had a sequential explanatory design, it was expected that the qualitative results would explain the quantitative results (Noyes et al., 2019). Specifically, the first and second research questions examined the participant's level of knowledge and decision-making processes which was measured in the initial set of quantitative results. The third research question refers to the factors that influence decision-making processes was addressed by analysing themes from the second set of qualitative results and synthesised in comparison with the theoretical framework. The synthesis of the findings answered the research questions in a narrative form and addressed the purpose of the study in this thesis (Collins & O'Cathain, 2009).

Ethics

The study was conducted in compliance with the University of Notre Dame Australia (UNDA) and WA Health ethical codes for human research. This study did not have direct involvement of patients; hence, there was minimal risk of harm to participants at any time during the study. Nevertheless, it was acknowledged that participants may have had feelings of uncertainty or loss of confidence as the research is examining their knowledge base and decision-making process. Therefore, every care was taken to adhere to the ethical principles

of beneficence and non-maleficence. Participants were provided with an information sheet outlining the risks and benefits of their involvement in the study. The information included clauses on withdrawal from the study at any time with no negative ramifications.

Counselling service information was also provided in case they became distressed, and contact information for the researchers if they had further questions on any aspect of the study.

A research proposal was submitted to the UNDA School of Nursing and Midwifery Research Coordinator for review and approval. It was then submitted to a sub-committee of the Human Research Ethics Committee (HREC) at UNDA for a low-risk review. Conditional ethical approval was granted on 11th June 2020 (reference number 2020-082F, see Appendix E).

A concurrent application was made via the Research Governance System to the East Metropolitan Health Service HREC for approval to conduct the study at a general public hospital in WA. The research proposal and associated documents were pre-reviewed and edited prior to being submitted for the HREC meeting at Royal Perth Hospital on 24th June 2020. Ethical approval was granted on 27th July 2020 (reference number RGS0000004076). The study was then reviewed by the Manager for Safety, Quality and Innovation at Armadale Health Service and governance approval was granted by the Acting Executive Director on 29th July 2020 (see Appendix E).

As this was a sequential explanatory, mixed methods study, there were multiple phases and consequently multiple layers for consent. Consent to participate in the study was implied if participants opened the survey link. The survey began with the participant information sheet and a second request for informed consent on the first page. There was no way to mitigate circumstances where participants discussed their involvement in the study among themselves or the utilisation of online search engines to assist them in answering the

survey questions. However, every effort was made to ensure that these discussions did not involve the researcher in any way. Although participants received the same set of questions in the same order (due to the case study being structured according to the CJM which will be discussed further in the next chapter), the order of the multiple-choice options were randomised to minimise collegiality between participants.

A second participant information sheet was provided in phase 3 prior to conducting the interviews (see Appendix B). The second participant information sheet varied slightly from the first due to the different type of data and method for data collection. The information provided served as a reminder of the background information provided within phase 2. It also emphasised that everything that was discussed in the interview was kept confidential.

Confidentiality is defined by the NHMRC as “the obligation of people not to use private information – whether private because of its content or the context of its communication – for any purpose other than that for which it was given to them (NHMRC et al., 2018, p.100). The confidentiality of the participants in this study was maintained in several ways. Firstly, the surveys were submitted anonymously. Secondly, interviews were conducted in private rooms to ensure no other parties were involved in the discussion. Thirdly, participants were de-identified in the transcript data through coding known only to the research team. And finally, all the research data was stored securely in accordance with data management legislation and the policies and procedures from the university.

Research data must be, collected, accessed, analysed, disclosed, stored, disposed of, shared or reused in accordance with the Australian Code for the Responsible Conduct of Research (NHMRC et al., 2019). The purpose of strict data management is to protect the confidentiality of research participants and to comply with data protection legislation. Data was generated from Survey MonkeyTM and Otter.aiTM (2021) as part of this study. The

International Organisation for Standardisation granted Survey Monkey™ ISO/IEC 27001:2013 certification which is one of the most secure and globally recognised data security standards (Gharib, 2019). Otter.ai™ (2021) uses cloud storage through Amazon™ with its 256-bit advanced encryption standard. This is the strongest encryption standard available to date (Lai, 2022). Therefore, the data generated from both Survey Monkey™ and Otter.ai™ (2021) is secured to a high standard.

Policies for data management may vary between institutions, which was the case for this study. As HREC approval to conduct the study was obtained from two different organisations, the organisation with the more stringent policy for data management was the one that was followed. All data, including data generated from Survey Monkey™ and Otter.ai™ (2021), will be stored on the WA Health server for a minimum of seven years from thesis publication (NHMRC et al., 2018).

Summary

This chapter describes the methodology utilised in the study on RNs knowledge and decision-making processes used regarding the management of adult patients with DKA. This study is a sequential explanatory, mixed methods design in four phases, including survey development, quantitative data collection, qualitative data collection and synthesis of both sets of results. The rationale for this design is twofold. Firstly, that there is close correlation between mixed methods research and the nursing process; secondly, mixed methods research is underpinned by the philosophy of pragmatism, where the ends justify the means. In the context of the study, this allowed the researcher to use an online survey for quantitative data collection and semi-structured interviews to obtain qualitative data. The complexity of the concepts under investigation in this study meant that a synthesis of both sets was required for the researcher to answer the guiding research questions. The next chapter will seek to

provide details of the development of validation of the online survey used to ascertain RNs level of knowledge and decision-making processes used in the context of managing adults with DKA.

Chapter 4

Phase 1: Development and validation of an online survey

Introduction

The previous chapter provided an overview of mixed methods research, underpinned by the philosophy of pragmatism. There was also a synopsis of specific data collection strategies, including online surveys and semi-structured interviews. This chapter will provide details on the process for developing and validating the online survey. It will include the process for creating an evolving case study as a forum for the survey questions, validating the survey with an expert review panel and reliability testing. Data will be presented to demonstrate the validity and reliability of the survey tool, prior to its' administration to the target population in phase 2.

Survey development

As discussed in the previous chapter, online surveys are cost effective, easy to administer and can be tailored to a specific research topic (Safdar et al., 2016). There were several reasons for adopting this type of survey to address the research question relating to the level of knowledge and decision making for RNs who manage patients with DKA. Firstly, it enabled nurses working on both day and night shifts to access the survey. Secondly, the online format was easy to complete with the touch of a button. And thirdly, the data was readily available for the researcher to monitor response rates and promote engagement in the study where possible.

The process of developing the survey started with examining pre-existing tools that measured knowledge and decision making. As discussed in previous chapters, no instrument was found that measured nurses' knowledge and decision making with specific reference to

managing patients with DKA. With this in mind, the researcher began with identifying key demographics from previous surveys that measured knowledge and decision making in different clinical contexts. One study on nurses' decision making in a non-specific clinical context, identified four demographics that were used to describe the participants. These demographics included: level of appointment, area of practice, education level and experience (Hoffman et al., 2004). Two out of these four demographics (education level and experience) were reported as not being predictive factors in decision-making processes (Hoffman et al., 2004). However, education and experience were deemed relevant and useful for the study for the context of nurses' managing patients with DKA. Therefore, the survey included all four of the aforementioned demographics, as well as job title, gender and type of employment contract.

The next step was to identify the key areas that needed to be included in the survey. The literature review in this thesis defined some of the key areas of knowledge to be assessed in the survey. It was apparent that some areas of DM knowledge had been tested previously, but there was generally a lack of focus on DKA knowledge. Hence it was identified that a focus was needed on DKA knowledge and decision-making.

Discussions were then held amongst the research team to identify the key elements of knowledge that would be expected for qualified nurses to have in order to manage DKA patients safely, based on their clinical experience and expertise. One of the recommended text books for undergraduate students at the UNDA, School of Nursing, Midwifery, Health Sciences and Physiotherapy was used in the development of the survey (Levett-Jones, 2018). This text book was utilised in the teaching of clinical reasoning to undergraduate nursing students. It presents a number of case studies, with corresponding questions to demonstrate decision making in a variety of clinical contexts according to the Clinical Reasoning Cycle. One of these case studies pertained to a child with DKA (Levett-Jones, 2018). Whilst the

focus of the study was on the management of adults with DKA, this case study was adapted and elaborated on for the purpose of investigating nurses' knowledge and decision making.

Levett-Jones (2010) reported that the Clinical Reasoning Cycle was an adaptation of a number of previous works. These works included Hoffman's doctoral thesis on novice and expert nurses' decision making in a specific clinical context and Tanner's CJM. The CJM was used as the theoretical framework to underpin the study because it was seminal work in the field of nurses' decision making. It also has strong correlations to the nursing process, which is still taught at a nursing undergraduate level today.

For the purpose of the study, a case study was developed and structured against the CJM. As discussed in chapter two, the CJM has close correlations to the nursing process, which was replicated in the layout of the evolving case study. Hence, the case study that was developed in the survey was structured against the CJM in an attempt to answer the research question on nurses' level of knowledge and decision-making process in relation to the management adults with DKA. The first step is *noticing*, or 'assessment' according to the nursing process. The case study started with some basic knowledge questions relating to DKA and provided some background and contextual information about the patient. The next step is *interpreting*, which corresponds to 'diagnose' and 'planning' in the nursing process. This section of the survey involved specific biochemical markers, signs, symptoms and other relevant information that nurses use in order to formulate a plan for the patient's care. The third step is *responding*, or 'intervention'. These questions focused on specific assessment and DKA management decisions that nurses would have to make in clinical practice on behalf of the patient. The final step, *reflecting* or 'evaluation' was two-fold. Firstly, these questions asked nurses to reflect on the effectiveness of their interventions for the patient. And secondly, they asked nurses to reflect on their own thoughts, attitudes and beliefs with respect to managing patients with DKA.

The questions in each of these sections were multiple-choice questions, scaffolded against Bloom's Cognitive Taxonomy. The scaffolding process was initially done by the researcher, and checked by the supervisor, to ensure that each level of knowledge was covered in the survey. This hierarchical structure, as described in detail in chapter two, guided the terminology of the questions to examine different levels of cognition. A four-point rating scale, ranging from inadequate, basic, intermediate and advanced, was used to code responses according to the level of knowledge the participant was able to demonstrate.

This process generated a 69-item draft survey in five sections. The first was the demographics section, with nine questions as discussed above. The subsequent sections had titles correlating to the stages of the CJM. The survey itself consisted of 27 DKA knowledge questions, to answer the research question relating to level of DKA knowledge. There were 16 decision making questions, relating to the research question on the decision-making processes used by nurses' who manage patients with DKA. There were also 17 questions that focused specifically on reflection. The latter group of questions were examined in more detail in the interviews (see chapter six) in response to the research question relating to factors that influence nurses' decision making for patients with DKA. The draft survey was transferred to the validation documents and then distributed to the expert review panel.

Expert review

Having discussed how the survey was developed, this section describes the process used to validate the survey for rigour. An expert review panel was recruited to the online survey and ensure that the survey measured what it was designed to measure. The validation process involved three main steps. Firstly, nurses with relevant expertise were selected to form an expert review panel. Secondly, distributing documents that tested the survey for clarity, internal consistency and content validity. The results of the review were presented in

terms of the agreement between experts and how issues were managed throughout the process. And thirdly, conducting a reliability test that examined the survey for test-retest reliability. The results of the reliability test will be discussed in terms of its influence on the administration of the survey in the subsequent phase of the study. The next section of this chapter will provide details on the expert panel members and their role within the study.

Panel members

The expert review panel involved in validating the survey tool consisted of nurses with varying clinical and academic backgrounds. Halek et al. (2017) provided examples of characteristics including academic disciplines, work experience, current position, theoretical knowledge and research experience in the development and validation of a measurement tool. Some of these criteria were taken into consideration when recruiting experts to review the survey.

Originally, nine experts were invited to be expert panel members for the study. The panel consisted of two male and seven female nurses. Three panel members worked predominantly in tertiary education. The remaining six worked at the hospital site in various roles including clinical, management and staff development. The panel members had different areas of expertise including critical care, general medical, aged care, diabetes education and research. The combination of the various areas of expertise made the contributions of the expert panel vital to the development of the survey.

The experts were contacted via email and provided with the details of the study and the role of the expert review panel. If they agreed to be an expert panel member, they were asked to sign a consent form (see Appendix F). The survey was validated in three steps: clarity, internal consistency and content validity using documents adapted from a recent Australian doctoral thesis (Hardman, 2018). The experts were provided with the step one documents, testing the survey for clarity, that were promptly returned to the researcher. The

responses for the first step were analysed and, in the interests of time constraints, the documents for steps two and three were combined and distributed to the experts. The feedback from the second and third steps were also analysed prior to the reliability test. The following subsections will present the results of each step in the survey validation process.

Clarity

Clarity relates to the participants ability to understand precisely what the survey item is asking them. A survey item is deemed clear if it addresses a single component of a broader concept (Monterosso et al., 2006). By examining the survey for clarity, it enabled the researcher to be confident that the survey items were well defined for participants to make decisions about their responses. A previous study used a four-point rating scale to measure clarity of survey items (1= not clear, 2= item needs some revision, 3= clear but needs minor revision, 4= very clear) and then dichotomised the scale into ‘clear’ or ‘not clear’ (Zamanzadeh et al., 2015). No rationale for this decision was presented in the study. It may have been a means of making the data more meaningful i.e., the difference between ‘some revision’ and ‘minor revision’ is arguably vague. Therefore, in the interest of simplicity and clarity for the expert review panel, the dichotomous scale was used. Zamanzadeh (2015) reported that their aim was to achieve 80% agreement amongst the experts reviewing the survey. This precedent was used as a benchmark for the study.

The draft survey was emailed to each of the experts to review it for clarity. The experts were asked to read each item, and circle a response of ‘clear’ or ‘unclear’ in the table provided (see Appendix G). There was also an opportunity to offer comments if they deemed a question to be unclear. The responses were returned to the researcher via email and collated in Microsoft Excel. This data was then analysed using Cohen’s kappa statistic to determine the interrater reliability between each of the experts (McHugh, 2012). A baseline

Cohen’s kappa of >0.80, or strong agreement between reviewers, was established to deem the survey items clear.

One expert was deemed an outlier as their responses were significantly different from the rest of the panel (Expert 4). As their data would bias the statistical analysis to over or under estimate mean scores, it was removed from the data set (Kwak & Kim, 2017). Two more reviewers withdrew their consent from participating in the study due to high workloads and changing positions (Expert 2 and Expert 9). This left, six experts who reviewed 69 questions, resulting in 414 ratings of clarity overall. The inter-rater agreement was calculated by totalling the number of ratings that agreed and the number of ratings overall. These figures were then converted into a fraction where 0 indicated agreement by chance, +1 or -1 represented perfect agreement. There were 15 paired agreements were calculated and presented in Table 2.

Table 2
Clarity inter-rater agreement results

	Expert 1	Expert 3	Expert 5	Expert 6	Expert 7	Expert 8
Expert 1						
Expert 3	0.957					
Expert 5	0.899	0.913				
Expert 6	0.913	0.928	0.928			
Expert 7	0.913	0.928	0.928	0.971		
Expert 8	0.913	0.899	0.899	0.942	0.913	

Out of the 69 survey items that were rated, the experts agreed on 62 to 67 items based on the above 15 permutations. This was calculated as an inter-rater agreement of 89.9% to 97.1%, with an average probability of agreement of 92.3% across all experts. In terms of the individual items, five out 69 were deemed unclear due to minor editing errors, which were promptly rectified by the researcher. A further four items were found to have less than 80% agreement. These four items were then edited according to the expert’s feedback and sent out

again for clarity testing. After this second review, all items achieved greater than 80% agreement between experts. The remaining six experts were then sent further documents to examine the survey items for internal consistency and content validity.

Internal consistency

Internal consistency is the measurement of the homogeneity of the survey items to ensure that each item relates to each other and measures the same overall concept (Connelly, 2011). In this stage of validating the survey, the expert panel were asked to examine each item again and answer two questions. These questions related to whether the items generally belong together in the question set, and if each item belonged within that set (see Appendix H).

The data was again collated in Microsoft Excel and inter-rater agreement was calculated in the same way against the 15 permutations. It was found that Expert 7 disagreed with one question in Set 1, therefore the inter-rater agreement for this set was 98.6%. The remaining sets all achieved 100% inter-rater agreement from all of the experts. The mean probability of agreement across all six sets was 99.3%. Due to the high inter-rater agreement for the internal consistency of the survey, no changes were made and the experts continued their review to examine the survey for content validity.

Content validity

Validity is an important in research because it ensures accuracy and truth of the results (Schneider et al., 2016). There are several types of validity; the most overarching of which is content validity. Content validity was defined by Zamanzadeh et al (2015, p.165-166) as “the ability of the selected items to reflect the variables in the construct in the measure”. In essence, content validity ensures that a measurement tool measure what it was designed to measure. For the present study, the expert review panel were asked to read each item set and answer four questions (see Appendix I). The questions were as follows:

1. Please read the label and definition above. Then please read all question items in the set below. In general, does the label and definition fit with the whole set of question items below?
2. Does each question item belong to the label and definition above?
3. Is each item unique in the set?
4. Is anything left off the question item list for the set that you feel should be added?

Once again, the data was entered and analysed in Microsoft Excel for inter-rater agreement. All of the experts agreed on the labels and definitions of each set, resulting in an inter-rater agreement of 100%. In set one, an expert questioned if gender “gave any information about training, experience and current role”. Therefore, the inter-rater agreement in response to question two above was 98.6%. All experts agreed that each item was unique in the set, therefore the inter-rater agreement was also 100%.

Question four was open ended allowing for the experts to make suggestions for additional content to be covered in the survey. One expert suggested that “seeing” a patient with DKA was not the same as having “experience” of managing that patient. They also suggested a reflection question on whether the DKA protocol at the hospital site was “easy to follow and interpret”. These comments were discussed amongst the research team and it was decided that these two ideas were similar to context already included in the survey. Also, due to the mixed methods design of the study, these questions required a more open-ended response than the survey catered for. Therefore, they were noted to be included as part of the interviews in phase 3. No further changes were made to the survey after this high degree of inter-rater agreement. The experts were thanked for their contribution to the study. The final step in validating the survey was to conduct a reliability test.

Reliability testing

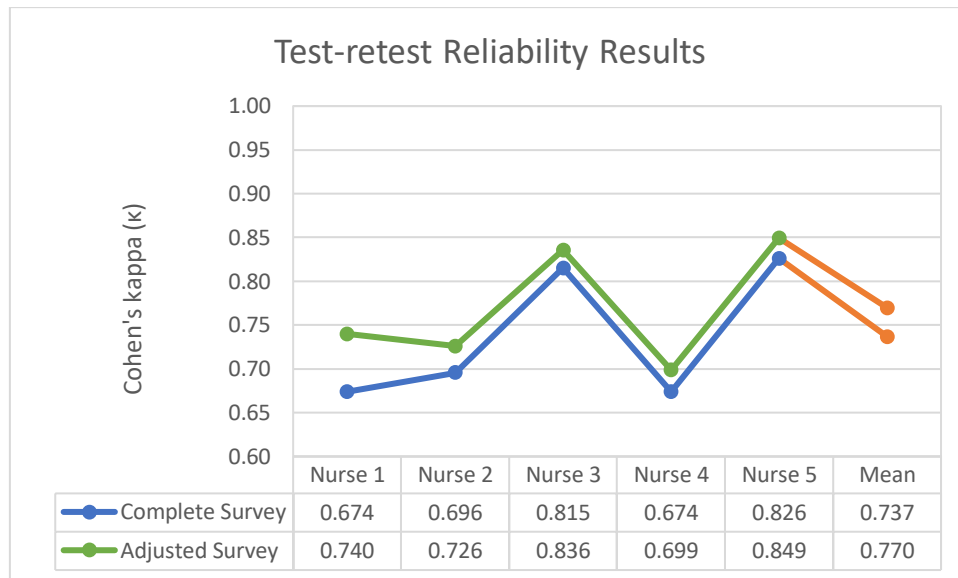
There are two types of reliability used in quantitative research with respect to data collectors: inter-rater and intra-rater reliability. Inter-rater reliability, as described above, is the measurement of agreement between the experts (McHugh, 2012). However, intra-rater reliability examines the consistency of participants to respond to the same set of questions over two separate time periods. To test intra-rater reliability for the present study, the final version of the survey after the expert review was distributed to a small sample (n=5) of the target population using a test-retest design.

As discussed in the previous chapter, HREC approval was obtained from both the tertiary institution and hospital site to conduct the study, including the reliability test. The purposive sample of participants in the reliability test were all RNs who currently worked in general medical or critical care at the hospital site. They were contacted via email with details of the study and the survey link. The participants were asked to complete the survey twice over different time periods and requested to provide feedback if they had any issues. Consent was implied if they opened the survey link, with a secondary layer of consent on the first page of the survey. All participants completed the survey on two occasions over a period of four weeks. Their responses were coded to de-identify them to maintain confidentiality. The resulting data was analysed in Microsoft Excel to determine if the responses were consistent on both occasions.

For analysis purposes, Cohen's kappa was calculated based on the results from the entire survey. Cohen's kappa statistic has been recognised as the most appropriate measure for intrarater reliability of categorical variables, such as those in the online survey (Sun, 2011). This standardised statistic can range from -1 to +1 where +1 signifies perfect consistency in participants responses over both time periods and 0 indicates agreement that

could be associated with random chance (McHugh, 2012). Cohen’s kappa was calculated in Microsoft Excel for the results of the reliability test and are presented in Figure 5.

Figure 5
Test-retest Reliability Cohen's kappa Results



As the figure demonstrates, Cohen’s kappa for the complete survey ranged from 0.67 to 0.83, with a mean of 0.74, suggesting a moderate to strong reliability over time. However, through further analysis and exclusion of the demographic and subjective items, termed ‘adjusted survey’, Cohen’s kappa ranged from 0.70 to 0.85 with a mean of 0.77, also suggesting a moderate to strong test-retest reliability. This implies that the survey data was reliable approximately 75% of the time. This is a potential limitation of the study that will be discussed in more detail in chapter seven of this thesis.

Summary

This chapter outlined the process used in phase 1 of this study to develop and validate an online survey. The survey was uniquely designed to answer the research questions on the level of knowledge and decision-making processes used in the management of adults with

DKA. An examination of previously used survey tools was conducted to identify relevant demographic information and key knowledge items. These items were then expanded on based on the clinical experience of the research team. An evolving case study was created that linked the key knowledge items with the CJM and nursing process. The draft of the survey was then distributed to an expert review panel who examined each item for clarity, internal consistency and content validity. Finally, the survey was tested for reliability on a small sample of the target population and found to be moderately reliable. The process for administering the survey and analysing the quantitative results will be described in the following chapter.

Chapter 5

Phase 2: Administration of the online survey and statistical analysis

Introduction

The previous chapter outlined the process for the development and validation of an online survey to examine RN's knowledge and decision-making processes used in the management of adults with DKA. This chapter describes phase 2 of the study, where the quantitative survey was administered to RNs at a metropolitan hospital to answer the aforementioned research questions. The population, sample and recruitment strategies will be discussed. The results of the survey were then analysed using descriptive statistics and used as the foundation for the qualitative data collection in phase 3.

Population and sample

This phase of the study utilised a purposive sampling technique. This type of sampling allowed the researcher to choose participants who had a unique insight into the topic being investigated (Bloomberg & Volpe, 2019). For the purpose of the study, a criterion-based strategy was used. Potential participants were RNs drawn from the ED, ICU and MAU at a Perth metropolitan hospital. This population of approximately 200 nurses were chosen because these clinical areas coincide with the journey of patients who are admitted to hospital with DKA. Patients usually present to ED, where they are assessed and commenced on treatment. From there, depending on their comorbidities and severity of DKA, as described in chapter one, they are admitted to either the ICU or MAU. It follows that RNs from each of these areas were likely to have seen patients with DKA and therefore were able to provide insight into their knowledge and decision-making processes.

Context

The study was conducted at an acute 290-bed WA general public hospital. The hospital provides services such as emergency department care, aged care, general medicine, general surgery, mental health, obstetrics, gynaecology, paediatrics, dialysis, rehabilitation and intensive care. The hospital employs over 1600 health care professionals and support staff.

Recruitment

After obtaining ethics approval from the UNDA HREC and East Metropolitan Health Service HREC, participants were recruited to this study through a series of three emails distributed through the WA Health Global email network (Appendix A). The first email was the initial invitation to participate in the study with the survey link and participant information sheet attached (see Appendix B). The second email was an expression of appreciation to those who had already participated, conveyed the usefulness of completing the survey and offered another invitation for RNs to participate (Dillman et al., 2009). The third email reiterated the aforementioned appreciation with an emphasis on the deadline to complete the survey as an appeal for assistance (Dillman et al., 2009). The contact details of the research team were also included if participants had any issues or concerns with completing the survey.

Flyers were also posted in visible areas of the three clinical areas to promote the study (see Appendix J). The purpose of the flyers was to advertise the study while nurses went about their daily tasks. Smaller copies of the flyers were also left in the staff rooms of each clinical areas. All of the flyers contained a QR code which provided an option for staff to complete the survey in a more convenient time or place using a mobile device. The decision

to use these strategies was based on consideration of the potential participants' patient loads, rotation between day and night duty and those who may have been on leave.

Inclusion criteria

The participants in the study were nurses who were registered with the Australia Health Practitioners Regulation Agency in the category of division one registered nurse. The inclusion criteria for the study were RNs who worked in either ED, ICU or MAU at the specific hospital site. Therefore, RNs who worked at the hospital site, but in different clinical areas, were excluded from the study.

The nursing teams in these areas also included enrolled nurses who may be involved in the care of patients with DKA. However, because of their different scope of practice and level of education, enrolled nurses were excluded from the study. The first question of the survey, asking for participants current job title, was used as a means of filtering potential participants (see Appendix C). If participants declared that they were enrolled nurses, they were redirected to the end of the survey to ensure no further data was collected from them.

There were no anticipated risks and several potential benefits outlined to participants in the participant information sheet (Appendix B). However, they were provided with contact information for an Employee Assistance Program if they experienced any distress. Beside the data provided, a secondary benefit of the study was that the RNs would be encouraged to reflect on their knowledge and decision making in the context of managing adult patients with DKA.

Data collection process

The first in the series of recruitment emails was sent on 22nd February 2021, for an initial period of four weeks. The email provided potential participants with an explanation of the purpose and significance of the study, with specific clauses for consent and withdrawal.

The participants information sheet was sent as an attachment for further details. A link to the survey was included in the email as well as the contact information for the research team.

The second and third recruitment emails were sent on 1st March and 18th March respectively, to promptly remind participants to complete the survey. After the initial four weeks, the response rate was lower than expected, less than 10%. Therefore, a final email was sent informing participants that the survey would be open for a further two weeks. Hard copies of the survey downloaded from Survey Monkey™ were also distributed in the clinical areas to allow nurses a third option for completing it.

After a total of seven weeks of data collection, a total of 17 responses (response rate 8.5%) were received. At this time, the hospital site was undergoing significant preparation and training in response to the COVID-19 pandemic. Nursing staff were subjected to additional education on new COVID-19 management policies, personal protective equipment updates, simulating the transport of COVID-19 suspects throughout the hospital and upskilling to work in critical care areas. The pandemic therefore added additional challenges to promoting the engagement of nurses with research at this time, and likely explains the response rate. The impact of the pandemic will be discussed further in chapter seven of this thesis. Irrespective of these challenges, the responses were analysed using descriptive statistics to ascertain the RNs knowledge and decision making with respect to the management of adults with DKA.

Statistical analysis

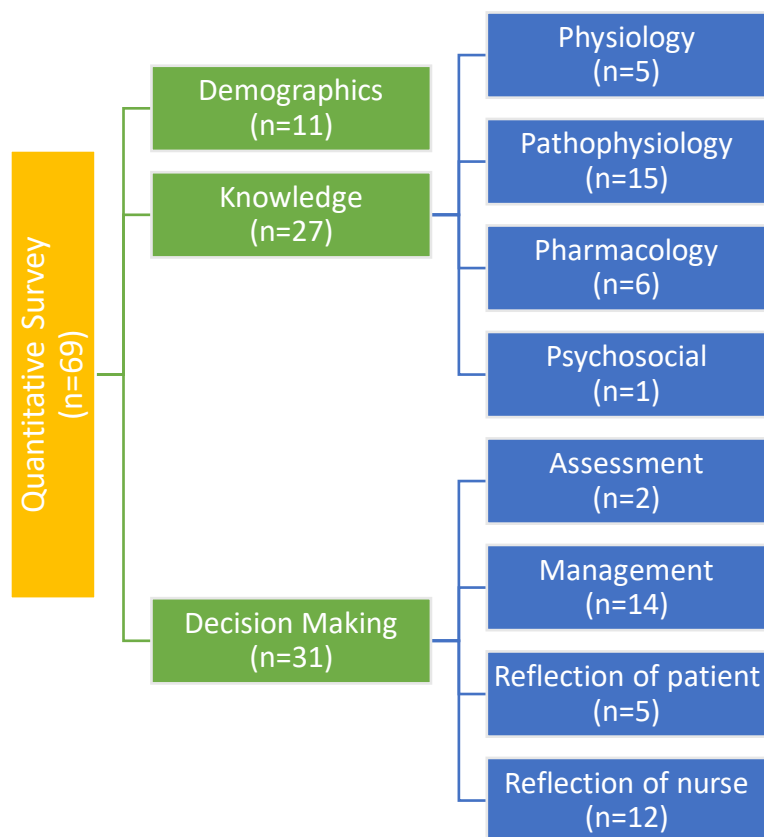
Descriptive statistics were used to analyse the data from the online survey to convey an overview of the levels of knowledge and decision-making processes for a specific sample of RNs who manage patients with DKA. The two main purposes of descriptive statistics are: to provide basic descriptions of the data, in terms of frequencies and measures of central

tendency (i.e., percentages and averages); and to highlight possible associations between variables. The online survey consisted of questions that collected both nominal and ordinal data, meaning that all of the variables could be classified under a particular name, but only the ordinal data could be arranged in order. Therefore, to account for the two different types of data, measures of frequency and central tendency were used to analyse the data.

To analyse the nominal and ordinal data, the 69-item online survey was divided into three key groups of questions: demographics, knowledge and decision-making (see Appendix C). The demographic questions asked about the participants job title, clinical work area, experience, education, qualifications and employment contract. This nominal data was analysed for frequencies. The questions relating to level of knowledge were analysed on a four-point scale of inadequate, basic, intermediate and advanced knowledge. Therefore, this ordinal data was also analysed for frequencies, but also mean scores that summarise the overall level of knowledge of the participants. Decision making processes were analysed in terms of the frequency of responses in each section of the survey (*noticing, interpreting, responding and reflecting*). The nominal and ordinal data for these questions were analysed for frequencies and mean score, to provide an overview of nurses' possible strengths and weaknesses at each stage of the decision-making process for patients with DKA.

The questions that tested knowledge were divided into themes of physiology, pathophysiology, pharmacology and psychosocial issues. The decision-making questions had four main components: assessment, management, reflecting on the care of the patient, and reflecting on the attitudes and beliefs of the nurse. The breakdown of these questions for analysis are present in Figure 6.

Figure 6
Breakdown of Survey Questions for Analysis



The data from Survey Monkey™ was downloaded into Microsoft Excel, where it was coded for SPSS (Version 27). The nominal demographic data was cleaned and coded to measure the frequency of each characteristic. The responses to the knowledge questions were coded according to the a four-point scale where 0= inadequate, 1= basic, 2= intermediate and 3= advanced levels of knowledge. The decision-making responses were coded on a three-point scale adapted from Karlawish (2008), where 1= inadequate, 2= marginal and 3= adequate. Allowances were made for a volume of missing data, meaning that statistical significance was unlikely to be achieved.

In order to take into consideration the small sample size, Fisher’s exact test was performed on the results of the quantitative survey. Fisher’s exact test is a calculation of precise independence, unlike other tests that are based on approximations, and is therefore

more accurate for small samples (Connelly, 2016). Fisher's exact test was used to determine if there were any associations between variables that could be considered non-random (Connelly, 2016). The results of Fisher's exact test and descriptive statistics are presented as a series of figures and tables in the following sections.

Findings

This section will present the findings from the survey in terms of descriptive statistics. It should be noted that the response rate was lower than expected (8.5%) and while 17 participants started the survey, only 10 completed it in full, thus altering the response rate to 5%. The rationale for this phenomenon is multifactorial and will be explained as a limitation of the study in the discussion chapter. All responses provided to the survey questions are included below, irrespective of whether the survey was completed in full or not.

Demographics

A summary of the participants in phase 2 of the study are shown in Table 3. The sample (n=17) consisted of 41.7% RNs, and 52.9% were clinical nurses (CNs) or staff development nurses (SDNs). They consisted of 11.8% males and 82.4% females, with one participant preferring not to state their gender. One participant worked in MAU, five participants from ICU and 11 participants from ED. The participants reported that they had worked in their respective clinical areas for one to 28 years, with a mean duration of 9.35 years.

Table 3
Demographics of Survey Participants

Demographics	Frequency (n)	Percentage (%)
Registered Nurse	8	47.1
Clinical/ Staff Development Nurse	9	52.9
Male	2	11.8
Female	14	82.4
Prefer not to say	1	5.9
MAU	1	5.9
ICU	5	29.4
ED	11	64.7
Bachelor's Degree	9	52.9
Postgraduate Certificate/Diploma	7	41.2
Masters	1	5.9
Emergency	7	41.2
Critical Care	2	11.8
Clinical Nursing	1	5.9
Nursing	6	35.3

In terms of their highest level of education, one participant had a Master's degree (5.9%), seven participants had Postgraduate Certificates or Diplomas (41.2%) and the remaining nine participants had Bachelor's degrees (52.9%). These qualifications were obtained in the specialties of critical care, emergency, clinical nursing and general nursing. All participants were employed at the hospital site on a permanent basis with either full or part time hours. The number of years of experience as registered nurses ranged from two to 30 years, with a mean of 12.88 years.

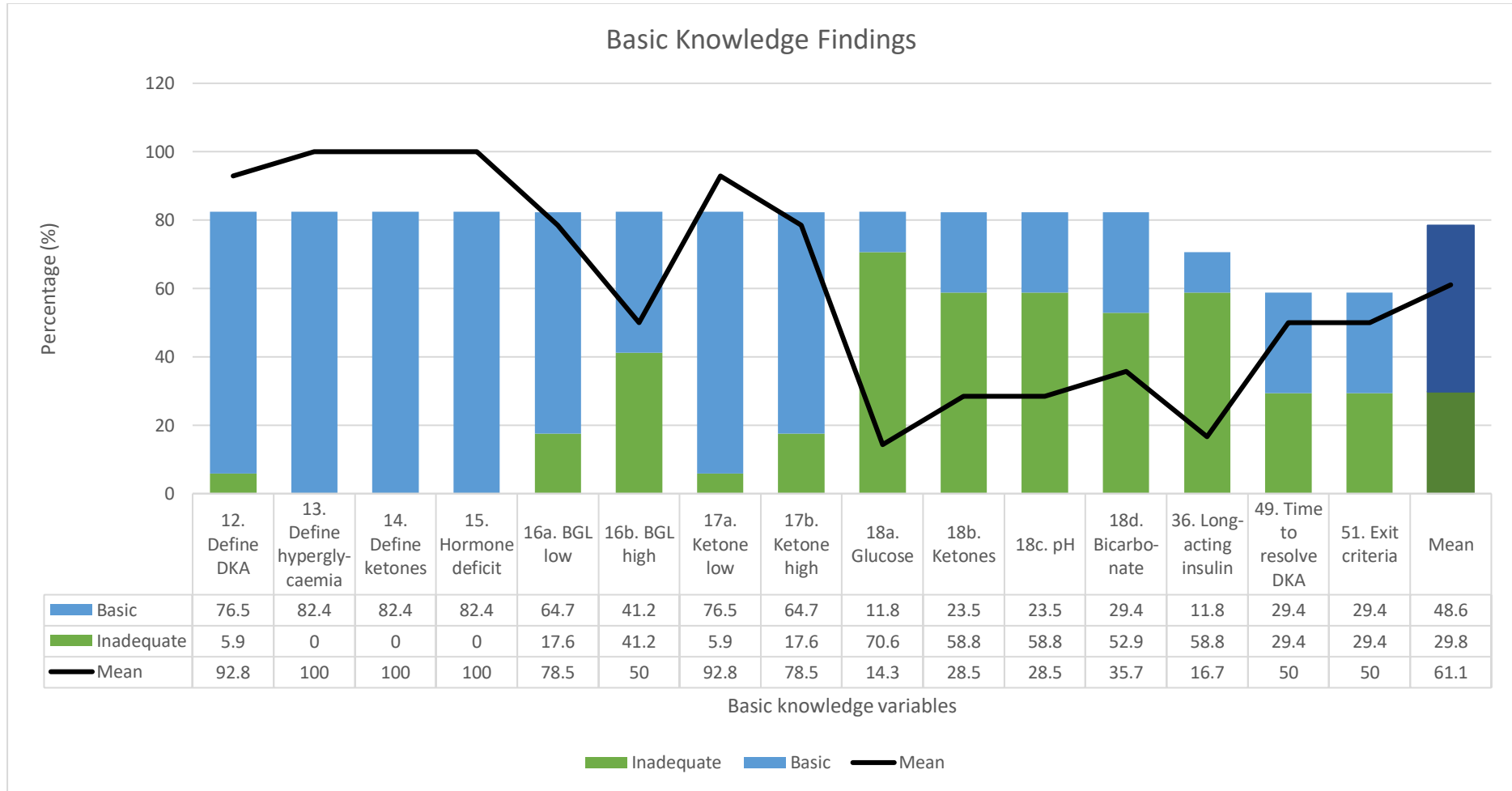
These demographics suggest that while the sample size was small, there was a broad range of qualified and experienced nurses who participated in the study. Every nurse reported that they had seen patients with DKA in their clinical practice, but only 17.6% (n=3) said that they had attended education on DKA in the preceding 12 months. Therefore, this sample is likely to be able to provide a snapshot of the knowledge and decision-making processes of RNs who manage patients with DKA.

Basic knowledge findings

There were 27 questions in the survey that assessed 33 variables relating to the knowledge of RNs who manage patients with DKA. In total, 15 variables measured basic knowledge across the question set, six variables measured intermediate knowledge, and 12 variables measured advanced knowledge. As mentioned above, these questions focused on four different themes relating to DKA: physiology; pathophysiology; pharmacology; and psychosocial factors. The series of figures below demonstrate how the respondents met these pre-determined benchmarks.

Figure 7 demonstrates the basic knowledge results of the participants in the survey as percentages, including the mean score. Overall, 48.6% of participants were able to demonstrate basic knowledge of DKA in the survey. It was clear from the data that participants strongest areas of basic knowledge related to areas concerning the definition of hyperglycaemia and the presence of ketones in the process of DKA, caused by a lack of insulin. All participants except one were able to accurately define DKA.

Figure 7
Basic Knowledge Findings

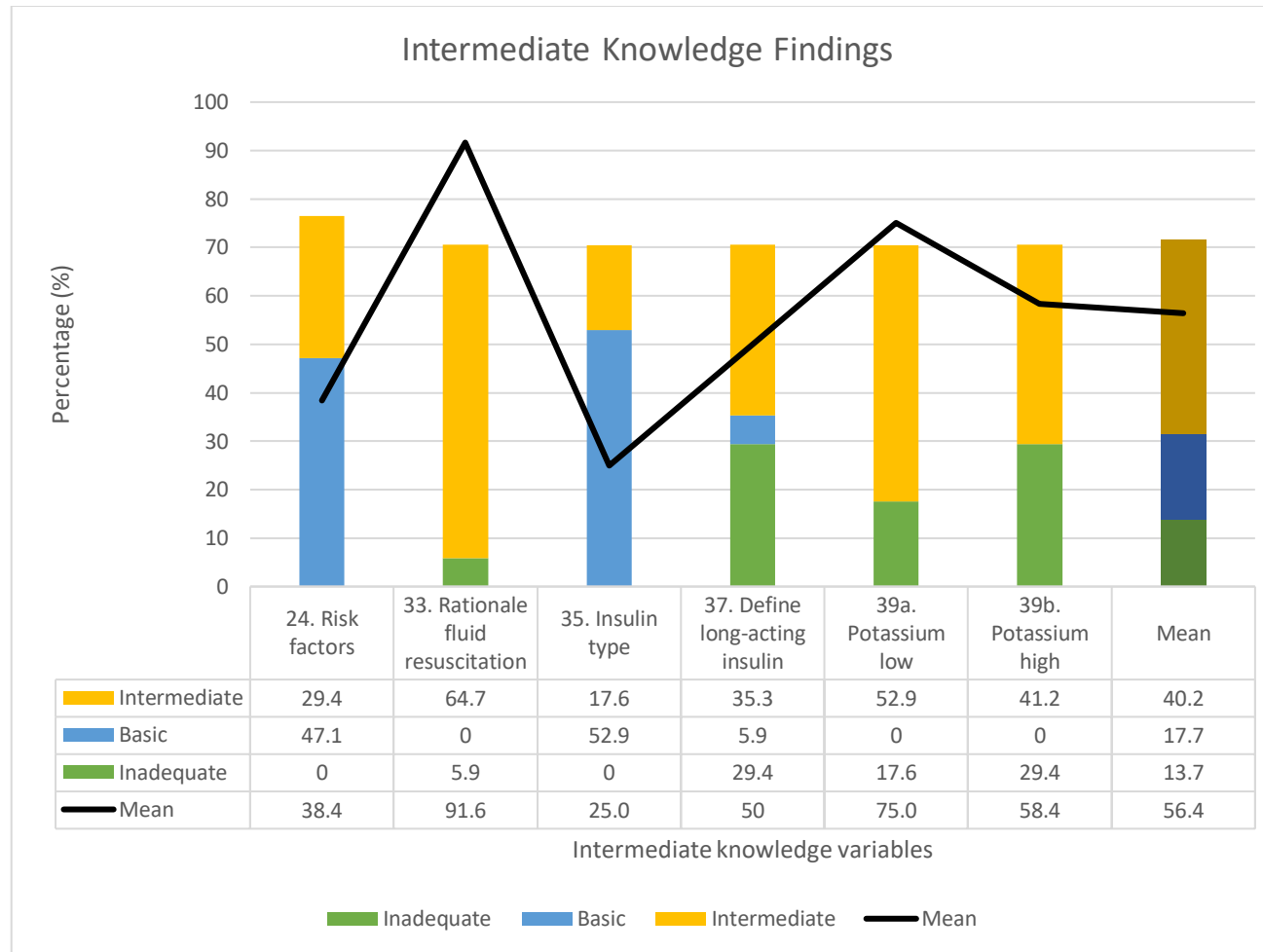


There was some concerning data demonstrating that a significant portion of participants had inadequate understanding of normal blood glucose levels (17.6-41.2%). It was also evident from the responses that a minority were also unable to identify normal ketone levels (5.9-17.6%). The level of inadequate knowledge grew to the majority of participants in relation to the specific biochemical parameters used to diagnose, and subsequently determine the resolution, of DKA (52.9-70.6%). Interestingly, the largest knowledge deficit was relating to the blood glucose level used to diagnose DKA. According to the JBDS guidelines (2013), DKA can be diagnosed with a blood glucose level over 11mmol/L, whilst many participants reporting greater than 15mmol/L. Half of the participants who completed the survey knew the expected timeframe for the resolution of DKA and more than half (58.8%) did not think that long-acting insulin was part of the initial treatment for DKA. These areas of inadequate knowledge will be discussed in more detail in the chapter seven of this thesis.

Intermediate knowledge findings

There were six variables that examined RNs intermediate knowledge of DKA with an overarching mean score of 56.4% of participants about to demonstrate this level of knowledge. The intermediate knowledge findings are displayed in Figure 8 below. The majority of participants (64.7%) understood the rationale for fluid resuscitation for patients who present with DKA, with only one participant having inadequate knowledge of this variable. Similar to the normal ranges for blood glucose and ketones mentioned above, there were some slight variations in knowledge of potassium levels with 52.9% identifying the low range, and 41.2% high range values.

Figure 8
Intermediate Knowledge Findings

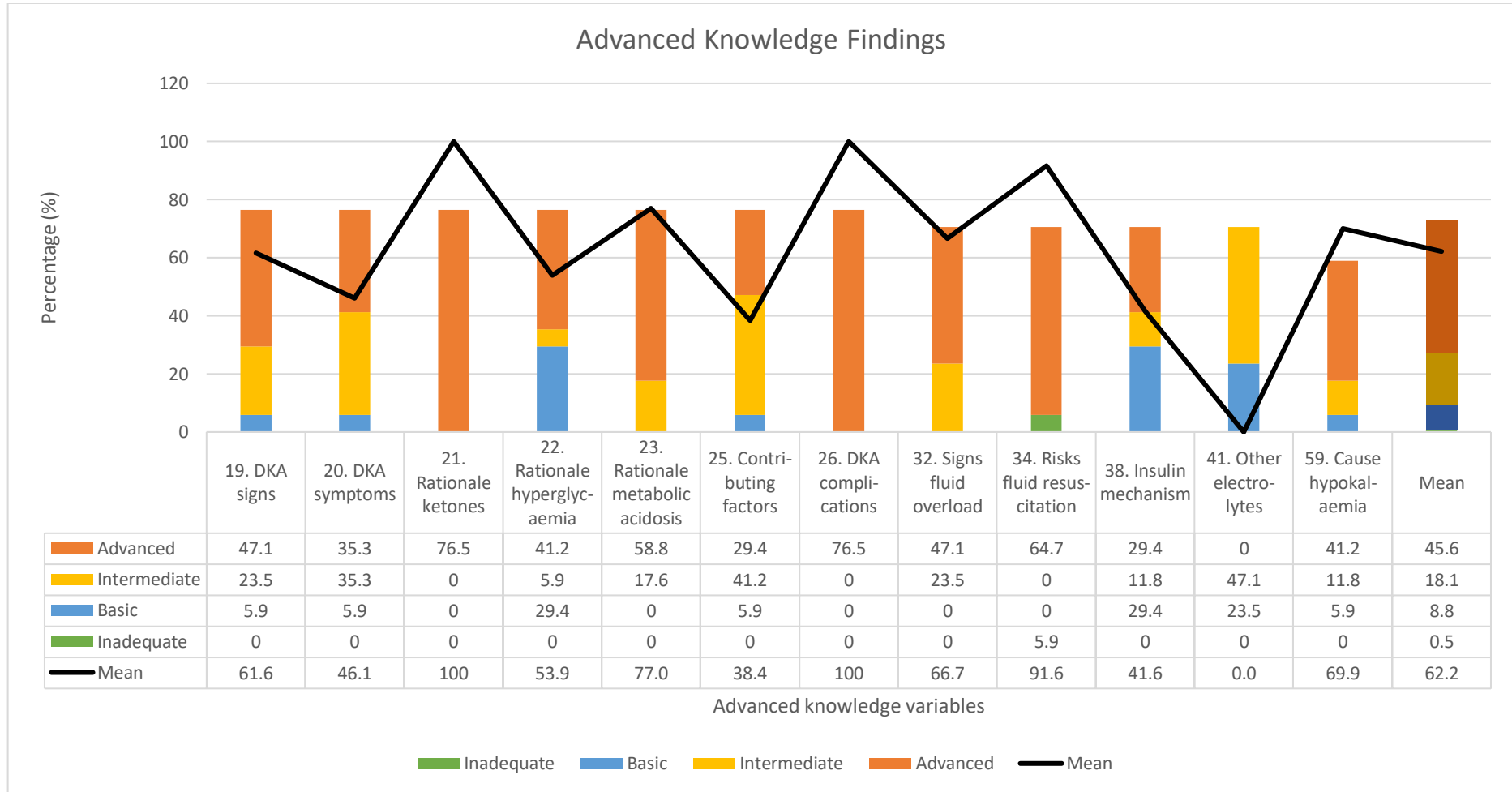


Also, 35.3% of participants correctly identified Optisulin as a long-acting insulin, with 5.9% classified Ryzodeg and 29.4% labelled Humalog incorrectly, thereby demonstrating basic and inadequate knowledge respectively. Only 17.6% of participants knew that Actrapid, used in the initial management of DKA, was a short acting insulin. The remaining participants, 52.9%, had basic knowledge and thought that Actrapid was a rapid acting insulin. The final intermediate knowledge question was about the risk factors for developing DKA, where 47.1% had basic knowledge of young patients with a history of IDDM being at higher risk. However, 29.4% had intermediate knowledge to know that low socioeconomic status could also put people at higher risk of DKA.

Advanced knowledge findings

There were 12 variables that explored RNs advanced knowledge in regard to the management of adults with DKA. As shown in orange in Figure 9 below, all of RNs knew why patients with DKA have ketones in their blood and understood the complications associated with DKA. The majority also knew why DKA patients develop metabolic acidosis (58.8%) and the risks associated with rapid fluid resuscitation (64.7%). With regards to the latter, one participant thought there were no risks associated with fluid resuscitation and were therefore deemed as having inadequate knowledge for this variable.

Figure 9
Advanced Knowledge Findings



There was a range of knowledge levels demonstrated for several variables. In terms of identifying signs of DKA, 47.1% had advanced knowledge, 23.5% had intermediate knowledge and 5.9% had basic knowledge. Similarly for the rationale for patients with DKA having hyperglycaemia: 41.2% had advanced knowledge, 5.9% had intermediate knowledge and 29.4% had basic knowledge. Participants responses to the cause of hypokalaemia in DKA also produce a range of answers with 41.2% having advanced, 11.8% having intermediate and 5.9% having basic knowledge. Participants had reasonable levels of knowledge of the signs of fluid overload with 47.1% having advanced knowledge and 23.5% having intermediate knowledge.

Participants had less advanced knowledge on concepts such as the identifying symptoms (35.3%), the contributing factors to developing DKA (29.4%) and insulin pharmacokinetics (29.4%). Interestingly, 23.5% of participants thought that potassium was the only electrolyte that needed to be replaced and 47.1% thought that other electrolytes needed to be replaced because the patient was at risk of developing refeeding syndrome.

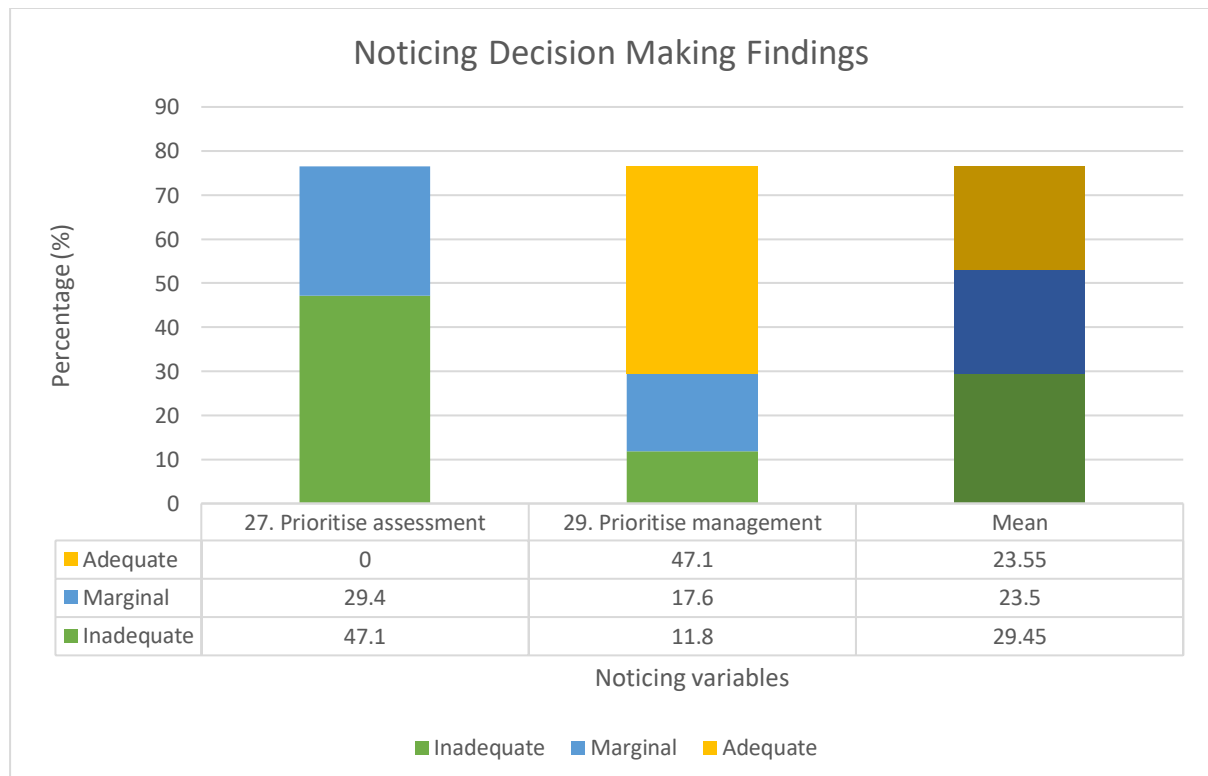
Decision making findings

There were 31 questions in the survey that examined the participants decision-making processes relating to the clinical scenario of a patients with DKA. These questions were divided into the sections corresponding to the CJM. There were two questions in the *noticing* section, another two for *interpreting*, 12 under *responding* and 11 questions that focused on *reflecting*. A further two *reflecting* questions were in the *noticing* section, and another two in *responding* to demonstrate that decision-making is not always a cyclical process. The decision-making findings will be presented according to each of these sections, and in relation to the three-point scale referenced earlier in this chapter.

Noticing findings

The first step of the CJM is *noticing*, where nurses identify problems that need to be addressed. The identification of nursing problems was measured by the participants ability to prioritise their assessment tasks and management options for a patient with DKA. The first question had a list of assessment tasks that the participants were asked to rank in order of priority from one to six. The second question provided a list of management strategies that participants were asked to rank in order of priority from one to seven. The results were then scored in terms of the accuracy of the response. If the order of prioritisation contained only two responses that were correctly prioritised, the participants answer was deemed as inadequate. Similarly, if the order of prioritisation contained three or four correct responses, the participants were deemed to have made marginal decisions. And finally, if the order of prioritisation contained five or more correct answers, the participant was classified as having made adequate decisions. The results of this ordinal data are presented in Figure 10.

Figure 10
Noticing Decision Making Findings

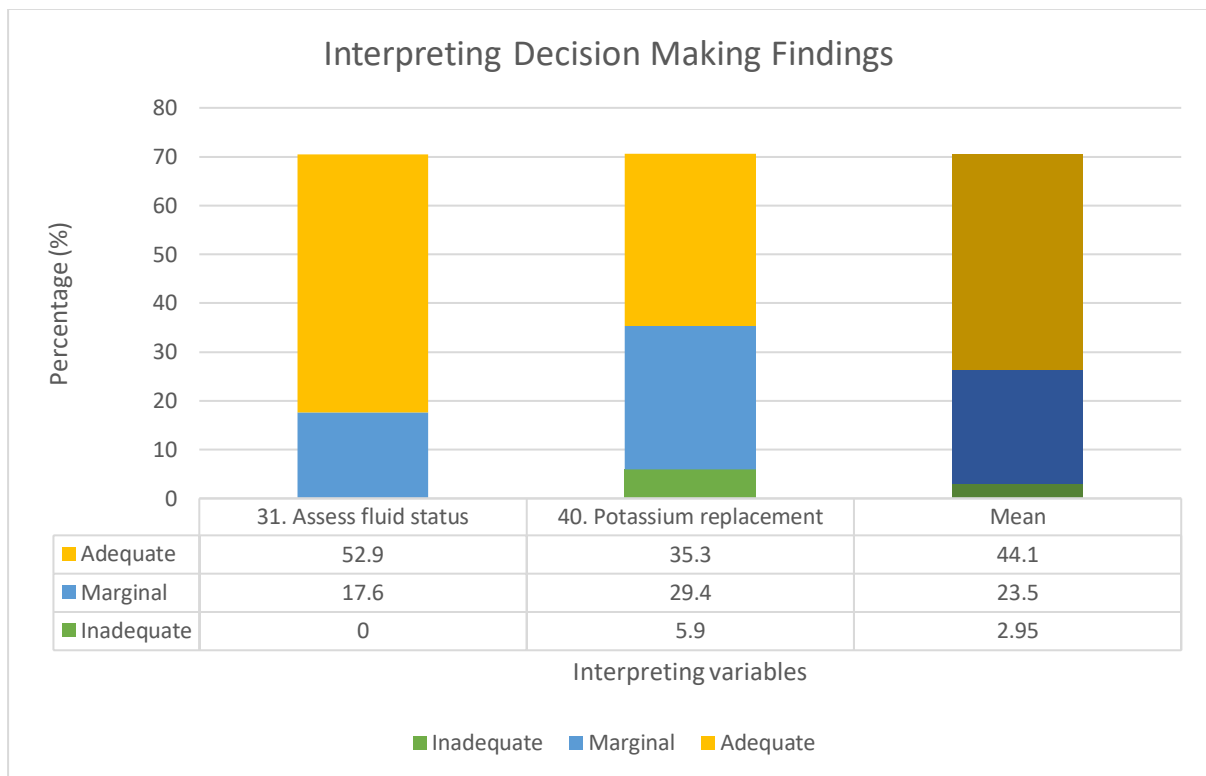


No participants were able to demonstrate adequate decision making in terms of how they prioritised their assessment of the patient. A small portion of participants, 29.4%, made marginal decisions about assessing the patient, but 47.1% made inadequate decisions. In comparison to how the participants prioritised their management of the patient, 47.1% made adequate decisions, 17.6% made marginal decisions and 11.8% made inadequate decisions. Note that the mean scores across all three categories were approximately the same, ranging from 23.5% to 29.5%. The same categories were also used to measure the participants decision making in the next step of the CJM.

Interpreting findings

The *interpreting* step of the CJM involved asking participants to analyse a situation and choose a response that best reflect their thought process when managing a patient with DKA. The two scenarios they were presented with related to how they would assess a patient's fluid status, and what they would do in response to an ambiguous prescription for potassium replacement. The findings are presented in Figure 11.

Figure 11
Interpreting Decision Making Findings

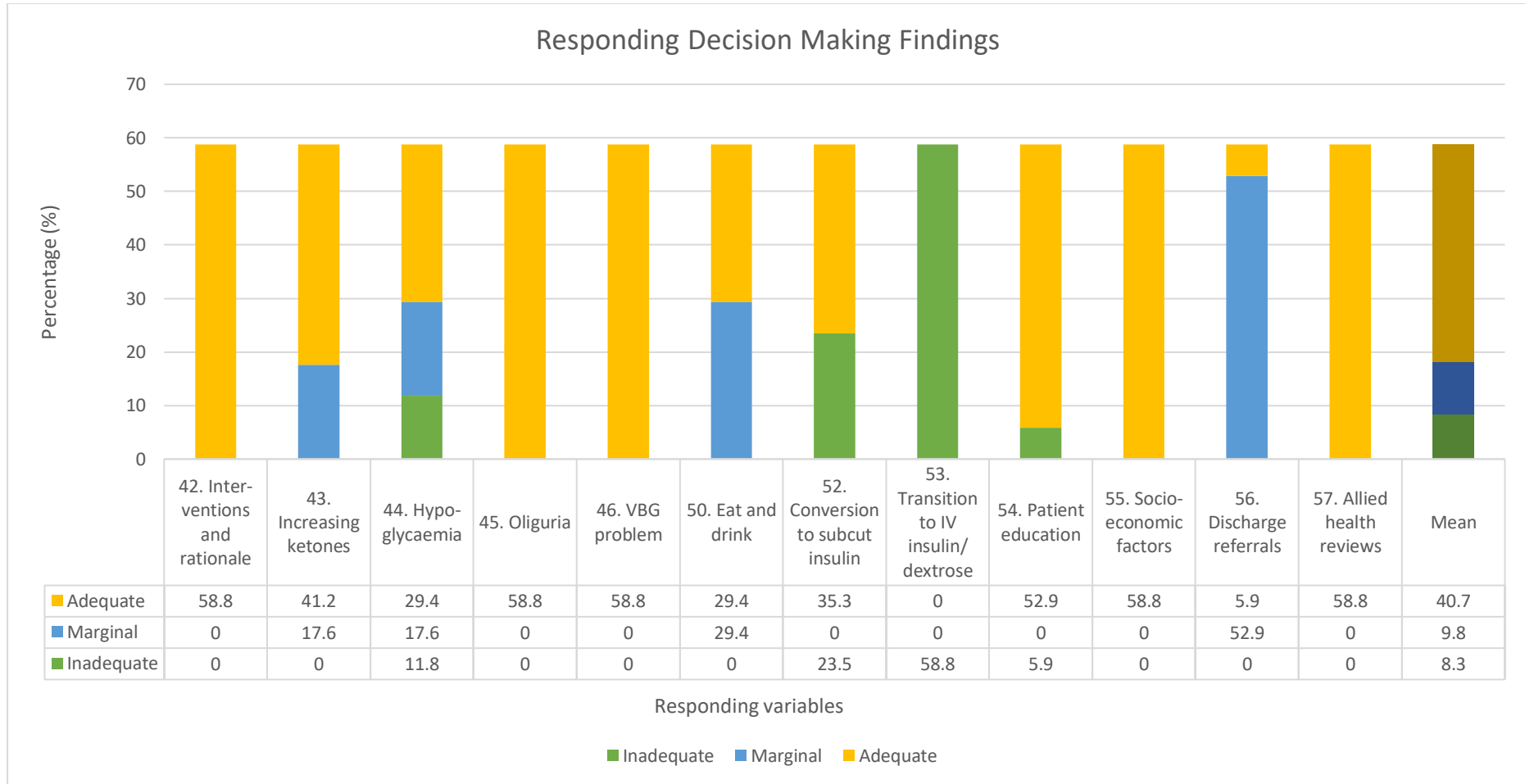


The participants all demonstrated at least marginal decisions (17.6%) when they assessed the patient’s fluid status, with 52.9% making adequate decisions. The difference between marginal and adequate decisions in the scenario related to whether nurses considered checking the patient’s renal function. In terms of the nurses’ responses to a prescription for a high dose of potassium replacement via peripheral venous access, 35.3% would have requested a central venous access device in order to administer the potassium, thereby demonstrating adequate decision making. Alternatively, 29.4% would have given the potassium but observed the patient on a cardiac monitor, a marginal decision. A small portion, 5.9%, would have requested that the prescription be changed. The mean scores indicated that overall, most of the participants (44.1%) would have made adequate decisions in response to these scenarios.

Responding findings

The third step of the CJM is *responding*, where nurses initiate a plan or intervention for patient care. In this section of the survey, nurses were presented with a series of scenarios and a list of interventions and were asked to choose what they would do in each scenario. They were rated on the same scale as the previous sections, with adequate decisions being the most holistic or evidence-based option, marginal decisions being safe but less comprehensive, and inadequate decisions demonstrating suboptimal care. The findings for the *responding* decisions are presented in Figure 12.

Figure 12
Responding Decision Making Findings



The mean score of 40.7% indicated that the participants who completed this section of the survey were able to demonstrate adequate decision making. All of the participants in this section (58.8%) were able to demonstrate adequate decision making in five scenarios. These scenarios were: matching interventions for a patient with DKA with a corresponding rationale, interventions to address an oliguric patient, strategies to ensure a VBG was performed on time, addressing socioeconomic issues and ensuring all the necessary allied health reviews were completed prior to discharge from hospital.

There were three scenarios where nurses responded with a combination of marginal and adequate decisions. Firstly, in response to a patient with worsening ketonaemia, 41.2% knew the adequate decision was to increase the insulin infusion rate and 17.6% simply requested a medical review. Secondly, in the scenario of a patient requesting to eat and drink while on treatment for DKA, 29.4% made the adequate decision by informing the patient that they could eat and drink but their glucose and ketone levels would need to be watched closely. Alternatively, 29.4% were either unsure and wanted to check with the doctor, or said the patient could not eat, thereby making marginal decisions. Thirdly, 52.9% of participants made marginal decisions about which discharge referrals the patient would require. One participant, 5.9%, would have made the adequate decision of including a referral to mental health upon discharge from hospital.

There was one scenario where participants responded with the full range of decisions. If the patient was found to be hypoglycaemic, 29.4% of participants would have made the adequate decision of increasing the rate of 10% glucose, 17.6% would have either stopped the insulin or given carbostest, and 11.8% would have only requested a medical review.

There were a further three scenarios where the decisions were dichotomous, either adequate or inadequate, because they relate to interventions described in the DKA management policy. When asked how they would transition a patient from intravenous

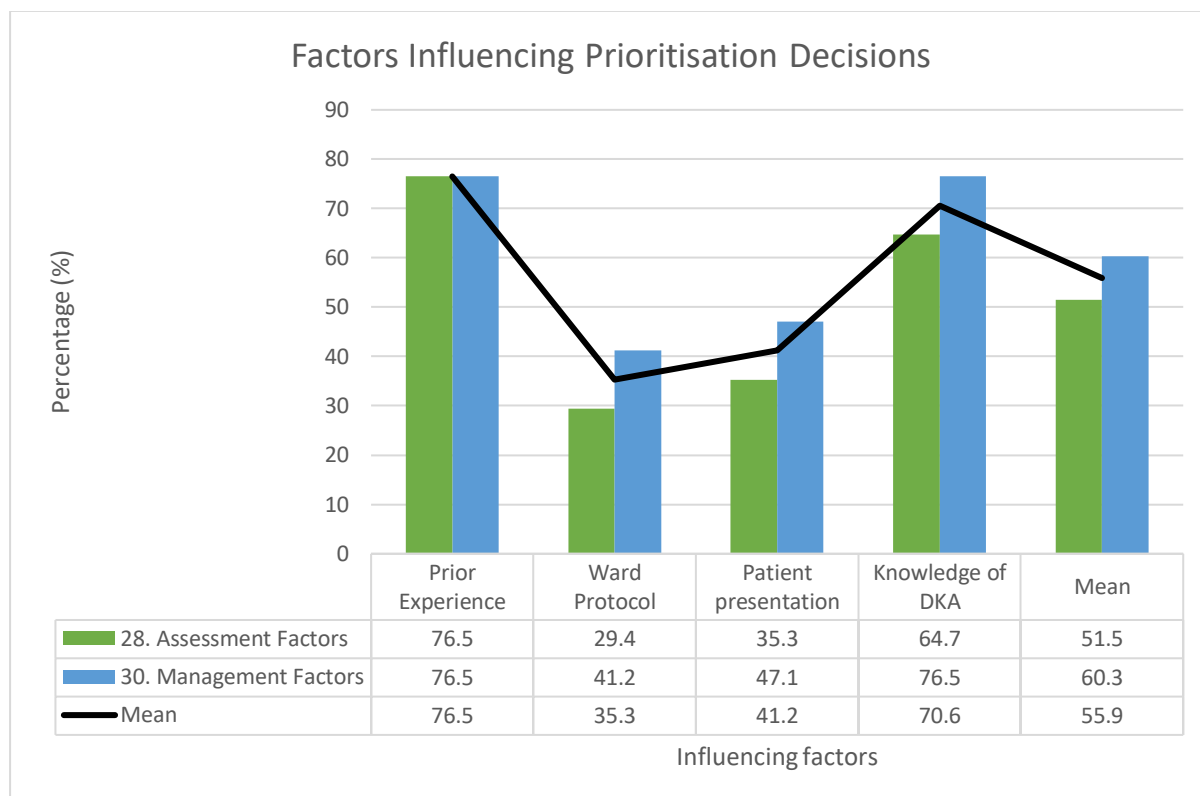
insulin back to their normal subcutaneous regime, 35.3% would have accurately given the injection and stopped the intravenous infusion 30 minutes later with the patient's next meal. If the patient was unable to eat and drink, none of the participants knew the correct procedure for converting a patient from the DKA protocol (with 10% glucose and intravenous insulin) to a standard insulin/ dextrose infusion (with 5% glucose and half the 24 hours dose of insulin). When the nurses were presented with the scenario of a patient asking for education about DKA, 52.9% would have educated the patient in simple terms and 5.9% would have asked for advice from the medical team or diabetes educator. The concept of nurses' inclination to provide patient education relates closely to the next step of the CJM.

Reflecting findings

The final step in the CJM is *reflecting*, which has two key components. Reflection-in-action relates to the nurses' ability to gauge a patient's response to care as it is occurring. Reflection-on-action happens after the event when nurses reflect on themselves, their response to the patient's situation and any learning that may have taken place (Tanner, 2006). Therefore, reflection could be considered subjective in terms of how patients and nurses believe DKA is managed. Reflection was measured in the survey in several ways. This section will discuss each component of reflection and will form the basis for the qualitative data collection described in the following chapter.

As aforementioned, nurses were asked to make a series of prioritisation decisions relating to the assessment and management of a patient with DKA. In terms of reflection-in-action, the nurses were then asked about the factors that influenced their prioritisation decisions. The questions were phrased such that respondent were able to choose as many options as they felt applied in that specific context. The results are presented in Figure 13.

Figure 13
Factors Influencing Prioritisation Decisions



All of the nurses said that their prior experience of assessing patients with DKA influenced their decision making. The next most significant influencing factor was their knowledge of DKA (64.7%) with the patient’s presentation (35.3%) and DKA protocol (29.4%) being less significant factors. When comparing the same factors in terms of how nurses prioritise the management of patients, the trends were similar. All of the nurses said that prior experience and their knowledge of DKA influenced how they managed DKA patients. The patient’s presentation (47.1%) and DKA protocol (41.2%) were again less significant factors.

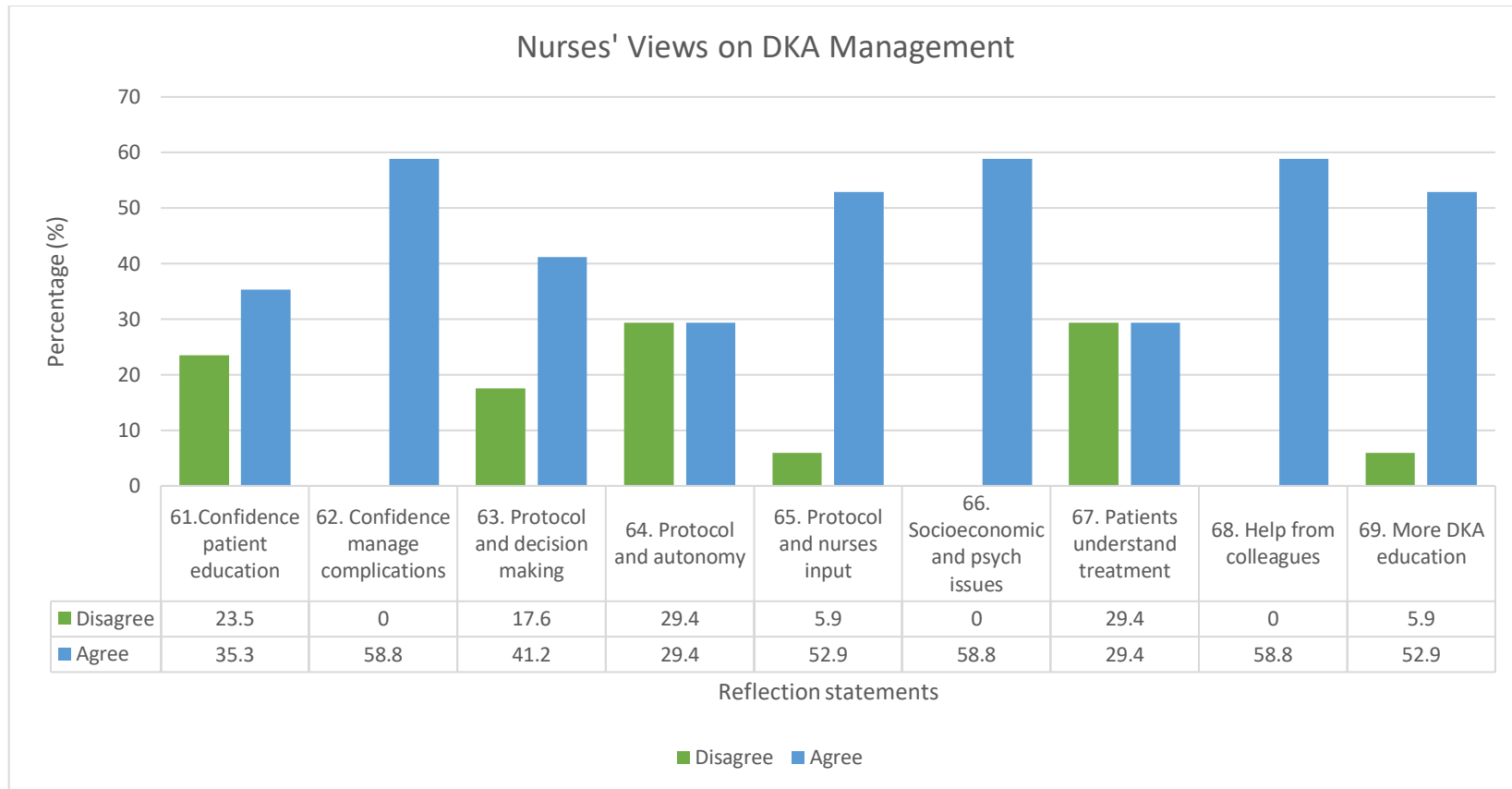
Reflection-in-action is a significant part of the nursing process, to evaluate patient care to ascertain if it progressed towards achieving the desired patient outcome. In the survey, participants were asked to reflect on a series of complications that the patient developed whilst receiving treatment for DKA, i.e. worsening ketonaemia, hypoglycaemia

and oliguria. The largest portion of the participants, 41.2%, thought that these changes were preventable with frequent monitoring. A small portion, 11.8%, thought they were normal fluctuations associated with the treatment of DKA and one respondent said that these changes would not have occurred if the pumps were working properly. Participants were then asked if they felt the aforementioned complications had an impact on patient outcomes. One respondent said no, they are normal issues that are easy to rectify. The remaining participants (52.9%) said yes, it would either prolong the patients' hospital stay or put them at risk of haemodynamic deterioration that would require critical care input.

On closer examination, when participants were asked about the specific cause of hypoglycaemia in a patient on treatment for DKA, a significant portion, 47.1%, associated it with infrequent monitoring or an insulin dose that was too high. The remaining participants, 11.8%, thought that the 10% glucose rate was incorrect, despite it being a fixed variable on the DKA protocol. Nurses' views on patient outcomes as well as the management of DKA at an organisation level, were also measured in the specific *reflecting* section of the survey.

The final section of the survey that related to reflection-on-action asked nurses to respond to a series of statements relating to their views on the care of patients with DKA at the hospital site. They were provided with a four-point Likert scale to indicate their level of agreement or disagreement. This scale was condensed to either "agree" or "disagree" as part of the data analysis. The results of these statements are presented in Figure 14.

Figure 14
Nurses' Views on DKA Management



The responses to these statements demonstrated that nurses engaged in reflection-on-action, but took their time to consider the broader issues associated with the management of patients with DKA. The responses suggest that all of the nurses believed they were confident to manage complications associated with patients receiving treatment for DKA. But they also would have sought help from colleagues to help them make decisions.

Participants were asked if factors such as socioeconomics and psychological issues had any impact on patients presenting with DKA and all of them agreed that this statement was true. Most of them (52.9%) felt that the DKA protocol at the hospital site should have more input from nurses who manage these patients and they would like more education on this topic.

There was less agreement amongst nurses to statements relating to their confidence to educate patients to prevent a recurrence of DKA: 35.3% said they were confident, 23.5% said they were not confident. When asked if the DKA protocol helped them to make decisions, 41.2% agreed and 17.6% said that it did not help. Interestingly, there were two statements that divided the nurses. When asked if the DKA protocol promoted autonomy among nurses, equal portion of participant, 29.4%, both agreed and disagreed with that statement. They were also asked to provide their views on patients understanding of the treatment of DKA. This question divided participants: five agreeing that patients understood their treatment plan, and the other five saying they did not understand. This shows a lack of consensus among the nurses, which is interesting in light of the final question on the factors that influence decision making in the context of managing patients with DKA.

As a summary of the decision making questions and to provide a foundation for the qualitative data collection, to be reported in the following chapter, the participants were asked about factors that would have helped them to make decisions for patients with DKA. They

were provided with a pre-determined list of options and permitted to choose as many options as they felt applied. The most significant results showed that 47.1%, said they wanted more confidence in their knowledge of DKA and a user-friendly protocol. A noteworthy portion of nurses, 41.2%, felt they needed a better understanding of DKA pathophysiology and 17.6% said they wanted more supervision and guidance from senior nurses. One participant also suggested that “doctors following protocol and not deciding different actions that don't correspond with protocol” would also help nurses to make decisions. These factors, among others, were investigated in further detail in the qualitative interviews, in conjunction with the findings from the Fisher's exact test.

Fisher's exact test

Fisher's exact test was used to examine the significance of the association between two variables. Each of the knowledge and decision making questions were compared against the following five key demographics: gender, job title, clinical area, level of education and specialty. None of the results of Fisher's exact test were found to be statistically significant. Regardless of the insignificant results, the survey provided sufficient insight into RNs' knowledge and decision making in the context of managing a patient with DKA to present interesting and relevant findings for clinical practice.

Summary

This chapter provided an overview of the process for administering an online survey to RNs who manage patients with DKA at a metropolitan hospital. A summary of the population and sample size was provided as well as a description of how they were recruited to the study. Once the survey was administered, statistical analysis was conducted on two main themes. The key findings were presented as a series of figures and tables relating to

basic, intermediate and advanced levels of knowledge. Decision making was also examined in terms of inadequate, marginal and adequate decisions as they correlated to the steps of the CJM. These results helped to answer the research questions relating to RNs level of knowledge and decision-making processes used in the management of adults with DKA. Fisher's exact test was also conducted as part of the statistical analysis, but with limitations in the sample size, no statistically significant results were found.

The results from the survey also helped guide the next phase of the study to respond to the research question relating to the factors that influence RNs decision making in the context of managing patients with DKA. In accordance with the mixed methods design described in chapter three, the quantitative results from this first stage of data collection were used to inform the second, qualitative stage of data collection (Leech & Onwuegbuzie, 2009). The process for obtaining qualitative data in the form of semi-structured interviews will be explained in the following chapter.

Chapter 6

Phase 3: Semi-structured interviews and thematic analysis

Introduction

The previous chapter outlined the process and results for the quantitative data collection phase of this study to determine RNs level of knowledge and the decision-making processes they use in the context of managing patients with DKA. In phase 3, a sample of RNs were involved in semi-structured interviews to discuss the factors that influence RNs decision making in the same context. This chapter will describe the sample of nurses involved in the interviews and the process for conducting the interviews. The qualitative data was then transcribed and analysed according to the Braun and Clark (2006) model. A series of diagrams will demonstrate how four key themes, and numerous subthemes, were identified in the data.

Permission and consent

Permission to conduct the semi-structured interviews was obtained through the HREC approval process from East Metropolitan Health Service and UNDA. Potential participants were provided with a hard copy of the participant information sheet (Interviews) (Appendix B) and two copies of the consent form (Appendix K). They were asked to read the information and sign both consent forms, one for the researcher's records and the other for the participant to keep. Once the audio recording was started, participants were given a preamble that included the details of the study and this phase of data collection. They were asked to confirm for the recording that they had read the participant information, signed the consent form and been given an opportunity to ask any questions they may have had relating

to either of those documents. This second layer of consent was included in the final transcription of the interviews.

Population and sample

The population of nurses involved in the qualitative data collection phase of this study were all employed at the same Perth metropolitan hospital. A convenience sample of nurses from the ED, ICU and MAU at the hospital were chosen, from their high likelihood of having worked with patients who were diagnosed with DKA. This type of sampling was used due to simplicity of the readily available RNs who volunteered to participate. Whilst convenience sampling had a risk of bias and may not have represented the broader population, the participants still provided insight into the phenomenon under investigation in the study. Furthermore, due to the different type of sampling used in this phase in comparison to phase 2 (purposive versus convenience), it was not guaranteed that participants in the interviews completed the survey. There was a significant time lapse between both sets of data collection. Therefore, participants who consented to be interviewed in the survey, were unavailable at the time to be interviewed, thus necessitating an alternative type of sampling. While this is not entirely in line with the sequential design of the study, the same inclusion criteria applied for this phase of data collection.

Nurses working outside the specified clinical areas were not invited to participate. Enrolled nurses were also excluded in this phase due variations in their scope of practice in comparison to their RN colleagues as mentioned in the previous chapter.

Unlike quantitative data collection, there is no prescribed sample size in qualitative methodologies (Ellis, 2010). Therefore, the sample size for the qualitative interviews was determined by the concept of data saturation. Data saturation is gauged by the researcher, and refers to the point at which no further data needs to be collected for two reasons. The

first reason was because no new information was being obtained in response to the interview questions and the researcher was able to see patterns emerging from the data (Ellis, 2010).

The second reason pertains to when the researcher has no further participants from the population left to be interviewed (Liamputtong, 2013). Due to the transparency of the researcher question that was being addressed in the interviews, relating to the factors that influence nurses' decision making in the context of managing patients with DKA, data saturation was achieved after seven interviews.

Three RNs and three CNs, one from each clinical area, consented to be interviewed. The seventh participant was a specialist nurse, who worked in diabetes education, and therefore had an overarching perspective on the research topic. The participants consisted of six female nurses and one male nurse, with a broad age range and scope of clinical experience. All had worked at the hospital site for a minimum of three years and were familiar with the care of patients with DKA in their respective clinical areas. The timing for each interview ranged from 10 to 15 minutes.

Semi-structured interviews

Semi-structured interviews were conducted to collect qualitative data because they enabled a set of questions to guide a discussion, but have the flexibility to explore concepts as they arise during the dialogue (Ellis, 2010). The ability to follow a train of thought and elaborate on the issues provides the researcher with an opportunity to pursue and explore a phenomenon in greater detail (Schneider et al., 2016). A semi-structured interview guide (Appendix D) was developed based on the findings from the quantitative survey and in the interests of answering the research question on the factors that influence nurses' decision making while managing adults with DKA.

The survey results indicated that prior experience and knowledge of DKA pathophysiology were the main factors that influenced nurses' decision making. Therefore, in the interviews, these concepts were explored in more detail by asking the following questions:

- What influences your decision-making when managing patients with DKA?
- Who influences your decision-making when managing patients with DKA?
- What are the enablers for your decision-making for patients with DKA?
- What are the barriers for your decision-making for patients with DKA?

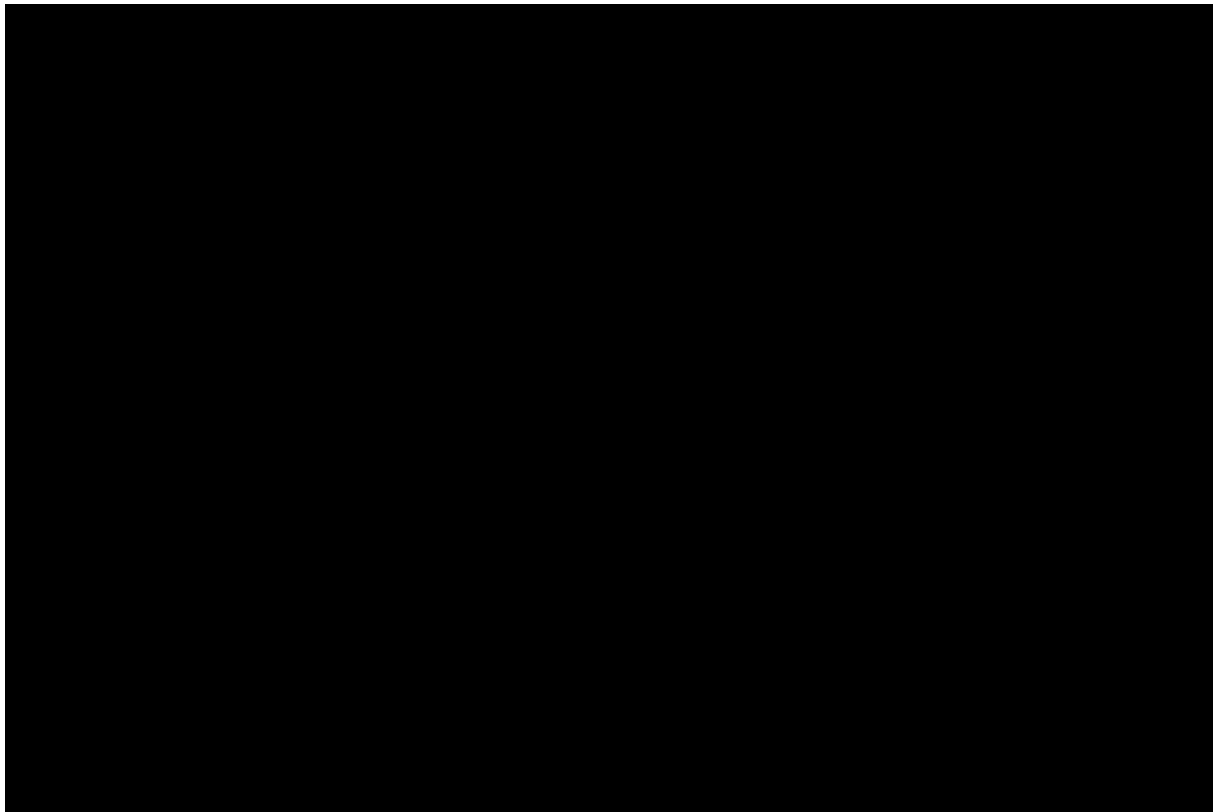
Each interview was conducted and audio recorded in a private room in each of the participants clinical area at the hospital site. This meant that the participant remained available to patients and other ward staff if required. The recordings were all transcribed using Otter.ai™ (2021) voice recognition and transcription software. The transcripts were coded N1 to N7 to maintain the confidentiality of the participants. The transcript documents were then manually edited and formatted against the original recording by the researcher within three days of conducting the interview. This ensured that the transcripts were accurately prepared in order to conduct a thematic analysis according to the Braun and Clark (2006) model.

Thematic analysis

The Braun and Clark (2006) model for thematic analysis is a recursive process for critiquing patterns in qualitative data. The themes that are generated as a result, are overarching concepts that encompass significant meanings from the data set. The six stages of thematic analysis are presented in Figure 15.

Figure 15

Braun and Clark (2006) Model for Thematic Analysis

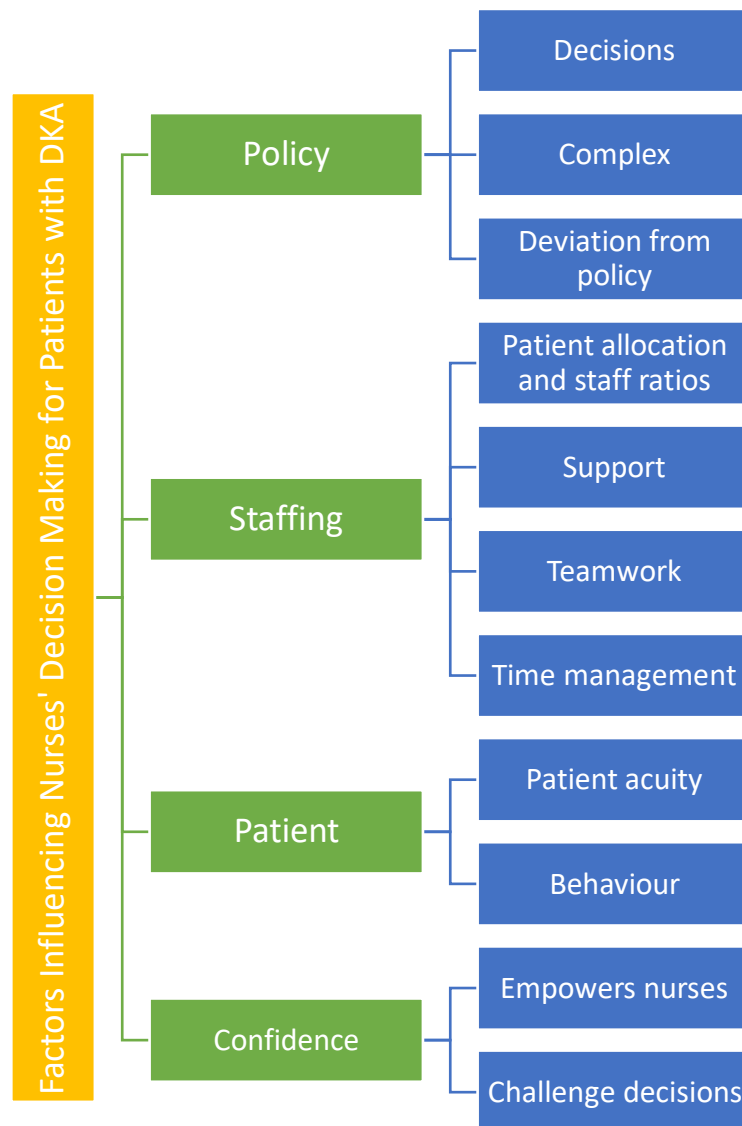


The first stage of the Braun and Clark (2006) model involves the researcher familiarising themselves with the data. In this stage, the researcher uploaded the audio recordings into Otter.ai™ (2021) to produce the transcripts. The transcript was then manually checked by reading the document and listening to the recording to ensure it was an accurate account of the data. Hard copies of the transcripts were then printed off and annotated with initial ideas for key concepts, in preparation for the next stage.

The second stage of the thematic analysis involved generating initial codes. For this study, a colour coding system was developed to differentiate between concepts and interviewees. A total of 14 key concepts were identified and coded systematically. The transcripts were then rearranged according to those concepts and maintaining connections between the original data and corresponding code.

These codes were then used in stage three of the analysis, where they were grouped together to form potential themes. The themes were arranged on a thematic map as a diagrammatic representation of how the ideas were interconnected. Several versions of this thematic map were produced, before the themes were narrowed down into four main themes and 11 sub-themes shown in Figure 16.

Figure 16
Spider Diagram of Themes and Subthemes



Stage four involved reviewing the themes and sub-themes to ensure they were distinct from each other and meaningfully represent the data. In this stage, the original transcripts

were reviewed again to ensure that each data extract corresponded with the theme. And finally, the transcript was reviewed in its entirety to ensure that the themes and subthemes represent the data holistically. This process served two purposes: to ensure the themes genuinely represented the data set, and to provide another opportunity to code and recode the data that may have been overlooked previously (Braun & Clark, 2006).

In stage five of Braun and Clark's (2006) model, defining and refining themes is discussed. In this stage, each theme was analysed and reported according to the overarching research questions. Therefore, the themes were clearly distinguished from each other, using as fewer words as possible, as individual factors that influence RNs decision making in the context of managing patients with DKA. Each theme had a corresponding narrative and relationship that connected them all together. These relationships are demonstrated in Figure 16.

The final stage of the thematic analysis is to report a captivating account of the data that persuades the reader of the trustworthiness of the research (Braun & Clark, 2006). This stage involved using verbatim quotes that clearly represent the themes, subthemes and connections between them. The researcher used a different colour code on the transcripts to correlate quotes that demonstrated the essence of the themes and subthemes. The results of this final stage of coding were the thick description of the qualitative data presented subsequent sections of this chapter. The discussion chapter will utilise the qualitative data as a means of presenting an argument that convinces the reader of the relevance of the data to the research questions (Braun & Clark, 2006). A key component for the persuasiveness of that argument, is to outline the trustworthiness of the data, in terms of credibility, transferability, dependability and confirmability.

Trustworthiness

As discussed in chapter four, the survey tool developed for this study underwent rigorous testing to ascertain its validity and reliability. The equivalent test for rigour in qualitative research is trustworthiness (Liamputtong, 2013). Trustworthiness has four key components: credibility, transferability, dependability and confirmability (Bloomberg & Volpe, 2019). In this section, each of these components will be discussed in detail, and how they were applied in the qualitative data collection phase of the study.

Credibility

Credibility in qualitative research refers to how the insights of the participants are represented by the researcher (Bloomberg & Volpe, 2019). To establish credibility in the interviews, each participant was provided with a summary of the discussion and asked two key questions. Firstly, which concept in the discussion did they believe was the most important. Secondly, whether the summary was an accurate overview of the topics that were discussed (Krueger & Casey, 2015). This “member check” served as a way of involving participants in the early stages of data analysis (Ellis, 2010). Credibility was also maintained by synthesising the qualitative data with the quantitative data from the previous phase of the study, which will be discussed in the following chapter.

Transferability

Transferability relates to whether the qualitative data offers insights that can be applied in a broader context beyond the scope of the original study (Liamputtong, 2013). Essentially, the transferability of qualitative data is about whether the findings can be extrapolated to different situations (Bloomberg & Volpe, 2019). In order to achieve transferability, the researcher provided thick description of the research setting, participants and their interactions to give the reader a comprehensive overview of the context of the study.

It is then the burden of the reader to ascertain the relevance and applicability of the findings in a different situation (Bloomberg & Volpe, 2019).

Dependability

Dependability is another criterion for trustworthiness where qualitative data is scrutinised for its' ability to remain constant over a period of time (Bloomberg & Volpe, 2019). The researcher ensured dependability by creating an audit trail of all recordings, notes, transcripts and analysis material used throughout the research process. The final chapter will demonstrate how synthesis was used to justify the research design and thereby meet the criteria for dependability.

Confirmability

Confirmability is the means by which researchers demonstrate their findings relate directly to the qualitative data, not their own personal insights into the research phenomenon (Liamputtong, 2013). Similar to dependability, confirmability was achieved in this study by reporting on all methodological, theoretical and analytical decisions made throughout the research process (Bloomberg & Volpe, 2019). The researcher ensured the confirmability of the data through an audit trail and synthesis of the data from previous phases of the study.

Findings

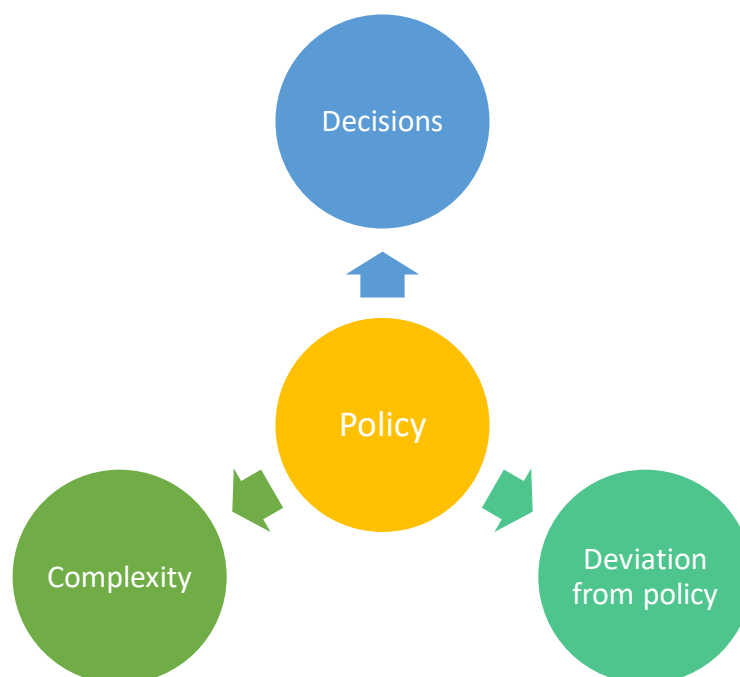
This section presents the findings from the semi-structured interviews. The themes and subthemes that were identified will be explained in detail. A series of verbatim quotes from the participants will be used to clearly define each theme and subtheme for the purpose of answering the research question relating to the factors that influence RNs decision making whilst managing adults with DKA.

Theme 1: Policy

The first theme the RNs felt influenced their decision making for patients with DKA related to policy. The policy was referred to interchangeably by participants as the “protocol”, “chart” or “flowchart”. This is the document used at the bedside for patients with DKA that provides all of the information clinicians require to manage the patient.

The participants referred to the policy for managing patients with DKA, but they had both positive and negative views of the use of the policy. Some found the DKA policy to be beneficial in terms of decision making. One participant said “the main thing that enables you to make a decision is policy. DKA is very policy driven. If you follow the policy, you will get through it” (N2). But they also said it was “confusing” with one participant claiming “they’re a bit bamboozled with the whole chart” (N6). Some found that the policy was often changed or “manipulated according to the patient’s condition” (N1), which influenced decision making. From these ideas, three subthemes relating to policy emerged as described in Figure 17.

Figure 17
Theme 1: Policy and Subthemes



Theme 1: Subtheme 1 Decisions

The first subtheme related to decisions. A number of participants stated that the policy enables and supports decision-making. Participant N2, a junior nurse said “I think the most important thing that would influence my decision making is obviously following the policy”. Participant N1, another junior nurse said “we have a policy that’s very clearly written on our ward. And following that policy is what guides my decision making”. Participant N7, a senior nurse, stated “the policy tells us what to do in which situation”. Interestingly, participants also said that the policy serves a means of safeguarding their decision making. Participant N1 said “my mind will always go back to policy... because policy is what ensures that I’m protected and makes sure most of my DKA patients are treated appropriately”.

Theme 1: Subtheme 2 Complex

The second subtheme refers to the complexity of the DKA protocol. Participant N2 said “it’s very, very complicated. There lots of different aspects to the protocol that you have to understand...”. When asked if they found the DKA protocol easy to use, Participant N5, a CN, said “no, no, not at all” and Participant N4, an RN, said “now that I’ve looked lots of DKA patients, yes. But in the beginning, no”. When she was questioned as to why she found it difficult to use, she said “there’s just a lot of writing and it’s not concise. It’s actually quite easy once you get your mind around it. But reading through the document of the protocol is quite convoluted and confusing at times” (N4). Therefore, the participants felt that the policy was complex because it had multiple components that were presented with a lot of detail. This level of detail meant that it was not easy for them to pick up and use in a timely manner without prior experience.

Theme 1: Subtheme 3 Deviation from policy

The third subtheme related to deviations from the policy which were reported as common occurrences whilst managing patients with DKA. Deviations from policy serve to further confuse nurses who try to follow the policy as written.

Often times, when the patients present to the ward... the DKA protocol hasn't been followed correctly. And then that makes it very hard to get the patient back on track... it's very difficult to figure out where you are with the patient and exactly where I'm meant to go from here (N3).

Participant N6, a senior nurse, acknowledged that more deviations from policy occurred in the critical care areas than the general medical ward. The rationale for these deviations was because critical care patients are "usually a lot sicker and there's usually other things going on as well... whereas when they make it to MAU, it's purely, usually just DKA" (N6). This is consistent with the response of a nurse from ED who said that they admit patients with DKA to "either ICU or the medical ward" depending on the "severity of the DKA" (N4).

The decision to deviate from policy is predominantly medically driven and based on numerous factors including the patient's presentation, the medical hierarchy and the confidence of the doctor treating the patient. "Quite often the policy is manipulated according to the patient's condition, and influences the opinion of the registrar or consultant" (N1). Another nurse raised the issue of inconsistency in medical decision making:

I'd be happy if all the doctors... were on the same page. It shouldn't be doctor dependent on how you treat a DKA patient... It's based on their experience. So, whether a junior doctor picks up the DKA patient or a consultant... is dependent on how they were treated... And then the consultants are the ones who say 'no, this

works better than the protocol'. And then you feel like you can't really say 'no' to a consultant. So you have to do what they want you to do (N4).

Furthermore, nurses claimed that the time of day also influence how they make decisions for patients with DKA. "If it's night shift and we've got junior doctors on, it's very much nurse driven. If it's during the day, as we've got consultants and senior (registrars) on, it's very much driven by them" (N5). When the diabetes specialist nurse was asked about factors that hinder nurses' ability to make decisions for patients with DKA, she said:

If the doctor's not confident, and if they haven't got that support of the... team. If the patient comes in overnight, so when we've got very few doctors floating around, and... quite often it can be a junior... doctor that's on overnight... not having that increased support on the floor (N6).

Nurses suggested that the confidence of the medical decisions, especially by junior doctors consequentially influenced the nurses' decision make for patients with DKA. "If you get a junior doctor that's not confident with the DKA chart... knowing that they can contact me and I can go through it with the doctor... that makes a difference as well" (N6). The ability of a senior nurse to facilitate medical decision making in this manner, also serves to clarify the rationale for deviations from policy that bedside nurses do not always understand.

The reasoning behind some deviations from policy was also raised as an issue among nurses in the interviews. They said:

I think the number one thing, for me personally, that hinders my ability to make decisions on DKA patients is knowing the rationale behind deviations from policy. And... having a deeper understanding...to a pathophysiological level as to why there's that deviation. And...what benefit that deviation from policy actually has for that patient. And conversely, what... impact it would have on the patient if we...

were to follow the policy. So if we were to strictly follow policy, as it's written, why is that not suitable for that patient? (N1).

This participant raised interesting questions about the application of policy in clinical practice. These issues will be discussed in the following chapter as well as the other themes and subthemes that emerged from the interviews.

Theme 2: Staffing

The second theme that was identified from the semi-structured interviews was about staffing. Inadequate staffing, including poor skill mix, was an influencing factor in decision making that was raised mainly by the participants in the interviews who had more senior positions. Participant N3 said “poor staffing or inexperienced staffing or under staffing on the ward”. Participant N6 said “staff mix can make a difference as well”. Within the overarching theme, there were a number of subthemes that emerged that will be discussed in more detail. They are presented in Figure 18.

Figure 18
Theme 2: Staffing and Subthemes



Theme 2: Subtheme 1 Patient allocation and staff ratios

The first subtheme related to staffing was patient allocation and staff ratios that had both positive and negative impacts on their decision making whilst managing patients with DKA. Participant N3 said that patient movement such as “multiple admissions, discharges, interhospital transfers, other medical emergencies. Those things would either disable or enable the situation”. Furthermore, the same participant said:

They’re (patients) acutely unwell, they’ll often need cardiac monitoring. So then my decision around if I pull that patient up from (ED), in what bed am I going to put the patient so that they’re safe and they get the best patient care? (N3).

Principles such as nurse/patient ratios were also raised as staffing issues, both on the medical ward, and in ED. “Staffing on the ward... I’d say that’s a big factor... they (DKA patients) almost require if they really are unwell, like a one to two kind of ratio, which we don’t have in the medical unit” (N3). A second participant also comments that “for the first two or three hours, you’d like to be one to one. But because you have four other patients to look after, sometimes... the work will not be commenced as quick as you want it to” (N4). Comments were made about “your staff mix can make a difference as well” (N6). A staffing skill mix of nurses, with varying levels of knowledge and experience, was also discussed as a factor that influence decision making for patients with DKA.

Theme 2: Subtheme 2 Support

The second subtheme relating to staffing referred to providing and receiving support from nursing colleagues. Support was a key component of the role of the senior nurses. Participant N6 said “...mainly with the DKA, just helping the nurses wade through what they need to do, and what their responsibilities are with the DKA chart... knowing that I’m there as a backup, if they’re not sure”. Nurses’ ability and willingness to provide support appeared to be closely associated with their knowledge and experience.

A trend was identified in terms of how nurses determined who was able to provide support to them while they managed patients with DKA. The nurses who were in more senior roles were presumed to have more knowledge and experience, and therefore were utilised to support their junior colleagues. In terms of treatment, one participant demonstrated their knowledge by explaining their way through the nursing process. This nurse demonstrated both confidence and competence to apply her knowledge in a clinical context.

It's always about fluid to start with. So give them the first bag of fluid while we're getting the blood gas, to then determine that they're in DKA...for me, being a CN, we can determine the VBG to see if they're improving (N5).

By demonstrating a higher level of knowledge, junior nurses felt they could rely on their senior colleagues to justify or reinforce their decisions. Participant N2 said "I think the most important thing is making sure that if there is a junior nurse, that it's been double checked by a senior nurse and the CN and the after-hours CNS."

Senior nurses were also suggestive of their willingness to provide support to more junior staff. They made this statement:

If you don't know how to manage a DKA patient, being able to put your hand up and say 'look, I've never done this before. Can you support me in caring for this patient and in the decisions that I make?' (N3).

Conversely, the junior nurses in each area, knew who they could go to for support and to validate the decisions that they were making for the patient. "Support from senior RNs and coordinators who reinforce whether or not I'm actually following the right protocol at the time for that patient" (N1). "More experienced nurses... broke it down, into easy dot points. This is what you do next...step by step basis" (N4). Therefore, nurses experience and subsequent ability to provide support to their colleagues was a factor that influenced decision making for patients with DKA.

Nurses who believe their knowledge or skill may be suboptimal, require more confidence to ask questions, than those with advanced knowledge and experience. The purpose of asking questions was to clarify their understanding, and rationalise the interventions for the patient. "And if there was anything that I didn't understand, or that I had questions about, I would first of all get a really really good handover from the nurse that I've taken the patient from. And then if there was anything else that I needed, I'd ask

someone that was more senior to me” (N2). Another nurse reported that asking questions is not always easy to do. “So having that lack of understanding, and I suppose that comes down maybe to a communication level... or me just not asking those questions at the time” (N1). The concept of asking questions relates to previous subthemes about support and teamwork, where nurses are resources to each other and work together to provide care to a patient with DKA.

Theme 2: Subtheme 3 Teamwork

During the interview, some participants discussed the importance of multidisciplinary teams and the need for teamwork. Hence the third subtheme of teamwork emerged. “We work as a team” (N7). “So we pretty much like co-care for that patient when they come in” (N5). Allied health also made valuable contributions to managing DKA patients. If the “patient has a low GCS, and they can’t speak, then that will make a slight difficult in identifying their previous medications, identifying their previous dose of insulin... we can overcome that with... Pharmacists looking up their records...” (N7). Communication between the medical team and specialist input from diabetes education also demonstrated a teamwork approach to patient care. “The doctors over there sometimes will contact me and say, ‘look, we’ve got this DKA patient. Can you just come over and make sure we’ve done everything right?’” (N6). Therefore, staffing in terms of the communication and therapeutic relationships between all team members, including the patient and their family, is an influencing factor for decision making for patients with DKA.

Theme 2: Subtheme 4 Time management

The fourth and final subtheme under staffing, was time management. When discussing the importance of time management, participant N3 stated:

If you know you’re going to get a DKA patient, you know, get an IV pump and pole, get a syringe driver, make sure you’ve got a bag of fluid... or that you’ve got extra

bags to go because you know, you're going to need to run them... the insulin infusion, having the normal saline with 40 of KCl, actually having that charted and documented by the doctors and not having to chase them up (N3).

The purpose of being organised was to prevent delays in the patient's treatment. Nurses' ability to organise and manage their time can be made more problematic if they are allocated additional patients, as per the previous section. One participant also reported on an issue they had with time management due to a lack of documentation. They said "the patient didn't have dextrose running for two hours because we couldn't get a doctor to chart it and somehow that got missed" (N2). Another participant discussed an issue getting blood tests done on time in order to titrate treatment according to the protocol. "We were asking the doctors to come and (take VBGs). And often times it would be four or five hours later before they did it. And then that obviously raised concerns for us because we weren't following the protocol" (N3).

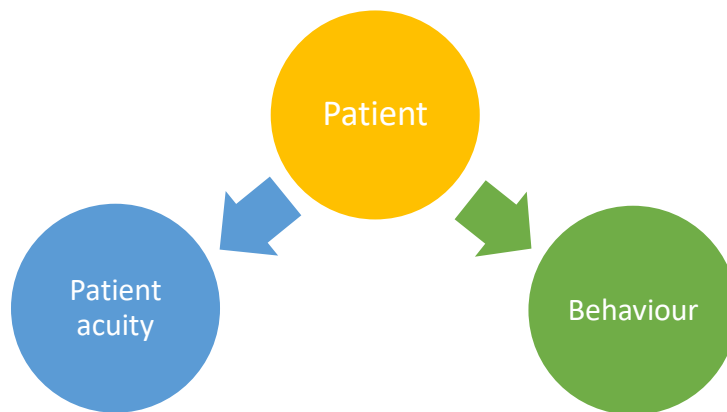
These issues relating to time management are intertwined with the previous subthemes of support and teamwork, where every staff member has a role in the management of a patient with DKA. When staffing issues arise, there is a snowball effect on other aspects of the patient's care. Therefore, staffing and the subthemes of patient allocation and staff ratios, support, teamwork and time management were all interconnecting factors that influenced nurses' decision making for patients with DKA.

Theme 3: Patient

Every participant who took part in the semi-structured interviews, referred to the patient as a significant factor that influenced decision making. Nurses prioritise the patient to ensure they are safe and receiving high quality care. "The patient should always come first" (N3). "When it comes to policy, decision making, you know, my top priority is patient safety above all" (N1). "The patient is looked after the way they should be looked after" (N7). This

demonstrates the values of the nurses who care for patients with DKA. These nurses are influenced by how the patient presents clinically and behaviourally. An examination of the theme of the patient, identified two relating subthemes, as demonstrated in the Figure 19.

Figure 19
Theme 3: Patient and Subthemes



Theme 3: Subtheme 1 Patient acuity

The first subtheme relating to the patient that influenced nurses’ decision making, was the patient’s acuity. Participants seem to claim that as patient acuity tended to vary, they required flexibility in their decision making to adapt to each patient individually. Nurses used a combination of objective and subjective information in order to assess the patient’s acuity.

Well, the patient themselves. It will depend on... how do they present. And your first indication would be on their adult deterioration detection score... most of my clinical decision making will be made around the patient... their past medical history, their presentation, how many times that they presented... social circumstances... so it’s multifactorial (N3).

“So how is the patient presenting, and how their blood results, their ABG, their pH on the ABG, their blood sugar level... and ketone level at the minute, they all influence my decision

making about the patient” (N7). These claims imply that decision making according to the patient’s acuity was neither positive or negative, it was simply different. Decision making based on unique individual circumstances does enable nurses to provide holistic patient care.

The patient’s medical, social and psychological history, as well as their haemodynamics, are used to determine acuity, this can also be used to make decisions around appropriate bed allocation. “I know sometimes they’ll often be a fine line as well between the patient being acute enough to really be in a high dependency bed... and they end up on the medical ward” (N3). Therefore, allocating a patient to the right clinical area based on their acuity can cause issues for staff, especially when staffing ratios vary between the areas as per the previous section. Aside from acuity, patients are also allocated beds according to availability, therefore patients are not guaranteed to be admitted to a clinical area based on their acuity alone.

Theme 3: Subtheme 2 Behaviour

Characteristics about the patient with DKA were also assessed in terms of the second subtheme; their behaviour. Patients often displayed different types of behaviours when clinically unwell with DKA. This impacted the participants in terms of their decision making and management options for the patient. “I know they’re acutely unwell, but they can also be quite behaviourally difficult patients to manage as well” (N3).

In terms of the types of behaviour that makes DKA patient difficult to manage, one nurse said “some of them are quite non-compliant, and will demand different things” (N4). Another participant said “they might be emotional” (N7). Some of these behaviours also manifested as cases of recurring DKA. “We’ve got our frequent DKA fliers. And yes, it’s usually for much the same reason, is they’ve had a binge weekend, whether it’s drugs or alcohol, or just there’s poor diabetes control. They’re missing their insulin all the time” (N6).

Therefore, the management of patients with DKA, according to this specific group of nurses, was made somewhat more complicated by their behaviour. Issues of compliance and recurrence will be discussed in the next chapter. Despite the complexity of the numerous issues identified throughout the interviews relating to the management of patients with DKA, the patient remains at the forefront of nurses' mind when they are making decisions. It was therefore important to examine what enables them, as individuals, to care for their patients and adhere to these values.

Theme 4: Confidence

The final theme that influenced nurses' decision making for patients with DKA, was confidence. One participant described how nurses' confidence was influenced by the regularity in which they manage patients with DKA.

So that's the main thing, and just the frequency, when we get the batch, like we get a big run of them, then I find there's much more increased confidence. But when we have like a bit of a drought, we don't have any or they've been infrequent, then that confidence tends to wane a bit (N6).

Therefore, in order to build on their confidence to making decisions, nurses require knowledge and experience of working with patients with DKA.

Nurses' knowledge was also reported as being very important for their confidence in managing patients with DKA. Senior nurses reported "I think the most important thing is... nurses having an understanding of DKA" (N3). "I think if we have a better understanding of the pathophysiology of DKA, and then the rationale for the treatment that we have, you can get your head around what we do" (N5). Another participant who was less experienced, was able to explain what she knew, but also noted limitations in her knowledge.

I'm a level 1.4 and I still don't completely understand DKA. I can tell you that you need a VBG every... two hours, or I can tell you off the protocol what the... blood lab

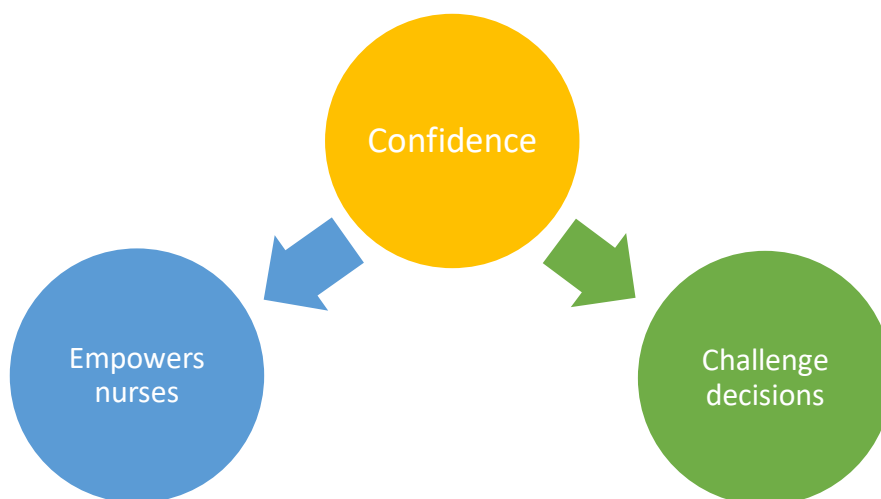
results should be when they exit. But I can't tell you like the pathophysiology of that (N2).

This demonstrates a close link between confidence, knowledge and experience in terms of factors that both help and hinder nurses' abilities to make decisions for patients with DKA.

A possible solution to this discrepancy between confidence, knowledge and experience was also offered. "And if I had, say, a junior nurse looking after that patient, I would need to provide more support to that person than if I had another clinical nurse or another senior registered nurse on the ward, who may require less support to look after that patient" (N3). According to the participants, their confidence to manage patients with DKA is proportional to their level of experience and knowledge base.

In terms of decision making, confidence manifested as two subthemes: empowering nurses and challenging decisions when they are unsure. These subthemes are presented in Figure 20.

Figure 20
Theme 4: Confidence and Subthemes



Theme 4: Subtheme 1 Empowers nurses

The first subtheme around confidence is empowering nurses. Many participants identified that confidence empowered them to make clinical decisions in a timely manner and to engage with the multidisciplinary team. Participant N3 stated “I think it’s really nurses feeling empowered to make the decisions because I believe the protocol itself is really driven by us because we’re the primary person caring for that patient on the floor at any point in time”. Nurses who are empowered are more likely to be proactive in their decisions, especially if they are supported by policy. “Nurses are the ones who do the VBGs hourly and change all the insulin levels and pumps and then fluids, because that chart does give you the freedom to be able to see what needs to happen next” (N5).

Conversely, a lack of confidence causes disempowerment, which could be a result of a lack of knowledge around DKA, or lack of confidence in the multidisciplinary team. Both of these issues may have an impact on nurses’ decision making. One participant discussed how nurses’ confidence relates to that of their medical colleagues when questions were being asked.

If they’ve queried with the medical officer or a doctor, and the doctors not confident with the DKA chart, then that really can sort of drop their (the nurses) confidence in being able to manage a patient. So that’s where I go and intervene and just go through and say ‘this is what you need to do’. And we make sure everything’s put in place (N6).

This suggests that doctors and nurses require similar support systems to empower them and foster their confidence to make decisions in the interest of patient care.

Theme 4: Subtheme 2 Challenge decisions

The second subtheme around confidence was the skill required to challenge decisions in the midst of uncertainty. Several participants discussed their confidence and how this

impacted on their ability to challenge clinical decision making within the multidisciplinary team. Participant N2 reported that “I think a lot of the times we... get a lot of decisions made from doctors, and we have to double check those decisions, because sometimes they don’t align with policy and guidelines” (N2). A senior nurse had a more confident perspective, boldly claiming that “if they are doing something wrong, we’ll tell them and we rectify” (N7). Both alternatives are means of challenging decision-making nurses believe varied from the standard of practice. One nurse claimed that the policy “enables me to make more confident decisions around the treatment of DKA” (N1). Therefore, challenging decision making was also enabled if it was supported by policy.

Summary

This chapter has provided details of the semi-structured interviews that were conducted in the study. The process for data collection met the standards of trustworthiness in qualitative research. The data was analysed using the Braun and Clark (2006) model for thematic analysis, with four themes and 11 subthemes being identified. These themes were described in response to the research question relating to the factors that influence RNs decision making in the context of managing adults with DKA. The final chapter of this thesis will provide a synthesis of both the quantitative and qualitative data, a discussion of the results and recommendations according to the mixed methods design of the study.

Chapter 7

Phase 4: Mixed Methods Analysis, Discussion and Recommendations

Introduction

The final chapter of this thesis will discuss an amalgamation of the quantitative and qualitative data from previous chapters, in accordance with the mixed method study design. The synthesised data will form meta-inferences that will demonstrate how the research questions relating to RNs knowledge and decision-making processes used in the management of adults with DKA were addressed. These meta-inferences will be correlated with existing literature to reveal how the present study contributes to nursing research. The limitations will also be disclosed and a series of recommendations presented as outcomes to the study.

Study aims and research questions

This study utilised a sequential explanatory mixed methods design, where quantitative data was collected first, followed by qualitative data. The purpose of the qualitative data was to explain the results found in the quantitative data. This design was used because it allowed for flexibility in data collection methods that could be tailored to broad and complex research questions (Johnson et al., 2007). Mixed methods research is underpinned by the philosophy of pragmatism, arguably called the third research paradigm. Pragmatism is the middle ground on a continuum with positivism and interpretivism as polar opposites (Hammond, 1996).

The aims of the study were threefold. Firstly, to identify the level of knowledge of RNs who manage patients with DKA. Secondly, to identify the decision-making processes of those nurses. And thirdly, to examine the factors that influences RNs decision making when managing these patients. These aims correspond with the following research questions:

- What level of knowledge do RNs have regarding the management of adults diagnosed with DKA?
- What are the decision-making processes of RNs when managing a patient diagnosed with DKA?
- What are the factors that influence the decision-making processes of RNs with respect to managing adults with DKA?

Nurses' knowledge and the management of diabetic ketoacidosis

As discussed in the literature review, nurses' knowledge in the context of diabetes management has been widely reported in the nursing literature. This study is unique in the sense that no previous study was found to have investigated nurses' knowledge in the context of managing patients with DKA in any depth. Nurses' knowledge of DKA management was examined in relation to the topics of physiology, pathophysiology, pharmacology and psychosocial issues. Some gaps in nurses' knowledge of DKA and assumptions about levels of knowledge were identified and will be discussed in this section in relation to current nursing literature.

Nurses' pathophysiology knowledge

Participants in the study reported that they felt they had a lack of pathophysiological knowledge when managing patients with DKA. However, the survey results suggested that the nurses had a solid grasp of the concepts such as identifying signs, symptoms and risks of complications to a sufficient standard across all levels of knowledge. This discrepancy where nurses appeared to have more knowledge than they thought they did is in contrast to the previous research in the field of nurses' knowledge of DM.

As discussed in the literature review, seminal work by Drass et al. (1989) compared perceptions and actual levels of knowledge about DM. The researchers found that nurses'

perceived levels of knowledge were higher than their actual knowledge. Whilst the contexts of these studies differ, it is interesting that variations in actual and perceived levels of nurses' knowledge still exist. In terms of comparing knowledge of DM as a chronic condition and DKA as an acute complication, the actual and perceived levels of pathophysiological knowledge seem to have reversed. This may demonstrate the evolution of nursing education over time; where nurses are taught and retain more pathophysiological knowledge through formal tertiary education.

Nurses' pharmacology knowledge

As part of the aforementioned tertiary education, nurses are also taught the key aspects of pharmacology, which is an important aspect of the management of patients with DKA. Unfortunately, this was an area of knowledge deficit throughout the survey and was not mentioned by the nurses in the interviews. This omission may imply that nurses either did not consider pharmacology knowledge a significant aspect of their patient's care, or they were unaware of this gap in their knowledge. There are a number of factors documented in the nursing literature that may offer some explanation of nurses' lack of pharmacological knowledge in the context of managing patients with DKA.

One gap in nurses' pharmacological knowledge related to the pharmacokinetics of insulin. Intravenous insulin is used in the acute phase of DKA to stop the release of glucagon, and inhibit glycogen conversion and release from the liver (Gosmanov et al., 2014). The impact on the patient is that their blood glucose levels should decrease, as well as their ketones. Unlike many other indications for intravenous insulin, in the treatment of DKA, insulin is titrated against the patient's blood ketone level, not blood glucose (Dhatariya, 2016). For some nurses, this may be counter-intuitive. However, the purpose of the treatment of DKA is to clear ketones with high dose insulin, while stabilising blood glucose levels with an infusion of glucose (Kinney et al., 2021). This process should prevent

hypoglycaemic events provided nurses understand how to titrate insulin in the context of managing patients with DKA.

The second aspect of pharmacological knowledge deficit related to distinguishing between different types of insulin. In 2020, Lantus was rebranded to Optisulin, but maintained the same chemical formulation (NPS Medicinewise, 2020a). Ryzodeg, a combination of ultra-long and rapid acting insulin (NPS Medicinewise, 2020b), was only added to the Pharmaceutical Benefits Scheme in 2018. Therefore, nurses may have struggled with identifying these different types of insulin due to recent developments that may still be taking time to integrate into everyday practice. Senior nurses are often responsible for spearheading these types of changes in practice due to the assumption that they have more advanced knowledge than their junior colleagues.

Nursing seniority

A theme emerged in the interviews that senior nurses were thought to have more knowledge than junior nurses. However, Fisher's exact test performed on the survey results found that there was no relationship between nurses' job title and their level of knowledge. In the interviews, senior nurses demonstrated their more advanced knowledge through their ability to anticipate the next step in the patient's treatment based on their interpretation of the patient's blood results. This discrepancy between nurses' perceived levels of knowledge according to their seniority has previously been reported in the nursing literature.

A study showed that senior nurses had more confidence to access and utilise evidence-based practice (Gerrish et al., 2008). Meanwhile junior nurses appeared to be met with barriers to obtaining knowledge and instigating change in clinical practice due to lack of confidence, time and resources. This phenomenon was associated with the hierarchal structure of nursing; where senior nurses were perceived to have more 'power' than junior nurses and were able to overcome the aforementioned barriers (Gerrish et al., 2008). This

perceived power may equate to a nurses' level of knowledge, but also may relate to some of the issues associated with the application of knowledge and policy in practice.

Issues relating to application of knowledge

An interesting finding from both data sets was an apparent difference between nurses' knowledge of managing a patient with DKA, and their understanding of applying the policy in clinical practice. The policy is intended to be a resource at the patient's bedside that enables them to apply evidence-based practice. A study from the UK supports this concept by reporting that the purpose of policy, or protocol-based care, was to standardise nurses' decision making in clinical practice based on the latest research evidence (Rycroft-Malone et al., 2008). However, the survey results indicated that there were knowledge deficits in relation to elements that were straight out of the policy. In the interviews, nurses reported that the policy was "complicated" and "confusing", with "a lot of writing" that meant it was difficult to use in practice.

There are a number of studies that report on issues associated with applying DKA protocols in clinical practice. One study reported on the factors that hindered health professionals' (not specifying doctors or nurses) adherence to a DKA protocol. These factors were unclear or incomplete documentation, lack of supporting charts or inadequate staff education (Jervis et al., 2013). While the study does not refer to nurses specifically, it does report that some of the non-adherence to policy related to nursing-specific tasks. For example, the frequency of blood glucose and ketone monitoring on the bedside chart was two-hourly, when the JBDS guidelines (2013) that the policy was based on, recommended hourly (Jervis et al., 2013).

Therefore, issues relating to the application of policy are arguably somewhat circular. If nurses are unable to access or comprehend a policy that may or may not be poorly designed, it arguably serves as a barrier to its' application in practice. Nurses may then be

left to rely on their knowledge, which has been shown to be adequate for many elements of DKA management but may result in variations in practice. This phenomenon appears to accurately summarise the results from the study; where variations in practice occurred as a result of the policy being interpreted in different ways by healthcare professionals. Further issues relating to the application of policy will be discussed in more detail in relation to nurses' decision-making processes used in the management of adults with DKA to help answer the second research question.

Irrespective of the barriers to applying the DKA policy in practice, nurses reported in the study that knowledge of the policy was empowering. The nurses who understood the intricacies of the policy were enabled with the confidence to possibly question deviations from policy. The literature also demonstrates that education on policy can improve its application in practice. A Canadian study showed that in order for policy to be implemented, a comprehensive education plan needed to be conducted to provide doctors and nurses with the knowledge of how the policy works (Mohamed et al., 2018). An interesting finding within the study was that knowledge of policy also enabled nurses to educate patients on their treatment plan, and therefore promote patient engagement with their own health care.

Nurses' decision making associated with the management of patients with diabetic ketoacidosis

In order to address the second research question relating to the decision-making processes for nurses' who manage patients with DKA, the participants were asked to respond to a series of questions structured against the CJM. Each step of this cycle relates to the nursing process, and the results analysed to ascertain the quality of decisions made at each stage of the cycle. The results of the survey suggest that nurses were capable of making decisions whilst managing patients with DKA based on the patient's presentation. However,

in the interviews, nurses felt they were reliant on the policy to reinforce or support their decision making. They utilised all of the stages of the CJM in the context of patients with DKA, however, there were strengths and weaknesses noted at different stages. Each of these stages will be discussed in detail.

Assessment

Nurses reported in both the survey and the interviews, that collecting clinical cues from the patient as part of an assessment was an important part of their decision-making process. They demonstrated that they were able to collect both objective and subjective data that would be used later in their decision-making process. Interestingly, the survey results suggested that nurses prioritised their assessment differently than the research literature suggests.

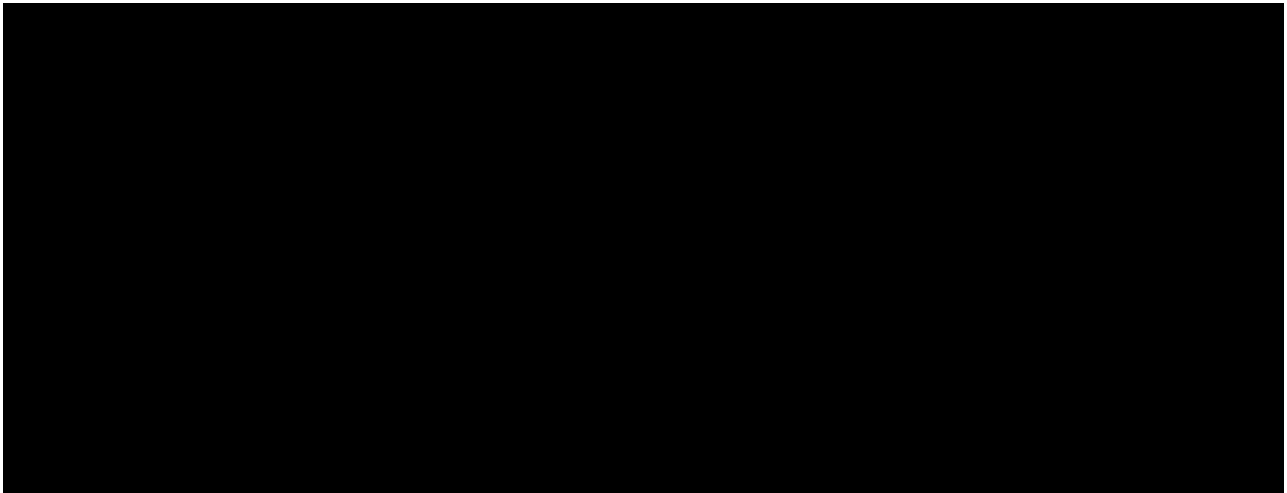
Seminal work that demonstrated a relationship between nurses' prioritisation and decision making concluded that that nurses' confidence to prioritise patient care was the epitome of nursing expertise (Lake et al., 2009). Prioritisation could be defined as the ability to identify options, and choosing the most significant, and potentially opposing, of those options (Lake et al., 2009). The process for nursing prioritisation, much like decision making, is dynamic and non-linear and appears to be patient focused (Lake et al., 2009). Therefore, nurses demonstrating how they prioritise patient care may be an effective way of ascertaining their decision-making ability.

In the context of the study nurses were asked to demonstrate how they prioritise the assessment and management of a patient with DKA. The survey results suggested that nurses were unable to demonstrate adequate decision making with respect to the assessment of patients with DKA. All of the nurses agreed to assess the patient's airway first. There were mixed responses in terms of assessing vital signs, commencing cardiac monitoring and taking blood samples for ketones, glucose and VBGs. Generally, nurses chose to assess the

patient's fluid status and report to the doctor as either last or second last on their list of priorities. In the interest of clarification and in conjunction with evidence-based practice, patients with DKA should be assessed as per Figure 21.

Figure 21

Prioritisation of assessment of patient with DKA (Kempegowda et al., 2017)



There were variations in the assessment prioritisation decisions for this cohort of nurses who manage patients with DKA. In a medical emergency, there is a strict process to follow to ensure timely and accurate lifesaving interventions are implemented. Diabetic ketoacidosis is a metabolic emergency and there are numerous elements that need to be considered.

The A to E approach is used broadly in nursing contexts as an orderly way to approach patient assessment (Cathala & Moorley, 2020). This model is a systematic approach that has been shown to detect and prevent clinical deterioration (Cathala & Moorley, 2020). It also demonstrates how nurses prioritise potentially life-threatening issues first, and then work their way through to less critical or time sensitive issues. This process is to ensure that the patient remains safe, particularly when there are multiple issues that nurses need to address in a short period of time. It may be the case that provided all of those elements in the patient's assessment are examined and acted upon, the exact order may not necessarily matter in every case. Therefore, these nurses may not have made inadequate

assessment decisions, they may just have different critical thinking strategies so they prioritise their assessment in a slightly different way.

Interpretation

The nurses in the study were able to use critical thinking to solve problems associated with applying the policy to manage patients with DKA safely. For example, when aspects of patient care were omitted from policy, nurses were able to analyse the situation and make decisions that were in the best interest of the patient. When medical decisions appeared to deviate from policy, nurses had to think critically and adapt their care according to those changes. Some nurses reported that deviations from policy made decision making more difficult. This issue will be discussed in more detail in the following section. Regardless of policy issues, nurses were able to maintain the safety of the patient by able to analyse the patient's situation and plan interventions.

Interventions

Interventions are a significant part of nurses' role in the management of patients with DKA. Again, nurses used their critical thinking ability to demonstrate what they knew about DKA management. Critical thinking was demonstrated in the survey by asking nurses troubleshoot complications associated with the treatment of DKA. These complications were inspired by the literature, which reports on worsening ketonaemia, hypoglycaemia and oliguria as a result of the treatment of DKA (Muneer & Akbar, 2020). Nurses are reported in the literature as often being the first to notice when complications arise with a patient, therefore their ability to think critically and respond appropriately is important for patient safety (Jacob et al., 2017). In the study, nurses were generally able to detect these complications and intervene to prevent clinical deterioration.

Furthermore, nurses critical thinking was examined by their ability to justify their interventions. They were asked to match their interventions from a pre-determined list of

rationales, as adapted from a nursing textbook (Levett-Jones, 2018). However, in some respects, their interventions were constrained by following policy. Nurses felt that even if they knew what the intervention for a patient should be, their decision could be overridden by medical decisions. In this situation, nurses felt that they could not contradict the plan of senior medical staff and subsequently their autonomy was compromised. Some of these decisions may have been outside the scope of practice for a nurse, especially with respect to prescribing insulin and fluids. However, nurses can autonomously identify when those prescriptions deviate from policy, but this knowledge may not necessarily enable them to question the decisions of senior medical staff. These issues also relate to factors that influence decision making that will be discussed in the following section.

Reflection

The final phase of both the nursing process and CJM require nurses to reflect in and on their practice. Nurses reported in both sets of data that they wanted more support and education to manage patients with DKA because it made them more confident in their decision making. As discussed in the previous section, nurses felt that their colleagues in more senior roles had more knowledge and would therefore be able to provide additional support to their colleagues. However, on reflection, nurses also suggested that additional staff and further education would enable their decision making for patients with DKA.

Based on the responses of the nurses in the interviews, they said that they would prefer different nurse/ patient ratios in the clinical areas that manage patients with DKA. The nurses suggested that in the first few hours of the patient's hospital stay, patients with DKA can be labour intensive. They required close monitoring, multiple interventions and, at times, behaviour management strategies that are time consuming for nurses who are trying to manage other patients concurrently. This is an ongoing nursing issue and the subject of debate in the field of industrial relations. The nurses' union in Victoria managed to negotiate

prescribed nurse/ patient ratios as part of their industrial award agreement in 2000 (Gerdtz & Nelson, 2007). The debate continues in WA, with the state branch of the Australian Nursing Federation yet to secure nurse/ patient ratios despite the precedent interstate.

The nurses in the study supported this campaign. They suggested that in light of the acuity and complexity of the patient's presentation and treatment of DKA, they required at least 1:4, sometimes 1:2 or even 1:1, nursing care. These ratios were to ensure that patients with DKA were monitored closely, due to the high risk of acute deterioration, and treatment was administered in a timely fashion. The decision regarding which ratio would be appropriate for DKA patients may be based on their acuity, as is the current staffing ratios in critical care areas, or based on precedent from interstate. Alternative nurse/ patient ratios would also result in more nurses on the floor to provide the level of support that the nurses reported would assist them in managing patients with DKA.

The site where the study was conducted already had a team of nurses whose role was to provide support and education to nurses who work with patients with DM. These nurses had additional education that made them a valuable resource to nurses on the floor and their patients, as reported in the interview data. The importance of these expert nurses has also been reported in the research literature.

A study shows that nurses are expected to provide high levels of education to patients on the management of their diabetes. However, nurses are not necessarily equipped with the knowledge and confidence to educate their patient (Corl et al., 2014). The study proposed that a designated nurse with additional expertise on diabetes management, was shown to increase the knowledge and confidence of their colleagues by acting as a readily available resource to help them manage their patient (Corl et al., 2014). Therefore, one of the recommendations of this study will be in relation to targeted education to meet the actual and

perceived knowledge gaps, which may in turn, boost nurses' confidence in their decision making.

Factors influencing nurses' decision making

Nurses in the study reported multiple factors that influenced their decision making in the context of managing adults with DKA. Again, a recurring theme was differences in the opinions of junior and senior nurses in relation to these factors. Junior nurses appeared to lack confidence in their decision making and therefore required strategies that validated those decisions. Those strategies ranged from more knowledge of DKA, a better understanding of the policy and more support from their senior colleagues. Senior nurses pointed out the many perceived flaws in the policy, and therefore had ideas to redesign the document to make it more user friendly. Regardless of the seniority of the nurses, the factors that influence their decision making were knowledge, experience, the policy as both an enabler and a barrier and compliance of the patients under their care. Each of these factors will be discussed in detail.

Knowledge

As discussed earlier, knowledge was an important influencing factor in nurses' decision making when managing patients with DKA. A lack of knowledge of DKA served as a barrier because nurses were less confident in their decision making. The nurses claimed that increased knowledge through education made them more confident. Studies have demonstrated that nurses' confidence in their knowledge of diabetes increases after receiving education. A recent interventional study provided nurses with a structured approach to educating patients on the management of NIDDM in the form of an online module and 1-hour tutorial (Coonfare & Miller, 2020). The confidence of the nurses to provide this education to the patient was tested 30 days before and 30 days after the intervention. The results indicated a statistically significant increase in nurses' confidence. There was also a

close link between knowledge and experience throughout the study as deliberated in the following section.

Experience

Confidence was a theme closely associated with knowledge and experience in the interviews. The pattern seemed to be that senior nurses were more experienced and consequently more confident to use their knowledge of DKA in clinical practice. Interestingly, the same study that found nurses' knowledge increases after receiving education, also found that there was no relationship between years of nursing experience and the increase in nurses' confidence (Coonfare & Miller, 2020). While this study does not refer to patient education in the specific context of DKA, it does appear to contradict the claim that more experienced nurses have more confidence.

Furthermore, another study found that nurses prefer to communicate with their colleagues or draw on previous experience to guide their decision making, rather than consult a protocol (Rycroft-Malone et al., 2008). This appears to be more representative of the study results as nurses reported that they valued knowledge of DKA and their prior experience, over the use of the policy. The reason for this preference may be related to the themes of the policy serving as both an enabler and barrier to nurses' decision making.

Policy as enabler

The nurses in the study had conflicting opinions on the policy they use to manage patients with DKA. Some felt that once they understood how it worked, it was good because it meant they did not have to manage the patient unaided. They said that the present policy was better than a previously used policy because it minimised complications of fluid overload and hypoglycaemia. The current policy as an enabler of decision making was dependent on nurses' understanding of the policy and their experience of using it. The nurses said that the more they worked with patients with DKA, the easier the policy was to use in practice.

Some nurses acknowledged that the policy served as more of a guide than a prescriptive tool for the management of patients with DKA. The research has suggested that protocols in clinical practice were used ‘flexibly’ and on an individual basis according to the complexity of the patient. The nurses acknowledged that the policy was often modified in practice based on the patient’s presentation, but they relied on it being followed to validate their decision making. Whilst policy was considered a safeguard to protect health professionals by having a theoretical basis on which to base their decisions, there was a key flaw. If the policy was not applied in practice, then that insurance of that safeguard is not guaranteed. Therefore, the policy for the management of adults with DKA served as an enabler of decision making by guiding and safeguarding the nurses, but also hindered decision making at the same time.

Policy as barrier

The policy used at the hospital site for the management of patients with DKA was found to both help and hinder nurses decision making. Nurses reported that deviations from policy, for reasons that were frequently unclear, accounted for some of their confusion. In the context of managing patients with DKA, there are a number of studies that support this claim. Singh et al. (1997) reported that the DKA guidelines were only followed in 24% of the cases they studied. Ilag et al. (2003) reported multiple delays in patient treatment despite their critical pathway. Only 22% of patients were started on the right dose of intravenous insulin and had a statistically significant improvement in the volume of fluid replaced, but only in the first eight hours of treatment not the full duration of the patient’s care. A more recent study showed that clinical application of a DKA protocol is accurate in the early management stages, but there were ongoing issues with monitoring, fluid management and a high incidence is iatrogenic hypoglycaemia (Crasto et al., 2015).

They said it was a common occurrence, and often a medical decision, to refocus the treatment of the patient with DKA away from the evidence-based protocol. A study by Devalia (2010) reported on several possible reasons for variations in the clinical application of a DKA protocol. The researchers found that the document was in the patients notes, but not used as a guide to ensure investigations had been carried out. It was reported that the protocol encouraged medical practitioners to use their clinical judgment at all times, yet there was no clear documentation as to why they made variations in the patients' treatment. Another rationale was the possibility of an incomplete handover between healthcare professionals. And there was no clear documentation as to when or why patients were referred to critical care (Devalia, 2010).

The RNs in the study felt that this put the patient at risk of relapsing back into DKA or clinical deterioration. In the event of deviation from policy in the management of patients with DKA, nurses opted to work together to decipher ambiguous plans and make decisions in the interest of the best possible outcome for the patient. It was implied that the RNs did not seek clarification of these plans due to the medical hierarchy and their corresponding experience that nurses felt they could not contradict.

Ambiguity in the application of policy in practice may also be associated with contradictions with other policies. For example, the recommendation for potassium replacement in the DKA protocol at the hospital site was different than the approved dosage outlined in the potassium administration policy. Several studies made reference to contradicting organisational policies, but none provided specific details. A Danish study examined DKA protocols that were used throughout the country. The study identified 24 different insulin regimens and 21 unique fluid replacement protocols. Not surprisingly, the researchers called for national guidelines for the management of DKA (Henriksen et al., 2006). With this array of variation in policy documents in one country, it would not be

unimaginable for there to be contradictions and confusion amongst healthcare professionals. In the context of the present study, nurses were required to use their own interpretation of the policies and make decisions based on other factors, when the policy served as a barrier, rather than enabler, of decision making.

Patient behaviours

Nurses reported that, at times, their decision making was both helped and hindered by patients themselves. Some patients who presented with DKA were considered relatively straight forward: normally young, fit and well, with either an incidental or accidental diagnosis of DKA. Others however, were more challenging due to their medical history, as well as their behaviour. Nurses recalled instances of the same patients presenting with DKA on multiple occasions, often for similar reasons. The issue of recurring DKA is reported in the nursing literature and often associated with insulin non-compliance.

Nurses reported that patient's compliance and understanding of the treatment of DKA influenced their decision making. In the survey, nurses were divided on whether they thought patients understood their treatment plan for DKA. An analysis of the interview data showed that nurses' thought patients were sometimes difficult to manage because they were "non-compliant" or "made demands" about their treatment. The nurses affiliated this behaviour with potentially underlying psychosocial issues, and felt that this consequently led to cases of recurrent DKA. An American study showed that 50% of first presentations with DKA, and approximately 80% of cases of recurrent DKA were related to patient non-compliance with their treatment regime (Randall et al., 2011). Nurses' awareness of the patient's behaviour influencing the management, and subsequent decision making for their DKA, demonstrates their holistic approach to meeting their patient's care needs. However, the issue of recurring DKA raises more questions about strategies that nurses' may be able to implement in the future to break this cycle and minimise patient presentations.

Conclusion of discussion

This chapter provided a discussion of the findings in the study relating to nurses' knowledge and decision-making processes used in the management of adults with DKA. The study answered the guiding research questions. It was the first of its kind to examine knowledge and decision making in this specific context. The results indicated that nurses generally had acceptable levels of knowledge with some gaps that were often associated with information directly out of the hospital policy. They utilised all the stages of the CJM whilst managing patients with DKA and on reflection, made some suggestions for strategies that would influence their decision making. These factors included further education to increase their confidence and a redesign of the policy to make it more user friendly. These strategies form the basis for the recommendations for this study.

Recommendations

The findings of the study indicate that nurses have a range of knowledge and decision-making capabilities in the context of managing patients with DKA. The factors that influence this decision making are also multifactorial in the context of the organisation, the clientele and characteristics of the nurses' themselves. The recommendations for this study are based on the findings to enable nurses to provide high quality care to patients with DKA.

The recommendations of this study include:

- A review of the DKA policy at the hospital site, with input from nurses, to clarify practice points and align the protocol with existing hospital policies.
- The development of a flowchart and a mnemonic as a quick reference guide for the multidisciplinary team to prioritise and plan the care of patients with DKA that can be used at the patient's bedside.

- The integration of pathophysiology, pharmacology, socioeconomic factors and psychological factors into education provided at the hospital site on DKA presentations.

Limitations

There were multiple limitations in this study that need to be taken into consideration. Firstly, the study was conducted at one hospital site. Results may have been different if the study was conducted at a larger or multiple acute care settings.

Secondly, the response rate from the survey was low and did not achieve statistical significance. However, if the survey, which was tested and validated, were to be used again, an alternative method for distributing the survey to the participants could be recommended. The response may have been higher if the survey was sent as multiple small parts, rather than one large document.

Thirdly, as referred to in chapter 6, different types of sampling were used for the quantitative and qualitative data collection due to a significant time lapse. Therefore, different participants in both data sets may have influenced the results as this is not strictly consistent with a sequential mixed methods design.

Finally, the COVID-19 pandemic put significant strain on the practical and human resources in the WA health system. Restrictions and upskilling were the priorities of both the participants and the researcher. Consequently, the high demand and acuity of patients were prioritised over engagement with research opportunities during this time.

Summary

This study has demonstrated the use of a mixed methods design to examine the concepts of knowledge and decision-making processes used in the management of adults with

DKA. It has contributed to nursing research by being the first of its kind to investigate these concepts in detail and in relation to a specific clinical context. The complexity of the research questions meant that a pragmatic approach using mixed methods was the most appropriate study design.

In order to answer the research questions, a new survey was developed, tested and administered to a population of nurses who work directly with patients with DKA. The purpose of the survey was to investigate the levels of knowledge and decision-making processes the nurses used whilst managing patients with DKA. Whilst this survey achieved reasonable levels of validity and reliability, its administration strategy would need to be reviewed if it was used in the future in order to optimise the response rate. Following the survey, a series of interviews were conducted to examine the factors that influence decision making. Both data sets were then synthesised and the findings presented in this discussion.

This study has shown that nurses generally have acceptable levels of knowledge and are capable of making decisions for the care of patients with DKA. However, their decision making is both helped and hindered by hospital policy, patients themselves and their perceived level of knowledge. As part of the decision-making process, nurses reflected on the processes and care of their patients and felt there were strategies that they required that enable them to provide better care for their patients.

These strategies, as outlined in the recommendations, include further education and a redesign of the protocol to make it more user friendly. The study was also significantly impacted by the COVID-19 pandemic, amid other limitations including time lapse between data sets and the small scale of the study. Nevertheless, this study has provided valuable insights into the knowledge and decision-making processes used by RNs in the management of patients with DKA.

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Appendix A

Recruitment Emails

From: Megan Westphalen

Sent: 22/02/2021

To: AHS MAU Nursing, AHS ICU Nursing, AHS ED Nursing

Subject: Registered nurses and the management of adults with DKA

Dear Colleague,

You are invited to participate in a study that I am conducting for my Master of Philosophy through the University of Notre Dame, Australia. I am investigating what registered nurses know about managing patients with diabetic ketoacidosis (DKA), what decisions they make and the factors that influence decision making. Your participation would be greatly appreciated and may contribute to nursing research by helping to clarify the nurses' contribution to the management of patients with DKA.

To participate in this study, I am asking registered nurses to complete an online survey. The survey has a number of statements and multiple-choice questions related to a case study of a patient with DKA. You will be asked to decide which is the most appropriate answer for the multiple-choice questions and your level of agreement or disagreement with the presented statements. Please choose the response that best reflects your thoughts or actions.

The survey should take 20-30 minutes to complete. Once your responses are saved and submitted, they are de-identified and cannot be withdrawn. However, if you have opened the survey and decide not to participate, simply close the survey window without saving the responses and all information will be deleted.

At the end of the survey, you will be invited to participate in a follow up interview with me to discuss the findings of the survey and to explore the factors that you believe influence your decision making.

The survey will be available for 4 weeks from 22nd February 2021. If you would like to be involved in this study, please read the attached participant information sheet and then provide consent by clicking on the link below to complete the survey.



If you have any questions regarding the study, my contact details are below. The University of Notre Dame is responsible for this study.

Thank you for your participation.

Regards,

Megan Westphalen RN

MPhil Student

School of Nursing & Midwifery

University of Notre Dame Australia

Email: megan.westphalen@my.nd.edu.au

Supervisors: Dr Steven Hardman and Dr Robin Fowler

From: Megan Westphalen

Sent: 01/03/2021

To: AHS MAU Nursing, AHS ICU Nursing, AHS ED Nursing

Subject: Registered nurses and the management of adults with DKA

Dear Colleague,

I'd like to take this opportunity to thank everyone who has participated in this study so far. I hope you found the survey helpful as a way of reflecting on your practice when managing patients with DKA.

For those of you who have not completed the survey yet, don't worry, the link is still available. I just wanted to send you a friendly reminder that I am conducting this study for my Master of Philosophy through the University of Notre Dame, Australia. I am investigating what registered nurses know about managing patients with diabetic ketoacidosis (DKA), what decisions they make and the factors that influence decision making. Your participation would be greatly appreciated and may contribute to nursing research by helping to clarify the nurses' contribution to the management of patients with DKA.

As per my previous email, I am asking registered nurses to complete an online survey. The survey has a number of statements and multiple-choice questions related to a case study of a patient with DKA. You will be asked to decide which is the most appropriate answer for the multiple-choice questions and your level of agreement or disagreement with the presented statements. Please choose the response that best reflects your thoughts or actions.

The survey should take 20-30 minutes to complete. Once your responses are saved and submitted, they are de-identified and cannot be withdrawn. However, if you have opened the survey and decide not to participate, simply close the survey window without saving the responses and all information will be deleted.

At the end of the survey, you will be invited to participate in a follow up interview with me to discuss the findings of the survey and to explore the factors that you believe influence your decision making.

The survey will be available for 4 weeks from 22nd February 2021 so there is still time to participate. If you would like to be involved in this study, please read the attached participant information sheet and then provide consent by clicking on the link below to complete the survey.



If you have any questions regarding the study, my contact details are below. The University of Notre Dame is responsible for this study.

Thank you for your participation.

Regards,

Megan Westphalen RN

MPhil Student

School of Nursing & Midwifery

University of Notre Dame Australia

Email: megan.westphalen@my.nd.edu.au

Supervisor: Dr Steven Hardman

From: Megan Westphalen

Sent: 18/03/2021

To: AHS MAU Nursing, AHS ICU Nursing, AHS ED Nursing

Subject: Registered nurses and the management of adults with DKA

Dear Colleague,

Thank you to everyone who has participated in this study! I really appreciate your engagement with this research and hope that you can see the relevance for your clinical practice.

Time is running out for those of you who haven't yet completed the survey.

Remember that research into nurses' knowledge and decision-making processes with respect to managing patients with DKA has never been done before. By completing this survey, you are helping to fill this gap in the nursing research literature and helping to clarify the nurses' contribution to the management of patients with DKA.

This is your last chance to complete the survey. Remember, the survey has a number of statements and multiple-choice questions related to a case study of a patient with DKA. You will be asked to decide which is the most appropriate answer for the multiple-choice questions and your level of agreement or disagreement with the presented statements. Please choose the response that best reflects your thoughts or actions.

It should only take 20-30 minutes to complete. Once your responses are saved and submitted, they are de-identified and cannot be withdrawn. However, if you have opened the survey and decide not to participate, simply close the survey window without saving the responses and all information will be deleted.

At the end of the survey, you will be invited to participate in a follow up interview with me to discuss the findings of the survey and to explore the factors that you believe influence your decision making.

The survey will be closed from 28th March 2021 so please submit it prior to this date. If you would like to be involved in this study, please read the attached participant information sheet and then provide consent by clicking on the link below to complete the survey.



If you have any questions regarding the study, my contact details are below. The University of Notre Dame is responsible for this study.

Thank you for your participation.

Regards,

Megan Westphalen RN

MPhil Student

School of Nursing & Midwifery

University of Notre Dame Australia

Email: megan.westphalen@my.nd.edu.au

Supervisor: Dr Steven Hardman

Appendix B

Participant Information Sheets

PARTICIPANT INFORMATION SHEET (SURVEY)

An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis

You are invited to participate in the research project described below. The University of Notre Dame, Australia is responsible for this study.

What is the project about?

The research project will investigate registered nurses' level of knowledge and explore their decision-making processes related to the management of patients diagnosed with diabetic ketoacidosis.

Who is undertaking the project?

This project is being conducted by Megan Westphalen and will form the basis for the degree of Master of Philosophy at The University of Notre Dame Australia, under the supervision of Dr Steven Hardman and Dr Robin Fowler.

What will I be asked to do?

You are invited to complete an online survey, which has a series of multiple-choice questions based on a case study. These questions will ask you to demonstrate what you know about diabetic ketoacidosis and what decisions you make when managing these patients. It should take you about 30 minutes to complete and you will be completely anonymous.

At the end of the survey, you will be invited to participate in a follow-up interview focusing on the factors that influence your decision making when managing adults with diabetic ketoacidosis. This is *optional* so you can choose to complete the survey without participating in an interview. However, if you would like to be involved in an interview, another link will

be provided with further information and a request for contact details. Once the interview has been conducted, the link and contact details will be destroyed.

Are there any risks associated with participating in this project?

It is not anticipated that there will be any risks to participants in this study. However, if you find that the questions asked in this survey raise distressing topics, you may seek support from the Employee Assistance Program at Converge International on 1300 687 327.

What are the benefits of the research project?

One of the benefits of participating in this project is to contribute to the nursing research community by filling a gap in the literature. This study may help to target appropriate education and training for registered nurses and identify areas for further research. The results of this study may also be used in policy development to promote more consistent and evidence-based nursing care of these patients.

What if I change my mind?

Participation in this study is completely voluntary, you are free to withdraw by simply closing the survey window. However, once you complete the survey and submit it back to us, you won't be able to withdraw it because we will have no way of knowing which one is yours.

Will anyone else know the results of the project?

Completed surveys will be anonymised and stored securely on the WA Health server and only the researchers will have access to this information during the project. Once the study is completed, the survey information will be stored securely in the School of Nursing and Midwifery at The University of Notre Dame Australia for at least a period of seven years. The results of the research project will be published as a thesis.

Will I be able to find out the results of the project?

Once the data has been analysed from this study, we will email a link to the published thesis to all of the invited participants. You can expect to receive this feedback in approximately twelve months.

Who do I contact if I have questions about the project?

If you have any questions about this project, please feel free to contact Megan Westphalen at megan.westphalen@my.nd.edu.au. Alternatively, you can contact Dr Steven Hardman at steven.hardman@nd.edu.au. We are happy to discuss with you any concerns you may have about this study.

What if I have a concern or complaint?

The study has been approved by the Human Research Ethics Committee (HREC) at The University of Notre Dame Australia (approval number 2020-082F). If you have a concern or complaint regarding the ethical conduct of this research project and would like to speak to an independent person, please contact Notre Dame's Research Ethics Officer at (+61 8) 9433 0943 or research@nd.edu.au. Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

This project has also been granted ethical approval by the Royal Perth Hospital (RPH) HREC. If you have any concerns about the conduct of the project or your rights as a research participant, please contact the East Metropolitan Health Service (EMHS) Research Ethics and Governance Unit on (08) 9224 2292 or EMHS.REG@health.wa.gov.au and quote the ethics approval number RGS0000004076

How do I sign up to participate?

If you are happy to participate, please click on the link in the email to complete the survey.

Thank you for your time.

Yours sincerely,

Megan Westphalen RN

MPhil Student

University of Notre Dame, Australia.

PARTICIPANT INFORMATION SHEET (INTERVIEWS)

An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis

You are invited to participate in the research project described below. The University of Notre Dame, Australia is responsible for this study.

What is the project about?

The research project will investigate registered nurses' level of knowledge and explore their decision-making processes related to the management of adults diagnosed with diabetic ketoacidosis.

Who is undertaking the project?

This project is being conducted by Megan Westphalen and will form the basis for the degree of Master of Philosophy at The University of Notre Dame Australia, under the supervision of Dr Steven Hardman and Dr Benjamin Hay.

What will I be asked to do?

Thank you for completing the online survey. You are now invited to participate in a follow up interview focusing on your views of nurses' knowledge and decision making when managing adults with diabetic ketoacidosis. The interview will take about 30 minutes and will be audio-recorded using two Dictaphones (one to back up the other). The interview will take place at a mutually convenient private location (via Microsoft Teams to comply with social distancing if required). You will be asked to check a transcript of the interview for accuracy prior to analysis that will be conducted by the researcher. This transcript should be available within a month of the interview and should take less than one hour to review.

Are there any risks associated with participating in this project?

It is not anticipated that there will be any risks to participants in this study. However, if you find that the questions asked in this survey raise distressing topics, you may seek support from the Employee Assistance Program at Converge International on 1300 687 327.

What are the benefits of the research project?

One of the benefits of participating in this project is to contribute to the nursing research community by filling a gap in the literature. This study may help to target appropriate education and training for registered nurses and identify areas for further research. The results of this study may also be used in policy development to promote more consistent and evidence-based nursing care of these patients.

What if I change my mind?

Participation is completely voluntary. Even if you agree to participate in the interview, you are free to withdraw from further participation at any time without giving a reason and with no negative consequences. You are also free to ask for any information which identifies you to be withdrawn from the study. If you choose to withdraw from the study, a form will be provided to declare your withdrawal, signed by yourself and the researcher.

Will anyone else know the results of the project?

Information gathered about you will be held in strict confidence. This confidence will only be broken if required by law. Confidentiality will be maintained by de-identifying the recording and transcript through coding only known to the researcher and their supervisors. The audio-recording from the interview will be transcribed and stored on the WA Health server and the audio-recordings will be deleted from the recording devices. Only the researchers will have access to this information during the project. Once the study is completed, the coded data will be stored securely in the School of Nursing and Midwifery at

The University of Notre Dame Australia for at least a period of seven years. The results of the research project will be published as a thesis.

Will I be able to find out the results of the project?

Once the data has been analysed from this study, we will email a link to the published thesis to all invited participants. You can expect to receive this feedback in around twelve months.

Who do I contact if I have questions about the project?

If you have any questions about this project, please feel free to contact Megan Westphalen at megan.westphalen@my.nd.edu.au. Alternatively, you can contact Dr Steven Hardman at steven.hardman@nd.edu.au. We are happy to discuss with you any concerns you may have about this study.

What if I have a concern or complaint?

The study has been approved by the Human Research Ethics Committee (HREC) at The University of Notre Dame Australia (approval number 2020-082F). If you have a concern or complaint regarding the ethical conduct of this research project and would like to speak to an independent person, please contact Notre Dame's Research Ethics Officer at (+61 8) 9433 0943 or research@nd.edu.au. Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

This project has also been granted ethical approval by the Royal Perth Hospital (RPH) HREC. If you have any concerns about the conduct of the project or your rights as a research participant, please contact the East Metropolitan Health Service (EMHS) Research Ethics and Governance Unit on (08) 9224 2292 or EMHS.REG@health.wa.gov.au and quote the ethics approval number RGS0000004076.

How do I sign up to participate?

If you are happy to participate in this interview, please sign both copies of the consent form.

Retain one copy for yourself and please provide one copy either to myself in person or via email (megan.westphalen@my.nd.edu.au).

Thank you for your time. This sheet is for you to keep.

Yours sincerely,

Megan Westphalen RN

MPhil Student

University of Notre Dame, Australia

Appendix C

Final Online Survey



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Phase 2: Administration of the survey and statistical analysis

Thank you for your interest in this research study. Please refer to the email for and attached participant information sheet for full details of this study.

This survey has a number of statements and multiple-choice questions related to a case study. You will be asked to decide which is the most appropriate answer for the multiple-choice questions and your level of agreement or disagreement with the statements. Please choose the response that best reflects your thoughts or actions. The survey should take approximately 30-40 minutes to complete.

If you have any questions regarding the study, my contact details are below. Thank you for your participation.

Regards,

Megan Westphalen RN

MPhil Student

School of Nursing & Midwifery

The University of Notre Dame Australia

megan.westphalen@my.nd.edu.au

* 1. Would you like to continue with this survey?

Yes

No



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 1: Demographics

Please answer the following questions regarding your nursing training and clinical experience.

* 2. What is your current job title?

- Enrolled nurse
- Graduate registered nurse
- Registered nurse
- Clinical nurse/ staff development nurse
- Other

* 3. What is your gender?

- Male
- Female
- Other
- Prefer not to say

* 4. In which clinical area do you predominantly work?

- Medical Admissions Unit
- Intensive Care Unit
- Emergency Department

* 5. How long have you worked in this area?

6. What is your highest level of education?

- Bachelor's Degree
- Postgraduate Certificate/ Diploma
- Master's Degree
- Doctorate

7. What area or specialty did you complete your highest qualification? Please specify

* 8. How many years in total have you worked as a registered nurse?

* 9. At which institution did you complete your undergraduate degree (or equivalent)? Please specify

* 10. What type of employment contract do you currently have?

- Permanent full/ part time
- Fixed term full/ part time
- Secondment
- Casual



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 2: Background

Please answer yes or no to the following statements on your background knowledge of caring for patients with DKA.

- * 11. I have attended education related to the management of adults with DKA within the last 12 months.

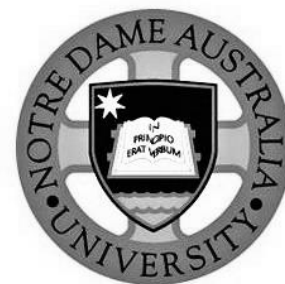
Yes

No

- * 12. I have seen a patient with DKA in my clinical area.

Yes

No



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 3: Noticing

Cameron is a 25-year-old man with Type I diabetes, diagnosed when he was 10. He is normally fit and well, doesn't smoke, drinks alcohol on social occasions and doesn't use illicit drugs. Up until recently, he worked as a carpenter. He attends his diabetes clinic appointments regularly and has never been hospitalised for diabetes.

Cameron made an appointment with his GP because he was feeling generally unwell with nausea and vomiting. He tested his BGL at home, and his machine said "HI", so he went to the GP to have his sugar checked. He told the GP that he hadn't taken his insulin for a couple of days, but didn't say why. The GP suspected he had diabetic ketoacidosis (DKA) so he wrote a letter referring Cameron to the hospital. Cameron shows the letter to the nurse when he arrives at the hospital.

* 13. From the list of definitions below, select the one that best matches your understanding of diabetic ketoacidosis. New or known diabetes and:

- presence of ketones and metabolic acidosis
- absence of ketones and metabolic acidosis
- presence of ketones and metabolic alkalosis
- absence of ketones and metabolic alkalosis

* 14. What is hyperglycaemia? High blood concentration of:

- Glucose
- Iron
- Insulin
- Bicarbonate

* 15. What are ketones?

- Protein for muscle development
- Neurotransmitter for fine motor skills
- Hormone to lower glucose level
- By-product of breaking down fats

* 16. Cameron has a deficiency of which of the following hormones?

- Insulin
- Cortisol
- Glucagon
- Catecholamines

* 17. What is the normal range for blood glucose level?

From

To

* 18. What is the normal range for blood ketone level? Please enter number to 1 decimal place.

From

To

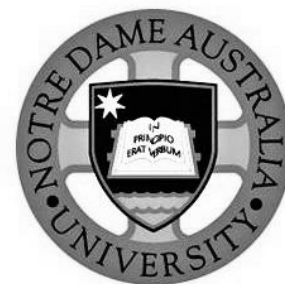
* 19. What values do you expect to see for the following biochemical markers if Cameron has DKA?

Blood glucose >

Blood ketones >

pH <

Bicarbonate <



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 3: Noticing

You have conducted an initial assessment of Cameron. His vital signs and first venous blood gas are as follows:

Respiratory rate	28	pH	7.20
Blood pressure	110/50	pO₂	95
Oxygen saturations	94% on room air	pCO₂	23
Heart rate	120	Bicarbonate	15
Temperature	37.5	Potassium	4.2
Blood ketones	4.4	Glucose	32

- * 20. Cameron is tachycardic and tachypnoeic. Based on your experience of managing adults with DKA, what other signs do you expect to observe during your assessment?

(All that apply)

- Acetone smell
- Hypovolaemia
- Altered conscious level
- Dysrhythmias
- Confusion

* 21. Which of the following symptoms do you expect Cameron to report? (All that apply)

- Vomiting
- Polyuria
- Polydipsia
- Weight loss
- Warm/ dry skin
- Lethargy

* 22. Why does Cameron have ketones in his blood? (All that apply)

- He has been on a high protein, no carbohydrate diet
- He hasn't eaten for several days due to feeling unwell
- He has taken ketone supplements to build muscle
- His body has broken down fats instead of glucose because he lacks insulin

* 23. Why do you think Cameron has a high blood sugar? (All that apply)

- Consumed too many carbohydrates
- Break down of stored glycogen in the liver due to a lack of insulin
- Dehydration from nausea and vomiting
- Didn't use his insulin

* 24. Which of the following factor/s may contribute to Cameron's metabolic acidosis? (All that apply)

- Sepsis
- Dehydration
- He is dying
- Ketonaemia

* 25. Which factor/s increase Cameron's risk of developing DKA? (All that apply)

- Young age
- Type I diabetes
- Obesity
- Low socioeconomic status

* 26. From the list of factors below, which factor may have contributed to Cameron developing DKA? (All that apply)

- Prescription had expired
- His GP had moved away
- Feeling low from the burden of managing his diabetes
- Not understanding the importance of taking his medications regularly
- Losing his job and not being able to afford to buy his insulin and testing supplies

* 27. What are the potentially life threatening complications Cameron is at risk of developing while in DKA? (All that apply)

- Cardiac arrhythmias due to hypo- or hyperkalaemia
- Cerebral oedema due to rapid change in blood osmolarity if BGL falls too rapidly
- Refeeding syndrome from having not appetite for several days
- Pulmonary embolism due to the high viscosity of the blood whilst hyperglycaemic

* 28. Consider the following nursing actions in the table below. Please order them according to how

you would prioritise your **assessment** of Cameron's condition. Number 1 being the top priority, and 6 being the lowest.

- ECG and cardiac monitoring
- Ensure patent airway at all times
- Vital signs including neurological status
- Measuring and regular monitoring of fluid status
- Capillary BGL, ketones and VBG
- Report findings to medical staff to investigate precipitating cause

* 29. What factor/s do you think might have influenced your decisions to prioritise Cameron's **assessment** above? (All that apply)

- Prior experience
- Ward protocol
- Patient presentation
- Knowledge of DKA

* 30. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your **management** of Cameron's condition. Number 1 being the top priority and 7 being lowest priority.

- Administer oxygen if appropriate
- Educate Cameron on the management plan
- Obtain IV access
- Set up insulin infusion as per doctor's plan
- Commence fluid resuscitation as per doctor's plan
- Give 10% glucose when indicated
- Supplement electrolytes as required or prescribed

* 31. What factor/s do you think might have influenced your decisions to prioritise Cameron's **management** above? (All that apply)

- Prior experience
- Ward protocol
- Patient presentation
- Knowledge of DKA



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 4: Interpreting

The doctor has charted a plan consisting of intravenous fluids, insulin and electrolyte replacement. You have found another nurse to check the medication you have prepared. The other nurse asks you the following questions about managing your patient with DKA.

- * 32. How will you assess Cameron's fluid status? (All that apply)
 - Skin turgor and capillary refill time
 - Accurate fluid balance
 - Heart rate and blood pressure
 - Check his renal function

- * 33. What signs will you look for to determine if Cameron is fluid overloaded? (All that apply)
 - Desaturation, tachycardia, tachypnoea
 - Elevated urea and creatinine
 - Pitting oedema, dysuria
 - History of heart and renal failure

- * 34. Why do patients with DKA require fluid replacement? (All that apply)
 - Replace circulating volume
 - Dilute glucose in blood stream
 - To keep IV cannula patent
 - Replace depleted electrolytes

* 35. What are the risks associated with aggressive fluid resuscitation? (All that apply)

- None, these patients always need fluid
- Acute pulmonary oedema
- Acute renal failure
- Cardiac arrhythmias

* 36. What would be the most appropriate type of insulin to administer in the initial management of DKA?

- Long acting
- Short acting
- Rapid acting
- Intermediate acting

* 37. Patients receiving initial treatment for DKA require subcutaneous long-acting (basal) insulin.

- True
- False

* 38. Which of the following is a long-acting (basal) insulin?

- Novorapid
- Optisulin
- Humulog
- Ryzodeg

* 39. How does insulin work to lower blood glucose level? (All that apply)

- Stops the production of ketones
- Stimulates uptake of glucose into cells
- Stops the release of glucagon
- Inhibits glycogen conversion and release from the liver

* 40. What potassium level will you aim for? Please enter a number to 1 decimal place

From

To

* 41. The prescription states that you are required to supplement Cameron's potassium with 20mmol/hr of potassium chloride through a peripheral cannula. What are you going to do? (All that apply)

- Medical review to change the prescription
- Follow the prescription as written
- Request a central line to give higher doses of potassium
- Cardiac monitor the patient while infusion is running

* 42. Do other electrolytes such as magnesium, calcium and phosphate need to be routinely replaced in patients with DKA?

- No, potassium is the only electrolyte that needs replacing
- No, it does not change the outcome for these patients
- Yes, these patients are at risk of refeeding syndrome
- Yes, only if the patient is cardiac monitored



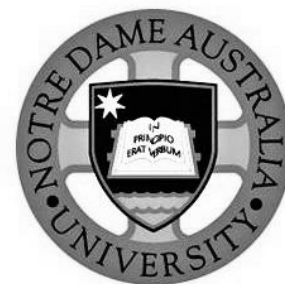
An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 5: Responding

You have started Cameron his treatment as per the plan. You are monitoring him regularly for signs of deterioration. He looks tired but says he "feels fine and just wants to sleep".

43. Match the following nursing interventions with the corresponding rationale.

Intervention	Rationale
Monitor fluid balance	<input type="text"/>
ECG and cardiac monitoring	<input type="text"/>
Hourly capillary BGL and ketones, 2-hourly VBGs	<input type="text"/>
Titrate insulin infusion	<input type="text"/>
Check vital signs and neurological status hourly	<input type="text"/>
Check glycosylated haemoglobin (HbA1c)	<input type="text"/>
Given 10% glucose when indicated	<input type="text"/>



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 5: Responding

You have been busy and haven't managed to check on Cameron for 2 hours. When you go to his room to check his glucose level and ketones, you find that his infusion pumps are alarming.

Cameron says that he fell asleep so he doesn't know how long the pumps were not working. When you assess Cameron again, you identify the following issues.

* 44. Cameron's ketones have increased from 1.6 to 2.5. What do you do? (All that apply)

- Medical review
- Increase insulin infusion rate
- Decrease insulin infusion rate
- Nothing

* 45. Cameron has a BGL of 3.6. What do you do? (All that apply)

- Stop insulin
- Stop everything
- Give 60mL Carbotest
- Increase 10% glucose rate
- Request a medical review

* 46. Cameron has not passed urine for 4 hours despite receiving 3 litres of fluid. What do you do? (All that apply)

- Request a medical review to check his renal function
- Bladder scan and give him an opportunity to pass urine
- Stop the fluid until he voids, in case he becomes overloaded
- Insert an indwelling catheter and check his output hourly
- Request a medical review to check his renal function

* 47. You inform the doctor that Cameron is due for a blood gas. They tell you that it's not urgent, they are late for a meeting and will do it later. What do you do? (All that apply)

- Wait until after the meeting, and remind the doctor again
- Inform the coordinator who follows up with the doctor
- Find a nurse who is competent to take blood to do the test
- Leave all the infusions running and hand over that the blood gas is due

* 48. You reflect on the increase in Cameron's ketone level, his hypoglycaemic event and oliguria. What do you think was the cause for these changes in Cameron's status?

- These are normal fluctuations associated with the treatment for DKA
- These changes were preventable with frequent monitoring
- If the pumps were working properly, these changes would not have occurred
- Overall, Cameron was getting better so these changes don't matter
- Other (please specify)

* 49. Do you think these complications had an impact on Cameron's outcome?

- Yes, they prolonged his treatment and hospital stay
- Yes, there was a risk of haemodynamic deterioration that would have required critical care input
- No, they are normal issues that arise and are easy to fix
- No, Cameron said he felt fine and was able to sleep
- Other (please specify)



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 5: Responding

Cameron is feeling much better, but he has some questions for you. He wants to know when he can eat again and when he can go home.

* 50. How long does it typically take for DKA to fully resolve?

- 6 hours
- 12 hours
- 24 hours
- 48 hours

* 51. How do you respond to Cameron's question about when he can eat and drink?

- "Sorry, you can't eat whilst on treatment for DKA"
- "You can eat whatever you like, but you'll probably just vomit"
- "I'm not sure but I can check with the doctor"
- "Yes, you can eat. I'll just watch your sugars and ketones closely"

* 52. What are the criteria for stopping the DKA treatment?

- pH >7.3, Ketones <0.6 *and* Bicarbonate >18
- pH >7.3, Ketones <0.6 *or* Bicarbonate >18
- Potassium >3.5, BGL <11
- Whenever the doctors decide

* 53. Select the best option to convert Cameron from the IV insulin infusion to his normal subcutaneous insulin regime, assuming he is eating and drinking.

- Stop IV insulin, give subcutaneous injection 30 minutes later with meal
- Give subcutaneous injection with meal and stop IV insulin infusion 30 minutes later
- Follow instructions from the doctor
- Follow instructions from the senior nurse

* 54. How would you transition Cameron from the DKA protocol to an insulin/dextrose infusion if

he wasn't eating and drinking?

- Change 10% to 5% glucose, leave insulin rate the same, monitor BGL hourly
- Change 10% to 5% glucose, halve insulin rate, monitor BGL hourly
- Start 5% glucose at 60-80mL/hr and insulin at half daily dose over 24 hours
- Whatever the doctor prescribes



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 5: Responding

Cameron is eating and drinking and has had his normal Novorapid with his breakfast. He still wants to go home but you want to make sure he understands what has happened so that he doesn't come back with the same problem.

- * 55. Cameron asks you about what DKA is and how it works. (All that apply)
- Refer to medical staff to answer the Cameron's questions
 - Educate Cameron on DKA pathophysiology in simple terms
 - Consult Diabetes Educator for advice
 - Ask shift coordinator to help you answer the Cameron's questions
- * 56. Cameron tells you he didn't take his insulin because he ran out and recently lost his job so he couldn't afford to buy more. How do you respond? (All that apply)
- Refer to social work for review of his social situation
 - Ignore it, he should be more responsible
 - Say sorry that that has happened to him
 - Consult Diabetes Educator for advice
- * 57. Which of the following referrals will Cameron need on discharge from hospital? (All that apply)
- General Practitioner
 - Diabetes Educator or Endocrinologist
 - Mental health
 - None

* 58. Which allied health reviews do you think Cameron will need prior to discharge from hospital? (All that apply)

- Physiotherapy
- Pharmacy
- Dietitian
- Social Worker
- None



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 6: Reflecting

Cameron was discharged home. You reflect on how you managed his DKA.

* 59. What do you think caused Cameron to have a hypoglycaemic event?

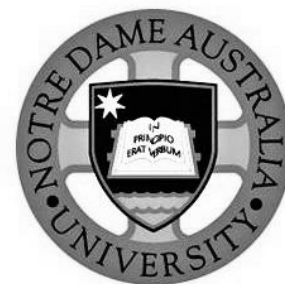
- 10% glucose rate was incorrect
- Infrequent monitoring
- Insulin dose too high
- DKA patients always hypo, it's normal

* 60. You noticed that Cameron's potassium level dropped to 3.1 shortly after starting his treatment. What do you think happened? (All that apply)

- Potassium replacement wasn't infusing
- Potassium ions move from the extracellular to the intracellular compartment, therefore serum potassium level drops
- Renal function improved with increased perfusion to the kidneys, therefore potassium level dropped
- Potassium level on a VBG is not always accurate

* 61. What would have helped you make decisions whilst managing Cameron's DKA? (All that apply)

- A better understanding of DKA pathophysiology
- More confidence in what you know about DKA
- A user-friendly protocol to follow
- More supervision and guidance from senior nursing staff
- Other (please specify)



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Section 6: Reflecting

Please reflect on the following statements and respond with your level of agreement or disagreement

* 62. I am confident to educate patients on how to prevent a recurrence of DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 63. I am confident to manage complications associated with treating patients for DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 64. I think the DKA protocol used at Armadale Health Service helps me to make decisions as a nurse.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 65. I think the DKA protocol used at Armadale Health Service promotes autonomy among nurses.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 66. I think the DKA protocol at Armadale Health Service should have more input from nurses who manage patients with DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 67. I think socioeconomic and psychological issues contribute to patients presenting with DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 68. I think patients who have experienced DKA usually understand their treatment plan.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 69. I would have sought help from one of my colleagues to help me manage Cameron's DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree

* 70. I would like more education on the nursing management of patients with DKA.

- Strongly agree
- Agree
- Disagree
- Strongly disagree



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Follow up interviews

Thank you for completing the online survey. You are now invited to participate in a follow up interview focusing on your views of nurses' knowledge and decision making when managing adults with DKA.

The interview will take about 30 minutes and will be audio-recorded. It will take place at a mutually convenient location and anything that is said during the interview will be kept confidential.

Please answer the following question to indicate your interest in participating in an interview. Further information will be provided prior to the interview being arranged. Alternatively, the researcher is available to answer any questions you may have on the contact details provided in the email.

* 71. Would you like to participate in a follow up interview with the researcher?

- Yes
- No



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Follow up interviews

72. Please provide your contact details below.

Name

Email Address

Phone Number



An investigation of registered nurses' knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis

Survey Completed

Thank you again for your participation in the pilot study. Your contribution is a valuable addition to research literature on nurses' role in the management of adults with DKA.

Please feel free to contact the researcher or their supervisors with any questions you have about the study.

Appendix D

Interview Guide

INTERVIEW GUIDE

Title of Project: **An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis**

Introduction

Thank you for completing the online survey and consenting to participate in this interview. The questions in this interview have been created based on the findings from the survey and focus on the decision-making processes and factors that influence decision making for registered nurses who manage patients with DKA. There are no right or wrong answers, only differences of opinion and experience. The results of this interview will be used for chapter in my Master's thesis.

Participation in this study is voluntary and it is not expected to have any negative consequences to you as the participant. However, you are free to withdraw your consent at any time. The interview will take about 30 minutes and will be audio-recorded and transcribed verbatim for thematic analysis. Everything discussed in the interview will remain confidential and your responses will be de-identified in my published thesis. Do you have any questions?

Open-ended interview questions:

1. What influences your decision-making when managing patients with DKA?
2. Who influences your decision-making when managing patients with DKA?
3. What are the enablers for your decision-making for patients with DKA? (What are the people, resources or processes that *help* your decision-making for patients with DKA?)

4. What are the barriers for your decision-making for patients with DKA? (What are the people, resources or processes that *hinder* your decision-making for patients with DKA?)

Prompts:

Would you explain further?

Can you give me an example?

Is there anything else?

Please describe what you mean.

Conclusion:

5. Of all the things we have discussed, what is the most important to you?
6. Give short summary of the discussion then ask, is this an accurate summary of our discussion?

Thank you so much for your time. It is greatly appreciated.

Megan Westphalen RN

MPhil student

University of Notre Dame, Australia

megan.westphalen@my.nd.edu.au

Appendix E

Ethics Approval Letters



19 Mouat St (PO Box 1225) Fremantle WA 6959
+61 8 9433 0555 | enquiries@nd.edu.au

11 June 2020

Dr Steven Hardman & Megan Westphalen
School of Nursing & Midwifery
The University of Notre Dame Australia
Fremantle Campus

Dear Steven and Megan,

Reference Number: 2020-082F

Project Title: "An investigation of registered nurses' knowledge and decision-making processes in to the management of adults with diabetic ketoacidosis."

Thank you for submitting the above project for Low Risk ethical review. Your application has been reviewed by a sub-committee of the University of Notre Dame Human Research Ethics Committee (HREC) in accordance with the *National Statement on Ethical Conduct in Human Research* (2007, updated 2018). I advise that approval has been granted conditional on the following issues being addressed:

- Researchers to please provide the Royal Perth Hospital HREC approval letter upon receipt.
- Researchers to please clarify whether the student researcher is currently employed at Armadale Hospital. If so, please provide details for how any dependent relationships or conflict of interest will be managed.
- It is understood that survey participants who are interested in participating in the interview component of the research will be taken to another link to provide contact details. Please amend the Participant Information Sheet (PIS) to include clear instructions for this and that if participants choose not to participate in the interview component they are not required to and can simply complete the survey. In addition, clarify that this information will be stored separately from the survey responses, which will remain anonymous.
- Section 18b states that participants will receive feedback via an email but in the PIS it states that a link to a webpage will be provided. This is inconsistent and neither is possible if participants are anonymous. Please clarify and amend the PIS accordingly.

Please send your response addressing each of the issues as listed above, including supporting information where applicable, to me at Natalie.Giles@nd.edu.au by **25 June 2020**. Failure to respond and/or communicate by this time could result in a suspension of the ethical review of the project.

Yours sincerely,

Dr Natalie Giles
Research Ethics Officer
Research Office

cc: A/Prof Caroline Bulsara, SRC Chair, School of Nursing & Midwifery

Broome Campus 88 Guy St (PO Box 2287) Broome WA 6725
Sydney Campus 140 Broadway (PO Box 944) NSW 2007

Fremantle Broome Sydney

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Royal Perth Hospital Human Research Ethics Committee

27 July 2020

Miss Megan Westphalen
Armadale Health Service
Intensive Care Unit, 3065 Albany Highway
Armadale Western Australia 6112

Dear Miss Westphalen

PRN: RGS0000004076

Project Title: An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis

Note: This project cannot commence until site governance approval has been obtained.

I am pleased to advise you that the Royal Perth Hospital (RPH) Human Research Ethics Committee (HREC) has granted **ethical approval** of this research project.

The nominated participating site(s) for this project is/are:
Armadale Health Service

If additional sites are recruited prior to the commencement of, or during the research project, the Coordinating Principal Investigator is required to notify the HREC. Notification of withdrawn sites should also be provided to the HREC in a timely fashion.

The approved documents include:

Document	Version	Version Date
1st Recruitment Email	2	17/07/2020
2nd Recruitment Email	1	17/07/2020
3rd Recruitment Email	1	17/07/2020
Consent Form	2	17/07/2020
MPhil Proposal FINAL	2	17/07/2020
Participant Information Sheet (Interviews)	3	17/07/2020
Participant Information Sheet (Survey)	3	17/07/2020
Questionnaire		
Recruitment Flyer	3	17/07/2020
Withdrawal of Consent Form	2	06/07/2020

This ethical approval is valid to **27 July 2023** subject to compliance with the 'Conditions of Ethics Approval for a Research Project' (Below).

A copy of this ethical approval letter must be submitted by all site Principal Investigators to the Research Governance Office or equivalent body or individual at each participating institution in a timely manner to enable the institution to authorise the commencement of the project at its site/s.

This letter constitutes ethical approval only. This project cannot proceed at any site until separate site authorisation has been obtained from the Chief Executive or Delegate of the site under whose auspices the research will be conducted at that site.

Should you have any queries about the HREC's consideration of your project, please contact the Ethics Office at EMHS.REG@health.wa.gov.au or on 08 9224 3799. The HREC's Terms of Reference, Standard Operating Procedures and membership are available from the Ethics Office or from <http://ww2.health.wa.gov.au/About-us/East-Metropolitan-Health-Service/About/Human-Research-Ethics-and-Governance>.

The HREC wishes you every success with this project.

Yours sincerely

Adj Prof FRANK van BOCKXMEER
Chairman | Royal Perth Hospital Human Research Ethics Committee



29 July 2020

Miss Megan Westphalen
Intensive Care Unit
Armadale Hospital

Dear Megan

PRN: RGS0000004076

Project Title: An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis

Thank you for submitting the above research project for governance review. I am pleased to advise you that East Metropolitan Health Service Executive has granted authorisation for this research project to be conducted at the following participating site:

Armadale Health Service

The approved documents are as outlined in the Royal Perth Hospital Human Research Ethics Committee (HREC) approval letter dated 27 July 2020.

Site conditions: Any further amendments to the survey and the interview questions (once developed) are to be submitted to the RPH HREC and EMHS Research Governance Office for approval.

Site authorisation of this project is valid from 29 July 2020, subject to continued ethical approval from the Royal Perth Hospital Human Research Ethics Committee and compliance with the 'Conditions of Site Authorisation for a Research Project'.

Should you have any queries about East Metropolitan Health Service Executive's consideration of your project, please contact the Research Governance Office at EMHS.REG@health.wa.gov.au or on 08 9224 2260. The Research Governance Office's Standard Operating Procedures are available from the Research Governance Office or from <http://ww2.health.wa.gov.au/About-us/East-Metropolitan-Health-Service/About/Human-Research-Ethics-and-Governance>.

I wish you every success in your research.

Yours sincerely

Mary Ferrier
A/EXECUTIVE DIRECTOR
ARMADALE KALAMUNDA GROUP

East Metropolitan Health Service Research Hub
Level 2 Kirkman House, Royal Perth Hospital, GPO Box X2213 Perth WA 6847
Telephone: (08) 9224 2260 / (08) 9224 2292
Email: EMHS.REG@health.wa.gov.au

Appendix F

Expert Information Sheet and Consent Form

Dear Colleague,

I am currently enrolled as a Master of Philosophy candidate at the University of Notre Dame Australia, School of Nursing and Midwifery. My research project is entitled “An investigation of registered nurses’ knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis”. I am investigating what level of knowledge Registered Nurses (RN) have with respect to Diabetic Ketoacidosis (DKA), how they make decisions and what factors influence their decision-making processes when managing these patients.

There are four phases in my research project, two of which will involve RNs and data collection. The first phase of data collection involves asking RNs to complete an online survey looking at what they know about DKA and what decisions they make. This will take the form of multiple-choice questions based on an unfolding case study of a patient diagnosed with DKA. The second phase of data collection will involve one-on-one interviews with RNs to discuss the findings from the survey and how they made decisions in response to the case study.

At present there is nothing in the literature that describes RNs’ knowledge or decision-making process in relation to DKA. This research aims to fill this gap and clarify the RN’s role in managing patients with DKA. This study is also expected to direct further research in this field and contribute to policy development.

I am inviting you to participate in the development of the survey for this project. I require experienced academic and clinical nurses to help by reviewing the questions to be posed in the survey for clarity, internal consistency and validity. A full set of instructions and a response sheet for comments will be provided to reviewers. Once it has been determined

that the survey has met the criteria for clarity, internal consistency and validity, the survey will be pilot tested with a group of RNs.

This project has been approved by the University of Notre Dame Australia Human Research Ethics Committee (approval number 2020-082F) and Royal Perth Hospital Human Research Ethics Committee (reference number RGS0000004076). According to the requirements of these Ethics committees, your privacy and the confidentiality of information you provide are guaranteed.

I hope you will be willing to contribute to the study and look forward to receiving your feedback. A consent form for involvement in the survey development phase of the study is provided below. If you choose to participate, please sign and date the consent form and return it to myself either by hand or via the email address below. Thank you for contributing to this study.

Kind regards,

Megan Westphalen RN

MPhil Student

School of Nursing & Midwifery

The University of Notre Dame Australia

Email: megan.westphalen@my.nd.edu.au

CONSENT FORM

Title of Project: *“An investigation of registered nurses’ knowledge and decision-making processes in relation to the management of adults with diabetic ketoacidosis”.*

Name of Researcher: **Megan Westphalen**

Please Initial

1. I confirm that I have read and understand the information concerning the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason or having any fear of discrimination.
3. I agree to take part in the development of the above MPhil study and will treat all information associated with the study as confidential.

Name of Reviewer			
Signature of Reviewer		Date	

Signature of Researcher		Date	
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Appendix G

Expert Panel Review of Clarity

Step 1 Instructions: Clarity of Questions

The questions below have been designed to gather data to measure the level of knowledge of RNs who manage patients with DKA and what decisions they make. The questions were developed following an extensive review of the literature focusing on current DKA management protocols and nursing decision-making processes.

This review of the questions is designed to highlight any issues with the clarity of each question. Please read each question carefully and indicate whether the item is considered clear or unclear in terms of how well you believe it can be interpreted by the study participants. Please circle the appropriate response next to each item. Making comments is encouraged and a space has been provided next to each question to facilitate this.

I am also keen to discuss any comments with you. Once you have finished reviewing the questions please feel free to contact me on [REDACTED] to discuss your comments if required. Please return the completed questionnaire to me via email by **Friday, 28th August 2020**. Thank you for your help.

Kind regards,

Megan Westphalen

MPhil Student

School of Nursing & Midwifery

The University of Notre Dame Australia

Email: megan.westphalen@my.nd.edu.au



Question	Please circle appropriate response	Comments
<p><u>Section 1A: Demographics</u></p> <p>Please answer the following demographic questions regarding your training, experience and current role at Armadale Health Service.</p>		
<p>1. What is your current job title?</p> <p>a. Enrolled Nurse</p> <p>b. Graduate Registered Nurse</p> <p>c. Registered Nurse</p> <p>d. Clinical Nurse/ Staff Development Nurse</p> <p>e. Other _____</p>	<p>Clear</p> <p>Unclear</p>	
<p>2. What is your gender?</p> <p>a. Male</p> <p>b. Female</p>	<p>Clear</p> <p>Unclear</p>	
<p>3. In which clinical area do you predominantly work?</p> <p>a. Medical Admissions Unit</p> <p>b. Intensive Care Unit</p> <p>c. Emergency Department</p>	<p>Clear</p> <p>Unclear</p>	
<p>4. How long have you worked in this area? (Number in whole years)</p>	<p>Clear</p> <p>Unclear</p>	
<p>5. What is your highest level of education?</p> <p>a. Bachelor's Degree</p> <p>b. Postgraduate Certificate / Diploma</p> <p>c. Master's Degree</p> <p>d. Doctorate</p>	<p>Clear</p> <p>Unclear</p>	



6. What area or speciality did you complete your highest qualification? (Please specify)	Clear Unclear	
7. How many years have you worked as a registered nurse? (Number in whole years)	Clear Unclear	
8. At which university did you complete your undergraduate degree? (Please specify)	Clear Unclear	
9. What type of employment contract do you currently have? a. Permanent full/ part time b. Fixed full/ part time c. Secondment d. Casual	Clear Unclear	
<u>Section 1B: Background</u> Please answer the following questions based on your experience of managing adult patients with DKA.		
10. I have attended education related to the management of adults with DKA within the last 12 months. a. Strongly Agree b. Agree c. Disagree d. Strongly Disagree	Clear Unclear	



11. Diabetic ketoacidosis is a common presentation in my clinical area. a. Strongly Agree b. Agree c. Disagree d. Strongly Disagree	Clear Unclear	
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Section 2: Noticing

Cameron is a 25-year-old man with Type I diabetes, diagnosed when he was 10. He is normally fit and well, doesn't smoke, drinks alcohol on social occasions and does not use illicit drugs. Up until recently, he worked as a carpenter. He attends his diabetes clinic appointments regularly and has never been hospitalised for diabetes.

Cameron made an appointment with his GP because he was feeling generally unwell with nausea and vomiting. He tested his BGL at home and his machine said "HI" so he went to the GP to have his blood glucose level checked. He told the GP that he hadn't taken his insulin for a couple of days, but didn't say why. The GP suspected he had diabetic ketoacidosis (DKA) so he wrote a letter referring Cameron to the hospital. Cameron shows the letter to a nurse when he arrives at the hospital.



<p>12. From the list of definitions below, select the one that best matches your understanding of diabetic ketoacidosis?</p> <p>New or known diabetes and...</p> <p>a. Presence of ketones and metabolic acidosis</p> <p>b. Absence of ketones and metabolic acidosis</p> <p>c. Presence of ketones and metabolic alkalosis</p> <p>d. Absence of ketones and metabolic alkalosis</p>	<p>Clear</p> <p>Unclear</p>	
<p>13. What is hyperglycaemia? High blood concentration of:</p> <p>a. Glucose</p> <p>b. Iron</p> <p>c. Insulin</p> <p>d. Bicarbonate</p>	<p>Clear</p> <p>Unclear</p>	
<p>14. What are ketones?</p> <p>a. Protein for muscle development</p> <p>b. Neurotransmitter for fine motor skills</p> <p>c. Hormone to lower glucose level</p> <p>d. By-product of breaking down fats</p>	<p>Clear</p> <p>Unclear</p>	



<p>15. Cameron has a deficiency of which of the following hormones?</p> <p>a. Insulin</p> <p>b. Cortisol</p> <p>c. Glucagon</p> <p>d. Catecholamines</p>	<p>Clear</p> <p>Unclear</p>	
<p>16. What is the normal range for blood glucose level?</p> <p>From [] to []</p>	<p>Clear</p> <p>Unclear</p>	
<p>17. What is the normal range for blood ketone level?</p> <p>From [] to []</p>	<p>Clear</p> <p>Unclear</p>	
<p>18. What values do you expect to see for the following biochemical markers if Cameron has DKA?</p> <p>Blood Glucose > []</p> <p>Blood Ketones > []</p> <p>pH < []</p> <p>Bicarbonate < []</p>	<p>Clear</p> <p>Unclear</p>	



You have conducted an initial assessment of Cameron. His vital signs and first venous blood gas results are as follows:

Respiratory rate	28
Blood pressure	110/50
O₂ saturations	94% on room air
Heart rate	120
Temperature	37.5
Ketones	4.4

pH	7.20
pO₂	95
pCO₂	23
Bicarbonate	15
Potassium	4.2
Glucose	32

<p>19. Cameron is tachycardic and tachypneic.</p> <p>What other signs do you expect to observe during your assessment? (All that apply)</p> <ul style="list-style-type: none">a. Acetone smellb. Hypovolaemiac. Altered conscious leveld. Dysrhythmiase. Confusion	<p>Clear</p> <p>Unclear</p>	



<p>20. What of the following symptoms do you expect Cameron to report? (All that apply)</p> <ul style="list-style-type: none">a. Vomitingb. Polyuriac. Polydipsiad. Weight losse. Warm/ dry skinf. Lethargy	<p>Clear</p> <p>Unclear</p>	
<p>21. Why does Cameron have ketones in his blood? (All that apply)</p> <ul style="list-style-type: none">a. He has been on a high protein, no carbohydrate dietb. He hasn't eaten for several days due to feeling unwellc. He has taken ketone supplements to build muscled. His body has broken down fats instead of glucose because he lacks insulin	<p>Clear</p> <p>Unclear</p>	
<p>22. Why do you think Cameron has a high blood sugar? (All that apply)</p> <ul style="list-style-type: none">a. Consumed too many carbohydratesb. Breakdown of stored glycogen in the liver due to a lack of insulinc. Dehydration from nausea and vomitingd. Didn't use his insulin	<p>Clear</p> <p>Unclear</p>	



<p>23. Which of the following factor/s may contribute to Cameron’s metabolic acidosis? (All that apply)</p> <ul style="list-style-type: none">a. Sepsisb. Dehydrationc. He is dyingd. Ketonaemia	<p>Clear</p> <p>Unclear</p>	
<p>24. Which factor/s increase Cameron’s risk of developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Young ageb. Type I diabetesc. Obesityd. Low socioeconomic status	<p>Clear</p> <p>Unclear</p>	
<p>25. Which precipitating factor/s do you think led Cameron to developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Prescription had expired and his GP had movedb. Feeling low from the burden of managing his diabetesc. Not understanding the important of taking his medications continuouslyd. Losing his job and being unable to afford to buy his supplies	<p>Clear</p> <p>Unclear</p>	



<p>26. What are the potentially life threatening complications Cameron is at risk of developing whilst in DKA? (All that apply)</p> <p>a. Cardiac arrhythmias due to hypo- or hyperkalaemia</p> <p>b. Cerebral oedema due to rapid change in blood osmolarity if BGL falls too rapidly</p> <p>c. Refeeding syndrome from having no appetite for several days</p> <p>d. Pulmonary embolism due to the high viscosity of the blood whilst hyperglycaemic</p>	<p>Clear</p> <p>Unclear</p>	
<p>27. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your assessment of Cameron's condition. Number 1 being the top priority and 6 being lowest priority.</p>	<p>Clear</p> <p>Unclear</p>	

Priority	Nursing Action
	Measuring and regular monitoring of fluid status
	ECG and cardiac monitoring
	Ensure patent airway at all times
	Hourly vital signs including neurological status
	Hourly capillary BGL and ketones and 2-hourly VBGs
	Report findings to medical staff to investigate precipitating cause



<p>28. What factor/s do you think might have influenced your decisions to prioritise Cameron’s assessment above? (All that apply)</p> <p>a. Prior experience</p> <p>b. Ward protocol</p> <p>c. Patient presentation</p> <p>d. Knowledge of DKA</p>	<p>Clear</p> <p>Unclear</p>	
<p>29. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your management of Cameron’s condition. Number 1 being the top priority and 7 being lowest priority.</p>	<p>Clear</p> <p>Unclear</p>	

Priority	Nursing Action
	Administer oxygen if appropriate
	Obtain IV access
	Set up insulin infusion as per doctor’s plan
	Commence fluid resuscitation as per doctor’s plan
	Give 10% glucose when indicated
	Educate Cameron on the management plan
	Supplement electrolytes as required/ prescribed



<p>30. What factor/s do you think might have influenced your decisions to prioritise Cameron's management above? (All that apply)</p> <ul style="list-style-type: none">a. Prior experienceb. Ward protocolc. Patient presentationd. Knowledge of DKA	<p>Clear</p> <p>Unclear</p>	
<p><u>Section 3: Interpreting</u></p> <p>The doctor has charted a plan consisting of intravenous fluids, insulin and electrolyte replacement. You have found another nurse to check the medications you have prepared. The other nurse asks you the following questions about managing your patient with DKA:</p>		
<p>31. How will you assess Cameron's fluid status? (All that apply)</p> <ul style="list-style-type: none">a. Skin turgor and capillary refill timeb. Accurate fluid balancec. Heart rate and blood pressured. Check his renal function	<p>Clear</p> <p>Unclear</p>	
<p>32. What signs will you look for to determine if Cameron is fluid overloaded? (All that apply)</p> <ul style="list-style-type: none">a. Desaturation, tachycardia, tachypnoeab. Elevated urea and creatininec. Pitting oedema, dysuriad. History of heart and renal failure	<p>Clear</p> <p>Unclear</p>	



<p>33. What do patients with DKA require fluid replacement? (All that apply)</p> <ul style="list-style-type: none">a. Replace circulating volumeb. Dilute glucose in blood streamc. To keep IV cannula patentd. Replace depleted electrolytes	<p>Clear</p> <p>Unclear</p>	
<p>34. What are the risks associated with aggressive fluid resuscitation? (All that apply)</p> <ul style="list-style-type: none">a. None, these patients always need fluidb. Acute pulmonary oedemac. Acute renal failured. Cardiac arrhythmias	<p>Clear</p> <p>Unclear</p>	
<p>35. What would be the most appropriate type of insulin to administer in the initial management of DKA?</p> <ul style="list-style-type: none">a. Long actingb. Short actingc. Rapid actingd. Intermediate acting	<p>Clear</p> <p>Unclear</p>	
<p>36. Patients receiving initial treatment for DKA require subcutaneous long-acting (basal) insulin.</p> <ul style="list-style-type: none">a. Trueb. False	<p>Clear</p> <p>Unclear</p>	



<p>37. Which of the following is a long-acting (basal) insulin?</p> <ul style="list-style-type: none">a. Novorapidb. Lantusc. Humulogd. Ryzodeg	<p>Clear</p> <p>Unclear</p>	
<p>38. How does insulin work to lower blood glucose level? (All that apply)</p> <ul style="list-style-type: none">a. Stops the production of ketonesb. Stimulates uptake of glucose into cellsc. Stops the release of glucagond. Inhibits glycogen conversion and release from the liver	<p>Clear</p> <p>Unclear</p>	
<p>39. What potassium level will you aim for?</p> <p>From [] to []</p>	<p>Clear</p> <p>Unclear</p>	
<p>40. The prescription states that you are required to supplement Cameron's potassium with 20mmol/hr of potassium chloride through a peripheral cannula.</p> <p>What are you going to do? (All that apply)</p> <ul style="list-style-type: none">a. Medical review to change the prescriptionb. Follow the prescription as writtenc. Request a central line to give higher doses of potassiumd. Cardiac monitor the patient while infusion is running	<p>Clear</p> <p>Unclear</p>	



<p>41. Do electrolytes such as magnesium, calcium and phosphate need to be routinely replaced in patients with DKA?</p> <p>a. No, potassium is the only electrolyte that needs replacing</p> <p>b. No, it does not change the outcome for these patients</p> <p>c. Yes, these patients are at risk of refeeding syndrome</p> <p>d. Yes, only if the patient is cardiac monitored</p>	<p>Clear</p> <p>Unclear</p>	
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Section 4: Responding

You have started Cameron on his treatment as per the plan. You are monitoring him regularly for signs of deterioration. He looks tired but says he “feels fine and just wants to sleep”.



42. Match the nursing actions with the corresponding rationale.	<p>Clear</p> <p>Unclear</p>	
<p>Nursing Action</p>	<p>Rationale</p>	
Monitor fluid balance	To assess hydration status and titrate fluid resuscitation	
ECG and cardiac monitoring	Electrolyte imbalances may cause cardiac arrhythmias	
Hourly capillary BGL and ketones, 2-hourly VBGs	To monitor response to insulin and changes to acid-base status	
Titrate insulin infusion	To provide adequate insulin to clear ketones and correct acidosis	
IV fluid and electrolyte replacement	To correct fluid and electrolyte imbalances	
Check vital signs and neurological status hourly	To identify improvement or deterioration in patient's condition and cognition	
Check glycosylated haemoglobin (HbA1c)	To determine the average plasma glucose over a period of time	
Give 10% glucose when indicated	To stabilise BGL whilst continuing IV insulin	
<p>You have been busy and haven't managed to check on Cameron for 2 hours. When you go to his room to check his glucose level and ketones, you find that his infusion pumps are alarming. Cameron says that he fell asleep so he doesn't know how long the pumps were not working. When you assess Cameron again, you identify the following issues.</p>		



<p>43. Cameron's ketones have increased from 1.6 to 2.5. What do you do? (All that apply)</p> <ul style="list-style-type: none">a. Medical reviewb. Increase insulin ratec. Decrease insulin rated. Nothing	<p>Clear</p> <p>Unclear</p>	
<p>44. Cameron has a BGL of 3.6. You get a medical review and... (All that apply)</p> <ul style="list-style-type: none">a. Stop insulinb. Stop everythingc. Give 60mL Carbotestd. Increase 10% glucose rate	<p>Clear</p> <p>Unclear</p>	
<p>45. Cameron has not passed urine for 4 hours despite having received 3 litres of fluid. What do you do? (All that apply)</p> <ul style="list-style-type: none">a. Request a medical review to check his renal functionb. Bladder scan and give me an opportunity to pass urinec. Stop the fluid until he voids, in case he becomes overloadedd. Insert an indwelling catheter and check his output hourly	<p>Clear</p> <p>Unclear</p>	



<p>46. You inform that doctor that Cameron is due for a blood gas. They tell you that it's not urgent, they are late for a meeting and will do it later. What do you do? (All that apply)</p> <p>a. Wait until after the meeting, and remind the doctor again</p> <p>b. Inform the coordinator who follows up with the doctor</p> <p>c. Find a nurse who is competent to take blood to do the test</p> <p>d. Leave all the infusions running and hand over that the blood gas is due</p>	<p>Clear</p> <p>Unclear</p>	
<p>47. What do you think was the cause for these changes in Cameron's status?</p> <p>a. These are normal fluctuations associated with the treatment for DKA</p> <p>b. These changes were preventable with frequent monitoring</p> <p>c. If the pumps were working properly, these changes would not have occurred</p> <p>d. Overall, Cameron was getting better so these changes don't matter</p> <p>e. Other [_____]</p>	<p>Clear</p> <p>Unclear</p>	



<p>48. Do you think these complications had an impact on Cameron's outcome?</p> <p>a. Yes, they prolonged his treatment and hospital stay</p> <p>b. Yes, there was a risk of haemodynamic deterioration that would have required critical care input</p> <p>c. No, they are normal issues that arise and are easy to fix</p> <p>d. No, Cameron said he felt fine and was able to sleep</p> <p>e. Other [_____]</p>	<p>Clear</p> <p>Unclear</p>	
<p>Cameron is feeling much better, but he has some questions for you. He wants to know when he can eat again and when he can go home.</p>		
<p>49. How long does it typically take for DKA to fully resolve?</p> <p>a. 6 hours</p> <p>b. 12 hours</p> <p>c. 24 hours</p> <p>d. 48 hours</p>	<p>Clear</p> <p>Unclear</p>	



<p>50. How do you respond to Cameron's question about when he can eat and drink?</p> <p>a. "Sorry, you can't eat whilst on treatment for DKA"</p> <p>b. "You can eat whatever you like, but you'll probably just vomit"</p> <p>c. "I'm not sure but I can check with the doctor"</p> <p>d. "Yes, you can eat. I'll just watch your sugars and ketones closely"</p>	<p>Clear</p> <p>Unclear</p>	
<p>51. What are the criteria for stopping the DKA treatment?</p> <p>a. pH >7.3, Ketones <0.6 <i>and</i> Bicarbonate >18</p> <p>b. pH >7.3, Ketones <0.6 <i>or</i> Bicarbonate >18</p> <p>c. Potassium >3.5, BGL <11</p> <p>d. Whenever the doctors decide</p>	<p>Clear</p> <p>Unclear</p>	



<p>52. Select the best option to convert Cameron from the IV insulin infusion to his normal subcutaneous insulin regime, assuming he is eating and drinking.</p> <ul style="list-style-type: none">a. Stop IV insulin, give subcutaneous injection 30 minutes later with mealb. Give subcutaneous injection, stop IV infusion 30 minutes later with mealc. Follow instructions from the doctord. Follow instructions from the senior nurse	<p>Clear</p> <p>Unclear</p>	
<p>53. How would you transition Cameron from the DKA protocol to an insulin/dextrose infusion if he wasn't eating and drinking?</p> <ul style="list-style-type: none">a. Change 10% to 5% glucose, leave insulin rate the same, monitor BGL hourlyb. Change 10% to 5% glucose, halve insulin rate, monitor BGL hourlyc. Start 5% glucose at 60-80mL/hr and insulin at half daily dose over 24 hoursd. Whatever the doctor prescribes	<p>Clear</p> <p>Unclear</p>	
<p>Cameron is eating and drinking and has had his normal Novorapid with his breakfast. He still wants to go home but you want to make sure he understands what has happened so that he doesn't come back again with the same problem.</p>		



<p>54. Cameron asks you about what DKA is and how it works. (All that apply)</p> <ul style="list-style-type: none">a. Refer to medical staff to answer Cameron's questionsb. Educate Cameron on DKA pathophysiology in simple termsc. Consult Diabetes CNS for adviced. Ask shift coordinator to help you answer Cameron's questions	<p>Clear</p> <p>Unclear</p>	
<p>55. Cameron tells you he didn't take his insulin because he ran out and recently lost his job so he couldn't afford to buy more. How do you respond? (All that apply)</p> <ul style="list-style-type: none">a. Refer to social work for review of social situationb. Ignore it, he should be more responsiblec. Say sorry that that has happened to himd. Consult Diabetes CNS for advice	<p>Clear</p> <p>Unclear</p>	
<p>56. Which of the following referrals will Cameron need on discharge from hospital? (All that apply)</p> <ul style="list-style-type: none">a. General Practitionerb. Diabetes CNS or Endocrinologistc. Mental Healthd. None	<p>Clear</p> <p>Unclear</p>	



<p>57. Which allied health reviews do you think Cameron will need prior to discharge from hospital? (All that apply)</p> <ul style="list-style-type: none">a. Physiotherapyb. Pharmacyc. Dietitiand. Social Workere. None	<p>Clear</p> <p>Unclear</p>	
<p><u>Section 5: Reflecting</u></p> <p>Cameron was discharged home. You reflect on how you managed his DKA.</p>		
<p>58. What do you think caused Cameron to have a hypoglycaemic event?</p> <ul style="list-style-type: none">a. 10% glucose rate was incorrectb. Infrequent monitoringc. Insulin dose too highd. DKA patients always hypo, it's normal	<p>Clear</p> <p>Unclear</p>	



<p>59. You noticed that Cameron’s potassium level dropped to 3.1 shortly after starting his treatment. What do you think happened? (All that apply)</p> <ul style="list-style-type: none">a. Potassium replacement wasn’t infusingb. Potassium ions move from the extracellular space to the intracellular compartment, therefore serum potassium level dropsc. Renal function improved with increased perfusion to the kidneys, therefore potassium level droppedd. Potassium level on a VBG is not always accurate	<p>Clear</p> <p>Unclear</p>	
<p>60. What would have helped you make decisions whilst managing Cameron’s DKA? (All that apply)</p> <ul style="list-style-type: none">a. A better understanding of DKA pathophysiologyb. More confidence in what you know about DKAc. A user-friendly protocol to followd. More supervision and guidance from senior nursing staffe. Other [_____]	<p>Clear</p> <p>Unclear</p>	



Please reflect on the following statements and respond with your level of agreement or disagreement.

<p>61. I am confident to educate patients on how to prevent a recurrence of DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>62. I am confident to manage complications associate with treating patients for DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>63. I think the DKA protocol used at Armadale Health Service helps me to make decisions as a nurse.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	



<p>64. I think the DKA protocol used at Armadale Health Service promotes autonomy among nurses.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>65. I think the DKA protocol at Armadale Health Service should have more input from nurses who manage patients with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>66. I think socioeconomic and psychological issues contribute to patients presenting with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	



<p>67. I think patients with DKA usually understand their treatment plan.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>68. I would have sought help from one of my colleagues to help me manage Cameron's DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	
<p>69. I would like more education on the nursing management of patients with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>Clear</p> <p>Unclear</p>	

End of Questions

Thank you for completing Step 1

Appendix H

Expert Panel Review of Internal Consistency

Step 1 Clarity of Questions: Follow Up

Thank you for completing Step 1 of the expert review and for your very helpful feedback. Based on an analysis of your feedback, I have edited several of the questions to make them clearer. I now ask that you review these four questions again, and indicate if they are clear or unclear. You can refer back to the original clarity feedback document if required.

I am available via phone and email to discuss the feedback or if you have any further suggestions on the clarity of these questions. Once you have completed the clarity follow up, please move on to Step 2 of this expert review.

You have conducted an initial assessment of Cameron. His vital signs and first venous blood gas results are as follows:

Respiratory rate	28	pH	7.20
Blood pressure	110/50	pO₂	95
O₂ saturations	94% on room air	pCO₂	23
Heart rate	120	Bicarbonate	15
Temperature	37.5	Potassium	4.2
Ketones	4.4	Glucose	32



Question	Please circle appropriate response	Comments
19. Cameron is tachycardic and tachypneic. Based on your experience of managing adults with DKA, what other signs do you often observe during your assessment? (All that apply) a. Acetone smell b. Hypovolaemia c. Altered conscious level d. Dysrhythmias e. Confusion	Clear Unclear	
25. From the list of factors below, which factor may have contributed to Cameron to developing DKA? (All that apply) a. Prescription had expired b. His GP had moved away c. Feeling low from the burden of managing his diabetes d. Not understanding the importance of taking his medications regularly e. Losing his job and not being unable to afford to buy his insulin and testing supplies	Clear Unclear	



<p>27. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your assessment of Cameron’s condition. Number 1 being the top priority and 6 being lowest priority.</p>	<p>Clear</p> <p>Unclear</p>		
	<p>Priority</p>	<p>Nursing Action</p> <p>Measuring and regular monitoring of fluid status</p> <p>ECG and cardiac monitoring</p> <p>Ensure patent airway at all times</p> <p>Vital signs including neurological status</p> <p>Capillary BGL, ketones and VBG</p> <p>Report findings to medical staff to investigate precipitating cause</p>	
<p>47. You reflect on the increase in Cameron’s ketone level, his hypoglycaemic event and oliguria. What do you think was the cause for these changes in Cameron’s status?</p> <p>a. These are normal fluctuations associated with the treatment for DKA</p> <p>b. These changes were preventable with frequent monitoring</p> <p>c. If the pumps were working properly, these changes would not have occurred</p> <p>d. Overall, Cameron was getting better so these changes don’t matter</p> <p>e. Other [_____]</p>	<p>Clear</p> <p>Unclear</p>		

End of Questions

Please continue on to Step 2

Step 2 Instructions: Internal Consistency

The questions below have been designed to gather data to measure the level of knowledge of RNs who manage patients with DKA and what decisions they make. The questions were developed following an extensive review of the current literature focusing on current DKA management protocols and nursing decision-making processes.

You are being asked to look at questionnaire items listed in separate sets below and indicate if these items belong together. Please look at one set of items at a time.

1. Please read the entire set of items in the list before answering the response questions for that set.
2. Once you have read the entire set of items, please answer question 1 at the top of the page first.
3. Then please answer question 2 for each individual item in the set.
4. Please write any comments you feel are appropriate in the space provided next to each item.

Once you have finished reviewing the questionnaire items, feel free to discuss your comments with me. Please return the completed review to me by **21st September 2020**.

Thank you for your help.

Regards,

Megan Westphalen

Apparent Internal Consistency: Set 1

1. Do these question items “generally” belong together in this question set?

YES / NO (Please circle answer)

2. Please read each question item carefully and decide if each question belongs in this set of questions. In the box below, please circle **YES or NO** and add any comments you feel are necessary.

Question item	Does each question item belong in this set of questions?	Comments
<p><u>Section 1A: Demographics</u></p> <p>Please answer the following demographic questions regarding your training, experience and current role at Armadale Health Service.</p>		
<p>1. What is your current job title?</p> <p>a. Enrolled Nurse</p> <p>b. Graduate Registered Nurse</p> <p>c. Registered Nurse</p> <p>d. Clinical Nurse/ Staff Development Nurse</p> <p>e. Other _____</p>	<p>YES</p> <p>NO</p>	
<p>2. What is your gender?</p> <p>a. Male</p> <p>b. Female</p> <p>c. Other</p> <p>d. Prefer not to say</p>	<p>YES</p> <p>NO</p>	



3. In which clinical area do you predominantly work? a. Medical Admissions Unit b. Intensive Care Unit c. Emergency Department	YES NO	
4. How long have you worked in this area? (Number in whole years)	YES NO	
5. What is your highest level of education? a. Bachelor's Degree (or equivalent) b. Postgraduate Certificate / Diploma c. Master's Degree d. Doctorate	YES NO	
6. What area or speciality did you complete your highest qualification? (Please specify)	YES NO	
7. How many years in total have you worked as a registered nurse? (Number in whole years)	YES NO	
8. At which institution did you complete your undergraduate degree (or equivalent)? (Please specify)	YES NO	



9. What type of employment contract do you currently have? a. Permanent full/ part time b. Fixed full/ part time c. Secondment d. Casual	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	
--	---	--

End of set

Internal Consistency: Set 2

1. Do these question items “generally” belong together in this question set?

YES / NO (Please circle answer)

2. Please read each question item carefully and decide if each question belongs in this set of questions. In the box below, please circle **YES or NO** and add any comments you feel are necessary.

Question item	Does each question item belong in this set of questions?	Comments
<p><u>Section 1B: Background</u></p> <p>Please answer the following questions based on your experience of managing adult patients with DKA.</p>		
<p>10. I have attended education related to the management of adults with DKA within the last 12 months.</p> <p>a. Yes</p> <p>b. No</p>	<p>YES</p> <p>NO</p>	
<p>11. I have seen a patient with DKA in my clinical area.</p> <p>a. Yes</p> <p>b. No</p>	<p>YES</p> <p>NO</p>	

End of set

Internal Consistency: Set 3

1. Do these question items “generally” belong together in this question set?

YES / NO

(Please circle answer)

2. Please read each question item carefully and decide if each question belongs in this set of questions. In the box below, please circle **YES or NO** and add any comments you feel are necessary.

Question item	Does each question item belong in this set of questions?	Comments
<p><u>Section 2: Noticing</u></p>		
<p>Cameron is a 25-year-old man with Type I diabetes, diagnosed when he was 10. He is normally fit and well, doesn't smoke, drinks alcohol on social occasions and does not use illicit drugs. Up until recently, he worked as a carpenter. He attends his diabetes clinic appointments regularly and has never been hospitalised for diabetes.</p>		
<p>Cameron made an appointment with his GP because he was feeling generally unwell with nausea and vomiting. He tested his BGL at home and his machine said “HI” so he went to the GP to have his blood glucose level checked. He told the GP that he hadn't taken his insulin for a couple of days, but didn't say why. The GP suspected he had diabetic ketoacidosis (DKA) so he wrote a letter referring Cameron to the hospital. Cameron shows the letter to a nurse when he arrives at the hospital.</p>		
Empty space for student response		



<p>12. From the list of definitions below, select the one that best matches your understanding of diabetic ketoacidosis? New or known diabetes and...</p> <p>a. Presence of ketones and metabolic acidosis</p> <p>b. Absence of ketones and metabolic acidosis</p> <p>c. Presence of ketones and metabolic alkalosis</p> <p>d. Absence of ketones and metabolic alkalosis</p>	<p>YES</p> <p>NO</p>	
<p>13. What is hyperglycaemia? High blood concentration of:</p> <p>a. Glucose</p> <p>b. Iron</p> <p>c. Insulin</p> <p>d. Bicarbonate</p>	<p>YES</p> <p>NO</p>	
<p>14. What are ketones?</p> <p>a. Protein for muscle development</p> <p>b. Neurotransmitter for fine motor skills</p> <p>c. Hormone to lower glucose level</p> <p>d. By-product of breaking down fats</p>	<p>YES</p> <p>NO</p>	



<p>15. Cameron has a deficiency of which of the following hormones?</p> <p>a. Insulin</p> <p>b. Cortisol</p> <p>c. Glucagon</p> <p>d. Catecholamines</p>	<p>YES</p> <p>NO</p>	
<p>16. What is the normal range for blood glucose level?</p> <p>From [__] to [__]</p>	<p>YES</p> <p>NO</p>	
<p>17. What is the normal range for blood ketone level?</p> <p>From [__] to [__]</p>	<p>YES</p> <p>NO</p>	
<p>18. What values do you expect to see for the following biochemical markers if Cameron has DKA?</p> <p>Blood Glucose > [__]</p> <p>Blood Ketones > [__]</p> <p>pH < [__]</p> <p>Bicarbonate < [__]</p>	<p>YES</p> <p>NO</p>	



You have conducted an initial assessment of Cameron. His vital signs and first venous blood gas results are as follows:

Respiratory rate	28
Blood pressure	110/50
O₂ saturations	94% on room air
Heart rate	120
Temperature	37.5
Ketones	4.4

pH	7.20
pO₂	95
pCO₂	23
Bicarbonate	15
Potassium	4.2
Glucose	32

19. Cameron is tachycardic and tachypneic. Based on your experience of managing adults with DKA, what other signs do you often observe during your assessment? (All that apply)

- a. Acetone smell
- b. Hypovolaemia
- c. Altered conscious level
- d. Dysrhythmias
- e. Confusion

YES

NO



<p>20. Which of the following symptoms do you expect Cameron to report? (All that apply)</p> <ul style="list-style-type: none">a. Vomitingb. Polyuriac. Polydipsiad. Weight losse. Warm/ dry skinf. Lethargy	<p>YES</p> <p>NO</p>	
<p>21. Why does Cameron have ketones in his blood? (All that apply)</p> <ul style="list-style-type: none">a. He has been on a high protein, no carbohydrate dietb. He hasn't eaten for several days due to feeling unwellc. He has taken ketone supplements to build muscled. His body has broken down fats instead of glucose because he lacks insulin	<p>YES</p> <p>NO</p>	
<p>22. Why do you think Cameron has a high blood sugar? (All that apply)</p> <ul style="list-style-type: none">a. Consumed too many carbohydratesb. Breakdown of stored glycogen in the liver due to a lack of insulinc. Dehydration from nausea and vomitingd. Didn't use his insulin	<p>YES</p> <p>NO</p>	



<p>23. Which of the following factor/s may contribute to Cameron’s metabolic acidosis? (All that apply)</p> <ul style="list-style-type: none">a. Sepsisb. Dehydrationc. He is dyingd. Ketonaemia	<p>YES</p> <p>NO</p>	
<p>24. Which factor/s increase Cameron’s risk of developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Young ageb. Type I diabetesc. Obesityd. Low socioeconomic status	<p>YES</p> <p>NO</p>	
<p>25. From the list of factors below, which factor may have contributed to Cameron to developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Prescription had expiredb. His GP had moved awayc. Feeling low from the burden of managing his diabetesd. Not understanding the importance of taking his medications regularlye. Losing his job and not being unable to afford to buy his insulin and testing supplies	<p>YES</p> <p>NO</p>	



<p>26. What are the potentially life threatening complications Cameron is at risk of developing whilst in DKA? (All that apply)</p> <p>a. Cardiac arrhythmias due to hypo- or hyperkalaemia</p> <p>b. Cerebral oedema due to rapid change in blood osmolarity if BGL falls too rapidly</p> <p>c. Refeeding syndrome from having no appetite for several days</p> <p>d. Pulmonary embolism due to the high viscosity of the blood whilst hyperglycaemic</p>	<p>YES</p> <p>NO</p>	



27. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your **assessment** of Cameron's condition. Number 1 being the top priority and 6 being lowest priority.

YES

NO

Priority	Nursing Action
	Measuring and regular monitoring of fluid status
	ECG and cardiac monitoring
	Ensure patent airway at all times
	Vital signs including neurological status
	Capillary BGL, ketones and VBG
	Report findings to medical staff to investigate precipitating cause

28. What factor/s do you think might have influenced your decisions to prioritise Cameron's **assessment** above? (All that apply)

- a. Prior experience
- b. Ward protocol
- c. Patient presentation
- d. Knowledge of DKA

YES

NO



<p>29. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your management of Cameron's condition. Number 1 being the top priority and 7 being lowest priority.</p>	<p>YES</p> <p>NO</p>																	
<table border="1"> <thead> <tr> <th>Priority</th> <th>Nursing Action</th> </tr> </thead> <tbody> <tr> <td></td> <td>Administer oxygen if appropriate</td> </tr> <tr> <td></td> <td>Obtain IV access</td> </tr> <tr> <td></td> <td>Set up insulin infusion as per doctor's plan</td> </tr> <tr> <td></td> <td>Commence fluid resuscitation as per doctor's plan</td> </tr> <tr> <td></td> <td>Give 10% glucose when indicated</td> </tr> <tr> <td></td> <td>Educate Cameron on the management plan</td> </tr> <tr> <td></td> <td>Supplement electrolytes as required/ prescribed</td> </tr> </tbody> </table>	Priority	Nursing Action		Administer oxygen if appropriate		Obtain IV access		Set up insulin infusion as per doctor's plan		Commence fluid resuscitation as per doctor's plan		Give 10% glucose when indicated		Educate Cameron on the management plan		Supplement electrolytes as required/ prescribed	<p>YES</p> <p>NO</p>	
Priority	Nursing Action																	
	Administer oxygen if appropriate																	
	Obtain IV access																	
	Set up insulin infusion as per doctor's plan																	
	Commence fluid resuscitation as per doctor's plan																	
	Give 10% glucose when indicated																	
	Educate Cameron on the management plan																	
	Supplement electrolytes as required/ prescribed																	
<p>30. What factor/s do you think might have influenced your decisions to prioritise Cameron's management above? (All that apply)</p> <p>a. Prior experience</p> <p>b. Ward protocol</p> <p>c. Patient presentation</p> <p>d. Knowledge of DKA</p>	<p>YES</p> <p>NO</p>																	

End of set



<p>32. What signs will you look for to determine if Cameron is fluid overloaded? (All that apply)</p> <ul style="list-style-type: none">a. Desaturation, tachycardia, tachypnoeab. Elevated urea and creatininec. Pitting oedema, dysuriad. History of heart and renal failure	<p>YES</p> <p>NO</p>	
<p>33. Why do patients with DKA require fluid replacement? (All that apply)</p> <ul style="list-style-type: none">a. Replace circulating volumeb. Dilute glucose in blood streamc. To keep IV cannula patentd. Replace depleted electrolytes	<p>YES</p> <p>NO</p>	
<p>34. What are the risks associated with aggressive fluid resuscitation? (All that apply)</p> <ul style="list-style-type: none">a. None, these patients always need fluidb. Acute pulmonary oedemac. Acute renal failured. Cardiac arrhythmias	<p>YES</p> <p>NO</p>	
<p>35. What would be the most appropriate type of insulin to administer in the initial management of DKA?</p> <ul style="list-style-type: none">a. Long actingb. Short actingc. Rapid actingd. Intermediate acting	<p>YES</p> <p>NO</p>	



<p>36. Patients receiving initial treatment for DKA require subcutaneous long-acting (basal) insulin.</p> <p>a. True</p> <p>b. False</p>	<p>YES</p> <p>NO</p>	
<p>37. Which of the following is a long-acting (basal) insulin?</p> <p>a. Novorapid</p> <p>b. Optisulin</p> <p>c. Humulog</p> <p>d. Ryzodeg</p>	<p>YES</p> <p>NO</p>	
<p>38. How does insulin work to lower blood glucose level? (All that apply)</p> <p>a. Stops the production of ketones</p> <p>b. Stimulates uptake of glucose into cells</p> <p>c. Stops the release of glucagon</p> <p>d. Inhibits glycogen conversion and release from the liver</p>	<p>YES</p> <p>NO</p>	
<p>39. What potassium level will you aim for?</p> <p>From [__] to [__]</p>	<p>YES</p> <p>NO</p>	



<p>40. The prescription states that you are required to supplement Cameron's potassium with 20mmol/hr of potassium chloride through a peripheral cannula. What are you going to do? (All that apply)</p> <p>a. Medical review to change the prescription</p> <p>b. Follow the prescription as written</p> <p>c. Request a central line to give higher doses of potassium</p> <p>d. Cardiac monitor the patient while infusion is running</p>	<p>YES</p> <p>NO</p>	
<p>41. Do electrolytes such as magnesium, calcium and phosphate need to be routinely replaced in patients with DKA?</p> <p>a. No, potassium is the only electrolyte that needs replacing</p> <p>b. No, it does not change the outcome for these patients</p> <p>c. Yes, these patients are at risk of refeeding syndrome</p> <p>d. Yes, only if the patient is cardiac monitored</p>	<p>YES</p> <p>NO</p>	

End of set

Internal Consistency: Set 5

1. Do these question items “generally” belong together in this question set?

YES / NO

(Please circle answer)

2. Please read each question item carefully and decide if each question belongs in this set of questions. In the box below, please circle **YES or NO** and add any comments you feel are necessary.



Question item	Does each question item belong in this set of questions?	Comments
42. Match the nursing actions with the corresponding rationale.	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	

Nursing Action	Rationale
Monitor fluid balance	To assess hydration status and titrate fluid resuscitation
ECG and cardiac monitoring	Electrolyte imbalances may cause cardiac arrhythmias
Hourly capillary BGL and ketones, 2-hourly VBGs	To monitor response to insulin and changes to acid-base status
Titrate insulin infusion	To provide adequate insulin to clear ketones and correct acidosis
IV fluid and electrolyte replacement	To correct fluid and electrolyte imbalances
Check vital signs and neurological status hourly	To identify improvement or deterioration in patient's condition and cognition
Check glycosylated haemoglobin (HbA1c)	To determine the average plasma glucose over a period of time
Give 10% glucose when indicated	To stabilise BGL whilst continuing IV insulin



You have been busy and haven't managed to check on Cameron for 2 hours. When you go to his room to check his glucose level and ketones, you find that his infusion pumps are alarming. Cameron says that he fell asleep so he doesn't know how long the pumps were not working. When you assess Cameron again, you identify the following issues.

43. Cameron's ketones have increased from 1.6 to 2.5. What do you do? (All that apply) a. Medical review b. Increase insulin rate c. Decrease insulin rate d. Nothing	YES NO	
44. Cameron has a BGL of 3.6. What do you do? (All that apply) a. Stop insulin b. Stop everything c. Give 60mL Carbotest d. Increase 10% glucose rate e. Request a medical review	YES NO	



<p>45. Cameron has not passed urine for 4 hours despite having received 3 litres of fluid. What do you do? (All that apply)</p> <p>a. Request a medical review to check his renal function</p> <p>b. Bladder scan and give him an opportunity to pass urine</p> <p>c. Stop the fluid until he voids, in case he becomes overloaded</p> <p>d. Insert an indwelling catheter and check his output hourly</p>	<p>YES</p> <p>NO</p>	
<p>46. You inform the doctor that Cameron is due for a blood gas. They tell you that it's not urgent, they are late for a meeting and will do it later. What do you do? (All that apply)</p> <p>a. Wait until after the meeting, and remind the doctor again</p> <p>b. Inform the coordinator who follows up with the doctor</p> <p>c. Find a nurse who is competent to take blood to do the test</p> <p>d. Leave all the infusions running and hand over that the blood gas is due</p>	<p>YES</p> <p>NO</p>	



<p>47. You reflect on the increase in Cameron's ketone level, his hypoglycaemic event and oliguria. What do you think was the cause for these changes in Cameron's status?</p> <p>a. These are normal fluctuations associated with the treatment for DKA</p> <p>b. These changes were preventable with frequent monitoring</p> <p>c. If the pumps were working properly, these changes would not have occurred</p> <p>d. Overall, Cameron was getting better so these changes don't matter</p> <p>e. Other [_____]</p>	<p>YES</p> <p>NO</p>	
<p>48. Do you think these complications had an impact on Cameron's outcome?</p> <p>a. Yes, they prolonged his treatment and hospital stay</p> <p>b. Yes, there was a risk of haemodynamic deterioration that would have required critical care input</p> <p>c. No, they are normal issues that arise and are easy to fix</p> <p>d. No, Cameron said he felt fine and was able to sleep</p> <p>e. Other [_____]</p>	<p>YES</p> <p>NO</p>	



Cameron is feeling much better, but he has some questions for you. He wants to know when he can eat again and when he can go home.

49. How long does it typically take for DKA to fully resolve? a. 6 hours b. 12 hours c. 24 hours d. 48 hours	YES NO	
50. How do you respond to Cameron's question about when he can eat and drink? a. "Sorry, you can't eat whilst on treatment for DKA" b. "You can eat whatever you like, but you'll probably just vomit" c. "I'm not sure but I can check with the doctor" d. "Yes, you can eat. I'll just watch your sugars and ketones closely"	YES NO	



<p>51. What are the criteria for stopping the DKA treatment?</p> <p>a. pH >7.3, Ketones <0.6 <i>and</i> Bicarbonate >18</p> <p>b. pH >7.3, Ketones <0.6 <i>or</i> Bicarbonate >18</p> <p>c. Potassium >3.5, BGL <11</p> <p>d. Whenever the doctors decide</p>	<p>YES</p> <p>NO</p>	
<p>52. Select the best option to convert Cameron from the IV insulin infusion to his normal subcutaneous insulin regime, assuming he is eating and drinking.</p> <p>a. Stop IV insulin, give subcutaneous injection 30 minutes later with meal</p> <p>b. Give subcutaneous injection with meal and stop IV infusion 30 minutes later</p> <p>c. Follow instructions from the doctor</p> <p>d. Follow instructions from the senior nurse</p>	<p>YES</p> <p>NO</p>	



<p>53. How would you transition Cameron from the DKA protocol to an insulin/dextrose infusion if he wasn't eating and drinking?</p> <p>a. Change 10% to 5% glucose, leave insulin rate the same, monitor BGL hourly</p> <p>b. Change 10% to 5% glucose, halve insulin rate, monitor BGL hourly</p> <p>c. Start 5% glucose at 60-80mL/hr and insulin at half daily dose over 24 hours</p> <p>d. Whatever the doctor prescribes</p>	<p>YES</p> <p>NO</p>	
<p>Cameron is eating and drinking and has had his normal Novorapid with his breakfast. He still wants to go home but you want to make sure he understands what has happened so that he doesn't come back again with the same problem.</p>		
<p>54. Cameron asks you about what DKA is and how it works. (All that apply)</p> <p>a. Refer to medical staff to answer Cameron's questions</p> <p>b. Educate Cameron on DKA pathophysiology in simple terms</p> <p>c. Consult Diabetes Educator for advice</p> <p>d. Ask shift coordinator to help you answer Cameron's questions</p>	<p>YES</p> <p>NO</p>	



<p>55. Cameron tell you he didn't take his insulin because he ran out and recently lost his job so he couldn't afford to buy more. How do you respond? (All that apply)</p> <p>a. Refer to social work for review of social situation</p> <p>b. Ignore it, he should be more responsible</p> <p>c. Say sorry that that has happened to him</p> <p>d. Consult Diabetes Educator for advice</p>	<p>YES</p> <p>NO</p>	
<p>56. Which of the following referrals will Cameron need on discharge from hospital? (All that apply)</p> <p>a. General Practitioner</p> <p>b. Diabetes Educator or Endocrinologist</p> <p>c. Mental Health</p> <p>d. None</p>	<p>YES</p> <p>NO</p>	
<p>57. Which allied health reviews do you think Cameron will need prior to discharge from hospital? (All that apply)</p> <p>a. Physiotherapy</p> <p>b. Pharmacy</p> <p>c. Dietitian</p> <p>d. Social Worker</p> <p>e. None</p>	<p>YES</p> <p>NO</p>	

End of set



<p>59. You noticed that Cameron’s potassium level dropped to 3.1 shortly after starting his treatment. What do you think happened? (All that apply)</p> <ul style="list-style-type: none">a. Potassium replacement wasn’t infusingb. Potassium ions move from the extracellular space to the intracellular compartment, therefore serum potassium level dropsc. Renal function improved with increased perfusion to the kidneys, therefore potassium level droppedd. Potassium level on a VBG is not always accurate	<p>YES</p> <p>NO</p>	
<p>60. What would have helped you make decisions whilst managing Cameron’s DKA? (All that apply)</p> <ul style="list-style-type: none">a. A better understanding of DKA pathophysiologyb. More confidence in what you know about DKAc. A user-friendly protocol to followd. More supervision and guidance from senior nursing staffe. Other [_____]	<p>YES</p> <p>NO</p>	



Please reflect on the following statements and respond with your level of agreement or disagreement.

61. I am confident to educate patients on how to prevent a recurrence of DKA. a. Strongly agree b. Agree c. Disagree d. Strongly Disagree	YES NO	
62. I am confident to manage complications associate with treating patients for DKA. a. Strongly agree b. Agree c. Disagree d. Strongly Disagree	YES NO	
63. I think the DKA protocol used at Armadale Health Service helps me to make decisions as a nurse. a. Strongly agree b. Agree c. Disagree d. Strongly Disagree	YES NO	



<p>64. I think the DKA protocol used at Armadale Health Service promotes autonomy among nurses.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	
<p>65. I think the DKA protocol at Armadale Health Service should have more input from nurses who manage patients with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	
<p>66. I think socioeconomic and psychological issues contribute to patients presenting with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	



<p>67. I think patients who have experienced DKA usually understand their treatment plan.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	
<p>68. I would have sought help from one of my colleagues to help me manage Cameron's DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	
<p>69. I would like more education on the nursing management of patients with DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	

Thank you for completing Step 2

Please continue on to Step 3.

Appendix I

Expert Panel Review of Content Validity

Step 3 Instructions: Content Validity

The questions below have been designed to gather data to measure the level of knowledge of RNs who manage patients with DKA and what decisions they make. The questions were developed following an extensive review of the current literature focusing on current DKA management protocols and nursing decision-making processes.

You are being asked to look at the questionnaire items listed in the separate sets below and indicate if these items measure registered nurses' DKA knowledge and decision-making.

Please look at one set of items at a time. Read the entire set of items in the list before answering the response questions for that set.

1. Once you have read the entire set of items, please answer question 1 at the top of the page first.
2. Then answer questions 2 and 3 for each individual item in the set.
3. Finally indicate if anything has been left off the question item list for the set that you feel should be added.

Once you have finished reviewing the potential questionnaire items, feel free to discuss your comments with me. Could you please return the completed review to me by **21st September 2020**. Thank you for your help.

Regards,

Megan Westphalen.

Set 1 Label: Demographics

Definition: Characteristics of the nurses' training, experience and current role at Armadale Health Service.

1. Please read the label and definition above. Then please read all question items in the set below. In general, does the label and definition fit with the whole set of question items below?

YES / NO (Please circle)

Please read each question item carefully and answer questions 2 and 3 by circling **YES** or **NO** in the boxes below.

Question item	2. Does each question item belong to the label and definition above?	3. Is each item unique in the set?
1. What is your current job title? a. Enrolled Nurse b. Graduate Registered Nurse c. Registered Nurse d. Clinical Nurse/ Staff Development Nurse e. Other _____	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>
2. What is your gender? a. Male b. Female c. Other d. Prefer not to say	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>



3. In which clinical area do you predominantly work?	YES	YES
a. Medical Admissions Unit		
b. Intensive Care Unit	NO	NO
c. Emergency Department		
4. How long have you worked in this area? (Number in whole years)	YES	YES
	NO	NO
5. What is your highest level of education?		
a. Bachelor's Degree (or equivalent)	YES	YES
b. Postgraduate Certificate / Diploma		
c. Master's Degree	NO	NO
d. Doctorate		
6. What area or speciality did you complete your highest qualification? (Please specify)	YES	YES
	NO	NO
7. How many years in total have you worked as a registered nurse? (Number in whole years)	YES	YES
	NO	NO
8. At which institution did you complete your undergraduate degree (or equivalent)? (Please specify)	YES	YES
	NO	NO
9. What type of employment contract do you currently have?		
a. Permanent full/ part time	YES	YES
b. Fixed full/ part time		
c. Secondment	NO	NO
d. Casual		

4. Is anything left off the question item list for the set that you feel should be added?

End of set

Set 2 Label: Background

Definition: Description of nurses' experience with specific reference to adult patients with diabetic ketoacidosis.

1. Please read the label and definition above. Then please read all question items in the set below. In general, does the label and definition fit with the whole set of question items below?

YES / NO (Please circle)

Please read each question item carefully and answer questions 2 and 3 by circling **YES** or **NO** in the boxes below.

Question item	2. Does each question item belong to the label and definition above?	3. Is each item unique in the set?
10. I have attended education related to the management of adults with DKA within the last 12 months. a. Yes b. No	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>
11. I have seen a patient with DKA in my clinical area. a. Yes b. No	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">NO</p>

4. Is anything left off the question item list for the set that you feel should be added?

End of set

Set 3 Label: Noticing

Definition: First aspect of the Clinical Judgment Model; “a perceptual grasp of the situation at hand” (Tanner, 2006)

1. Please read the label and definition above. Then please read all question items in the set below. In general, does the label and definition fit with the whole set of question items below?

YES / NO (Please circle)

Please read each question item carefully and answer questions 2 and 3 by circling **YES** or **NO** in the boxes below.

Question item	2. Does each question item belong to the label and definition above?	3. Is each item unique in the set?
<p>Cameron is a 25-year-old man with Type I diabetes, diagnosed when he was 10. He is normally fit and well, doesn't smoke, drinks alcohol on social occasions and does not use illicit drugs. Up until recently, he worked as a carpenter. He attends his diabetes clinic appointments regularly and has never been hospitalised for diabetes.</p> <p>Cameron made an appointment with his GP because he was feeling generally unwell with nausea and vomiting. He tested his BGL at home and his machine said “HI” so he went to the GP to have his blood glucose level checked. He told the GP that he hadn't taken his insulin for a couple of days, but didn't say why. The GP suspected he had diabetic ketoacidosis (DKA) so he wrote a letter referring Cameron to the hospital. Cameron shows the letter to a nurse when he arrives at the hospital.</p>		



<p>12. From the list of definitions below, select the one that best matches your understanding of diabetic ketoacidosis?</p> <p>New or known diabetes and...</p> <p>a. Presence of ketones and metabolic acidosis</p> <p>b. Absence of ketones and metabolic acidosis</p> <p>c. Presence of ketones and metabolic alkalosis</p> <p>d. Absence of ketones and metabolic alkalosis</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>13. What is hyperglycaemia? High blood concentration of:</p> <p>a. Glucose</p> <p>b. Iron</p> <p>c. Insulin</p> <p>d. Bicarbonate</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>14. What are ketones?</p> <p>a. Protein for muscle development</p> <p>b. Neurotransmitter for fine motor skills</p> <p>c. Hormone to lower glucose level</p> <p>d. By-product of breaking down fats</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



15. Cameron has a deficiency of which of the following hormones? a. Insulin b. Cortisol c. Glucagon d. Catecholamines	YES	YES
16. What is the normal range for blood glucose level? From [] to []	YES	YES
17. What is the normal range for blood ketone level? From [] to []	YES	YES
18. What values do you expect to see for the following biochemical markers if Cameron has DKA? a. Blood Glucose > [] b. Blood Ketones > [] c. pH < [] d. Bicarbonate < []	YES	YES



You have conducted an initial assessment of Cameron. His vital signs and first venous blood gas results are as follows:

Respiratory rate	28
Blood pressure	110/50
O₂ saturations	94% on room air
Heart rate	120
Temperature	37.5
Ketones	4.4

pH	7.20
pO₂	95
pCO₂	23
Bicarbonate	15
Potassium	4.2
Glucose	32

19. Cameron is tachycardic and tachypneic.
Based on your experience of managing adults with DKA, what other signs do you often observe during your assessment? (All that apply)

- a. Acetone smell
- b. Hypovolaemia
- c. Altered conscious level
- d. Dysrhythmias
- e. Confusion

YES

YES

NO

NO



<p>20. Which of the following symptoms do you expect Cameron to report? (All that apply)</p> <ul style="list-style-type: none">a. Vomitingb. Polyuriac. Polydipsiad. Weight losse. Warm/ dry skinf. Lethargy	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>21. Why does Cameron have ketones in his blood? (All that apply)</p> <ul style="list-style-type: none">a. He has been on a high protein, no carbohydrate dietb. He hasn't eaten for several days due to feeling unwellc. He has taken ketone supplements to build muscled. His body has broken down fats instead of glucose because he lacks insulin	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>22. Why do you think Cameron has a high blood sugar? (All that apply)</p> <ul style="list-style-type: none">a. Consumed too many carbohydratesb. Breakdown of stored glycogen in the liver due to a lack of insulinc. Dehydration from nausea and vomitingd. Didn't use his insulin	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



<p>23. Which of the following factor/s may contribute to Cameron's metabolic acidosis? (All that apply)</p> <ul style="list-style-type: none">a. Sepsisb. Dehydrationc. He is dyingd. Ketonaemia	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>24. Which factor/s increase Cameron's risk of developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Young ageb. Type I diabetesc. Obesityd. Low socioeconomic status	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>25. From the list of factors below, which factor may have contributed to Cameron to developing DKA? (All that apply)</p> <ul style="list-style-type: none">a. Prescription had expiredb. His GP had moved awayc. Feeling low from the burden of managing his diabetesd. Not understanding the importance of taking his medications regularlye. Losing his job and not being unable to afford to buy his insulin and testing supplies	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



<p>26. What are the potentially life threatening complications Cameron is at risk of developing whilst in DKA? (All that apply)</p> <p>a. Cardiac arrhythmias due to hypo- or hyperkalaemia</p> <p>b. Cerebral oedema due to rapid change in blood osmolarity if BGL falls too rapidly</p> <p>c. Refeeding syndrome from having no appetite for several days</p> <p>d. Pulmonary embolism due to the high viscosity of the blood whilst hyperglycaemic</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>27. Consider the following nursing actions in the table below. Please order them according to how you would prioritise your assessment of Cameron's condition. Number 1 being the top priority and 6 being lowest priority.</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>

Priority	Nursing Action
	Measuring and regular monitoring of fluid status
	ECG and cardiac monitoring
	Ensure patent airway at all times
	Vital signs including neurological status
	Capillary BGL, ketones and VBG
	Report findings to medical staff to investigate precipitating cause



30. What factor/s do you think might have influenced your decisions to prioritise Cameron's management above? (All that apply) a. Prior experience b. Ward protocol c. Patient presentation d. Knowledge of DKA	YES NO	YES NO
--	-----------------------------	-----------------------------

4. Is anything left off the question item list for the set that you feel should be added?

End of set



32. What signs will you look for to determine if Cameron is fluid overloaded? (All that apply)	YES	YES
a. Desaturation, tachycardia, tachypnoea		
b. Elevated urea and creatinine	NO	NO
c. Pitting oedema, dysuria		
d. History of heart and renal failure		
33. Why do patients with DKA require fluid replacement? (All that apply)	YES	YES
a. Replace circulating volume		
b. Dilute glucose in blood stream	NO	NO
c. To keep IV cannula patent		
d. Replace depleted electrolytes		
34. What are the risks associated with aggressive fluid resuscitation? (All that apply)	YES	YES
a. None, these patients always need fluid		
b. Acute pulmonary oedema	NO	NO
c. Acute renal failure		
d. Cardiac arrhythmias		
35. What would be the most appropriate type of insulin to administer in the initial management of DKA?	YES	YES
a. Long acting		
b. Short acting	NO	NO
c. Rapid acting		
d. Intermediate acting		



36. Patients receiving initial treatment for DKA require subcutaneous long-acting (basal) insulin. a. True b. False	YES NO	YES NO
37. Which of the following is a long-acting (basal) insulin? a. Novorapid b. Optisulin c. Humalog d. Ryzodeg	YES NO	YES NO
38. How does insulin work to lower blood glucose level? (All that apply) a. Stops the production of ketones b. Stimulates uptake of glucose into cells c. Stops the release of glucagon d. Inhibits glycogen conversion and release from the liver	YES NO	YES NO
39. What potassium level will you aim for? From [__] to [__]	YES NO	YES NO



<p>40. The prescription states that you are required to supplement Cameron's potassium with 20mmol/hr of potassium chloride through a peripheral cannula.</p> <p>What are you going to do? (All that apply)</p> <p>a. Medical review to change the prescription</p> <p>b. Follow the prescription as written</p> <p>c. Request a central line to give higher doses of potassium</p> <p>d. Cardiac monitor the patient while infusion is running</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>41. Do electrolytes such as magnesium, calcium and phosphate need to be routinely replaced in patients with DKA?</p> <p>a. No, potassium is the only electrolyte that needs replacing</p> <p>b. No, it does not change the outcome for these patients</p> <p>c. Yes, these patients are at risk of refeeding syndrome</p> <p>d. Yes, only if the patient is cardiac monitored</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>

4. Is anything left off the question item list for the set that you feel should be added?

End of set

Set 5 Label: Responding

Definition: Third aspect of the Clinical Judgment Model; “deciding on a course of action deemed appropriate for the situation” (Tanner, 2006).

1. Please read the label and definition above. Then please read all question items in the set below. In general, does the label and definition fit with the whole set of question items below?

YES / NO (Please circle)

Please read each question item carefully and answer questions 2 and 3 by circling **YES** or **NO** in the boxes below.



Question item	2. Does each question item belong to the label and definition above?	3. Is each item unique in the set?																		
<p>You have started Cameron on his treatment as per the plan. You are monitoring him regularly for signs of deterioration. He looks tired but says he “feels fine and just wants to sleep”.</p>																				
<p>42. Match the nursing actions with the corresponding rationale.</p>	<p>YES NO</p>	<p>YES NO</p>																		
	<table border="1"> <thead> <tr> <th>Nursing Action</th> <th>Rationale</th> </tr> </thead> <tbody> <tr> <td>Monitor fluid balance</td> <td>To assess hydration status and titrate fluid resuscitation</td> </tr> <tr> <td>ECG and cardiac monitoring</td> <td>Electrolyte imbalances may cause cardiac arrhythmias</td> </tr> <tr> <td>Hourly capillary BGL and ketones, 2-hourly VBGs</td> <td>To monitor response to insulin and changes to acid-base status</td> </tr> <tr> <td>Titrate insulin infusion</td> <td>To provide adequate insulin to clear ketones and correct acidosis</td> </tr> <tr> <td>IV fluid and electrolyte replacement</td> <td>To correct fluid and electrolyte imbalances</td> </tr> <tr> <td>Check vital signs and neurological status hourly</td> <td>To identify improvement or deterioration in patient’s condition and cognition</td> </tr> <tr> <td>Check glycosylated haemoglobin (HbA1c)</td> <td>To determine the average plasma glucose over a period of time</td> </tr> <tr> <td>Give 10% glucose when indicated</td> <td>To stabilise BGL whilst continuing IV insulin</td> </tr> </tbody> </table>	Nursing Action	Rationale	Monitor fluid balance	To assess hydration status and titrate fluid resuscitation	ECG and cardiac monitoring	Electrolyte imbalances may cause cardiac arrhythmias	Hourly capillary BGL and ketones, 2-hourly VBGs	To monitor response to insulin and changes to acid-base status	Titrate insulin infusion	To provide adequate insulin to clear ketones and correct acidosis	IV fluid and electrolyte replacement	To correct fluid and electrolyte imbalances	Check vital signs and neurological status hourly	To identify improvement or deterioration in patient’s condition and cognition	Check glycosylated haemoglobin (HbA1c)	To determine the average plasma glucose over a period of time	Give 10% glucose when indicated	To stabilise BGL whilst continuing IV insulin	
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Give 10% glucose when indicated	To stabilise BGL whilst continuing IV insulin																			



You have been busy and haven't managed to check on Cameron for 2 hours. When you go to his room to check his glucose level and ketones, you find that his infusion pumps are alarming. Cameron says that he fell asleep so he doesn't know how long the pumps were not working. When you assess Cameron again, you identify the following issues.

43. Cameron's ketones have increased from 1.6 to 2.5. What do you do? (All that apply) a. Medical review b. Increase insulin rate c. Decrease insulin rate d. Nothing	YES NO	YES NO
44. Cameron has a BGL of 3.6. What do you do? (All that apply) a. Stop insulin b. Stop everything c. Give 60mL Carbotest d. Increase 10% glucose rate e. Request a medical review	YES NO	YES NO



<p>45. Cameron has not passed urine for 4 hours despite having received 3 litres of fluid.</p> <p>What do you do? (All that apply)</p> <p>a. Request a medical review to check his renal function</p> <p>b. Bladder scan and give him an opportunity to pass urine</p> <p>c. Stop the fluid until he voids, in case he becomes overloaded</p> <p>d. Insert an indwelling catheter and check his output hourly</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>46. You inform the doctor that Cameron is due for a blood gas. They tell you that it's not urgent, they are late for a meeting and will do it later. What do you do? (All that apply)</p> <p>a. Wait until after the meeting, and remind the doctor again</p> <p>b. Inform the coordinator who follows up with the doctor</p> <p>c. Find a nurse who is competent to take blood to do the test</p> <p>d. Leave all the infusions running and hand over that the blood gas is due</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



<p>47. You reflect on the increase in Cameron's ketone level, his hypoglycaemic event and oliguria. What do you think was the cause for these changes in Cameron's status?</p> <p>a. These are normal fluctuations associated with the treatment for DKA</p> <p>b. These changes were preventable with frequent monitoring</p> <p>c. If the pumps were working properly, these changes would not have occurred</p> <p>d. Overall, Cameron was getting better so these changes don't matter</p> <p>e. Other [_____]</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>48. Do you think these complications had an impact on Cameron's outcome?</p> <p>a. Yes, they prolonged his treatment and hospital stay</p> <p>b. Yes, there was a risk of haemodynamic deterioration that would have required critical care input</p> <p>c. No, they are normal issues that arise and are easy to fix</p> <p>d. No, Cameron said he felt fine and was able to sleep</p> <p>e. Other [_____]</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



Cameron is feeling much better, but he has some questions for you. He wants to know when he can eat again and when he can go home.

49. How long does it typically take for DKA to fully resolve? a. 6 hours b. 12 hours c. 24 hours d. 48 hours	YES NO	YES NO
50. How do you respond to Cameron's question about when he can eat and drink? a. "Sorry, you can't eat whilst on treatment for DKA" b. "You can eat whatever you like, but you'll probably just vomit" c. "I'm not sure but I can check with the doctor" d. "Yes, you can eat. I'll just watch your sugars and ketones closely"	YES NO	YES NO
51. What are the criteria for stopping the DKA treatment? a. pH >7.3, Ketones <0.6 <i>and</i> Bicarbonate >18 b. pH >7.3, Ketones <0.6 <i>or</i> Bicarbonate >18 c. Potassium >3.5, BGL <11 d. Whenever the doctors decide	YES NO	YES NO



<p>52. Select the best option to convert Cameron from the IV insulin infusion to his normal subcutaneous insulin regime, assuming he is eating and drinking.</p> <p>a. Stop IV insulin, give subcutaneous injection 30 minutes later with meal</p> <p>b. Give subcutaneous injection with meal and stop IV infusion 30 minutes later</p> <p>c. Follow instructions from the doctor</p> <p>d. Follow instructions from the senior nurse</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>53. How would you transition Cameron from the DKA protocol to an insulin/dextrose infusion if he wasn't eating and drinking?</p> <p>a. Change 10% to 5% glucose, leave insulin rate the same, monitor BGL hourly</p> <p>b. Change 10% to 5% glucose, halve insulin rate, monitor BGL hourly</p> <p>c. Start 5% glucose at 60-80mL/hr and insulin at half daily dose over 24 hours</p> <p>d. Whatever the doctor prescribes</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>Cameron is eating and drinking and has had his normal Novorapid with his breakfast. He still wants to go home but you want to make sure he understands what has happened so that he doesn't come back again with the same problem.</p>		



<p>54. Cameron asks you about what DKA is and how it works. (All that apply)</p> <p>a. Refer to medical staff to answer Cameron's questions</p> <p>b. Educate Cameron on DKA pathophysiology in simple terms</p> <p>c. Consult Diabetes Educator for advice</p> <p>d. Ask shift coordinator to help you answer Cameron's questions</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>55. Cameron tell you he didn't take his insulin because he ran out and recently lost his job so he couldn't afford to buy more. How do you respond? (All that apply)</p> <p>a. Refer to social work for review of social situation</p> <p>b. Ignore it, he should be more responsible</p> <p>c. Say sorry that that has happened to him</p> <p>d. Consult Diabetes Educator for advice</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>56. Which of the following referrals will Cameron need on discharge from hospital? (All that apply)</p> <p>a. General Practitioner</p> <p>b. Diabetes Educator or Endocrinologist</p> <p>c. Mental Health</p> <p>d. None</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



57. Which allied health reviews do you think Cameron will need prior to discharge from hospital? (All that apply) a. Physiotherapy b. Pharmacy c. Dietitian d. Social Worker e. None	YES NO	YES NO
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4. Is anything left off the question item list for the set that you feel should be added?

End of set



<p>59. You noticed that Cameron’s potassium level dropped to 3.1 shortly after starting his treatment. What do you think happened? (All that apply)</p> <p>a. Potassium replacement wasn’t infusing</p> <p>b. Potassium ions move from the extracellular space to the intracellular compartment, therefore serum potassium level drops</p> <p>c. Renal function improved with increased perfusion to the kidneys, therefore potassium level dropped</p> <p>d. Potassium level on a VBG is not always accurate</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>60. What would have helped you make decisions whilst managing Cameron’s DKA? (All that apply)</p> <p>a. A better understanding of DKA pathophysiology</p> <p>b. More confidence in what you know about DKA</p> <p>c. A user-friendly protocol to follow</p> <p>d. More supervision and guidance from senior nursing staff</p> <p>e. Other [_____]</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>Please reflect on the following statements and respond with your level of agreement or disagreement.</p>		



<p>61. I am confident to educate patients on how to prevent a recurrence of DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>62. I am confident to manage complications associate with treating patients for DKA.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>63. I think the DKA protocol used at Armadale Health Service helps me to make decisions as a nurse.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>64. I think the DKA protocol used at Armadale Health Service promotes autonomy among nurses.</p> <p>a. Strongly agree</p> <p>b. Agree</p> <p>c. Disagree</p> <p>d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



<p>65. I think the DKA protocol at Armadale Health Service should have more input from nurses who manage patients with DKA.</p> <p>a. Strongly agree b. Agree c. Disagree d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>66. I think socioeconomic and psychological issues contribute to patients presenting with DKA.</p> <p>a. Strongly agree b. Agree c. Disagree d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>
<p>67. I think patients who have experienced DKA usually understand their treatment plan.</p> <p>a. Strongly agree b. Agree c. Disagree d. Strongly Disagree</p>	<p>YES</p> <p>NO</p>	<p>YES</p> <p>NO</p>



68. I would have sought help from one of my colleagues to help me manage Cameron's DKA. a. Strongly agree b. Agree c. Disagree d. Strongly Disagree	YES NO	YES NO
69. I would like more education on the nursing management of patients with DKA. a. Strongly agree b. Agree c. Disagree d. Strongly Disagree	YES NO	YES NO

4. Is anything left off the question item list for the set that you feel should be added?

End of set

Thank you for completing Step 3

Appendix J

Recruitment Flyer

Registered nurses managing patients with diabetic ketoacidosis

If you are a registered nurse from ED, MAU or ICU at Armadale Health Service, you are invited to participate in this research study.

This study focuses on the nursing management of adults diagnosed with diabetic ketoacidosis and provides an opportunity for registered nurses to participate in research.

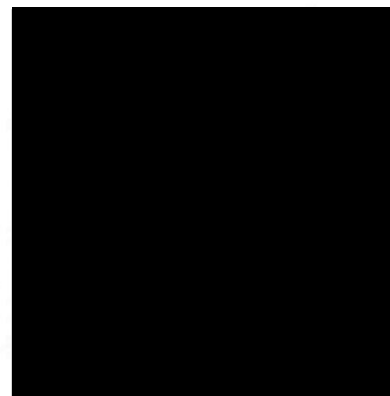
The purpose of this study is threefold: to identify what level of knowledge RNs have, what decision-making processes they use and what factors influence decision making when managing adults with DKA. This study will help nurses to fill a gap in the research literature on the role of registered nurses who manage these patients.

To participate in this study, RNs will be asked to:

- complete an online survey to explore what nurses know and what decisions they make in response to a DKA case study
- take part in a follow up interview to discuss the rationale for the responses to the case study.

Surveys will be emailed to registered nurses from ED, MAU and ICU via WA Health Global network on Monday 22nd Feb 2021, with 4 weeks for participants to respond. Those who consent to a follow up interview will be asked to provide contact details at the end of the survey.

Participation is completely voluntary. The University of Notre Dame, Australia is responsible for this study. This project has been granted ethical approval by the Royal Perth Hospital Human Research Ethics Committee.



If you have any questions, please email the researcher:

Megan Westphalen, MPhil student
University of Notre Dame, Australia
megan.westphalen1@my.nd.edu.au

<https://www.surveymonkey.com/r/M8Z8YV>



University of Notre Dame, Australia

Appendix K

Interview Consent Form

CONSENT FORM

An investigation of registered nurses' knowledge and the decision-making processes used in the management of adults with diabetic ketoacidosis

- I understand that the research staff are conducting the study on behalf of the University of Notre Dame.
- I agree to take part in this research project.
- I have read the Information Sheet provided and been given a full explanation of the purpose of this research project and what is involved.
- I understand that I will be interviewed and that the interview will be audio-recorded.
- The researcher has answered all of my questions and has explained possible risks that may arise as a result of the interview and how these risks will be managed.
- I understand that I do not have to answer specific questions if I do not want to and may withdraw from participation in the project at any time without reason or justification and that this will not have an impact on my employment status.
- I understand that all information provided by me is treated as confidential and will not be released by the researcher to a third party unless required to do so by law.
- I agree that any research data gathered for the study may be published provided my name or other identifying information is not disclosed.

Name of participant			
Signature of participant		Date	

- I confirm that I have provided the Information Sheet concerning this research project to the above participant, explained what participating involves and have answered all questions asked of me.

Signature of researcher		Date	
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