A Reflective Learning Conversation Model for Active Clinical Reasoning Skills for Nurses Undertaking Critical Care Simulation-Based Courses

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ABSTRACT

Background: Critical care nurses should be competent and have effective clinical reasoning skills to avoid errors in practice. Simulation-Based Education (SBE) develops nurses' competence and clinical reasoning skills. During SBE, debriefing enhances and optimises participants' clinical reasoning skills through guided reflection. However, the current debriefing models were established to develop general nursing clinical reasoning skills. They were not explicitly developed or evaluated to consider how different learners' experience, seniority, and competence levels within a multicultural learning environment can impact the development of clinical reasoning skills. Based on gaps in the literature, a multimodal and multi-phasic post-simulation Reflective Learning Conversation (RLC) debriefing model was co-designed to enhance learners' clinical reasoning skills while accounting for variations in learners' professional experience, using a range of scenarios. This study aimed to evaluate this newly co-designed debriefing model for immersive critical care SBE.

Design: The study was conducted in three phases: systematic scoping review, co-design of a post-simulation reflective learning conversation debriefing model, and finally, testing the validity and reliability of the model. The co-design phase included a working group of healthcare practitioners and patients (n=18). Reliability measures were tested through mixed methods experimental and pre-test/post-test research design. The study sample consisted of a cohort of critical care nurses and advanced nurse practitioners recruited from nine governmental tertiary hospitals in Qatar (n=110) equally split between experimental and control groups, both taking part in immersive critical care SBE sessions. The data collected included questionnaire responses, focus group, subsequent direct observations, and video reviews of nurses' clinical reasoning using valid and reliable assessment tools. Descriptive and inferential statistical analyses were applied to the quantitative data. The descriptive

analysis included the mean, median, and standard deviation. The inferential data analysis included Mann-Whitney/ Wilcoxon Sum tests to compare the clinical reasoning levels between the experimental and control groups. Friedman test was used to conduct repeated measures to evaluate the progress of the clinical reasoning levels within both groups. Thematic analysis was performed on the qualitative data.

Results: The scoping review findings, based on 26 articles, revealed that despite the availability of several debriefing and clinical reasoning models and tools to enhance the development of clinical reasoning skills while attending SBE, these models were not explicitly developed or evaluated with consideration for variations in learners' competence, seniority, culture, and prior exposure to SBE. A multimodal and multiphasic post-simulation reflective learning conversation debriefing model was co-designed for immersive SBE. The model included four phases incorporating: Bloom's Taxonomy; Appreciative Inquiry; and the Plus/Delta (continuous improvement discussion) methods. It includes scripted examples to guide the simulation educators during the simulation debriefing sessions. The new model was deemed valid and reliable for critical care immersive SBE. It enabled nurses to develop clinical reasoning skills whilst considering their psychological safety and mitigating the risk of cognitive overload. The experimental group had a significantly higher level of clinical reasoning compared to the control group ($p = [.608, <.001, <.001]$ $z = [-.513, -3.729, -5.850]$ respectively) for three different observations. The model demonstrated Cronbach alpha and intra-class correlation coefficients of $\alpha = 0.968$ and $\alpha = 0.972$ respectively.

Conclusion: A post-simulation reflective learning conversation debriefing model was co-designed and tested in the context of critical care immersive SBE sessions, considering variations in nurses' seniority, experiences, and competence levels in a multicultural learning environment. The model was deemed to be valid and reliable for enhancing and optimising nurses' clinical reasoning skills.

GLOSSARY

ASPiH	Association for Simulated Practice in Healthcare
CCFP	Critical Care Foundation Programme
CR	Clinical Reasoning
ECMO	Extracorporeal Membrane Oxygenation
HEE	Health Education England
HEE TEL	Education England Technology Enhanced Learning
HMC	Hamad Medical Corporation
ICC	Intra-class Correlation Coefficient
ICU	Intensive Care Unit
MICU	Medical Intensive Care Unit
SICU	Surgical Intensive Care Unit
TICU	Trauma Intensive Care Unit
CICU	Cardiac Intensive Care Unit
INACSL	International Nurses Association for Clinical Simulation and Learning
IJoHS	International Journal of Healthcare Simulation
JBI	Joanna Briggs Institute
JCI	Joint Commission International
JEMTAC	Journal of Emergency Medicine, Trauma, and Acute Care
NHS	National Healthcare Service
NMED	Nursing and Midwifery Education Department
PRISMA	Preferred Reporting Items for Systematic Reviews
PRISMA-ScR	Preferred Reporting Items for Systematic Reviews-Extension for Scoping Reviews
RCT	Randomised Control Trials
RLC	Reflective Learning Conversation
SBE	Simulation-Based Education
SNIP	Source-Normalized Impact per Paper
NCRS	Nurses Clinical Reasoning Scale
GSE	General Self-Efficacy
LCJR	Lasater Clinical Reasoning Rubric
CREST	Clinical Reasoning Evaluation Simulation Tool

CHAPTER 1: INTRODUCTION AND PROBLEM STATEMENT

1.1 Introduction

This chapter explores clinical reasoning as a pivotal component of healthcare practices, emphasising its relevance within the high-stakes critical care environment and varying patient severity levels. It includes an overview of the post-simulation Reflective Learning Conversation (RLC) as a simulation debriefing method, the research site and included departments, the research problem and questions, and the structure and chapters of this PhD thesis.

1.2 Qatar's Cultural Context

Qatar is in the Middle East and has a unique population structure characterized by a high proportion of expatriates. Although Qatar is often perceived as a monocultural context, its healthcare sector—particularly within Hamad Medical Corporation (HMC)—is characterised by a highly multicultural workforce. Expatriate clinicians from Asia, Africa, Europe, and the Middle East constitute most staff, bringing varied professional norms and communication styles (National Planning Council, 2024). The total population of Qatar is approximately 2.9 million people (National Planning Council, 2024). Around 300,000 residents are of Qatari nationality, accounting for roughly 10-12% of the total population and the remaining 88-90% of the population are expatriates. Qatar's demographic profile features a notable gender

imbalance, with males constituting 75% of the population due to the high influx of male labourers.

This disparity creates unique challenges in healthcare provision, workforce planning, and Simulation-Based Education (SBE), necessitating culturally and contextually responsive educational models. SBE sessions at HMC routinely include nurses from multiple nationalities, creating a learning environment in which cultural diversity is not peripheral but central to group dynamics, communication, and reflective practice. The country provides healthcare services to nationals and expatriates through public and private healthcare facilities (Hijjeh et al., 2019). As described in section (1.5.1), Hamad Medical Corporation (HMC) - the study site, is the primary provider of public healthcare services operating several hospitals and clinics across Qatar (Hijjeh et al., 2019). HMC provides a wide range of healthcare services including the critical care services described in the next section.

1.3 The Critical Care Environment

Critical care has been regarded as a stressful environment with high work intensity (Vahedian-Azimi et al., 2019). In *critical care,* multiprofessional healthcare teams provide care and treatment for patients with, or at risk of developing, acute and life-threatening organ dysfunction (Jakimowicz et al., 2018). Every year in the UK around 200,000 patients are admitted to an Intensive Care Unit (ICU) (ICNARC, 2024), and in Qatar around 10,000 are annually admitted to an ICU (Hijjeh et al., 2019). The mortality rates of these patients are similar across countries, reaching 14% (23,000) of UK's ICU patients, and 15% (1,500) of Qatar's ICU patients (ICNARC, 2024; Hijjeh et al., 2019), reflecting their level of critical illness.

In 2021, the UK redefined the classification of adult critical care severity levels to align with the evolving delivery model and changing demands of critical care (ICS, 2024). This system categorises patient severity into four levels (ICS, 2021, p.1). Level 0 applies to patients whose needs are met through routine ward care in an acute hospital. This includes those recently transferred from higher levels of care but manageable on a ward with additional advice and support from the critical care outreach team. These patients remain at risk of clinical deterioration (ICS, 2021, p.1). Level 1 encompasses patients requiring more detailed observations or basic support for a single organ system. It also includes patients stepping down from higher care levels or needing interventions to prevent deterioration or address rehabilitation needs beyond standard ward capabilities. Critical care outreach teams may also provide ongoing interventions for such patients (ICS, 2021, p.1). Level 2 refers to patients needing close monitoring or intervention, including support for a single failing organ system, postoperative care, or those transitioning from higher care levels (ICS, 2021, p.1). Level 3 involves patients requiring advanced respiratory support alone or monitoring and support for two or more organ systems (ICS, 2021, p.1).

Outside the UK, many countries use a three-level critical care classification (Marshall et al., 2017; Sarkar et al., 2021). Level 1 provides oxygen, non-invasive monitoring, and enhanced nursing care compared to standard wards. Level 2 offers invasive monitoring and basic life support for brief periods. Level 3 delivers comprehensive monitoring and life support technologies and serves as a regional hub for critically ill patients (Marshall et al., 2017). In Qatar, the UK's critical care patient severity classification system is applied, as summarised in Table 1 (Hijjeh et al., 2019).

Table 1. Patient severity levels in Qatar

Level of Care	Description	Examples of Care Needs
Level 0	Normal ward care.	No additional support beyond routine care.
Level 1	Patients at risk of deteriorating or recently discharged from higher levels of care.	Requires increased observation or intervention.
Level 2 High Dependency Unit (HDU)	Patients need more intensive observation or support. Single-organ support	Patients need continuous support using intravenous blood pressure medication, non-invasive ventilation Postoperative care following major surgery. Step-down care for stabilized ICU patients
Level 3 Intensive Care Unit (ICU)	Patients requiring advanced respiratory support or multi-organ support.	Advanced respiratory support (e.g., mechanical ventilation). Monitoring and support for two or more organ systems (e.g., renal replacement therapy with respiratory support). Complex invasive interventions (e.g., intracranial pressure monitoring)

Critical care practice frequently involves urgent situations and emergencies where immediate interventions are critical to saving lives (Chamberlain et al., 2018). The high workload and complexity inherent in critical care can increase the risk of errors and mistakes by healthcare providers (Serafim et al., 2017; Siffleet et al., 2015).

A review of patient safety incidents in critical care units across England and Wales revealed that 77% of reported incidents with harm were classified as severe, with 23% resulting in patient deaths (Thomas & MacDonald, 2016). Similarly, a global systematic review by Panagioti et al. (2019) analysed 70 studies involving 337,025 patients. It found that 6% of patient harm was preventable (95% CI: 5%-7%), and 12% of preventable harm (95% CI: 9%-

15%) was severe or fatal. Additionally, a multisite observational cohort study involving 205 critically ill COVID-19 patients requiring orotracheal intubation between March 2020 and February 2021 demonstrated that delayed intubation following initial respiratory support was linked to increased in-hospital mortality (González et al., 2022). These findings underscore the necessity for highly skilled critical care teams with strong clinical reasoning, critical thinking, and decision-making abilities to respond promptly and effectively to critical situations (Chamberlain et al., 2018; González et al., 2022).

1.4 Research Site

1.4.1 Hamad Medical Corporation (HMC)

Hamad Medical Corporation (HMC), the research site for this study, is Qatar's primary governmental provider of secondary and tertiary healthcare and one of the leading hospital systems in the Middle East. HMC oversees 12 hospitals, comprising nine tertiary specialist hospitals and three community hospitals, along with the National Ambulance Service and Home and Residential Care Services (HMC, 2024).

In January 2016, HMC's hospitals were accredited by the Joint Commission International under the Academic Medical Centre accreditation program. Additionally, HMC earned institutional accreditation from the Accreditation Council for Graduate Medical Education (ACGME) (HMC, 2024). The corporation operates a critical care multisite system and network offering a comprehensive range of critical care specialties and subspecialties (Hijjeh et al., 2019).

Hamad Medical Corporation HMC employs 12,000 nurses, including 1,050 critical care nurses (Hijjeh et al., 2019). HMC has a multicultural workforce reflected by the diversity of nationalities from 45 countries (HMC, 2024). In HMC, nine tertiary hospitals provide critical care services with a different scope of services including but not limited to medicine, surgery, trauma, oncology, neurology, burns, orthopaedics, psychiatry, and cardiology (Hijjeh et al., 2019). The different critical care services within HMC provide services to four levels of patient severity classified as in the UK National Health Service system (Intensive Care Society (ICS), 2024), (Table 1).

In a multicultural learning environment like HMC, where healthcare professionals come from diverse cultural backgrounds (HMC, 2024), an effective simulation debriefing model plays a critical role in fostering inclusive and impactful learning experiences. A well-structured debriefing model promotes reflective practice and collaborative learning, encouraging participants to share perspectives shaped by their cultural contexts and clinical experiences (Higgins et al., 2021). This approach helps bridge cultural differences, enhances communication skills, and builds mutual understanding within the team. By supporting culturally responsive debriefing, the model enables healthcare professionals to engage meaningfully, fostering a sense of psychological safety that is essential for open dialogue, critical thinking, and continuous improvement in patient care practices.

In HMC, where nurses' competence is classified using the Benner framework (Benner et al., 1996), ranging from Novice to Expert. A simulation debriefing model tailored to these varying competence levels can help nurses regardless of their clinical experience and

competence levels to gain meaningful insights and learning opportunities from SBE. By aligning debriefing discussions and feedback with the individual's competence level, such simulation debriefing model can foster engagement and confidence among novices while providing complex and thought-provoking challenges for proficient and expert nurses. This inclusive approach can enhance learning outcomes, promote mutual respect within the group, and support professional growth, ultimately strengthening the team's collective ability to deliver high-quality patient care (Verkuyl et al., 2020; DiPierro et al., 2022).

Having many nurses in HMC from different cultures with varying experiences, levels of competence, specialties, and subspecialties, highlights the challenge of establishing a robust educational system to develop competent critical care nurses with optimal levels of critical thinking, clinical reasoning, judgment, and decision-making. To meet this challenge, HMC established a dedicated centre for nurses' continuing professional development (CPD) called the Nursing and Midwifery Education Department (NMED, 2024).

1.4.2 Nursing and Midwifery Education Department (NMED) at HMC

The Nursing and Midwifery Education Department (NMED) serves as a centralised nursing education service under the Corporate Nursing Services of HMC, providing educational support and expertise to all nursing departments within the organisation (NMED, 2024). Its multicultural workforce includes administrative assistants and nurse educators who maintain interdepartmental connections with clinical practitioners across multiple hospitals.
NMED also employs qualified educational nurse planners certified by the American Nursing Credentialing Centre (ANCC). These planners are actively involved in designing, implementing, and evaluating formal and informal nursing education programs in alignment

with international educational and simulation standards (NMED, 2024; INACSL, 2021; Diaz-Navarro et al., 2024). In recognition of its excellence, the department was designated a Centre of Excellence in Nursing Education by the ANCC in 2020 (NMED, 2024).

The Nursing and Midwifery Education Department provides specific modular competency-based programmes designed to meet each clinical specialty and subspecialty requirement. The NMED courses were designed for both new and experienced nurses to contribute to the delivery of the highest possible quality patient care and optimal outcomes (NMED, 2024). In relation to critical care education, the NMED provides a different level of courses for critical care nurses including, but not limited to, the foundation, specialty, and subspecialty levels (NMED, 2024). For active, learner-centred, and immersive learning experiences, NMED uses SBE in all the critical care curriculums. The critical care courses are designed on a modular basis, and some of them are mandatory modules, while others are subspecialty modules designed to be taken based on the departmental needs, for example, Extracorporeal Membrane Oxygenation (ECMO) SBE designed for ECMO nurses only (Hijjeh et al., 2019). All the HMC's critical care nurses are mandated to attend the Critical Care Foundation Programme. The critical care SBE foundation programme aimed at enhancing nurses' critical care competence and associated clinical reasoning and judgment skills. The foundation programme consists of eight SBE modules incorporating 25 immersive simulation scenarios, and in each scenario, the critical care nurses are asked to perform a patient assessment using the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach (Smith & Bowden, 2017; Peran et al., 2020). This PhD study used the Critical Care Foundation Programme for data collection and validating the RLC debriefing model. The programme is

conducted in a large training facility called the “Clinical Simulation and Innovation Centre”, comprising a multitude of simulated clinical settings (Itqan, 2024)

1.4.3 Clinical Simulation and Innovation Centre

The Clinical Simulation and Innovation Centre is an educational and training facility under HMC. It is one of the world’s largest clinical simulation centres (Itqan, 2024) that accommodates SBE activities for HMC and other health institutions in Qatar. The Centre is equipped to provide for different SBEs and includes debriefing rooms and video and audio recording systems. The simulation centre provides various kinds of SBE modalities including but not limited to manikin-based simulation, task trainers, simulated patient, and virtual reality incorporating deliberate practice (Itqan, 2024). Deliberate practice is described as a structured and intentional approach to skill development, characterized by repetitive practice and progressive feedback (Ericsson, 2004; Karageorge et al., 2020). In healthcare SBE, deliberate practice involves recreating clinical scenarios in a controlled environment where learners can repeatedly perform specific tasks or address complex situations to refine their skills (Ericsson, 2004). The focus is on targeting specific areas for improvement, breaking down complex procedures into manageable steps, and gradually increasing the difficulty to match the learner's growing competence (Higgins et al., 2021).

1.4.4 Hamad International Training Center (HITC)

The Hamad International Training Center (HITC) a primary educational centre for health professions and public health education within Hamad Medical Corporation (HMC), Qatar’s largest public healthcare provider (HITC, 2024). Established to enhance the competence, performance, and preparedness of healthcare professionals. HITC is equipped with teaching

halls and simulation labs, enabling the delivery of immersive, scenario-based training that replicates the complexity and demands of real clinical environments.

HITC operates within a distinctly multicultural context, reflecting the diversity of both HMC's and Qatar's healthcare workforce. It delivers education and training at both basic and advanced levels across a wide range of topics, including but not limited to trauma, obstetrics, critical care, and resuscitation. The centre is affiliated with the European Resuscitation Council (ERC) to conduct the Advanced Life Support (ALS) courses, within which the RLC model was validated for Interprofessional Education (IPE) (Appendix 19). In HMC's simulation centre (Itqan) and HITC different simulation debriefing models are used which discussed in (Chapter 3, section 3.2.5).

1.5 Research Problem

The current research problem centred around the limitations of existing tools, multicultural learning environments, and addressing learner competence and seniority. The subsequent sections describe these.

Hamad Medical Corporation's nurse educators use Gather; Analyse; Summarise GAS (Phrampus & O'Donnell, 2013) and the DIAMOND debriefing models (Jaye et al., 2015). It is used to develop and evaluate nurses' competence incorporating clinical reasoning skills. Despite its potential, the impact of RLC on clinical reasoning remains underexplored, particularly in multicultural settings with diverse learners varying in experience, seniority, and competence levels.

To develop effective clinical reasoning skills, critical care nurses should get the chance to practise and be exposed to various experiences of patient complexities over time (Sullivan et al., 2021). Taking into consideration the critical care environment's context, high patient acuity levels, and potential risks and consequences of clinical practice mistakes, SBE is used to enable both experienced and less experienced critical care nurses to develop their clinical reasoning and to practise critical care skills and be exposed to different case complexities while ensuring patient safety (Rivaz et al., 2021; Suwardianto & Astuti, 2020; Liyew et al., 2020). Using well-structured SBEs has been stated as enabling nurses to practise focused, selected, and prioritized skills, in a controlled, low-risk, and safe learning environment (Kiernan, 2018; Rotter & Braband, 2020). A simulation learning environment helps nurses overcome the emotional strain of the situation and enhances optimal clinical reasoning development and confidence (Kang & Kang, 2020; Dieckmann et al., 2020).

Conducting critical care SBEs with different learner's experience levels and competence in a multicultural environment, highlighted the need to explore optimising clinical reasoning skills while attending SBE incorporating RLC in consideration of the most important influencing and contributing factors. This is described and discussed in Chapter 2, section 2.6. The need to explore the most important influencing and contributing factors while attending SBE arose because expert nurses may use an effective clinical reasoning approach to find workable solutions and relate more cues together, with a better ability to proactively predict patient progress, while non-experts and less experienced nurses are mostly reactive and tend to use analytical approaches (Croskerry, 2009; Young et al., 2020). This is fully described and discussed in Chapter 2, section 2.6.

The currently available clinical reasoning simulation-related tools and models have not been tested and validated in critical care and acute clinical settings or within critical care specialties. As described and discussed in the literature review, Chapter 2, section 2.6, these tools and models were established to develop general nursing clinical reasoning skills and have not been applied to critical care. The multidimensional nature of clinical reasoning associated with learners' tendency to use analytical and non-analytical reasoning processes based on their background, previous experience, seniority, and competence levels has not been previously explored. Therefore, it would be helpful to develop a theoretically driven and research-based debriefing model to achieve clinical reasoning skills development and enhancement while attending critical care SBEs. For that, in this study, following a review of the literature, a RLC model was co-designed as a simulation debriefing model. The model will aim to enhance and optimise nurses' clinical reasoning skills while attending critical care immersive SBE in consideration of variations in nurses' seniority, experiences, and competence levels in a multicultural learning environment with a range of scenario complexity. The study aims to evaluate the co-designed RLC model using experimental, mixed methods, and pre-test/post-test design described in the methods section, Chapter 4. The research questions are mentioned below.

1.6 Research Questions

The primary research questions are:

- How valid and reliable is the newly co-designed RLC model for use in adult critical care SBE courses?

- How does a co-designed reflective learning model enhance the clinical reasoning skills of adult critical care nurses attending the RLC sessions of SBE courses?

The secondary research questions are:

- How do RLC affect individuals' clinical reasoning skills when participating in adult critical care SBE courses?
- What is the current evidence for RLC debriefing models to be used in critical care SBE?
- What are the valid and reliable clinical reasoning assessment tools or models for RLC that can be used in adult critical care SBE courses?
- What should a co-designed RLC model incorporate?

1.7 Structure of the Thesis

Chapter 1: *Introduction and Problem Statement*. This chapter introduces clinical reasoning, the critical care environment, and its associated patient severity levels. In this chapter, an overview of the RLC as a simulation debriefing method, the context of the research site, the research problem and questions, and the structure and chapters of this PhD thesis are described.

Chapter 2: *Literature Review*. This chapter describes literature about the concepts and theories surrounding reflection, reflective learning, reflective practice, RLC, debriefing, clinical reasoning and judgment, decision-making, and the theories of experiential learning, dual loop learning, and cognitive load. The systematic review section of this chapter describes a scoping review aimed at examining clinical reasoning assessment tools and models used in adult critical care SBE.

Chapter 3: *Co-design of a post-simulation reflective learning conversation model*. This chapter describes the co-design process and co-design principles in healthcare education. It incorporates phases and steps undertaken to co-design the RLCmodel. The theories and frameworks underpinning the co-design phase of the model are also described.

Chapter 4: *Methods*. This chapter describes the research methods and methodological considerations. It discusses and provides details of how the research was conducted to test the newly co-designed RLC model using experimental, mixed methods, pre-test/post-test design. Justifications for the research paradigm, design, sample size, data collection, ethical considerations, and quantitative and qualitative data analysis methods are discussed in this chapter. A section for reflexivity is also included in this chapter.

Chapter 5: *Quantitative results*. This chapter describes the results of the quantitative elements of this research study. It incorporates the pilot results, demographics, normal distribution checks, and descriptive and inferential tests. The findings of the repeated measures within the experimental and control groups are also described in this chapter.

Chapter 6: *Qualitative results*. This chapter describes the results of the qualitative elements of this research study. The themes and subthemes of the focus group findings that identified from the thematic analysis are reported and described in this chapter.

Chapter 7: *Data integration*. This chapter describes an integration of the data sets of the literature review; the self-reported questionnaires obtained from the control and experimental groups; focus group conducted for the nurses who attended the SBE and for the simulation educators; direct subsequent objective observation of nurses' clinical reasoning; and subsequent video review to evaluate nurses' clinical reasoning while attending critical care SBE courses.

Chapter 8: *Discussions, limitations, and conclusion*. This chapter describes the key findings addressing the methodological issues including implications, strengths, limitations, and conclusions with recommendations for future research.

1.8 Conclusion

This introductory chapter described clinical reasoning and the RLC in relation to critical care practices and SBE. An overview of the research site, including departments, research problems, questions, and the structure of this PhD thesis, has been outlined in this chapter. The next chapter will present reviews of the literature relevant to this study.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter describes literature and systematic scoping reviews relevant to this PhD research. This chapter delves into the theoretical underpinnings of reflection, reflective learning, reflective practice, and RLC. It further explores debriefing, clinical reasoning and judgment, decision-making, experiential learning, dual-loop learning, and cognitive load. This chapter also describes a systematic scoping review aimed at examining clinical reasoning assessment tools and models used in adult critical care SBE. Specifically, those in which the RLC method was used for simulation debriefing. The scoping review aimed to answer the research questions: What is the current evidence for RLC debriefing models to be used in critical care SBE? What are the valid and reliable clinical reasoning assessment tools or models for RLC that can be used in adult critical care SBE courses?

2.2 Reflection in Healthcare:

Reflection is an integral aspect of academic, personal, and professional life (Ooi et al., 2021). Through reflection, nurses reasonably judge and make sense of experiences, construct learning, and challenge current beliefs and personal assumptions (Liaw et al., 2011; Almomani et al., 2020). Reflection enhances questioning to explore things in different ways instead of being passive receivers of new knowledge (Ooi et al., 2021). Reflection is described as observing a situation, feeling, realising, thinking, and then making decisions (Newell, 1992). It is a process during which self-conversation and critical reflection enhance personal and professional experiences to develop meaning (Astbury et al., 2020; Monteiro & Sibbald, 2020).

Reflective learners test the informal theories that are gained through personal experiences against formal theories and evidence-based practices, think consciously about past events, attend to the feelings and learning that arise from those events, and apply the new changes (Astbury et al., 2020). Reflective learners learn from previous experiences to plan future practices and investigate for a better understanding (Astbury et al., 2020; Monteiro & Sibbald, 2020). Nurses, as healthcare practitioners, require time to develop their expertise and strengthen their clinical reasoning skills through application and practice in diverse clinical scenarios (Ganz et al., 2015). However, nurses frequently face difficulty in practising effective clinical reasoning skills due to limited patient experiences and relevant encounters (Saintsing et at., 2011), alternatively, simulation gives chances to practise clinical reasoning with focused learning opportunities (Alinier et al., 2006; Nestel et al., 2011). Reflection as an integral SBE aspect has a practical application RLC as a debriefing method (Dieckmann et al., 2020; Olaussen et al., 2020). During simulation debriefing using the RLC method, learners reflectively discuss their experiences during the scenarios, highlighting the practical application of the Experiential Learning Theory and reflective practice. In this study, one of the most important theories that was explored to underpin the development of the RLC model during the co-design phase was the Experiential Learning Theory (Dewey, 1910) which is described in the next section.

2.3 Experiential Learning Theory

Dewey's (1910) foundational work on reflection positioned experience as central to learning, arguing that meaningful learning arises from active engagement and thoughtful inquiry. He proposed that learners make sense of experiences through a process of reflection that is

inherently social and collaborative. While Dewey's philosophy laid important groundwork for reflective practice, it has been critiqued for offering limited operational guidance in structured educational settings such as healthcare SBE (Boud et al., 1985). Moreover, the emotional and cultural dimensions of reflection—although briefly acknowledged—were not fully developed in his early work, highlighting the need for more nuanced frameworks in multicultural, high-stakes contexts like critical care education (Boud et al., 1985).

Building on Dewey's ideas, Schön (1983) introduced "reflection-in-action" and "reflection-on-action," emphasising the practitioner's ability to think both in real time and retrospectively. These concepts remain influential in SBE, particularly in scenarios requiring rapid decision-making followed by structured debriefing. However, Schön's model has been criticised for lacking empirical clarity and for its limited applicability in contexts requiring standardised assessment of learning (Eraut, 1995).

Kolb's Experiential Learning Theory (1984) offers a more structured representation of learning as a cyclical process: concrete experience, reflective observation, abstract conceptualisation, and active experimentation. While widely adopted in healthcare education, Experiential Learning Theory has been questioned for assuming a sequential and individualistic learning process (Coffield et al., 2004; Illeris, 2007). In reality, SBE learning often occurs in a dynamic, non-linear manner. Nevertheless, Experiential Learning Theory provides practical utility for structuring SBE and debriefing activities, particularly when adapted to account for learners' cultural contexts and varied clinical experience—as applied in this study.

In Kolb's framework, experience is processed through apprehension (understanding gained during active participation) and comprehension (reflection and meaning-making after the event) (Lisko & O'Dell, 2010; Kolbe et al., 2013). In this research, apprehension was developed during immersive SBE scenarios, and comprehension was fostered in debriefing sessions. Learners first engaged in simulation workstations to master specific skills through deliberate practice and immediate feedback (Karageorge et al., 2020). Once foundational skills were achieved, they progressed to complex critical care SBEs requiring holistic patient assessment and management. These immersive experiences established the concrete experience stage.

The reflective observation phase enabled participants to retrospectively analyse their actions, linking them to prior knowledge and identifying gaps (Jarvis, 1987; Morris, 2020). This bridged theoretical knowledge with practical application and allowed critical thinking about performance. Abstract conceptualisation followed, whereby learners compared their actions to best practice, synthesising insights to enhance future performance (Lisko & O'Dell, 2010; Holman, 1997; Morris, 2020). The debriefing sessions integrated self-reflection and group discussion, supporting metacognition and deeper comprehension (Rodgers & Hales, 2021; Robinson, 2020). However, while Experiential Learning Theory provides a useful scaffold, it is not without limitations in healthcare contexts. Its cultural assumptions may limit applicability in multinational teams, where hierarchical norms influence participation (Cheng et al., 2017).

The RLC model developed in this study addresses these gaps by embedding Flexible scaffolding to adapt questioning and reflection depth according to group needs; Culturally sensitive facilitation to ensure inclusive participation in multicultural environments;

Structured Appreciative Inquiry to foster psychological safety while promoting critical insight. These adaptations enabled Experiential Learning Theory principles to be applied in a way that promoted deep learning, critical thinking, and clinical reasoning development without being constrained by the RLC model's linearity or cultural limitations. The operationalisation of this integration is outlined in Chapter 3 (section 3.2.3) and discussed in Chapter 8 (section 8.2).

2.4 Simulation-Based Education (SBE)

Simulation - Based Education has long been integral to high-stakes industries such as the military, aviation, space exploration, and nuclear energy, where error tolerance is minimal and repetitive practice is essential (Bradley, 2006; Murray et al., 2008). This precedent has influenced healthcare, where SBE is now widely used to prepare clinicians for complex, high-risk scenarios (Bradley, 2006). While advocates emphasise its value in providing opportunities for repeated practice without patient risk, such optimism is not universally supported. Excessive reliance on SBE may inadvertently limit authentic clinical exposure—particularly for novice nurses still consolidating foundational knowledge and skills (Kneebone, 2005; Dieckmann et al., 2020). From a situated learning perspective (Lave & Wenger, 1991), this restriction can limit legitimate peripheral participation in real-world clinical practice, potentially slowing the progression from novice to competent practitioner (Benner et al., 1996).

Simulation - Based Education allows learners to engage in realistic clinical scenarios and enhance standardisation in healthcare education (Alinier et al., 2006; Alexander, 2020). Furthermore, SBE supplements real-world clinical experiences by offering opportunities to

practice skills and manage situations that may be rare or unavailable in traditional patient care environments (Gee, 2019). SBE has become a global approach to continuing education and professional development (Alexander, 2020). In the UK, Health Education England Technology Enhanced Learning Project (HEE TEL) (National Framework for SBE, 2018; Higham, 2021) and the Association for Simulated Practice in Healthcare (ASPiH) (Diaz-Navarro et al., 2024) recommend that SBE be incorporated for all mandatory procedural skills at least once annually to supplement clinical training. The ASPiH framework has also evolved in its terminology, adopting a broader emphasis on human factors, team performance, and interprofessional competencies (Diaz-Navarro et al., 2023). This emphasis aligns with international trends that frame these capabilities within the wider domains of patient safety and interprofessional collaboration. Many healthcare and academic institutions in the UK have training centres providing different SBE modalities. The Nursing and Midwifery Council (NMC) in the UK (2024) recommends that pre-registration nursing programs include a minimum of 2,300 hours of practice learning, which can include SBE (NMC, 2024). The specific number of hours dedicated to SBE can vary by institution, but it is generally a significant component of the overall number of practice hours. For practising nurses, while the NMC does not provide specific guidelines solely for SBE, it encourages its use to support lifelong learning and CPD (NMC, 2024).

The USA National Council of State Boards of Nursing (NCSBN) recommended that up to 50% of traditional clinical hours in pre-licensure nursing programmes can be replaced by SBE (NCSBN, 2024). This recommendation is based on evidence showing that SBE can be as effective as traditional clinical experiences when conducted properly (NCSBN, 2024). In Australia, the Australian Nursing and Midwifery Accreditation Council (ANMAC) provides standards for the accreditation of nursing and midwifery programs, including the use of SBE.

While ANMAC does not specify an exact number of hours dedicated solely to SBE, it outlines the role of SBE in complementing clinical practice and ensuring the quality of education (ANMAC, 2024).

In Qatar, the Qatar Council for Healthcare Practitioners (QCHP) oversees the standards for healthcare education, including nursing (QCHP, 2024). While there is not a specific, universally mandated number of SBE practice hours for nursing education explicitly outlined by QCHP, the use of SBE is highly encouraged to support educational needs (QCHP, 2024). As described in Chapter 1, section 1.5.2, the Nursing Education and Midwifery Department of HMC mandated the attendance and successful completion of the critical care foundation courses using SBE for all critical care nurses (NMED, 2024).

The literature frequently frames SBE as a safe space for developing competence, critical thinking, and clinical reasoning (Gee, 2019; Dieckmann et al., 2020), yet this portrayal risks overlooking the subjective and variable nature of psychological safety. While this ideal resonates with the concept of psychological safety (Edmondson, 1999), it is important to recognise that such safety cannot be guaranteed and is ultimately determined by individual perception. In reality, learner experiences of safety are shaped by a complex interplay of interpersonal, organisational, and cultural factors. In multicultural or hierarchical healthcare contexts, entrenched power asymmetries and culturally influenced communication norms can inhibit contributions, discourage questioning, and limit the depth of reflection (Rana et al., 2023). From a socio-constructivist perspective (Vygotsky, 1978), these variables are not peripheral barriers to be managed away but fundamental determinants of whether collaborative knowledge construction can occur (Chung et al., 2013; Palaganas et al., 2021).

Consequently, fostering an environment conducive to psychological safety requires ongoing, intentional facilitation strategies that acknowledge these dynamics, rather than assuming that a safe space exists simply by virtue of being in a SBE setting.

This recognition of psychological safety as a subjective and context-dependent construct informed the design of the RLC model. Rather than presuming that all participants will feel safe to speak openly, the RLC approach seeks to foster conditions that make constructive engagement more likely. This is achieved through deliberate scaffolding of reflective prompts, an Appreciative Inquiry approach that highlights strengths before addressing challenges, and a flexible progression from lower- to higher-order cognitive questioning (Almomani et al., 2023). These features are intended to lower perceived interpersonal risk and to accommodate diverse cultural and professional norms, without assuming that safety can be uniformly achieved. A more detailed discussion of this is provided in Chapter 8.

The literature often presents SBE as a consistently high-quality educational method (Alinier et al., 2006; Gee, 2019; Alexander, 2020), yet delivery in practice is highly variable, with differences in facilitator expertise, scenario fidelity, and institutional resources directly shaping learning outcomes (O'Regan et al., 2016; Gee, 2019; Dieckmann et al., 2020). While the literature often promotes SBE as a high-impact educational method, this assumption is undermined when delivery falls short of best practice (Dieckmann et al., 2020). Poorly designed or inconsistently facilitated sessions can inadvertently heighten extraneous cognitive load (Sweller, 1994; Leigh et al., 2021), diverting mental resources away from essential clinical reasoning and reflective processes. This is particularly problematic during debriefing, where learners may lack the cognitive bandwidth to engage in higher-order analysis if their working memory has already been overloaded during the scenario (Sweller,

1994). Such variability challenges the notion that SBE is inherently beneficial, highlighting instead that its pedagogical impact is contingent on quality, alignment, and facilitation skills.

These limitations directly informed the design of the RLC model. The RLC incorporates incremental cognitive scaffolding—progressing from concrete definitions to complex clinical reasoning—so that learners are not overwhelmed by simultaneous technical, emotional, and reflective demands (Almomani et al., 2023). By embedding structured yet flexible prompts grounded in Bloom's Taxonomy and Appreciative Inquiry (Blooms 1956; Cooperrider & Srivastva, 1987), the RLC aims to reduce unnecessary cognitive burden and optimise engagement, regardless of variability in scenario design or resource availability. In this way, the model acknowledges that while SBE quality cannot be entirely standardised across contexts, the debriefing structure can be intentionally designed to mitigate its inconsistencies and support meaningful learning.

The literature often assumes a shared understanding of simulation-based education (SBE), yet its definition remains contested, with differing interpretations shaping how it is designed, facilitated, and evaluated (Lioce et al., 2024). The Society for Simulation in Healthcare (SSH) describes SBE as a 'technique' (Lioce et al., 2024, p. 58) while simultaneously recognising its broader pedagogical role. This definitional ambiguity is more than semantic—it directly influences practice. When framed as a pedagogical method rather than a technical exercise, SBE requires deliberate integration of structured debriefing, skilled facilitation, and clearly articulated learning outcomes. Without these, Kolb's experiential learning cycle (Kolb, 1984) risks stalling at the 'concrete experience' stage, leaving learners without the guided reflection and conceptualisation necessary for meaningful knowledge transfer.

The tendency to present SBE as a straightforward substitute for reduced patient contact (Saintsing et al., 2011) further oversimplifies its role. Ganz (2015) suggests that rich, authentic clinical experiences—particularly when coupled with structured reflection—can equal or even surpass SBE in developing clinical reasoning. Yet, much of the literature adopts a near-universalist stance on SBE's benefits (Alinier et al., 2006; Nestel et al., 2011), overlooking limitations such as fidelity constraints, high resource demands, and inconsistent evidence of skill transfer to real-world practice. Moreover, the impact of SBE is mediated by learner-specific factors—including cultural background, prior clinical experience, and degree of learner autonomy—that remain underexplored in mainstream SBE research. These factors can profoundly shape how learners engage with scenarios, the depth of their reflective capacity, and the durability of their learning.

While SBE offers unique opportunities for experiential, low-risk learning, its effectiveness is mediated by sociocultural context, facilitator competence, and design quality (Gee, 2019; Dieckmann et al., 2020; Palaganas et al. 2021). From a socio-constructivist and situated learning perspective, these factors are interdependent and directly influence the depth of reflection and knowledge transfer (Sweller, 1994; Rana et al., 2023). This thesis therefore treats SBE not as a universally effective intervention but as a context-sensitive pedagogical tool whose impact must be interrogated in relation to diverse learner competence levels, cultural backgrounds, and hierarchical structures. These considerations directly informed the design of the RLC model, which seeks to address these contextual variables through structured, adaptive, and culturally responsive debriefing practices. These are discussed in Chapter 2, section 2.7. The model was established and co-designed in consideration of the multicultural variations in the SBE groups in addition to learners' expertise, seniority, and

competence level variations, described in chapter 3. The next section describes the RLC as a debriefing method.

2.5 Debriefing Using Reflective Learning Conversation (RLC)

Simulation-Based Education debriefing practices are guided by multiple international standards bodies, each emphasising structured, learner-centred reflection as a core pedagogical element. The International Nursing Association for Clinical Simulation and Learning (INACSL) articulates detailed standards for structured debriefing, often operationalised through approaches such as guided reflection. The Association for Simulated Practice in Healthcare (ASPiH) in the UK supports similar principles but stresses flexibility and cultural adaptation to local practice (ASPiH, 2024; Diaz-Navarro et al., 2024). The Society for Simulation in Healthcare (SSH) embeds debriefing expectations in its global accreditation framework, allowing for method variation while upholding the necessity of reflective dialogue (Lioce et al., 2024). The Association of Standardized Patient Educators (ASPE), while centred on simulated patients, equally positions post-encounter reflection as critical to skill integration (Lewis et al., 2017). While these organisations converge in viewing structured reflection as essential, they diverge in how prescriptive or adaptable that process should be, revealing philosophical tensions between standardisation for quality assurance and contextual tailoring for cultural and institutional fit—tensions that directly influence how RLC models are interpreted and applied across settings.

Debriefing in SBE is widely framed as a structured process combining feedback, guided reflection, and facilitated discussion—often conceptualised as a RLC (Norris & Bullock (2017; Decker et al., 2021). This triad is frequently positioned as central to integrating

learning (Oriot & Alinier, 2018). Yet, much of the literature presents these strategies as inherently effective across settings rather than interrogating the conditions under which they work. In particular, empirical evidence remains limited when SBE is implemented with learner groups that are culturally and hierarchically diverse, where the very assumptions underpinning structured dialogue may not hold.

The prevailing definition of debriefing as a "bidirectional, reflective exchange" (Salik & Paige, 2021, p. 15) rests on preconditions such as learner openness and cultural comfort with critique. Lioce (2024, p. 17) presents debriefing as "a formal, collaborative, and structured process". A body of evidence demonstrates how power gradients, seniority differences, and communication barriers can suppress contributions from less confident participants (Cheng et al., 2016; Rudolph et al., 2020; Palaganas et al., 2021; Rana et al., 2023). This highlights a rarely addressed concern in SBE scholarship: the extent to which debriefing can truly remain bidirectional when structural inequities shape whose voices are heard.

Reflective learning conversations, as articulated by Norris & Bullock (2017), were developed to move beyond unstructured dialogue toward a dialogic, peer-supported model grounded in social constructivism. Initially emerging from school-based performance discussions (Butler & Winne, 1995; Sadler, 2010), the approach has been adapted to healthcare SBE to encourage learners to unpack clinical and communication decisions in a socially mediated setting (Van der Schaaf et al., 2013; Bullock et al., 2015; Norris & Bullock, 2017). Over the past decade, this method has gained traction in SBE, with studies highlighting its role in supporting critical thinking through active articulation of reasoning, peer feedback, and collaborative analysis of systemic influences on performance (Walsh & Sethares, 2022).

The Almomani et al. (2023) RLC model extended Norris & Bullock's conceptual foundation by explicitly addressing competence diversity, multicultural dynamics, and hierarchical barriers in critical care SBE. Drawing on Bloom's Taxonomy for incremental scaffolding and Appreciative Inquiry to sustain engagement (Blooms 1956; Cooperrider & Srivastva, 1987), the model aims to mitigate dominance effects and encourage equitable reflection in mixed-ability, multicultural cohorts. While this adaptation offers a theoretically robust response to well-documented participation imbalances, its novelty also invites critical scrutiny: evidence for its effectiveness in dismantling entrenched hierarchical behaviours remains emergent, and questions persist about whether structured prompts alone can shift deep-seated cultural communication norms (Rana et al., 2023; Palaganas et al., 2021).

The move from solitary reflection toward facilitated, dialogic reflection—described in McLeod et al.'s (2015) integrative review—aligns with evidence that socially mediated reflection can promote deeper reasoning than self-reflection alone. Yet, this shift is not uncontroversial. Some scholars caution that dialogic formats risk becoming performative if learners sense they must align with dominant narratives rather than challenge them (Rana et al., 2023). Even in RLC, the balance between supportive dialogue and genuine critical interrogation can be difficult to maintain, particularly in culturally sensitive clinical scenarios.

Theoretically, RLC is designed to be flexible across contexts, from real patient encounters to simulated scenarios, and is endorsed by multiple simulation organisations for its potential to foster psychologically safe, peer-supported learning environments. However, the assumption that psychological safety can be designed in through structure and facilitation may be overly optimistic. Group dynamics—especially in hierarchically mixed, culturally heterogeneous

groups—can reproduce the very inequities RLC seeks to address. Dominance by senior participants, silencing of less experienced members, and culturally driven reticence are not easily resolved by facilitation alone (Mukherjee et al., 2016; Rana et al., 2023).

Furthermore, facilitator competence remains a pivotal but vulnerable variable. Norris & Bullock (2017) emphasise the need for skilled questioning to sustain reflective depth, while Almomani et al. (2023) embed structured prompts to support less experienced facilitators. Yet, evidence from Dann & Richardson (2015) and Persico et al. (2021) suggests that without advanced skills in managing group dynamics and emotional processing, even well-designed frameworks can devolve into superficial checklist conversations. The risk is particularly acute where institutional investment in faculty development is minimal (Dann & Richardson, 2015; Persico et al., 2021;).

Logistical constraints—such as restricted debriefing time—further complicate RLC implementation. Compressed sessions often prioritise factual recap over deeper exploration of decision-making processes (Walsh & Sethares, 2022). While some argue that any debrief is better than none, others contend that rushed or shallow debriefing may reinforce poor reasoning habits, effectively doing harm by normalising inadequate reflection (Mukherjee et al., 2016; Rana et al., 2023).

As presented in Table 2, many simulation debriefing models use guided reflection; however, these models were not explicitly developed or evaluated with consideration for variations in learners' experience, seniority, and competence levels. Moreover, they have not been explicitly evaluated for use in multicultural learning environments across a range of scenario complexities.

Table 2: The most common simulation debriefing models that use guided reflection

Model Name	Author(s)	Aim	Development Process	Reliability & Validity	Target Learning Group	Critical Care or Non-Critical Care
Debriefing for Meaningful Learning (DML)	Dreifuerst (2009)	Promote reflective thinking and clinical reasoning	Developed using experiential learning theory, with a focus on reflection to promote critical thinking. This model has six steps: Engage, Explore, Explain, Elaborate, Evaluate, and Extend.	Multiple studies showed validity, particularly in nursing education, by improving clinical reasoning and decision-making. The model was evaluated by an observational experimental study by Bradley,& Dreifuerst, (2016), and a quasi-experimental pre-test/post-test study by Huang et al. (2023).	Primarily nurses, applicable to all healthcare professionals.	Non-Critical Care
Promoting Excellence and Reflective Learning in Simulation (PEARLS)	Eppich and Cheng (2015)	Provide a blended approach, integrating different debriefing strategies.	Developed by combining debriefing approaches and educational research, with expert consensus. This paradigm contains four phases: reaction, description, analysis, and summary. The model incorporates the use of advocacy with inquiry-questioning techniques with enhanced self-assessment and focused facilitation.	PEARLS has received preliminary validation, demonstrating enhanced team dynamics and learner satisfaction. The model was verified by two pre-test/post-test design research (Meguerdichian et al., 2022; Høegh-Larsen et al., 2023).	Interprofessional teams (e.g., nurses, doctors, paramedics).	Both Critical and Non-Critical Care
GAS Model (Gather-Analyse-Summarise)	Phrampus & O'Donnell (2013).	Structured debriefing focused on bridging performance gaps and learning objectives.	Based on Kolb's experiential learning cycle, it was designed to help students via reflection. This model is divided into three phases: gathering, analysing, and summarising. In the Gather phase, the team collaborates to recap the simulation events, to establish a shared mental model. The Analyse phase focuses on student-centreed reflective thinking, encouraging	GAS has shown reliability in improving reflective practices and performance in educational settings. One-group, quasi-experimental design by Prendergast et al. (2021), and randomised control Study by Yang & Oh, (2021).	Nursing, allied health, interprofessional teams.	Non-Critical Care

Model Name	Author(s)	Aim	Development Process	Reliability & Validity	Target Learning Group	Critical Care or Non-Critical Care
			participants to analyse and reflect on the events during the simulation. In the summary phase, all the key learning objectives and teaching points are addressed.			
Team GAINS	Kolbe et al. (2013)	Improve team performance through structured, iterative debriefing sessions.	This approach consists of six sequential steps based on teamwork-focused methods and ideas from sectors such as aviation and crisis management. -How participants reacted. -Identifying the clinical aspect of the scenario. -Bridge the gap between simulation and real-world applications. -Discussing behavioural skills and their impact on clinical results. -Summing up the learning experience. -Controlled application of clinical expertise, as needed	Reliability was demonstrated in increasing clinical teamwork and communication, notably through SBE by Craft et al. (2016) quasi-experimental comparison research, and Eismann et al. (2019) pre-test/post-test randomised design.	Interdisciplinary healthcare education	Both Critical and Non-Critical Care
Diamond Debriefing Model	Jaye, Thomas, and Reedy (2015)	Offer a structured, three-phase approach to debriefing for simulation.	Developed by a qualitative study on debriefing procedures and expert consensus. The DIAMOND debriefing model is a structured approach to debriefing that consists of three main components. The three phases are description, analysis, and application.	Emerging research suggests increased learner satisfaction and deeper reflection. Reliability research is continuing but promising. Scott et al. (2023) conducted a quasi-experimental pre-test/post-test investigation to determine the model's validity.	Multidisciplinary healthcare teams.	Both Critical and Non-Critical Care

When situated alongside other debriefing models, RLC occupies a distinctive but contested space. DML (Dreifuerst, 2009) provides structured phases with strong evidence for reasoning development (Bradley & Dreifuerst, 2016) but is culturally brittle where direct self-analysis is not normative (Huang et al., 2023). PEARLS (Eppich & Cheng, 2015) offers adaptability, but this flexibility can dilute coherence in inexperienced hands (Meguerdichian et al., 2022). GAS (Phrampus & O'Donnell, 2013) is accessible for novices but risks privileging facilitator conclusions over learner-generated meaning. TeamGAINS (Craft et al., 2016) excels in cohesive, culturally aligned teams but loses traction in transient, heterogeneous groups. Diamond (Jaye et al., 2015) integrates emotional and cognitive dimensions but lacks longitudinal outcome evidence (Scott et al., 2023).

RLC's promise lies in its potential to facilitate reflection through peer dialogue and scaffolded questioning. Its risk lies in assuming that structure alone can overcome deep-seated cultural and hierarchical inequities. Without deliberate adaptation—such as that attempted in the Almomani's et al (2023) model—RLC may unintentionally replicate the very asymmetries it seeks to dismantle.

In conclusion, debriefing models are not pedagogical panaceas. From a socio-constructivist standpoint, success depends less on model selection than on its fit with learner needs, facilitator capabilities. This thesis therefore treats RLC not as inherently superior, but as a situated method—asking when, for whom, and under what conditions it succeeds or fails. By interrogating these boundaries, this work aims to extend the external validity and equity of RLC in culturally and hierarchically diverse SBE contexts.

2.6 Appreciative Inquiry, Plus/Delta, and Blooms Taxonomy

Structured approaches such as Appreciative Inquiry, Plus/Delta, and Bloom's Taxonomy (Blooms 1956; Cooperrider & Srivastva, 1987; Cheng et al., 2021) can be incorporated into simulation debriefings to guide reflection, scaffold cognitive challenge, and sustain learner engagement. While their integration can enhance the focus and coherence of post-scenario dialogue, literature cautions that their benefits are conditional, shaped by facilitator expertise, learner diversity, and the complexity of the clinical scenario (Eppich & Cheng, 2015; Nascimento et al., 2021).

Appreciative Inquiry, adapted from organisational development practice (Cooperrider & Srivastva, 1987), directs attention to strengths and what went well. In SBE, this orientation can foster psychological safety, encourage participation, and reduce defensiveness—particularly in culturally diverse or hierarchical groups where direct critique may inhibit contribution (Dewar et al., 2020). By validating competence before addressing shortcomings, Appreciative Inquiry can create the interpersonal conditions for more open discussion of errors. However, in high-acuity or error-sensitive scenarios, overemphasis on positives can unintentionally marginalise critical incident analysis, limiting exploration of decision-making under pressure and systemic vulnerabilities (Eppich & Cheng, 2015). The challenge lies in integrating Appreciative Inquiry's affirming stance with rigorous examination of performance gaps, ensuring that enhancing psychological safety does not come at the expense of depth.

Plus/Delta offers a deceptively simple reflective structure in which learners identify positive aspects (+) and opportunities for change (Δ) (Kainth, 2021; Cheng et al., 2021; Capogna et al., 2022). Its clarity and accessibility make it suitable for novices and psychologically sensitive groups, providing a low-barrier entry into reflection. Yet, research highlights that without skilled facilitation, Plus/Delta risks yielding superficial or descriptive feedback rather than analytical reasoning (Fanning & Gaba, 2007). Moreover, the literature rarely interrogates its reliance on facilitator intervention to deepen reflection, masking a hidden variable of debriefing success: the capacity to move learners beyond listing points toward exploring underlying cognitive, behavioural, and human factors (Sobeck, 2020; Cheng et al., 2020; Duff, et al., 2024; Kainth & Reedy; 2024).

Bloom's Taxonomy (Bloom, 1956; Anderson et al., 2001) offers a hierarchical framework for sequencing debrief questions from lower-order recall to higher-order analysis and synthesis. Applied to SBE, it can help facilitators align questions at an appropriate cognitive level and progressively challenge learners (Nascimento et al., 2021). When used adaptively, this progression makes implicit reasoning and supports knowledge integration, aligning with constructivist principles of scaffolding learning (Masava, et al., 2023). However, its implied linearity risks oversimplifying the iterative nature of clinical reasoning, which often involves moving back and forth between levels of analysis. In interprofessional and multicultural groups, rigid adherence to a Bloom's sequence can disengage experienced participants faced with basic prompts, while overwhelming novices prematurely confronted with complex analysis (Levett-Jones et al., 2010; Tutkun et al., 2012).

Integrating these approaches into debriefing has the potential to enhance reflection in several ways. Appreciative Inquiry can strengthen the relational climate, Plus/Delta can create a shared and transparent framework for feedback, and Bloom's Taxonomy can ensure cognitive progression rather than stagnation at descriptive levels (Nascimento et al., 2021; Masava, et al., 2023). When applied synergistically, they can help debriefers balance affective safety, learner agency, and intellectual challenge (Eppich & Cheng, 2015; Nascimento et al., 2021). Yet, across all three, similar vulnerabilities appear including balancing enhanced psychological safety and critique – Emphasising affirmation without adequate analysis can dilute critical learning; facilitator competence as a determinant – Each method's depth depends on adaptive questioning and contextual sensitivity, yet facilitator preparation is inconsistently addressed in research; alignment with the complexity of clinical reasoning – Prescriptive structures may clash with the dynamic, non-linear demands of real clinical decision-making (Levett-Jones et al., 2010; Wan & Hudson, 2020).

Consequently, these methods should not be regarded as prescriptive scripts but rather as adaptable tools within the broader craft of debriefing. Evidence suggests that their effectiveness lies in flexible application (Eppich & Cheng, 2015; Nascimento et al., 2021)- selecting and blending elements in response to learners' backgrounds, cultural norms, scenario complexity, and team dynamics. Applied in this way, they can enhance the debriefing process by integrating participatory, structure, and progressive cognitive challenge, while avoiding the pitfalls of prescriptive delivery (Robertson et al., 2022; Rana et al., 2023; Dogu et al., 2024; Nojima et al., 2025).

In the context of this thesis, the integration of Appreciative Inquiry, Plus/Delta, and Bloom's Taxonomy into the RLC model serves to address key debriefing challenges identified in the literature: fostering psychological safety without diluting critique, ensuring equitable participation in multicultural and hierarchical groups, and scaffolding reflection to deepen clinical reasoning. Their combined use is intended not as a rigid formula but as an adaptable, evidence-informed framework that supports facilitators in structuring dialogue, managing group dynamics, and progressively advancing cognitive engagement. This alignment with established educational theory and international simulation standards situates the RLC model as a structured yet flexible approach to optimising debriefing outcomes across diverse learner populations.

2.7 Multicultural Learning Environment

As outlined in Chapter 1 (Section 1.3), Hamad Medical Corporation (HMC) is characterised by a highly multicultural workforce, with expatriate clinicians bringing diverse personal beliefs, communication patterns, and adaptation styles (National Planning Council, 2024). Within this context, simulation-based education (SBE) sessions at HMC routinely involve nurses from multiple nationalities, making cultural diversity not a peripheral feature but a central factor shaping group dynamics and communication.

In such contexts, cultural diversity becomes a defining, not incidental feature of the learning environment. Existing literature offers a nuanced view of its influence. Rana et al. (2023) suggest that personal beliefs and adaptability may shape engagement in reflective group discussions. While insightful, their qualitative, self-reported findings are context-bound and cannot be generalised without caution. Importantly, they do not disentangle cultural factors

from other mediators such as facilitation style or group climate. Without examining these interactions, claims about culture's direct impact on learning risk being overstated.

Similarly, Pearson and Smith (2013) identify cultural variation as a barrier to debriefing effectiveness but provide limited analysis of whether disengagement results from facilitator insensitivity, under-representation of certain groups, or inflexible debriefing structures. Palaganas et al. (2021) note that cultural values can influence emotional expression, willingness to question authority, and perceptions of confidentiality. Yet, framing such patterns as inherently problematic risks essentialising culture, implying fixed traits rather than acknowledging the dynamic interplay between individual agency, professional identity, and situational context. Skilled facilitation, particularly when underpinned by intercultural competence can reframe these differences as assets, enabling participants to examine clinical decisions through multiple cultural and professional lenses.

Chung et al. (2013) observe that responses to open-ended debrief questions may vary across cultures. While valid, such interpretations can inadvertently isolate cultural norms from other influential variables, such as communication styles, group power dynamics, and perceived psychological safety—that often have greater explanatory power for participation patterns. Indeed, in high-stakes healthcare settings, hierarchies of seniority, gender, and discipline frequently intersect with cultural factors, making it reductive to treat culture as a single-variable determinant of engagement.

From a constructivist perspective, cultural diversity in SBE can be a source of enriched reflection rather than a limitation. Studies emphasise that when facilitators demonstrate

intercultural competence-including the ability to adapt questioning, feedback, and interaction styles-cultural variation can stimulate comparative reasoning, surface implicit assumptions, and expand perspectives on patient care (Jeffries, 2022; Palaganas et al., 2016). Learning simulation groups benefit from such diversity, as varied professional and cultural backgrounds introduce different heuristics and decision-making approaches, contributing to more robust clinical reasoning development and enhancement (Khalaila, 2015; Boet et al., 2014). Models that embed incremental, scaffolded questioning and strengths-based dialogue, such as those informed by Appreciative Inquiry, have been shown to support equitable participation and enhanced psychological safety in multicultural settings (Cheng et al., 2016; Rudolph et al., 2020). The RLC approach, by incorporating these evidence-based strategies, aligns with these recommendations for leveraging diversity to enhance reflection and learning in SBE.

2.8 Clinical Reasoning, Clinical Decision-Making, and Clinical Judgment.

Clinical reasoning is described as the cornerstone of clinical practice and professional competence (Daniel et al., 2019; Yong et al., 2021; Guerrero, 2019). Despite this widespread recognition, the concept remains theoretically fragmented, with limited consensus on its definition and on its boundaries in relation to clinical decision-making and clinical judgment (Benner et al., 2008; Tiffen et al., 2014; Wan & Hudson, 2020). This conceptual ambiguity complicates research design, measurement, and educational implementation, particularly in SBE, where clarity of focus is essential for targeting specific learning outcomes.

Much of the literature conceptualises clinical reasoning as an individual cognitive process involving cue acquisition, interpretation, and action planning (Simmons, 2010; Connor et al., 2023). Simmons' (2010, p. 10) widely cited definition as a "complex cognitive process" offers structure but underrepresents the contextual, social, and affective dimensions increasingly acknowledged in contemporary healthcare (Jensen, 2013; Victor-Chmil, 2013). While cognitive models provide valuable scaffolding for instruction, their reductionist tendencies risk neglecting the uncertainty, emotional regulation, and adaptive problem-solving that are integral to reasoning in fast-paced or ambiguous situations.

Other definitions, such as those by Edwards et al. (2004) and Kuiper et al. (2019), foreground reasoning's links to reflection and performance but often omit consideration of organisational culture, power gradients, and interprofessional dynamics. These omissions are particularly problematic in the context of SBE, where reasoning is not only a cognitive task but is also shaped by team interactions, cultural context, and workplace hierarchies. Failure to account for these dimensions risks overlooking barriers to reasoning development in multicultural or status-differentiated learning environments.

A persistent issue in the literature is the interchangeable use of the terms clinical reasoning, clinical decision-making, and clinical judgment (Alfaro-LeFevre, 2016; Wan & Hudson, 2020). In this thesis, these terms are explicitly differentiated: clinical reasoning is understood as the dynamic cognitive process, whereas clinical judgment and decision-making are considered the outcomes of that process, the conclusions or actions derived from reasoning (Lee & Park, 2019; Dawson, 2012). This distinction clarifies the focus of the study on reasoning development, as it addresses the formative, cognitive, and interactive stages that

precede and shape judgment or decision-making. By targeting the process rather than the endpoint, SBE interventions can more effectively scaffold learners' ability to arrive at sound judgments in diverse and complex clinical contexts.

In this thesis, clinical reasoning is conceptualised in line with Levett-Jones et al. (2010) as a interactive and cyclical process encompassing cue collection, interpretation, planning, action, evaluation, and reflection. While pedagogically useful, this model assumes a degree of linearity and rationality that does not always reflect real-world reasoning, which is often iterative, non-linear, and influenced by incomplete information, competing priorities, and time pressures. This limitation underscores the need for flexible, context-sensitive approaches in SBE that account not only for cognitive load but also for emotional demands and collaborative decision-making.

Although clinical reasoning is positioned in the literature as critical for patient safety and professional competence (Brentnall et al., 2022; Guerrero, 2019), less attention has been given to how SBE can equitably develop these skills across learners with varying levels of prior experience. Many assessment tools designed to measure reasoning (Lee & Park, 2019) have been criticised for weak construct validity and limited theoretical grounding, raising concerns about whether they capture the complexity of reasoning as enacted in practice. Moreover, Simmons (2010) highlights that reasoning is highly susceptible to cognitive biases, uncertainty, and time pressures, factors intrinsic to both clinical environments and well-designed SBEs. Yet these influences remain underexplored in much of the SBE literature, where interventions often prioritise procedural mastery or content acquisition over the nuanced development of reasoning strategies.

Crucially, reasoning should not be regarded as an exclusively individual process. Banning (2008) and Norman et al (2007) emphasise the interplay between analytical and intuitive thinking, and between tacit and explicit knowledge, suggesting that reasoning emerges through both personal cognition and social interaction. From this perspective, SBE learning must provide opportunities for learners to externalise tacit knowledge, articulate decision pathways, test assumptions, and receive immediate, contextually grounded feedback. Approaches that facilitate collaborative, post-simulation reflection, such as the structured, scaffolded dialogues embedded in the RLC model align with these principles by integrating cognitive, social, and contextual dimensions of reasoning with enhanced psychological safety.

2.8.1 Dual Loop and Cognitive Theories

As described in the previous section, clinical reasoning is a complex cognitive process that involves multiple steps of thinking, carrying a risk of cognitive overload (Croskerry, 2009; Van Merriënboer & Sweller, 2010). Research on clinical reasoning processes has been informed by Dual Loop learning and cognitive load theories (Croskerry, 2009; Young et al., 2020). Dual Loop theory emphasises the integration of analytical and intuitive cognitive processes within clinical reasoning (Croskerry, 2009; Young et al., 2020; Wan & Hudson, 2020). The non-analytical reasoning, a faster cognitive process, is often used by experienced nurses compared to the analytical reasoning process, which is slower, more deliberate, and commonly used by less experienced nurses (Young et al., 2020; Wan & Hudson, 2020). However, regardless of the tendency for experienced and inexperienced individuals to rely on analytical and non-analytical reasoning systems respectively, it has been argued that there are

limits to the amount of information humans can process (Pashler & Johnston, 1998). As humans, learners have a bounded cognitive capacity (Pashler & Johnston, 1998; Vlaev, 2018), and when faced with multiple and concurrent reasoning processes to make clinical decisions, this can lead to cognitive overload. Learners may struggle to focus on more than one task at a given moment (Tversky, 1972; Vlaev, 2018).

Cognitive load theory underpins clinical reasoning through two approaches: hypothetical-deductive reasoning (analytical) and pattern recognition (non-analytical) (Kassirer, 1989; Stempsey, 2009; Wan & Hudson, 2020). The hypothetical-deductive approach uses a process of: data collection, hypotheses generation; and data interpretation followed by hypothesis evaluation (Kassirer, 1989; Wan & Hudson, 2020), while the pattern approach uses the clinical findings of patients' symptoms and signs, and physical examination (Kassirer, 1989; Wan & Hudson, 2020). Practically, although the hypothetical deductive approach is commonly used by less experienced nurses (Lateef, 2018; Young et al., 2020) senior and experienced nurses use the clinical reasoning approach effectively, relating more cues together to proactively predict what may happen to a patient compared to novice nurses who are mostly reactive (Benner et al., 2008; Levett-Jones et al., 2010). On other the hand, senior and experienced nurses still may face new case complexities in which analytical reasoning skills may be required, especially for cases without previous experience leading to a higher chance of cognition overload. Critically, this may impact clinical reasoning optimisation while attending SBE and debriefing sessions in relation to potential risks of cognition overload associated with higher case complexity, and previous experience of the same situation, consequently presenting a risk of non-enhanced clinical reasoning development associated with these factors (Young et al., 2018; Lateef, 2018; Wan & Hudson, 2020).

The integration of Dual Loop theory and cognitive overload principles into SBE practice highlights several critical considerations. When nurses with varying levels of experience and competence participate in the same simulation group, without careful adjustment to the volume of information, pacing, and structure of content delivery, they may be required to engage both fast (intuitive) and slow (analytical) cognitive processes simultaneously. This concurrent processing, particularly when coupled with high information load (Pashler & Johnston, 1998; Vlaev, 2018), increases the risk of cognitive overload. Such risk should be addressed in simulation curriculum design to safeguard and optimise clinical reasoning development, especially in group-based SBE incorporating RLC.

Inadequate clinical reasoning development can potentially compromise patient safety and delay care or treatment (Guerrero, 2019; Wan & Hudson, 2020). This is influenced by factors such as experience, competence, case complexity, and cognitive overload (Van Merriënboer & Sweller, 2010; Lateef, 2018; Vahedian-Azimi et al., 2019). The impact of these factors is especially critical when caring for critically ill patients who require immediate interventions and critical decision-making (Saintsing et al., 2011). Healthcare SBE is commonly used to develop clinical reasoning and competence (Gee, 2019; Dieckmann et al., 2020; Olaussen et al., 2020). The overarching goal of healthcare SBE is patient safety through effective clinical reasoning and competence development. To achieve this, SBE should incorporate realistic scenarios that replicate patient experiences to mitigate potential practice errors and enhance patient safety and be followed by a debriefing process to get participants to reflect on their performance. Given the tendency for experienced and less experienced practitioners to use both analytical and non-analytical reasoning systems concurrently, and the associated risk of cognitive overload while shifting between these systems, it is important to consider factors

such as competence, seniority, prior experience, and case complexity as contributing to clinical reasoning optimisation.

All these factors are crucial, especially in group-based critical and acute care SBE with learners of varied levels of exposure to SBE, competence, seniority, and experience, where different scenarios and case complexities are used in multicultural learning environments. Ignoring these factors may lead to non-enhanced clinical reasoning development, thereby increasing patient safety risks. The next section will discuss the current clinical reasoning tools, models, and frameworks explored through a systematic scoping review process.

2.9 CLINICAL REASONING TOOLS AND MODELS - A SYSTEMATIC SCOPING REVIEW

2.9.1 Introduction

This section describes a systematic scoping review of the clinical reasoning assessment tools and models. The review highlighted current literature gaps around clinical reasoning process assessments and related models while attending SBE sessions. In addition to the narrative reviews presented in sections 2.5 and 2.6 which indicated unexplored areas on how to optimise and enhance clinical reasoning skills while attending critical care SBE, especially, when the RLC debriefing method is used for a group-based SBE including learners of varying competence, experience, and seniority levels in a multicultural learning environment. This scoping review aimed to examine clinical reasoning assessment tools or models used in adult critical care SBE (Almomani et al., 2023). Specifically, those in which RLC is used as a debriefing method, and to answer the research questions: What is the evidence for RLC models in critical care practice? Which clinical reasoning assessment tools or models for RLC are valid and reliable when applied to adult critical care SBE?

2.9.2 Systematic Scoping Review

Systematic reviews are evidence-based and help inform the development of trustworthy clinical and educational guidelines and research (Munn et al., 2018; Pollock et al., 2021). The scoping review has become increasingly popular as a form of knowledge synthesis and to map evidence from a variety of sources (Peterson et al., 2017). It allows the assessment of emerging evidence and provides indications for further research and informs the development of new research projects (Munn et al., 2018; Pollock et al., 2021). It is useful to map the existing literature on a broad topic or a new area of research and to identify key concepts,

types of evidence, and research gaps. That was a good fit for this study to summarise and evaluate the amount of literature available with this research focus and identify research gaps (Peterson et al., 2017; Peters et al., 2020). The scoping review applied to this study as there was an unexplored area around the clinical reasoning enhancement and optimisations while attending critical care SBE in the presence of different levels in terms of participants' competence, experience, and seniority in a multicultural learning environment. For that, there was a need to further explore the literature gaps around this topic instead of synthesising the current literature using a systematic review with meta-analysis. The review was conducted to understand concepts rather than compare outcomes across the literature.

2.9.3 Search Quality Measures

The scoping review was conducted to explore the literature on clinical reasoning and RLC as a debriefing method and their related concepts, models, tools, and frameworks (Colledge et al., 2010). It aims to synthesise a comprehensive body of research literature using methods set out by the Joanna Briggs Institute (JBI) and Systematic Reviews Extension for Scoping Reviews PRISMA-ScR (Tricco et al., 2018).

The review team consisted of five reviewers: two senior nurse educators, one clinical nurse specialist in critical care, and two senior academics with expertise in healthcare, critical care, and SBE. The search was conducted with the support of an academic health sciences librarian across eight databases: Medline, Scopus, PubMed, Cochrane Library, CINAHL, and ERIC, as well as Google Scholar and Open Grey to capture relevant grey literature. The systematic scoping review was registered on the Open Science Framework OSF platform with the registration DOI: 10.17605/OSF.IO/BDGWZ and was published (Almomani et al., 2023)

(Appendix 12). Articles identified through the search strategy were imported into the reference management software Mendeley®, and duplicates were removed

2.9.4 Search Strategy

The search strategy was informed by existing reviews and other literature, and included the MeSH (Medical Subject Headings) terms; “Reflective Practice”, “Reflective Conversation”, “Reflective Learning Conversation”, “Clinical Reasoning”, “Clinical Reasoning Models”, “Clinical Reasoning tools”, “Reflective Practice Assessment Tools”, “Reflective practice tools”, “Critical care simulation”, “Critical care simulation-based education”, “Debriefing”, and “After Action Review”. The search included primary quantitative, qualitative, and mixed methods primary studies published in English from the year 2000 onwards. There were very few studies before this review as it is a developing field, and studies published after 2000 are likely to reflect the most current developments, methodologies, and findings in the field. This helps ensure that the review captures the latest advancements and trends. Furthermore, defining a clear time frame, like starting from 2000, helps narrow the scope of the review and makes it more manageable. This approach ensures that the review remains focused and relevant to contemporary issues and educational practices.

The search included studies that described the use of clinical reasoning tools and models for nurses, physicians, physiotherapists, pharmacists, and respiratory therapists while attending adult critical care SBE in which RLC was used as a debriefing method. The review studies that described SBE and clinical reasoning were excluded, only primary studies were included. The list of search terms was developed based on an examination of reviews of clinical reasoning, reflective learning conversation, and debriefing. The search was conducted using

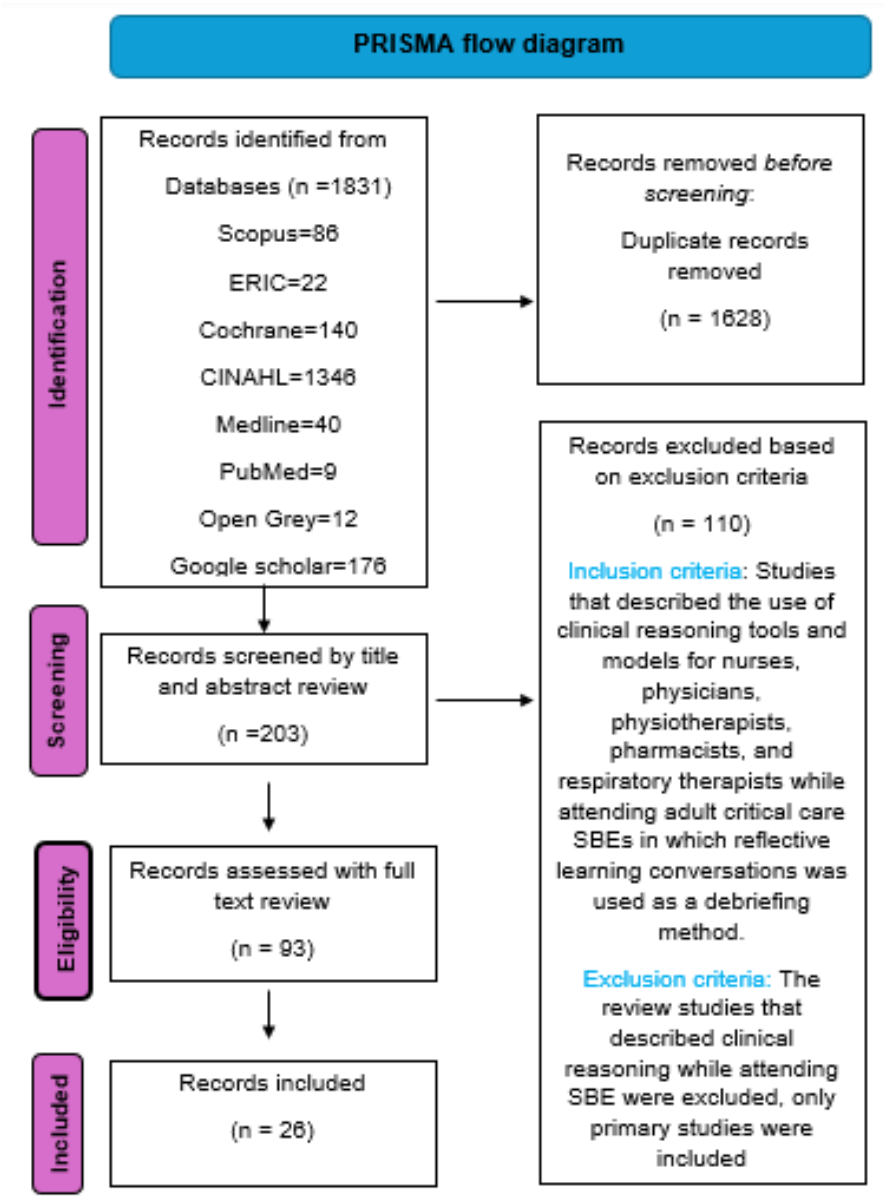
these search terms with Boolean operators, and 47 search terms were identified (Table 3). This strategy was refined with the support of an academic clinical librarian with expertise in systematic reviews.

Table 3: List of search terms for the scoping review

Alternative words (synonyms)			
"reflective conversation*" reflect*N3 conversation "learning conversation" learn*N3 conversation "reflective learn*" Learn*N3 reflective "reflective dialogue" "reflect*N3 dialogue "reflective feedback" "reflect*N3 feedback" "reflective debriefing" "Reflective debrief*" "reflect*N3 debriefing" "Reflective discussions" Reflect*N3 discussions	**AND** "clinical reasoning" "clinical reason*" "clinical judgment" "clinical judge*" "decision making" "clinical decision" "clinical sense"	**AND** "critical care" "intensive care" "ICU" "critically ill"	**AND** "simulation" "simulation based" "simulation training" Simulat*N3 training "simulation courses" "simulation program" "simulation upskilling" "simulation assessment" Simulat*N3 assessment "simulation development" simulat*N3 development "simulation feedback" Simulat*N3 feedback "simulation debriefing" simulat*N3 debriefing "simulation debrief*" "debriefing" "After Action Review" "AAR"

The PRISMA flow diagram (Figure 1) illustrates that 1,831 records were reduced to 203 after duplicates were removed. The primary investigator and two members of the research team reviewed all abstracts. Disagreements regarding inclusion for full-text review were resolved through discussion, further review, and team consensus as needed. A total of twenty-six articles were eventually included for data extraction.

Figure 1: PRISMA flow diagram reflecting the number of included and excluded studies in the scoping review



Information from each study was independently extracted by three reviewers based on the following criteria: [Title, year of publication, study objective, description, RLC method, study sample, study findings, and whether the SBE activity was related to critical care education] (Table 4). The reviewers documented key details from the included articles using a Microsoft Word data extraction form

Table 4: Example of scoping review extracting criteria.

Study	Tool/Model	Objective	Description/Method	Reflective learning conversation method	Sample	Critical care simulation Yes/No	Findings	Reason for exclusion
Lasater K. Clinical judgment development: Using simulation to create an assessment rubric. Journal of nursing education. 2007; 46(11):496-503. DOI:10.3928/01484834-20071101-04	**LCJR** **Lasater Clinical Judgment Rubric**	To investigate whether a standard debriefing script, based on Tanner's clinical judgment model,[58] could foster clinical judgment.	Data were gathered and analyzed from three sources: independent raters observing students in simulation, participating students, and the students' clinical instructors. During the simulation course, students had six clinical learning experiences in area hospitals and two **simulated learning experiences**. At the conclusion of each experience, the clinical instructor led a 30- to 45-minute debriefing guided by the standardized debriefing script to promote reflective discussion.	Debriefing	Senior baccalaureate nursing students enrolled in an 8-week synthesis course focused on providing complex, critical care at a large public university in the southeast United States	**Yes**	Students identified the script as an effective debriefing tool, and significant improvements were observed in clinical judgment scores from all data sources. The standardized debriefing script helped students focus on the learning process, resulting in student improvement in	The clinical reasoning was assessed for baccalaureate nursing students. Note: the inclusion criterion was registered health care critical care practitioners.

In addition to the extraction criteria presented in Table 4, the discussion section of the review is divided into eight categories where we present perspectives around the study, the clinical reasoning tool presented, the objective of the tool, description of the study and methodology, sample size, establishing if the tool was used for critical care SBE, findings of the study including the reliability and validity measures (Table 5). Finally, we address the gaps and propose suggestions in the conclusion section. The next sections will discuss the scoping review findings.

2.9.5 Clinical Reasoning Assessment Tools Used for Simulation-Based Education

Simulation-Based Education can be an effective approach to immersing learners in scenarios that closely replicate clinical situations, helping to mitigate safety risks and practice clinical

reasoning through targeted learning opportunities (Kang & Kang, 2020; Salvetti et al., 2021). Several clinical reasoning tools have been utilized to assess reasoning during these scenarios, recognizing that clinical reasoning is a multidimensional process involving intuition, knowledge, and experience, as well as both analytical and non-analytical thinking cycles (Liaw et al., 2018). Additionally, applying clinical reasoning involves integrating multiple sources of formal and informal knowledge, practical and declarative knowledge (Gruppen, 2017; Gee, 2019). Due to its complex nature, assessing clinical reasoning is challenging, affected by patient and case complexity as well as variations in nurses' competence and experience levels (Gruppen, 2017; Gee, 2019). This difficulty underscores the need for reliable and valid clinical reasoning assessment tools (Dickenson, 2015; Gee, 2019). In this section, the currently available clinical reasoning assessment tools for SBE will be identified and their application to practice and limitations will be mapped.

Several clinical reasoning tools have been identified and are presented in Table 5. These include the Clinical Reasoning Evaluation Simulation Tool (CREST) (Liaw et al., 2018); Lasater Clinical Judgment Rubric (LCJR) (Lasater, 2007); Creighton Competency Evaluation Instrument (C-CEI) (Hayden et al., 2014); Simulation Evaluation Tool (SET-dehydration) (Kim et al., 2016); Clinical Reasoning Indicators- History Taking-Scale (CRI-HT-S) (Fürstenberg et al., 2020); Clinical Decision-Making (CDM) tool (Macauley et al., 2018); Clinical Reasoning Assessment Tool (CRAT) (Furze et al., 2015); Nurses Clinical Reasoning Scale (NCRS) (Liou et al., 2016); and Clinical Reasoning/Script Concordance Test (SCT) (Charlin et al., 1998).

Table 5: Clinical reasoning tools identified during the scoping review..

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Liaw et al., 2018	**CREST** Clinical Reasoning Evaluation Simulation Tool	To create a valid and reliable tool for assessing the effectiveness of simulation in developing clinical reasoning skills for recognising and responding to clinical deterioration.	A prospective study with three phases was carried out: Phase 1: CREST's development and content verification. Phase 2: 15 second and 15 third-year nursing students took part in a simulation-based evaluation to test the tool's psychometrics. Phase 3: Nine academic staff members participate in a focus group discussion and survey questionnaire to test the tool's usability. The development of the tool was based on: - Levett-Jones' model, which describes clinical reasoning processes, and existing instruments (Levett, 2010). - Lasater Clinical Reasoning Assessment Tool (Lasater, 2007). - RAPIDS-tool, was developed to measure nurses' simulation performance in assessing and managing a deteriorating patient (Liaw et al., 2011).	Year 2 and year 3 undergraduate nursing students	NO	A content validity index of 0.93 was the outcome of the validation process, which involved 15 international experts. Third-year students demonstrated considerably higher clinical reasoning scores than second-year students ($p < 0.001$), confirming construct validity. Significant favorable relationships between global rating scores and almost all subscales and total scores provided evidence for concurrent validity. A pre-existing instrument was used to verify predictive validity. With an intra-class correlation coefficient of 0.88 and a Cronbach's alpha of 0.92, the instrument showed great inter-rater reliability and high internal consistency. Although the scoring process needed to be made simpler, nurse educators gave the tool a high usability rating. CREST is validated and reliable for measuring the effectiveness of simulation in developing clinical reasoning skills for recognising and responding to clinical deterioration.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Liou et al., 2016	**NCRS** Nurses Clinical Reasoning Scale	To develop and test the psychometric properties of the Nurses Clinical Reasoning Scale (NCRS)	The NCRS Self-reported CR Scale, which consists of 15 items on a Likert five-point scale, was created using the Clinical Reasoning Model by Levett-Jones et al. (2010). Prior to conducting pilot research to assess the NCR's Cronbach's alpha and 2-week test/retest reliability, a cross-sectional comparison study was carried out. Factor analysis and a pretest-posttest approach were used to evaluate known-group differences.	A convenience sample of (n= 151) pre-graduates, and (n=100) clinical medical-surgical nurses	NO	Bartlett's Test of Sphericity was significant for the entire scale ($p < 0{\cdot}001$). The Cronbach's alpha for the entire scale was 0·93 The test/retest ICC for the NCRS was ICC = 0·87, $p < 0{\cdot}001$
Alexander, 2020	**NCRS** Nurses Clinical Reasoning Scale	To look into how pre-licensure nursing students' and working nurses' clinical reasoning is affected by intentional simulation role assignments that take into account their preferred learning styles.	The experimental and control groups participated in a double-blind, randomized control trial. Each of the 15 items on the Nurses Clinical Reasoning Scale (NCRS) was scored on a 5-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree."	Pre-licensure nursing students and practicing nurses (n=204)	NO	Clinical reasoning ratings for direct care providers, observers, and both the experimental and control groups increased statistically significantly. High dependability was indicated by the NCRS instrument's overall Cronbach's alpha of 0.9. The scale is a useful instrument that is simple to use for clinical nurses and aspiring baccalaureate nursing graduates to self-evaluate their clinical reasoning proficiency.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Fürstenberg et al., 2020	**CRI-HT-S** Clinical Reasoning Indicators-History Taking-Scale	To assess advanced medical students' clinical reasoning skills in a history-taking simulation and empirically construct the Clinical Reasoning Indicators-History Taking-Scale (CRI-HT-S).	A comprehensive competency evaluation for new residents. To assess advanced medical students' clinical reasoning, the Clinical Reasoning Indicators-History Taking Scale (CRI-HT-S) was created. The CRI-HT-S was created to evaluate clinical reasoning indications using a 5-point Likert scale. ANOVA and factor analysis were used to test the scale.	5th and 6th year medical students (n=65).	NO	Three pertinent aspects were identified from the CRI-HT-S clinical reasoning indicators: 1) focusing queries, 2) establishing context, and 3) obtaining information. Students' mean scores for these three components were as follows: factor 1: 4.07 ± .47, factor 2: 3.72 ± .43, and factor 3: 2.79 ± .83. These scores were significantly different ($p < .001$). The experimentally developed CRI-HT-S showed satisfactory internal consistency and steady performance while evaluating clinical reasoning markers during history taking.
Macauley, 2020	**CDM** Clinical Decision-Making	To assess how simulation affects Doctor of Physical Therapy Students' Clinical Decision-Making (CDM) in a physical therapy curriculum.	Quasi-experimental study design with pre-test and post-test phases. Before and after the simulation, the students' clinical decision-making (CDM) skills were evaluated. The CDM tool assessed perceived work performance with 12 items graded on a four-point Likert scale. Stronger CDM skills were indicated by higher scores, which were determined by	The programme had 122 first- and second-year Doctor of Physical Therapy students, with 71 experimental and 51 control groups.	NO	There were 182 replies in all, for an overall response rate of 44.8%. Between 2013 and 2019, response rates varied per class, ranging from 24.5% to 74.6%. The Cronbach's α for the CDM tool was 0.993, indicating great internal consistency. Following a single simulation encounter, statistically significant changes in CDM were noted. To confirm these results and determine the ideal quantity of simulation sessions required for long-term learning, more research is required.

			adding the values assigned to each Likert scale item.			
Furze et al., 2015	**Clinical Reasoning Grading Rubric**	To describe how an instrument for evaluating clinical reasoning abilities in physical therapy students across the curriculum was developed and revised.	A thorough multi-step process was used to develop the Clinical Reasoning Grading Rubric: (1) preliminary pilot research was conducted to examine the clinical reasoning process; (2) theoretical frameworks from cognitive learning theory and skill acquisition were integrated; (3) subject matter experts reviewed the content; and (4) feedback from important stakeholders, such as students, faculty, and clinicians, was gathered. With the help of this observational tool, teachers or assessors can evaluate students' clinical reasoning skills in various settings, including real-world patient care situations, clinical simulations, and practical examinations. The rubric comprises five essential components: actual Knowledge; Conceptual Knowledge; Procedural Knowledge and Skills; Clinical Reasoning Process; and Reflection and Self-Assessment	Ten physical therapy education faculty members, and 4 key stakeholder groups.	NO	The focus on clinical reasoning categories—factual information, conceptual knowledge, and procedural knowledge and skills—that apply to all three professions was one of the tool's three main strengths, according to the interprofessional educator focus group. The committee agreed that these categories are useful for pinpointing particular components of conceptual comprehension and clinical reasoning. A flexible tool for assessing students' clinical reasoning at different curriculum stages is the Clinical Reasoning Grading Rubric. It is especially helpful for evaluating how clinical reasoning abilities develop from clinical education to residency. The rubric also provides information on the teaching and learning environment, which may help direct instructional practices and assist in the creation of curricula.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Keiser and Turkelson, 2019	**SSSCL** Student Satisfaction and Self-Confidence in Learning Scale	In order to assess clinical competence and reasoning in Adult-Geriatric Acute Care NP (AG-ACNP) students and to boost their confidence, a simulated patient (SP)-SBLE was created, put into practice, and evaluated.	The effect of an SP-SBLE on the clinical performance and reasoning of AG-ACNP students was evaluated using a mixed-methods approach. Every student completed the Self-Confidence in Learning Scale (SCLS) to assess their clinical performance and reasoning. The 13-item SCLS measures two important areas: student satisfaction with instruction (five items) and self-confidence in learning (eight items). It uses a 5-point Likert scale (1 being strongly disagree and 5 being strongly agree).	A convenient sample of 10 students in the AG-ACNP Doctor of Nursing Practice program.	NO	A Cronbach's alpha of 0.85 for the self-confidence scale and 0.94 for the satisfaction scale demonstrated the SSSCLS's dependability. The application of a novel SP-SBLE demonstrated potential as a successful strategy for raising AG-ACNP students' self-esteem and developing their clinical reasoning abilities. Furthermore, these students' confidence and clinical reasoning skills were developed through debriefing sessions and reflective writing projects.
Lasater, 2007	**LCJR** Lasater Clinical Judgment Rubric	To evaluate students' answers to situations using Tanner's (2006) Clinical Judgment Model as a framework. To create a rubric that outlines clinical judgment performance levels.	The study employed an exploratory design that included qualitative, quantitative, and qualitative methodologies. Over three weeks of simulation exercises, the description-observation-revision-review cycle was carried out once a week, incrementally improving the rubric until it was prepared for pilot testing. A total of 48 students participated in the 2½-	Third-term nursing students in an adult medical-surgical clinical course.	**NO**	For those working as primary nurses (n = 26), the average clinical judgment skill score was 22.98 points (SD = 6.07). The LCJR provided language for feedback and evaluation of students' clinical judgment development in addition to performance goals. All clinical settings, including acute care, long-term care, and community health, can benefit from using this

		The criteria used to score students' performance were tested in the pilot. investigate how simulation affects students' aptitude, experience, confidence, and clinical judgment skills by creating a rubric that offers a clinical judgment assessment.	hour simulation sessions, which were held weekly in groups of 12 students. The researcher improved the descriptors after each week's observations and sent them to professionals with experience in clinical judgment and rubric creation. Five independent variables were examined, and their effects were evaluated, using descriptive analysis. Eight observed student volunteers participated in a 90-minute focus group to confirm the clinical judgment ideas included in the rubric.			rubric. For instructors, preceptors, and students, LCJR provides a way to explain the idea of clinical judgment. It acts as a roadmap for students' clinical judgment development.
Study	**Clinical reasoning tool**	**Objective**	**Description**	**Sample**	**Critical care simulation**	**Findings including reliability and validity measures**
Hines et al., 2016	**LCJR** Lasater Clinical Judgment Rubric	To find out if using Tanner's clinical judgment model as the basis for a standard debriefing script could promote clinical judgment.	Three sources of data were gathered and analysed for this observational study: the students' clinical teachers, participating students, and independent raters who watched the students during the simulation. Students took part in two simulated learning experiences and six clinical learning	At a major public university in the Southeast United States, senior baccalaurea te nursing students	**Yes**	The validity and reliability of the LCJR were not established . Significant gains in clinical judgment scores were observed across all data sources, and students acknowledged the standardised debriefing script as an efficient debriefing tool. Students' ability to focus on the learning process was aided by the script, which improved their ability

			experiences in nearby hospitals during the simulation session. Clinical teachers used a standardised script to provide a 30- to 45-minute debriefing following each session in order to promote thoughtful conversations. After these debriefings, students used the LCJR to evaluate their clinical judgment skills on the second and fifth clinical days, as well as after both simulated experiences. Clinical instructors then used the LCJR's reflective level to evaluate each student's reflecting skills.	took an 8-week synthesis course on complex, critical care.		to notice, interpret, respond, and reflect—all components of clinical judgment.
Study	**Clinical reasoning tool**	**Objective**	**Description**	**Sample**	**Critical care simulation**	**Findings including reliability and validity measures**
Yang et al., 2021	**LCJR** Lasater Clinical Judgment Rubric	Applying Tanner's clinical judgment model-based flipped learning to nursing students' pre-simulation briefing to investigate the effects of	A non-equivalent control group and assessments conducted before and after the intervention were part of a quasi-experimental design. A neonatal nurse simulation exercise was preceded by a pre-simulation briefing curriculum that used flipped learning, which is based on	65 South Korean Undergraduate nursing students	Yes	In terms of clinical judgment, the results showed no significant differences between the groups ($t = 0.63$, $p = .169$), indicating that the two groups were generally similar. There were no differences in knowledge, satisfaction, or anxiety between the experimental and control groups, but the experimental group did show increases in critical

		neonatal simulation-based practice	Tanner's Clinical Judgment Model. Lasater's Clinical Judgment Rubric was used to evaluate clinical judgment in undergraduate nursing students as they compared the efficacy of flipped learning to a traditional pre-simulation briefing.			thinking, self-confidence, and clinical judgment ability. Increased critical thinking, self-confidence, and clinical judgment skills were linked to the pre-simulation briefing's use of flipped learning based on Tanner's clinical judgment model.
Letcher et al., 2017	**LCJR** Lasater Clinical Judgment Rubric	To ascertain whether simulation-based training improves patient outcomes by influencing NICU nurses' clinical judgment and nursing knowledge.	With 130 individuals, a quasi-experimental pre-test/post-test design was used. Every participant participated in three organised debriefing sessions and scenarios. The intervention comprised three three-hour simulation-based sessions using a high-fidelity manikin. Both before and after the intervention, data was gathered. Each nurse participant was randomly selected to be the lead nurse for a particular scenario throughout each session, and they completed self-assessments and observer evaluations using the LCJR.	Nurses with more than 30 years of experience in neonatal intensive care units (NICUs), as well as nurses who have just graduated, and six months after being hired.	**Yes**	There were overall variations in knowledge scores: p =.0021 (Year 2) and p =.0167 (Year 1). Both self-assessment and evaluator ratings using the LCJR showed trends of improvement in clinical judgment over time (Year 2). Pre/post-assessment scores and ratings show that simulation-based learning has been successful in improving NICU nurses' clinical judgment and expertise. Clinical judgment and nursing expertise have been found to have a positive impact on clinical outcomes.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Shinnick and Woo, 2017	**LCJR** Lasater Clinical Judgment Rubric	Clinical competence was evaluated using Time to Task (the capacity to complete specified, crucial nursing care tasks in five minutes) and contrasted with two subjective metrics: the Lasater Clinical Judgement Rubric (LCJR) and the standard "pass/fail" evaluation.	"Known Groups" of inexperienced and seasoned nurses took part in a manikin-based simulation of patients with decompensated heart failure on an individual basis as part of a prospective observational study. Time to Task was the main emphasis of the assessment, which included important nursing duties that needed to be finished in the first five minutes after entering the patient or manikin room. After reviewing a total of 28 simulation performances—15 expert and 13 novice—14 nursing educators or preceptors who were blind to group assignments used the LCJR to score the performances and issue pass/fail ratings.	Thirteen novice nurses and fifteen experts Expert nurses those with more than five years of clinical experience in the intensive care unit or emergency department Senior prelicensure nursing students who are about to graduate are known as novice nurses.	Yes	The LCJR's overall score showed a significant difference between Novices and Experts ($p < .01$), with low specificity (ability to properly identify "Novice" nurses: 0.40) and good sensitivity (ability to correctly identify "Expert" nurses: 0.72). Typical subjective assessments of clinical nursing proficiency frequently fall short of satisfactory specificity. But when it came to distinguishing between these groups, an objective metric like Time to Task showed strong sensitivity and specificity.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Hallin et al., 2016	**LCJR** Lasater Clinical Judgment Rubric	By analysing how pre-licensure nursing students perceive, interpret, and react in complex care settings as shown by team accomplishment, the study aimed to evaluate their clinical judgment skills. It also sought to investigate any relationship between these team accomplishments and hypothetical performance, individual traits, and situation-specific conditions.	Quasi experimental design. Video-recorded situations, a questionnaire evaluating students' personal traits and theoretical course grades, and the sum of the grading points from ten theory courses in the nursing programme were used to gather data. Students' clinical judgments were analysed and scored using the Lasater Clinical Judgment Rubric (LCJR) in high-fidelity simulation (HFS).	Three primary courses were taken by pre-licensed nursing students: anatomy and physiology, medicine and surgery, and leadership	NO	The team points in clinical judgment were considerably higher for students who had been observers and had participated in subsequent debriefing before their action ($\chi 2$ = 11.27, d.f. = 3, p=.010) than for those who had not.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Nune et al., 2021	**LCJR** Lasater Clinical Judgment Rubric	To ascertain the extent to which nursing students' diagnostic reasoning and clinical judgment are related in clinical simulation.	This study used quantitative techniques and a correlational research strategy. In a high-fidelity clinical simulation, 41 nursing students assisted a patient experiencing a vaso-occlusive crisis as part of the sample. Three impartial observers examined the simulation, which included a videotaped debriefing for each participant. Using the LCJR and the recorded videos of the simulation and debriefing, they evaluated the students' performance. .	Participants in the study were juniors and seniors who finished the penultimate and final terms of two undergraduate nursing courses, respectively. The study included seniors who had finished the urgent and emergency care course and juniors who had taken and passed the course on caring for hospitalised	NO	The "noticing" component of clinical judgment was linked to diagnostic reasoning (r=0.312; p=0.047), and clinical judgment itself was linked to diagnostic reasoning (r=0.313; p=0.046).

				adults and elderly patients (n = 41).		
Study	**Clinical reasoning tool**	**Objective**	**Description**	**Sample**	**Critical care simulation**	**Findings including reliability and validity measures**
Jensen, 2012	**LCJR** Lasater Clinical Judgment Rubric	To use the LCJR to assess nursing students' clinical reasoning abilities during patient simulation. to compare the clinical reasoning abilities ratings given by teachers and students.	Faculty assessments and student self-reports of clinical reasoning abilities throughout a two-semester patient care simulation were both part of the descriptive observational study. Students' performance in a simulated emergency patient scenario was evaluated using the LCJR. Following the simulation, lab staff led the students to a different room where they used the LCJR to rate themselves. After discussing the students' behavior, the faculty finished their own LCJR scoring. Scores were examined between programs (baccalaureate of science and associate degree) and between nursing students and teachers.	Nursing senior students of associate (AS) and baccalaureate degree (BS) programmes, (n=88).	NO	The mean LCJR total scores of BS students were considerably higher than those of AS students (AS M = 30.90; t (84) = −2.65, p = 0.010; Cohen's d = 0.65; BS M = 34.33). In terms of overall LCJR scores, students outperformed teachers (M = 31.81, SD = 6.9) and themselves (M = 33.04, SD = 3.8). More testing of the clinical reasoning tool and more studies in various programs with a bigger sample size are required.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Dubula, 2018	**LCJR** Lasater Clinical Judgment Rubric	To evaluate how debriefing affects second and fourth-year nursing students' growth in clinical judgment.	A quantitative, one-group quasi-experimental pre-test/ post-test design. The data was collected through a self-administered questionnaire and Lasater Clinical Judgement Rubric (LCJR).	Second and fourth-year nursing students (n=56).	NO	At a 95% confidence level, the mean difference between the pre- and post-tests is 3.267857. Following debriefing, the degree of clinical judgment significantly improved (p=0.000). Additionally, the findings demonstrated that debriefing enhanced clinical judgment in fourth-year students more than in second-year students (2nd-year p-value 0.003, 4th-year(p=0.000).
Yang et al., 2019	**C-LCJR** China- Lasater Clinical Judgment Rubric	To verify the Chinese version of the Lasater Clinical Judgment Rubric (C-LCJR) and compare the effectiveness of a simulation-teaching model to a traditional teaching approach in improving the clinical judgment skills of nursing undergraduate students.	In a comparative study, four nursing student courses were split into two experimental and two control groups at random. Traditional teaching techniques were used to instruct the control courses, while simulation teaching with standardised patients was used to instruct the experimental classes. Using the C-LCJR, students in both types of classrooms assessed their clinical judgment after the trial. Teachers gave observational rating.	Undergraduate nursing students (n = 157).	NO	The significant experimental effects on noticing ($\gamma = 0.14$, $p < .05$, CI [0.02, 0.29]), interpreting ($\gamma = 0.19$, $p < .05$, CI [0.03, 0.36]), responding ($\gamma = 0.16$, $p < .05$, CI [0.01, 0.31]), and reflecting ($\gamma = 0.17$, $p < .05$, CI [0.02, 0.33]) all showed that students in the experimental group outperformed those in the control group in every subdomain of C-LCJR.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Kim et al., 2016	**SET-dehydration Simulation Evaluation Tool**	To create a simulation assessment tool (SET-dehydration) based on the Lasater Clinical Judgment Rubric (LCJR) and evaluate its validity and reliability in order to gauge students' clinical judgment in treating dehydrated infants.	Two stages of quantitative study were carried out. creating (SET-dehydration) based on LCJR, followed by testing the tool's validity and dependability. The clinical judgment of nursing students was assessed. The data was analysed using confirmatory factor analysis (CFA), Cronbach's alpha, Cohen's kappa coefficient, and descriptive statistics.	Undergraduate nursing students (n=120).	NO	In simulation education, the SET-dehydration offered a way to assess clinical judgment. Cronbach's alpha was.87, and Cohen's kappa, which measured inter-observer reliability, varied from.73 to.95. For the four LCJR categories of clinical judgment, the mean scores were as follows: noticing (1.74 ±.27), interpreting (1.85 ±.43), responding (2.17 ±.32), and reflecting (1.79 ±.35). The instructors' mean overall rating of the SET-dehydration was 1.92 (±.25).
Hayden et al., 2014	**C-CEI** Creighton Competency Evaluation Instrument	To evaluate students' technical proficiency during the simulation as well as their ability to make decisions.	Five nursing programs helped examine the validity and reliability of the CCEI. Using a validated validation questionnaire, the faculty assessed how well the CCEI measured clinical competency and student performance. Videos that were scripted at three performance levels were used to test reliability.	Nursing faculty members (n=35) viewed films depicting scenarios at three distinct competency levels and scored each	NO	The CCEI is a valid and reliable tool for evaluating simulations as well as traditional clinical situations. On a four-point Likert-type scale, the content validity was scored between 3.78 and 3.89. Three different levels of simulation performance were found to have Cronbach's alpha values greater than 0.90.

				scenario using the CCEI to assess content validity.		
Seo et al., 2021	**C-CEI** Creighton Competency Evaluation Instrument	To assess the effects of a simulated nursing education program on nursing students' clinical reasoning, problem-solving abilities, self-efficacy, and clinical competency using the Outcome-Present State-Test (OPT) paradigm.	A non-equivalent control group pre-test/post-test design is used to recruit the experimental and control groups. The Creighton C-CEI-Tool was utilised to evaluate clinical reasoning.	45 senior undergraduate students, including a control group of 20 and an experimental group of 25.	NO	The experimental group significantly outperformed the control group in terms of clinical reasoning ($F = 10.59$, $p = 0.002$), problem-solving process ($F = 30.92$, $p < 0.001$), and self-efficacy ($F = 36.03$, $p < 0.001$). Additionally, the experimental group outperformed the control group in terms of clinical competency ($F = 11.07$, $p = 0.002$). Clinical reasoning showed a notable improvement. Undergraduate students' clinical reasoning, problem-solving techniques, self-efficacy, and clinical competency are all effectively promoted by the simulation nursing education programme that uses the OPT paradigm.

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Eubank et al., 2020	**C-CEI** Creighton Competency Evaluation Instrument	To assess the efficiency of high-fidelity simulation in helping new nurses become more knowledgeable, competent, and self-assured as a patient's condition worsens.	A design including pre- and post-tests. Participants' performance in clinical reasoning and patient care simulations was assessed using the Creighton Competency Evaluation Instrument (C-CEI).	Adult and pediatric medical-surgical patients (n = 24) were assigned to licensed practical nurses and novice registered nurses.	NO	From pre-simulation (M = 54, SD = 7.333) to post-simulation (M = 57, SD = 5.103), the novice nurses' confidence in evaluation, communication, clinical judgment, and patient safety in failure to rescue simulations significantly improved (t (9) = 2.401, p<.040 (two-tailed).
Study	**Clinical reasoning tool**	**Objective**	**Description**	**Sample**	**Critical care simulation**	**Findings including reliability and validity measures**
Kim and Kim, 2015	**Rubric for Evaluating the Clinical Reasoning Skill Categories**	To evaluate how adding a one-time simulation experience to the didactic curriculum affects nursing students' confidence, clinical reasoning abilities, and information acquisition.	Waitlist control groups and intervention groups were part of a quasi-experimental crossover design. The assignment of participants was not random. Criteria created by faculty consensus and a review of the literature were used to assess clinical reasoning ability. The validity and reliability of the tool were examined.	Junior nursing students (n=94) enrolled in the medical-surgical nursing course, which included two groups: interventio	NO	Students in the simulation group performed much better on clinical reasoning abilities and associated information than those in the didactic lecture group. There was a statistically significant difference between the intervention group B (M=7.30, SD=1.99) and the control group A (M=6.29, SD=2.64). The clinical reasoning scores for intervention group B (M=7.57, SD=1.67) and control group A (M=6.29, SD=1.76) differed

				n (Group A, n=48) and control (Group B, n=46).		considerably (t=-3.60, p=.001). There were no significant differences in self-confidence across groups (t=1.10, p=.276). The findings indicate that undergraduate nursing education necessitates a simulation-based curriculum for clinical reasoning development and information acquisition.
Dreifuerst, 2011	**HSRT** Health Sciences Reasoning Test	To investigate the impact of using a simulation teaching technique, Debriefing for Meaningful Learning (DML), on the development of clinical reasoning in nursing students. .	An exploratory, quasi-experimental, pre-test/post-test study. Participants were randomized to either the experimental or control group, and the DML was compared to standard debriefing. To assess clinical reasoning, the Health Sciences Reasoning Test (HSRT) was administered before and after the debriefing event. During the post-debriefing evaluation, the Debriefing evaluation for Simulation in Healthcare©-Student Version (DASH©-SV) was used to ask four additional questions concerning the DML (DMLSQ) process.	A total of 238 undergraduate nursing students took adult health-medical surgery courses, with 122 in the experimental group and 116 in the control group.	NO	There was a statistically significant difference in clinical reasoning scores between the pre-test and post-test for those who utilised the DML versus the control. t (237) = 3.50, p < 0.001

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Forneris et al., 2015	**HSRT** Health Sciences Reasoning Test	To replicate Dreifuerst's findings of improved clinical reasoning scores, we used a systematic debriefing called Debriefing for Meaningful Learning (DML).	Nursing students' clinical reasoning was assessed using the Health Sciences Reasoning Test (HSRT) in a quasi-experimental, pre-test/post-test, repeated measure research design.	Nursing students(n= 153) including experiment group (n=78) and control group (n=75).	NO	The difference in HSRT mean scores for clinical reasoning between the intervention and control groups was found to be significant. The results are as follows: pre-test, intervention group (n = 78, M = 22.74, SD = 3.6) and control group (n = 15, M = 22.06, SD = 3.7); post-test, after simulation and debriefing, intervention group (n = 78, M = 23.56, SD = 3.9) and control group (n = 75, M = 22.41, SD = 4.6).
Deschênes et al., (2011).	**NSSCT** The Nursing Specific Script Concordance Test	To develop a script concordance test and conduct a preliminary validation of its psychometric qualities for nurses	A script concordance test was developed, and the test scoring grid was built using the combined-score approach based on the responses of a panel of fifteen experts. A t-test was used to compare the scores of experts and students, and Cronbach's alpha coefficient was used to assess the reliability of the results.	First-year bachelor of nursing students (n=30)	NO	The scores' reliability of Cronbach's alpha for the entire was(α= 0·88). The script concordance test is an innovative instrument that provides a standardised method for undergraduate nurses

Study	Clinical reasoning tool	Objective	Description	Sample	Critical care simulation	Findings including reliability and validity measures
Gee, 2019	**NSSCT** The Nursing Specific Script Concordance Test	To examine the impact of high-fidelity patient simulator HFPS on the clinical reasoning skills of undergraduate nursing students.	Quasi-experimental design. Each participant took a baseline NSSCT, after which the experimental group participated in three scenarios and the control group just completed the usual curriculum. A second NSSCT was given to each participant. The control group then participated in three simulation scenarios, whereas the experimental group just completed the usual curriculum. Then a third NSSCT was performed. The NSSCT mean scores were compared between and within the groups.	First-semester, pre-licensure, Bachelor of Science in Nursing (BSN) students (n=14).	NO	After the second NSSCT administration, there were no statistical differences in mean NSSCT scores ($p = 0.064$) between the control and experimental groups, indicating that clinical reasoning skills were not different between students who completed the three scenarios and students who only participated in the standard curriculum. The study's findings did not indicate that HFPS improved clinical reasoning in first-semester, pre-licensure, and BSN students.

2.10 Clinical Reasoning Assessment Tools

As outlined in Table 5, a wide range of clinical reasoning assessment tools has been developed for use in SBE. However, most instruments remain narrowly targeted, often to undergraduate nursing students, with limited validation in more experienced or interprofessional cohorts. This narrow scope presents a significant barrier to their applicability in the heterogeneous learning environments typical of contemporary SBE practice.

The Lasater Clinical Judgment Rubric (LCJR) (Lasater, 2007), for instance, was originally designed for pre-registration nursing students and later adapted for practising nurses. Despite its widespread use, empirical evidence supporting its validity in experienced clinicians or interprofessional teams is sparse. This raises concerns about whether the rubric can accurately assess clinical judgment across diverse professional backgrounds, where reasoning processes and performance expectations may differ substantially.

Similarly, the Clinical Reasoning Evaluation Simulation Tool (CREST) (Liaw et al., 2018), Creighton Competency Evaluation Instrument (CCEI) (Hayden et al., 2014), SET-Dehydration (Kim et al., 2016), and the Rubric for Evaluating Clinical Reasoning were all designed for pre-registration nursing students. While these tools offer structured approaches to assessing reasoning, their lack of validation for registered practitioners means their reliability in more senior or specialised groups is unknown. This creates an empirical gap, as reasoning in advanced clinicians often integrates complex experiential knowledge and situational judgment that may not be captured by tools calibrated for novices.

The Nursing Clinical Reasoning Scale (NCRS) (Liou et al., 2016) attempted to address this by developing a self-report instrument applicable to both students and practising nurses. However, its reliance on subjective self-assessment introduces bias and questions about whether the scores reflect actual performance rather than perceived competence. The Nursing-Specific Script Concordance Test (NSSCT) (Gee, 2019) incorporated case complexity and was applied to both nurses and doctors, yet it does not sufficiently account for variations in clinical experience, specialty area, or seniority, limiting its transferability to mixed-experience simulation groups.

Beyond nursing, the Clinical Decision-Making (CDM) tool (Macauley, 2021) has been validated in undergraduate and postgraduate physiotherapy students, but not in practising clinicians or in other professional domains such as nursing or medicine. This underscores a tendency in the literature toward profession-specific validation, where assessment tools are rarely designed or tested for cross-disciplinary use.

Collectively, these examples illustrate three recurring weaknesses in the current landscape of clinical reasoning assessment tools including Population specificity – Instruments are often developed for a single profession or learner level, reducing relevance in interprofessional or mixed-seniority groups; Limited external validity – Tools validated in controlled or homogeneous cohorts may not translate to the diverse, high-pressure contexts of real-world simulation; Insufficient attention to the reasoning process – Many tools emphasise end-point judgments without adequately capturing the nuanced, context-dependent steps of reasoning that precede them.

These shortcomings are particularly problematic in SBE environments that aim to mirror the complexity of clinical teams, where clinical reasoning enhancement is influenced by experience, discipline, and collaborative dynamics. This thesis responds to these gaps by focusing explicitly on clinical reasoning as the process—encompassing cue collection, interpretation, and synthesis—rather than on judgment or decision-making as outcomes. The RLC model was co-designed as a reflective, dialogue-based approach to make reasoning processes visible, explore them collaboratively, and adapt questioning to the mixed cultural, professional, and experiential profiles of simulation participants. In doing so, it addresses the limitations of existing tools by fostering an inclusive environment that supports reasoning development across diverse healthcare roles and competence levels.

2.10.1 LCJR and CREST for Clinical Reasoning Observational Assessments

Lasater Clinical Judgment Rubric (LCJR) is a widely used tool designed to assess and enhance the clinical judgment of nursing students and professionals. It was developed by Lasater (2007), drawing upon Tanner's Clinical Judgment Model (Tanner, 2006) including four dimensions: noticing; interpreting, responding; and reflecting. The LCJR four dimensions include eleven elements rated on a four-point scale (Lasater, 2007). The noticing dimension of LCJR focuses on the nurses' ability to recognise and assess significant clinical cues. It includes identifying deviations from normal patterns, gathering comprehensive data, and anticipating potential complications. The LCJR interpreting dimension involves making sense of the data collected during the noticing phase. This includes prioritising information, clustering data to identify problems, and generating hypotheses about patient needs. The LCJR responding dimension refers to the nurses' ability to develop and implement appropriate interventions based on their interpretation of the situation. It also includes the

flexibility to adapt plans as needed. The reflecting dimension encompasses the process of reflecting on the effectiveness of the interventions and learning from the experience to improve future practice by incorporating evaluation and self-analysis (Lasater, 2007). LCJR measures clinical judgment and offers performance expectations, as well as language for feedback and assessment of nurses' clinical judgment development. It is intended to evaluate how well nursing students or practising nurses apply clinical judgment in simulated or real-world clinical settings.

A growing number of studies have used the LCJR to measure clinical judgment in the SBE setting. Table 5 demonstrates that several studies were undertaken to establish reliability and validity for the LCJR across different settings. Statistically significant improvements in clinical judgment as measured by the LCJR while attending SBE sessions have been demonstrated in the literature with an internal consistency for the total scale of Cronbach's Alpha ranging from 0.80 to 0.97 and 0.89 to 0.93 for subscales, and percentage agreement between 65% to 96%, reflecting good internal consistency and reliability levels. LCJR was validated in a qualitative-quantitative-qualitative exploratory research by Lasater (2007) aimed at assessing undergraduate nursing students' responses to scenarios, within the framework of Tanner's (2006) Clinical Judgment Model; descriptive observational study by Jensen (2012) aimed at evaluating nursing students' clinical reasoning skills during SBE using the LCJR, and comparing students' self-assessed and faculty-assessed ratings of clinical reasoning skills; and observational study by Hines et al. (2016) in which data were gathered and analysed from three sources: independent raters observing students in simulation, participating students, and the students' clinical instructors The study aimed at investigating whether a standard debriefing script, based on Tanner's clinical judgment model, could foster clinical judgment skills development. A quasi-experimental non-

equivalent control group pre- and post-intervention design by Yang (2021) aimed at examining the effects of neonatal SBE practice by applying flipped learning based on Tanner's clinical judgment model to the pre-simulation briefing for nursing students; A quasi-experimental pre-test/post-test design by Letcher et al. (2017) aimed at determining if SBE influences nurse knowledge and clinical judgment for NICU nurses, ultimately improving patient outcomes; One-group quasi-experimental pre-test/ post-test study by Dubula (2018) aimed at assessing the effect of debriefing on the development of clinical judgment in second and fourth-year nursing students; A prospective observational study by Shinnick and Woo (2018) aimed at assessing the ability to perform specific, critical nursing care activities within 5 min), and compared it to two subjective measures; A quasi-experimental study by Hallin et al. (2016) aimed to identify pre-licensure nursing students' ability to make clinical judgments in terms of how they perceive, interpret, and act in complex care situations measured in team achievements. A further aim was to investigate possible correlations between team achievements and theoretical performance, personal characteristics, and circumstances of the scenarios; A quantitative correlational study by Nunes et al. (2020) aimed at determining the degree of association between clinical judgment and diagnostic reasoning of nursing students in clinical SBE; A comparative study by Yang et al. (2019) in which four classes of nursing students were randomly assigned to two control and two experimental classes. The study aimed to compare a SBE-teaching model with a traditional teaching method in enhancing the clinical judgment ability of nursing undergraduate students.

However, despite these studies affirm LCJR’s robustness as a tool for both formative and summative evaluation of clinical judgment within nursing SBE, many studies primarily involve undergraduate nursing students or novice practitioners, raising questions about the tool’s sensitivity and applicability for experienced clinicians or across diverse healthcare

settings (Lee, 2021; Høegh-Larsen et al., 2023; Rogers, & Franklin, 2023). The majority of research relies on simulated scenarios, which may not fully capture the complexity and unpredictability of real clinical environments, potentially limiting ecological validity. Moreover, although inter-rater reliability is generally good, reported agreement varies widely (65% to 96%), indicating potential inconsistencies in scoring that may stem from subjective interpretation of rubric criteria or differences in rater training (Rogers, & Franklin, 2023). This variability could affect the robustness of assessment outcomes, particularly in multi-rater or high-stakes contexts. Additionally, LCJR's four broad dimensions, while comprehensive, may oversimplify the multifaceted nature of clinical judgment by imposing structured categories on dynamic cognitive processes (Lee, 2021). The tool's emphasis on observable behaviors may neglect deeper cognitive and affective components influencing decision-making, such as intuition or emotional factors. Furthermore, despite evidence linking simulation-based LCJR scores with improved clinical judgment, direct correlations to patient outcomes remain underexplored, limiting conclusions about the tool's impact on actual clinical effectiveness and safety (Høegh-Larsen et al., 2023).

In summary, although LCJR is a valuable and validated instrument for clinical judgment assessment in SBE, further research is warranted to evaluate its utility with experienced practitioners, in varied clinical environments, and its direct relationship to patient care outcomes. Attention to rater training and rubric refinement could also enhance reliability and applicability.

Clinical Reasoning Evaluation Simulation Tool (CREST):

As outlined in Chapter 4 (Section 4.6), this study employed CREST alongside the Lasater Clinical Judgment Rubric (LCJR) for observational assessment of clinical reasoning, and the Nursing Clinical Reasoning Scale (NCRS) (Liou et al., 2016) for participants' self-reported reasoning ability.

The Clinical Reasoning Evaluation Simulation Tool (CREST) was developed to assess clinical reasoning skills in healthcare professionals within SBE learning environments (Liaw et al., 2018). Grounded in an integrated understanding of clinical reasoning, CREST draws on empirical research, expert feedback, and iterative validation to provide a structured framework for evaluating the cognitive processes underpinning clinical decision-making. The tool includes 11 items grouped into seven subscales, measured on a five-point Likert scale: data collection, data interpretation, planning and decision-making, implementation of interventions, reflection-in-action, and reflection-on-action (Liaw et al., 2018).

Liaw et al. (2018) conducted a three-phase prospective study to evaluate CREST's psychometric properties. Phase 1 focused on tool development and content validation. In Phase 2, psychometric testing was conducted with fifteen second- and third-year nursing students engaged in SBE scenarios. Phase 3 involved a usability evaluation through focus group and questionnaires with nine academic staff members. The tool demonstrated high internal consistency (Cronbach's alpha = 0.92) and strong inter-rater reliability (ICC = 0.88). Educators reported the tool as usable but identified challenges with scoring complexity.

CREST was developed with reference to the Levett-Jones clinical reasoning cycle (Levett-Jones et al., 2010), the RAPIDS tool (Liaw et al., 2018), and the Lasater Clinical Judgment

Rubric (Lasater, 2007), integrating theoretical and practical elements of reasoning assessment in SBE contexts. Although originally validated for use with undergraduate nursing students, its broader application in assessing clinical reasoning among qualified practitioners remains limited, reflecting a gap in validation across levels of clinical experience and diverse healthcare professions.

While CREST offers a structured and theoretically grounded framework for assessing clinical reasoning within SBE, several critical limitations warrant discussion. First, its initial psychometric validation was conducted on a relatively small and homogeneous sample—fifteen nursing students at undergraduate levels (Meschia et al., 2025; Alshehri et al., 2023; Xiao et al., 2025)—which raises concerns about the tool's generalisability to broader and more experienced clinical populations. This limitation is especially relevant considering that clinical reasoning is known to evolve with professional experience and practice complexity; thus, the tool's sensitivity to different competence levels remains unclear.

Moreover, although CREST demonstrated high internal consistency (Cronbach's alpha = 0.92) and inter-rater reliability (ICC = 0.88), the complexity reported by educators regarding its scoring system suggests practical barriers to widespread adoption (Xiao et al., 2025). Tools that are perceived as difficult to use may undermine reliability in real-world settings, where raters' expertise and time availability vary. This may impact the consistency of assessments and limit CREST's utility in busy clinical education environments.

Another notable gap is the limited evidence of CREST's validity beyond undergraduate nursing students (Meschia et al., 2025; Alshehri et al., 2023). The tool was developed with

reference to established clinical reasoning frameworks such as Levett-Jones' clinical reasoning cycle and the Lasater Clinical Judgment Rubric, which supports its theoretical robustness. However, empirical evidence supporting its use in postgraduate, interprofessional, or experienced practitioner contexts is lacking (Meschia et al., 2025; Alshehri et al., 2023). This gap is significant because the nuances of clinical reasoning and decision-making processes differ across disciplines and seniority, and a valid tool must capture these variations to effectively guide educational interventions.

Additionally, while CREST captures multiple stages of clinical reasoning—including data collection, interpretation, planning, and reflection—the extent to which it can detect subtle differences in reasoning quality or complexity has not been fully explored (Xiao et al., 2025). Given the multifaceted nature of clinical reasoning, reliance on a fixed item set with Likert-scale ratings may risk oversimplifying complex cognitive processes or failing to account for contextual factors influencing reasoning during SBE.

In summary, while CREST contributes valuable structure and has promising psychometric properties within limited samples, further research is necessary to validate its applicability across varied clinical experience levels and healthcare professions. Practical challenges in scoring also suggest a need for refinement to enhance usability. Without addressing these limitations, the tool's effectiveness in promoting nuanced clinical reasoning assessment and tailored educational feedback remains constrained.

2.10.2 Nursing Clinical Reasoning Scale (NCRS)

The Nursing Clinical Reasoning Scale (NCRS) is a tool for self-evaluation of how people perceive their clinical reasoning skills, behaviours, attitudes, and overall self-concept. It offers standardised and comparable clinical reasoning elements with minimal bias and offers unique access to internal states of clinical reasoning that are otherwise challenging to measure externally (Wolters & Won, 2017). Each of the 15 items on the NCRS is scored on a 5-point Likert scale, with 1 denoting "strongly disagree" and 5 denoting "strongly agree."

Liou et al. (2016) conducted a cross-sectional comparison study in which they designed and psychometrically assessed the NCRS. Based on Levett-Jones et al.'s (2010) Clinical Reasoning Model, it evolved into the NCRS and underwent content, concept, and known-groups validity testing (Liou et al., 2016). Following its creation, a pilot study was carried out to assess the NCRS's Cronbach's alpha and 2-week test/retest reliability in advance. Factor analysis and a pre-test/post-test approach were used to evaluate known-groups differences. For the whole scale, Bartlett's Test of Sphericity was significant ($p < 0{\cdot}001$).

For the full scale, Cronbach's alpha was 0·93. According to Liou et al. (2016), the NCRS's test/retest ICC was 0·87 ($p < 0{\cdot}001$). The measure was considered a practical and simply administered instrument for nurses to self-evaluate their clinical reasoning skills. According to a comparative randomised control trial study by Alexander et al. (2020), statistically significant improvements in clinical reasoning as measured by the NCRS have been shown to be valid and reliable for undergraduate nursing students and practising nurses. The NCRS was used to compare the clinical reasoning skills levels of a convenience sample (n=204) of pre-registration nursing students from various academic levels who were randomly assigned into experimental and control groups before and after attending SBE (Table 5). Both the experimental and control groups' clinical reasoning scores increased in a statistically

significant way. Additionally, the clinical reasoning scores of the observers and the direct care provider both increased statistically significantly. The complete NCRS instrument had a Cronbach's alpha of 0·9. According to the study, the scale provides a practical and simple-to-use instrument for nurses to evaluate their own clinical reasoning proficiency.

While NCRS introspective nature provides unique access to subjective reasoning processes, this reliance on self-assessment introduces potential bias and raises questions about accuracy and overestimation (Wolters & Won, 2017), especially among less experienced participants. Moreover, while the NCRS offers practical advantages—such as ease of administration and standardisation—it remains a self-perception tool and should not be interpreted as a direct measure of reasoning competence (Bae et al., 2023). In this study, the NCRS was used as one of three tools to triangulate findings (see Section 4.6), offering insight into learners' internal reflections while being balanced against observed behaviours (CREST) and judgment outcomes (LCJR). Its inclusion enabled a more nuanced understanding of how SBE may influence not only what learners do, but how they think about what they do.

2.10.3 General Self-Efficacy (GSE)

Self-efficacy is the belief in one's competence, confidence, and capacity to manage a variety of stressful situations and accomplish a variety of activities (Schwarzer, 1995; Brennan, 2022). Schwarzer (1995) created the General Self-Efficacy (GSE) scale as a psychological evaluation instrument to gauge a person's self-reported general feeling of self-efficacy and belief in their capacity to handle a range of challenging tasks. Nurses' perceived competence and confidence were assessed in this study using GSE (details are covered in Chapter 4, section 4.6). Each of the ten items on the GSE scale is assessed using a 4-point Likert scale.

The overall score, which varies from 10 to 40, is calculated by adding the points for each item. A person with a score nearer 10 may have lower levels of overall self-efficacy, which means they may be less confident in their capacity to carry out tasks. A reasonable degree of confidence in one's skills is indicated by scores in the middle range. Higher self-efficacy is indicated by scores near 40, which suggests that the person feels competent and secure in general (Schwarzer, 1995). The validity and reliability of the GSE scale have been established in many contexts, demonstrating its usefulness as a gauge of overall self-efficacy in connection to competence and confidence (Luszczynska et al., 2005; Zeng et al., 2020; Galiana et al. 2024)

In order to investigate the relationships between general self-efficacy and cognitive factors, Luszczynska et al. (2005) carried out a cross-sectional study in three different countries: Germany (n = 633), Poland (n = 359), and South Korea (n = 941). Schwarzer and Jerusalem (1995) used the General Self-Efficacy Scale to measure perceived self-efficacy. With Cronbach's alpha value of α=.87, the GSE scale demonstrated a good level of internal consistency. Population effect values for four sets of covariates on 10 correlations between participants' coping skills and GSE were calculated using meta-analysis; the analysis showed an impact size of d =,58, p=0.02. Confirming the validity of the psychometric scale to assess self-efficacy, the study's findings showed consistent evidence of relationships between perceived self-efficacy and the GSE variables. In a qualitative validation study that sought to investigate the relationships between GSE and numerous other psychological dimensions in other nations, Luszczynska et al. (2005) also validated GSE. Among 8796 individuals from Costa Rica, Germany, Poland, Turkey, and the USA, the relationships between general self-efficacy and personality, well-being, stress assessments, social relationships, and accomplishments were investigated. The GSE showed a high internal consistency Cronbach's

alpha of 0.83 to measure self-efficacy through exploratory and confirmatory factor analysis. The results of the study showed that relationships between self-efficacy and other personality traits were consistent across samples and cultures. As a result, it seems that perceived general self-efficacy is a universal construct that has significant relationships with other psychological concepts. A further study by Zeng et al. (2020) involved three cross-sectional investigations with a total of 9578 respondents from Chinese universities, secondary schools, and primary schools. Exploratory and confirmatory factor analyses were used to assess the dimensionality and factor structure of the 10-item GSE scale. The scale demonstrated good internal consistency with $\alpha = 0.91$. According to the results, the GSE scale has good criterion validity when compared to other validated measures of confidence, self-esteem, and well-being. In order to validate the Spanish version of the GSE scale in a sample of undergraduate (pre-registration) nursing students (n=324), Galiana et al. (2024) conducted a recent longitudinal design study. Descriptive statistics, reliability estimations, and confirmatory factor analysis were all included of the analyses. With a Cronbach alpha of 0.708, the scale's dependability evidence was sufficient. The overall fit of the confirmatory factor analysis was outstanding, with $\chi 2(5) = 25.199$. According to the study, GSE is a reliable instrument for assessing nurses' perceived self-efficacy in relation to their perceived competence and confidence.

While the General Self-Efficacy (GSE) scale is widely recognised for its robust psychometric properties and cross-cultural applicability, several critical considerations warrant discussion when applying it within healthcare education contexts. The scale’s strength lies in its ability to capture a global, self-reported sense of competence and confidence across diverse populations, as evidenced by consistent internal consistency (Cronbach’s alpha ranging approximately 0.70 to 0.91) and construct validity demonstrated in multiple international

studies (Luszczynska et al., 2005; Zeng et al., 2020; Galiana et al., 2024). However, the GSE's broad focus on generalized self-efficacy may limit its sensitivity to the specific and nuanced competencies required in clinical reasoning and nursing practice (Chen et al., 2001; Barahona et al., 2018). Its design as a general psychological instrument means it does not directly assess task- or context-specific efficacy, which is crucial in high-stakes, complex healthcare environments where confidence in particular clinical skills and decision-making processes may vary significantly (Chen et al., 2001; Barahona et al., 2018).

Moreover, reliance on self-report measures introduces potential bias, including social desirability and over- or under-estimation of abilities (Barahona et al., 2018), which may not correlate reliably with actual performance or observable competence. This raises questions about the GSE's capacity to serve as a stand-alone indicator of clinical competence or readiness, especially without complementary objective or observational assessments. Additionally, while cross-cultural validations indicate the universality of the self-efficacy construct, variations in cultural norms around self-assessment and confidence expression could influence responses (Skliarova et al., 2023), thereby affecting the scale's interpretability across diverse healthcare workforces.

Finally, although recent studies have begun validating the GSE in nursing populations, including pre-registration students, there remains a gap in evidence regarding its longitudinal sensitivity to change in practicing clinicians and its predictive validity for clinical outcomes (Barahona et al., 2018).

In summary, while the GSE scale provides valuable insights into nurses' perceived confidence and competence, its application in clinical education and practice should be complemented with context-specific, performance-based measures to comprehensively evaluate clinical reasoning and competence development. The clinical reasoning models utilised in SBE learning of this study are explained in the next section.

2.10.4 Selected Tools in This Study

Among the clinical reasoning tools available, the CREST (Liaw et al., 2018) was selected, despite its original validation in pre-registration undergraduate nursing students. The rationale was its close alignment with Levett-Jones' Clinical Reasoning Cycle (2010)—a widely accepted nursing-specific model. CREST directly assesses observable clinical reasoning behaviours during SBE, thus offering practical insights into the reasoning process during high-fidelity scenarios. To address CREST tool limitation of lacking extensive validation in post-registration nurse populations, which may restrict the interpretability of findings when applied beyond undergraduate settings, the LCJR was also used alongside CREST. The LCJR has been tested and validated across multiple studies involving practising nurses and is grounded in Tanner's Clinical Judgment Model. Its use provided a complementary perspective by focusing on judgment development, particularly relevant in the care of deteriorating patients, the context for this study's scenarios.

Importantly, both the CREST and LCJR were originally designed to evaluate performance during simulated management of deteriorating and critically ill patients, making them contextually relevant to the scenarios in this research. Yet, a critical limitation of both tools is their focus on observable behaviours without probing the cognitive or affective domains that

underpin clinical reasoning—particularly nurses' self-perceived confidence in applying reasoning in complex, dynamic environments. To address this gap, the NCRS was used. The NCRS captures broader patterns in reasoning across clinical and simulated contexts. However, while it provides a reflective view of reasoning application, it does not assess the affective dimension—namely, nurses' confidence in their ability to engage in effective reasoning. This led to the inclusion of the General Self-Efficacy (GSE) scale.

While the GSE is not specific to clinical reasoning, it offers valuable insights into participants' global confidence in handling challenging situations. This is particularly relevant in the multicultural and high-stakes learning environment in which this study was situated, where confidence can significantly affect reasoning and decision-making. When used alongside the NCRS, the GSE allowed for a more holistic view, integrating affective and cognitive aspects of reasoning.

This study purposefully combined CREST, LCJR, NCRS, and GSE to evaluate clinical reasoning across observable behaviours, reflective self-assessment, and affective confidence. While this triangulation strengthened the depth and breadth of assessment, the process revealed a critical gap: the absence of an integrated tool that holistically measures clinical reasoning performance and confidence, validated for post-registration nurses in SBE and multicultural contexts. A further limitation is that, although multiple dimensions were captured, it remains uncertain which of these domains should be prioritised as the most critical targets for intervention.

2.11 Clinical Reasoning Model

The scoping review outlined several clinical reasoning models presented in Table 6. These included TANNER's model (Tanner, 2006), Debriefing for Meaningful Learning (DML) (Dreifuerst, 2011), The Outcome-Present State Test (OPT) model (Pesut & Herman, 1998), The Self-Regulated (SRL) model (Kuiper & Pesut , 2004), and The Clinical Reasoning Model (CRM) (Levett-Jones et al., 2010).

Table 6: Clinical reasoning models

CR Model	Objective	Methodology/Description	Sample	Critical care specific	Findings
TANNER's Model (Tanner 2006).	To describe nurses' clinical judgment and to provide recommendations to faculty members on how to assist undergraduate students in diagnosing breakdowns, identifying areas for progress, and considering learning opportunities that focus on these areas.	Literature synthesis on clinical judgment, with conclusions drawn from the literature. The approach emphasises that clinical judgment is a complex process that includes noticing, interpreting, responding, and reflecting. The approach provides a framework for teaching clinical judgment, emphasising the relevance of practical learning and reflection in the development of nursing skills	The model was developed based on a literature synthesis and conceptual framework model.	NO	Nurses begin patient care with a strong clinical judgment about what is good and right, as well as a vision of what constitutes exquisite care. The model can be used as a theoretical framework to investigate how clinical judgment develops in nurses and to assess the efficacy of education and simulation programs. The paradigm emphasizes noticing, interpreting, responding, and reflecting, which gives an organised framework for analysing how nurses make difficult decisions in practice.
DML Model **Debriefing for meaningful learning** (Dreifuerst, 2011).	To investigate the impact of a simulation teaching technique called Debriefing for Meaningful Learning (DML) on the development of clinical reasoning in undergraduate nursing students.	Participants were randomised to either the experimental or control group, where the DML was compared to traditional debriefing using the Health Sciences Reasoning Test (HSRT) before and after the debriefing experience, and the Debriefing Assessment for Simulation in Healthcare-Student Version (DASH-SV).	Nursing students taking an adult health course that uses simulation.	NO	The DML Model has a positive impact on the development of clinical reasoning skills in undergraduate nursing students when compared to traditional debriefing techniques. DML can be used as a framework to study the efficiency of debriefing approaches in simulation-based nursing education.
The Outcome-Present State Test (OPT) clinical reasoning model (Pesut, & Herman, 1998).	The OPT model of clinical reasoning is contemporaneous and iterative, with an emphasis on reflective self-monitoring. The OPT model demands undergraduate nursing students to use all aspects of the nursing process and to iteratively build on existing knowledge to improve their	The model is based on a literature assessment of the evolution of the nursing process across time. The OPT model has several components, including the client-in-context tale, keystone issue, cue logic, reflection, framing, testing, decision-making, and judgments. The OPT model emphasises outcomes and encourages backward thinking to help the client transition from his or her existing health status (present state) to the desired (outcome) state.	The model was developed based nursing process literature review.	NO	The approach can be utilised to improve educational practice, and research outcomes in contemporary nursing. OPT reinforces thinking skills by having students analyse nursing situations from several perspectives using a high-level thinking method. The paradigm supports training, clinical supervision, and building middle-range hypotheses based on nursing knowledge taxonomies.

	nursing thinking skills.	The OPT model is unusual in that it contrasts an identified keystone nursing issue with a stated result state, providing a conceptual framework for the use of standardised language "Present states" in the nursing model. The present state is derived from an analysis and synthesis of relationships between and among nursing and client nursing care needs.			
CR Model	**Objective**	**Methodology/Description**	**Sample**	**Critical Care specific**	**Findings**
The Self-Regulated Model SRL for reflective clinical reasoning Kuiper and Pesut, 2004).	To investigate the impact of self-regulated learning theory on reflective practice in nursing, as well as to advance the premise that both cognitive and metacognitive skills help enhance clinical reasoning skills.	A comprehensive examination of the published literature in social science, educational psychology, nursing education, and professional education. The SRL model defines self-regulation as a dynamic process that involves observing behaviors and self-regulating reactions in order to form self-judgments about competency and areas for growth in clinical reasoning. The environmental self-regulation of skills, activities, physical context, and relationships with preceptors, staff, and patients is required to determine the setting in which clinical reasoning occurs. Metacognitive self-regulation encompasses metacognitive (reflective) self-correction connected with the application of information and thinking processes to set goals.	The model was developed based on the Integrative review process.	NO	Reflective clinical reasoning was taught and learned in nursing practice settings with the help of the self-regulated learning paradigm. Higher-order cognitive abilities like interpretation, analysis, inference, explanation, and evaluation are supported in the growth and acquisition of SRL.
The Clinical Reasoning Model CRM (Levett-Jones, 2010)	To improve the clinical reasoning abilities of undergraduate nursing students and, in turn, their capacity for patient management.	A review of the literature and an analysis of study data to find similar ways of thinking. The work of (Alfaro-LeFevre, 2009; Andersen, 1991; Tanner, 2006; Hoffman, 2007) influenced the creation of the CRM model.	The model was developed based on a literature review and an examination of research.	NO	The CRM offers a framework that works well with inquiry-based and problem-based learning, and it has applications for classroom instruction. The model's stages and processes can be utilised to create case studies and computerised learning

		The eight-step cycle process described by the model is as follows: look, gather, process, decide, plan, act, evaluate, and reflect. The five rights of clinical reasoning—that is, the capacity to gather the appropriate cues and act appropriately for the appropriate patient at the appropriate time and for the appropriate reason—are closely related to nursing students' efficient use of the CRM and new nurses' practical implementation of it.			packages, and they are suitable for self-directed learning. Additionally, the CRM offers a method that may be used to simulated learning scenarios utilizing standardised patients or real patient manikins.

2.12 Literature Gaps and Aim of the Study

Clinical reasoning is a multi-step, intricate cognitive process that may lead to cognitive overload (Croskerry, 2009; Van Merriënboer, & Sweller, 2010). Referring to Chapter 2, section 2.6.1, less experienced healthcare professionals are more likely to employ the hypothetical-deductive (analytical) reasoning approach than experienced practitioners, who are more likely to employ the pattern-reasoning (non-analytical) approach (Daniel, 2017; Young et al., 2018; Lateef, 2018; Wan & Hudson, 2020). Both experienced and less experienced healthcare professionals may have a propensity to switch between fast and slow thinking processes due to the multifaceted nature of clinical reasoning using analytical and non-analytical thinking cycles, particularly when confronted with high case complexity and uncertainties in critical care practice (Lateef, 2018; Wan & Hudson, 2020). This highlights empirical, practical knowledge, and population literature gaps in relation to improving clinical reasoning skills in the presence of these potential influencing and contributing factors. Despite the most existing clinical reasoning and simulation debriefing models being designed to be learner-centred, there has been no central focus on optimising the use of analytical and non-analytical clinical reasoning and thinking processes in relation to variations in nurses' experience, seniority, competence levels, and simulation case complexity within a multicultural learning environment.

As presented in Table 2 and Table 6, despite the availability of several clinical reasoning and simulation debriefing models to be used for SBE (Dreifuerst, 2011; Tanner 2006; Pesut & Herman, 1998; Kuiper, 2004; Levett-Jones et al., 2010), there was no evidence as to which of these models is the best for practising and undergraduate nurses, and the best for clinical and educational settings for both critical and non-critical care related SBE. Tanner's model

(Tanner 2006) was developed for non-experienced practising nurses while Debriefing for Meaningful Learning (DML), the Outcome-Present State Test (OPT), the Self-Regulated Model (SRL), and the Clinical Reasoning Model (CRM) (Dreifuerst, 2011; Pesut & Herman, 1998; Kuiper, 2004; Levett-Jones et al., 2010) were developed for undergraduate nursing students. Moreover, the DML, OPT, SRL, and CRM models (Dreifuerst, 2011; Pesut & Herman, 1998; Kuiper, 2004; Levett-Jones et al., 2010) are academic-based, used for undergraduate students and non-critical care related, and were developed for a specific purpose and targeted groups of undergraduate nurses. Furthermore, existing clinical reasoning tools and debriefing models featured generic and broad clinical reasoning ideas and were not specifically designed to be utilised for practising nurses (post-registration), according to the empirical and scoping reviews in sections 2.5, 2.6, 2.8, and 2.9. In multicultural learning environments, despite most of the models being designed to be learner-centred, there was no central focus on thoroughly assessing and/or supporting post-registration practising nurses' clinical reasoning while taking seniority, experience, competency, and case complexity into account, pointing to population gaps and practical knowledge in relation to the best clinical reasoning and debriefing models and practice tools for post-registration nurses (Miles, 2017).

As described in section 2.6, the dual loop and cognitive load theories revealed potential risks of cognitive overload during critical care SBE. Specifically, SBEs involving nurses with varying experience, seniority, and competence levels within a multicultural learning environment can be problematic if they do not account for information volume, flow, and the simultaneous use of fast and slow cognitive reasoning processes. As described in Tables 2 and 6, existing simulation debriefing and clinical reasoning models have not explicitly

addressed the nuances of critical care or the challenges of multicultural and hierarchical learning environments. These aspects, not previously investigated, underscore empirical and practical gaps in preventing underdeveloped or sub-optimally enhanced clinical reasoning skills due to cognitive overload, particularly in group-based SBE activities with RLC (Guerrero, 2019; Wan & Hudson, 2020).

Compared to other nursing specialities, critical and acute care settings require a higher degree of clinical reasoning skills (Vahedian-Azimi et al., 2019). A wide range of critical care and acute simulation case complexity raises the possibility of cognitive overload because critical and acute care scenarios are typically linked to patient severity and acuity, multiple life-threatening dysfunctions, and the need for dynamic clinical reasoning to respond to these simulated clinical situations promptly (Vahedian-Azimi et al., 2019; Jakimowicz et al., 2018). There is a chance that attending critical care SBE activities will result in less-than-optimal clinical reasoning skill development because using non-critical care clinical reasoning models for critical and acute care may overlook some crucial components, such as the requirement for complex and fast-paced reasoning with multiple information sources and contributing factors related to the case and environmental complexities (Vahedian-Azimi et al., 2019; Jakimowicz et al., 2018; Liyew et al., 2020). The influence of factors such as experience, seniority, competence, multicultural learning environments, and cognitive load remains underexplored, as outlined in sections 2.5, 2.6, 2.8, and 2.9. This is particularly relevant in scenarios simulating critically ill patients with varying severity, where urgent interventions and complex decision-making are required. These gaps in empirical and practical knowledge relate to how nurses with differing levels of experience respond to cases of varying complexity while managing cognitive load to support optimal clinical reasoning development. The group dynamics and power balance (experienced versus less experienced)

during the RLC dialogue have not been fully investigated, as mentioned in sections 2.5 and 2.6. This disparity raises the possibility that senior and experienced nurses and nurses from cultures that value conversation and active engagement may dominate post-simulation reflection discussions if participants with different backgrounds, levels of seniority, and competence are included. Regarding improving and optimising clinical reasoning skills in consideration of simulation group dynamics and power balance in multicultural learning environments, these factors call for more research and improvement, especially when using RLC for group-based SBE that involve learners from a variety of cultural backgrounds and seniority levels.

In summary, the current empirical, practical knowledge, and population literature gaps highlight the need to investigate/explore competence, experience, seniority, previous experience and exposure to patient cases, case complexity, amount of information, and flow and structure of RLC delivery to enhance learners' clinical reasoning skills. Overlooking these factors may lead to sub-optimal clinical reasoning skill development. Hence, the review identified a need to establish a comprehensive RLC model in which each of these contributing factors could be considered, ultimately to enhance and optimise clinical reasoning skills. The development of this model, grounded in experiential learning theory and dual-loop frameworks, can inform the iterative and reflective processes embedded in the post-simulation RLC approach.

2.13 Conclusion

This chapter outlined the conceptual foundations of reflection, reflective practice, and RLC as a debriefing method, and their role in enhancing clinical reasoning skills. Several key messages emerge from the review.

The literature distinguishes clinical reasoning as a process, while clinical judgment and decision-making are understood as the outcomes of that process. The focus of this study is on enhancing and optimising clinical reasoning skills through SBE.

The dual-loop theory offers a valuable framework for understanding how intuitive (non-analytical) and analytical thinking interact during clinical reasoning. Recognising the strengths and limitations of each mode allows healthcare professionals to refine their reasoning and strengthen subsequent decision-making.

The next chapter presents the RLC model in detail and explains the rationale for adopting a co-design process to ensure it is responsive to these identified needs.

CHAPTER 3: CO-DESIGN OF POST-SIMULATION REFLECTIVE LEARNING CONVERSATION MODEL

3.1 Introduction

The conceptual and empirical literature gaps discussed in Chapter 2 highlighted the lack of evidence about the RLC model with a central focus on enhancing and optimising clinical reasoning skills in consideration of various simulation participants in a multicultural learning environment. This chapter describes the co-design process of the RLC model in consideration of the most important influencing and contributing factors to achieve enhanced and optimised clinical reasoning skills while attending critical care SBE activities. The SBE and clinical reasoning theoretical frameworks, tools, and models used to underpin and co-design the new model are also described in this chapter.

3.2 Co-Design in Healthcare

A co-design working group collaborated to co-design a SBE RLC debriefing model to enhance and optimise clinical reasoning skills in consideration of the most important influencing and contributing factors to clinical reasoning skills. Co-design processes in healthcare involve the equal partnership of individuals who work within the system (in this study, healthcare staff), individuals who have lived an experience (in this study, both staff as learners and recipients of the model, but also patients as ultimate end-recipients of health care), and the developers of the proposed models (Bird et al., 2021; Brown et al., 2021; McGowan et al., 2024). The literature increasingly supports the involvement of patients in

healthcare research and education (Brown et al., 2021; White et al., 2023; McGowan et al., 2024). Involving patients, or users, in the co-design process of the model centres on ensuring that their perspectives, needs, and experiences are directly integrated into developments, such as models Bird et al. (2021). Their involvement can bridge the gap between theory and practice, ensuring that SBEs address patients' concerns and improve clinical outcomes, leading to more relevant and impactful outcomes (Ward et al., 2018).

3.3 Co-design Process of Post-simulation Reflective Learning Conversation (RLC) Debriefing Model

To achieve a collaborative and structured co-design process that engages all relevant stakeholders, this study's RLC model was co-designed based on the Bird et al. (2021) co-design framework in healthcare. A co-design working group of ten critical care nurses reflecting a range of grades, clinical experience, and gender; one critical care doctor; three patient representatives (who had been previously admitted to critical care); two researchers, and two critical care educators with SBE experience, worked collaboratively (n=18) to co-design the RLC model. That diversity aimed at ensuring a comprehensive perspective, which is crucial for developing a robust debriefing model. The group size of (n=18) was decided to enable active participation and collaboration and to have enough participants to ensure meaningful input from all key perspectives while keeping the process manageable for in-depth collaboration. With that co-design working group size, the co-design process can be practical in terms of time, resources, and logistics, allowing for meaningful and sustained participation from each member (Brown et al., 2021; McGowan et al., 2024).

Using Bird et al. (2021) co-design framework, the co-design group collaboratively worked through a process of "*Framing the Issue", "Generative Design", and "Sharing Ideas"* (Bird et al., 2021). The *framing of the issue stage* incorporated the participants' experiences and what needs to be included in the model. In this stage, the group defined the scope of the RLC design process, ensuring that all participants had a shared understanding of the importance of the model against the practical and literature gaps. The critical care nurses, doctors, patient representatives, and educators of the co-design working group discussed their experiences, concerns, and expectations related to the model. However, in this phase, power dynamics, professional hierarchies, varied levels of expertise, and differences in communication styles and cultural perspectives were challenges to reaching an agreement on the model's process, pathway, and items. These challenges were addressed by establishing clear facilitation ground rules, encouraging equitable participation, and integrating culturally sensitive language into the model design. The inclusive and participatory facilitation approach ensured that all voices were equally heard, and everyone's input was valued and taken into consideration, with adequate time to address all arising concerns and suggestions over four workshops of 4 hours. The diversity of perspectives ultimately enriched the RLC's adaptability across varied cultural and professional contexts. Due to the COVID-19 pandemic and associated infection control restrictions, the workshop meetings were conducted and recorded via the online platform Microsoft Teams (Appendix 5). As discussed in Chapter 4, section 4.7, research ethics approval was obtained for these workshops, and informed consent was given by participants for the recording of these sessions.

During the co-design process, the "*generative design*" stage of Bird et al's. (2021) framework included creativity and innovation, where the co-design group participants collaboratively generate solutions to the defined problem concerning the need to have a universal debriefing

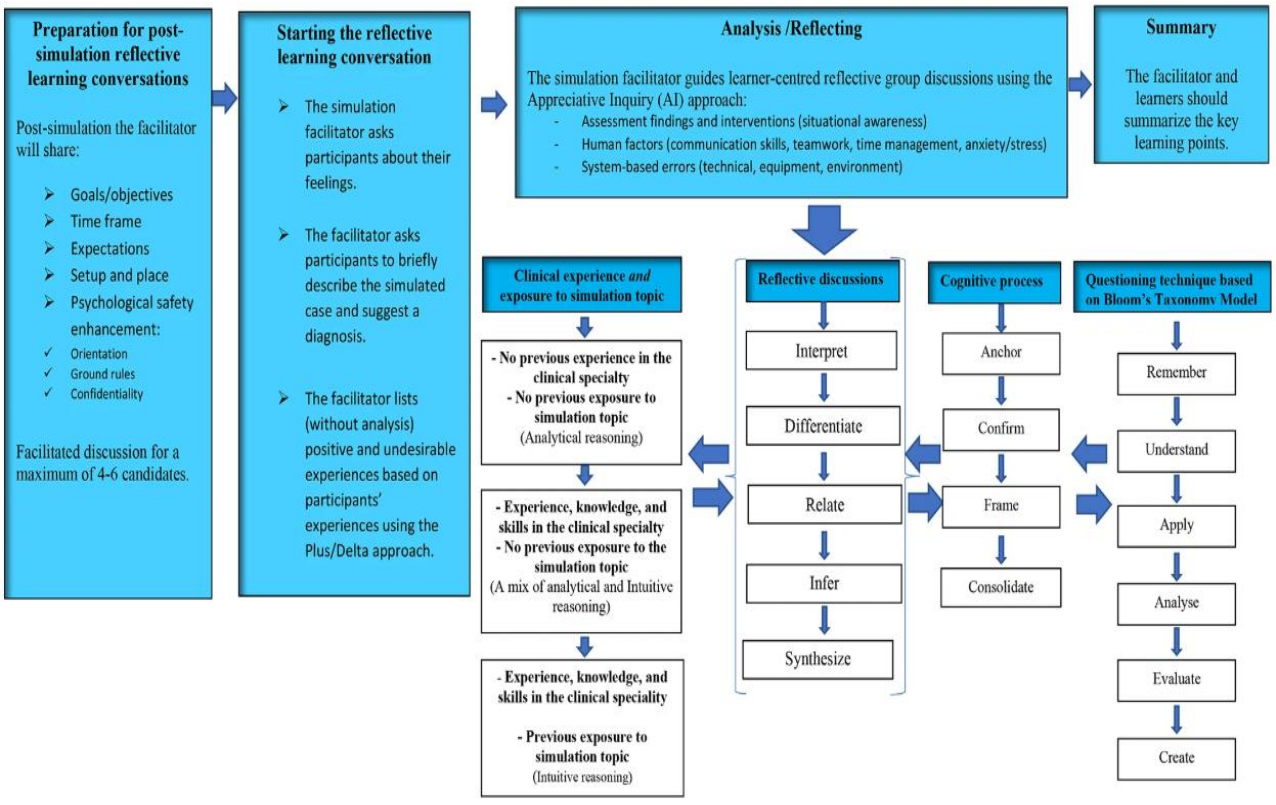
model that enhances and optimises clinical reasoning skills while attending multicultural immersive SBE including a diverse group of learners in terms of experience, seniority, and competence levels. In this stage, the co-design workgroups were engaged in brainstorming sessions, drawing on their unique perspectives to propose potential solutions underpinned by theoretical and conceptual frameworks discussed in the next sections of this chapter. The co-design workgroups were involved in creating visual representations of the model and scripting the model's content incorporating multiple iterations with flexibility, allowing the model to evolve as participants experimented with different ideas.

The final stage of Bird et al. (2021) framework "*sharing ideas*" involved refining and validating the RLC model by presenting it to broader stakeholders for feedback. That was applied by piloting the model and testing its validity using Content Validity Ratio (CVR) and Content Validity Index (CVI), and reliability through the pre-test/post-test research including experimental and control groups. The validity and reliability process, measures, and tests are explained in Chapter 4, sections 4.5, and 4.6.

The model was co-designed in alignment with the International Nursing Association of Clinical Simulation and Learning (INACSL) and The Association for Simulated Practice in Healthcare (ASPiH) standards of the debriefing process (Decker et al., 2021; Diaz-Navarro et al., 2024) and established to be self-explanatory for users (simulation educators) incorporating worked examples, steps, and elements of each step and phase. The INACSL and ASPiH simulation standards of debriefing mandate the inclusion of at least pre-briefing, analyses, and summary phases. In this study, in addition to these three phases, the co-design team members thought of the importance of adding a phase that focuses on guided reflection and advanced analysis and synthesis with a central focus on clinical reasoning optimisation;

therefore, the model was co-designed to be multiphasic, incorporating four phases. During the co-design process, the co-design team focused on the importance of enhancing and optimising participants' clinical reasoning skills considering the amount and flow of information to be delivered and discussed with mitigated risk of cognitive overload. That focus was decided by the co-design working group to enable the simulation participants to be actively engaged to reflect at different levels, including but not limited to emotional, technical, and non-technical and human factors- related aspects, despite their various experience, competence, and seniority levels (Oriot and Alinier, 2018). The non-technical and human factors- related aspects were included but were not limited to communication skills, collaboration, active listening, teamwork, and many other human factors-related aspects (Oriot and Alinier, 2018; Cheng et al., 2020). The four phases of the model are presented in Figure 2.

Figure 2: Post-simulation reflective learning conversation model



The co-design group reviewed the evidence and literature indicating the positive impact of pre-briefing in enhancing simulation participants' psychological safety (Jones & Alinier, 2009; Decker et al., 2021). In alignment with current evidence, to foster simulation participants' psychological safety, prepare them mentally for the next phases of the debriefing, and encourage them to be actively engaged during the SBE and debriefing sessions, the co-design working group decided to include the following elements in the first phase of the model:

- Introduction of the goals and objectives of the RLC.
- Expected duration of the RLC.
- Expectations from both facilitators and participants during the RLC.
- Exploring and addressing any concerning and distracting issues before the debriefing session and assuring confidentiality in a blame-free learning environment.

The second phase of the model, "*starting the learning conversation*", was co-designed by the working group to include exploring participants' feelings in relation to the scenario experience; describing the scenario's main course and diagnosis; and listing participants' positive and undesirable experiences but without analysis (Figure 2). The co-design working group included these elements to trigger candidates' self-awareness and mental preparation for advanced analyses and in-depth reflection (Alexander, 2020; Decker et al., 2021). During the co-design workshops, the co-design working group thought of the importance of this phase to reduce the potential risk of cognitive overload (Sweller, 1988), especially for those who are new to the SBE topic and without previous clinical experience of the skill/topic (Benner, 1987). This phase was established as a preparatory and a starting point for individual and team reflections, working toward advanced analysis and synthesis for enhanced and optimised clinical reasoning skills (Cheng et al., 2021).

During the multiple model development workshops, the co-design working group considered the potential impact of clinical experience and previous exposure to the SBE topic on clinical reasoning enhancement and advancement while attending the RLC, especially in the presence of experienced and less experienced within the simulation group. The co-design working group categorised simulation participants and their potential clinical reasoning types as no previous experience in the clinical specialty/ no prior exposure to SBE topic (tendency to use analytical-slow reasoning system); experience, knowledge, and skills in the clinical specialty/ no prior exposure to the SBE topic (tendency to mix using analytical-slow and intuitive-fast reasoning systems); experience, knowledge, and skills in the clinical specialty/ previous exposure to SBE topics (tendency to use intuitive-fast reasoning system) (Figure 2). That categorisation to clinical reasoning systems aimed at developing the model to meet the demands of different learners' experiences, seniority, and competence levels within the same simulation group, leading to balanced group dynamics and meeting the tendency of less experienced practitioners to use analytical reasoning in comparison to experienced ones who tend to use non-analytical (intuitive) reasoning skills (Evans, 2003; Croskerry, 2009; Kahneman, 2011; Young et al., 2018; Young et al., 2020).

The co-design working group established the model to start the simulation debriefing in the second phase of the model with the Plus/Delta approach. This aimed to provide clear guidance during the reflective discussions of the third phase of the model by identifying what went well (Plus) and what could be improved (Delta) (Kainth, 2021). The Plus/Delta method notes serve as a reference during the reflective discussions to highlight the most important issues to be reflectively discussed and drive the expanded reflective discussions using the

Appreciative Inquiry and Bloom's taxonomy models (these models are described in the next sections). That design was decided by the co-design working group to encourage constructive learning with a mitigated risk of cognitive overload (Kainth & Reedy, 2024).

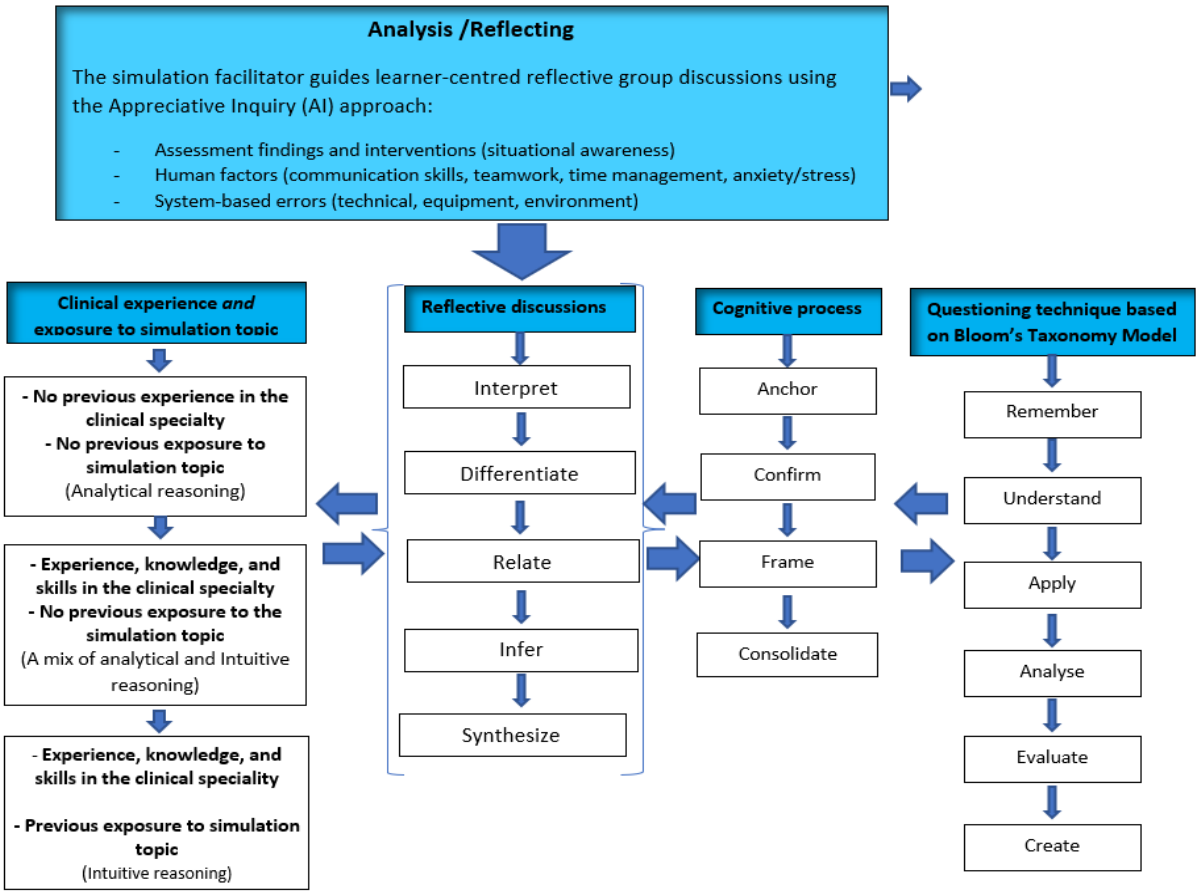
The co-design working group reviewed the current theoretical and conceptual frameworks to be used to mitigate the risk of cognitive overload associated with case complexity. After a review of the literature, the co-design working group decided to underpin the model with the dual loop learning theory (Evans, 2003) and cognitive load theory (Sweller, 1988) through a process of anchoring, confirming, framing, and consolidating. That was decided by the co-design working group considering that having a structured and incremental cognitive process with adequate time to think and reflect considering both experienced and non-experienced simulation participants can reduce the potential risk of cognitive load, especially after complex scenarios in the presence of different participants' previous experience, exposure, seniority, and competence levels (O'Rourke et al., 2023; Robinson et al., 2023).

In addition to underpinning the model with the Dual Loop learning theory (Evans ,2003) and the cognitive load theory (Sweller,1988) to avoid cognitive overload associated with case complexity, the flow and structure of the model were underpinned by the clinical reasoning cycle of Levett-Jones et al. (2010), the reflective simulation framework of Jones & Alinier (2009), and the experiential learning theory of Kolb (1984), through a sequential and progressive process including interpreting, differentiating, relating, inferring, and synthesising. In this stage, the co-design working group reviewed the evidence about the importance of reflective and experiential learning to construct and consolidate clinical reasoning skills (Sobeck, 2020; Kainth & Reedy, 2024). For that, the co-design working

group decided on a reflective conversation flow that can give adequate time to reflect, analyse, and synthesise incrementally from basic understanding and interpretations, towards higher analyses and syntheses levels, leading to enhanced and optimised clinical reasoning skills with mitigated risk of cognitive overload (Robinson et al., 2023).

Taking into consideration that reflection is a cornerstone of any debriefing process (Nagle & Foli, 2022; Kolbe et al., 2023). The third phase of the model, "*Analysis and Reflection*", was established for advanced analysis and deep reflection (Nagle & Foli, 2022) (figure 3). As described in Chapter 2, section 2. 5, there are many multiphasic simulation debriefing models with a guided reflection focus that were suggested by the RLC co-design working group to be adopted. One of the most relevant debriefing models discussed by the co-design group was the Promoting Excellence and Reflective Learning in Simulation (PEARLS) model (Eppich & Cheng, 2015). However, as outlined in the literature review (Chapter Two, Section 2.5), existing debriefing models have placed limited emphasis on the central enhancement and optimisation of clinical reasoning skills within multicultural learning environments involving learners with diverse experience, seniority, and competence levels. To fill that literature gap, the co-design working group decided to include a specific and advanced phase for reflection and analysis incorporating multiple and interconnected sub-phases in consideration of the clinical reasoning framework by Levette (2010), and the concurrent integration of Bloom's Taxonomy, Appreciative Inquiry, and the Plus/ Delta debriefing models (Bloom, 1956; Cooperrider & Srivastva, 1987; Fanning & Gaba, 2007). The co-design working group reviewed the evidence about the positive impact of these models to apply incremental, Socratic, open-ended, and reflective questioning techniques to achieve a learner-centred learning process with a mitigated risk of cognitive overload, leading to enhanced and optimised clinical reasoning skills, therefore, decided to include them in the model.

Figure 3: The third phase of the post-simulation reflective learning conversation model



The multiphasic and multimodal designs of the model were decided by the co-design working group to distribute cognitive load effectively instead of overwhelming simulation participants with information through a single mode. Having different modalities over multiple phases allows for a balanced and manageable distribution of cognitive load, leading to enhanced and optimised clinical reasoning skills development (Levin et al., 2019).

The co-design working group decided to include an Appreciative Inquiry approach (Cooperrider & Srivastva, 1987) in the model to enable participants to recognise their capabilities and encourage them to apply these strengths in the next scenarios (Figure 3). This was aimed at facilitating a debriefing session with a solution-oriented instead of a problem-focused approach, which led to a more positive, engaging, and effective learning experience

with enhanced clinical reasoning skills. Bloom's Taxonomy questioning approach (Bloom, 1956) was also decided by the co-design working group to be included in the model to encourage a smooth and systematic movement from knowledge and understanding focus to synthesis and evaluation focus toward clinical reasoning advancement and optimisation.

The fourth phase of the model, the “summary phase”, aimed to summarise the key learning points raised during the RLC and to ensure that learning objectives are achieved. The summary phase is a place to consolidate learning and achieve comprehensive metacognition. This is a critical phase for ensuring that key insights and lessons are clearly understood and can be carried forward into future practice. The co-design working group underpinned the summary phase of the model with the Experiential Learning Cycle (Dewey, 1910) and Kolb’s reflection model (Kolb, 1984). As described in the literature review chapter section 2.3, the summary phase was designed in alignment with the 'Reflective Observation' and 'Abstract Conceptualisation' stages of Kolb’s cycle, where simulation participants learn by experience and integrate new experiences with existing knowledge. Moreover, the co-design working group reviewed the evidence about the positive impact of debriefing scripts and cognitive aids to promote simulation faculty debriefing skills (Eppich, & Cheng, 2015; Forstrønen et al., 2020), especially, for facilitators who are still solidifying their debriefing expertise (Kolbe et al., 2013). The co-design team ultimately developed the model outlined in Figure 4, including examples and scripts (Figures 4, 5, and 6).

The final draft of the model was piloted and tested using a mixed methods pre-test/post-test research design. The evaluation of the co-designed model, including face and validity content testing, will be further discussed in Chapter 4.

Figure 4: The final version of the post-simulation reflective learning conversation model

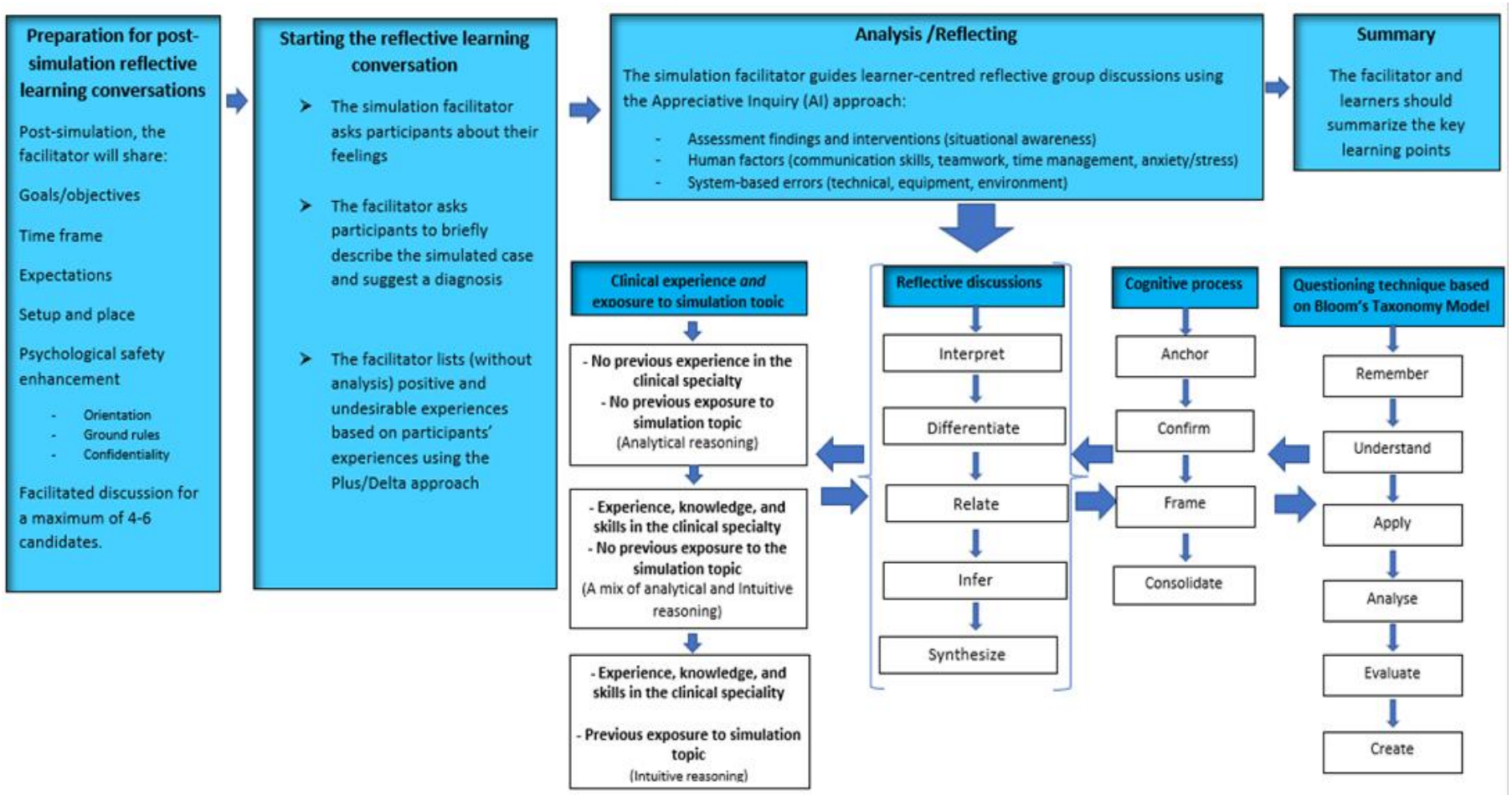


Figure 5: Reflective learning conversation RLC model script

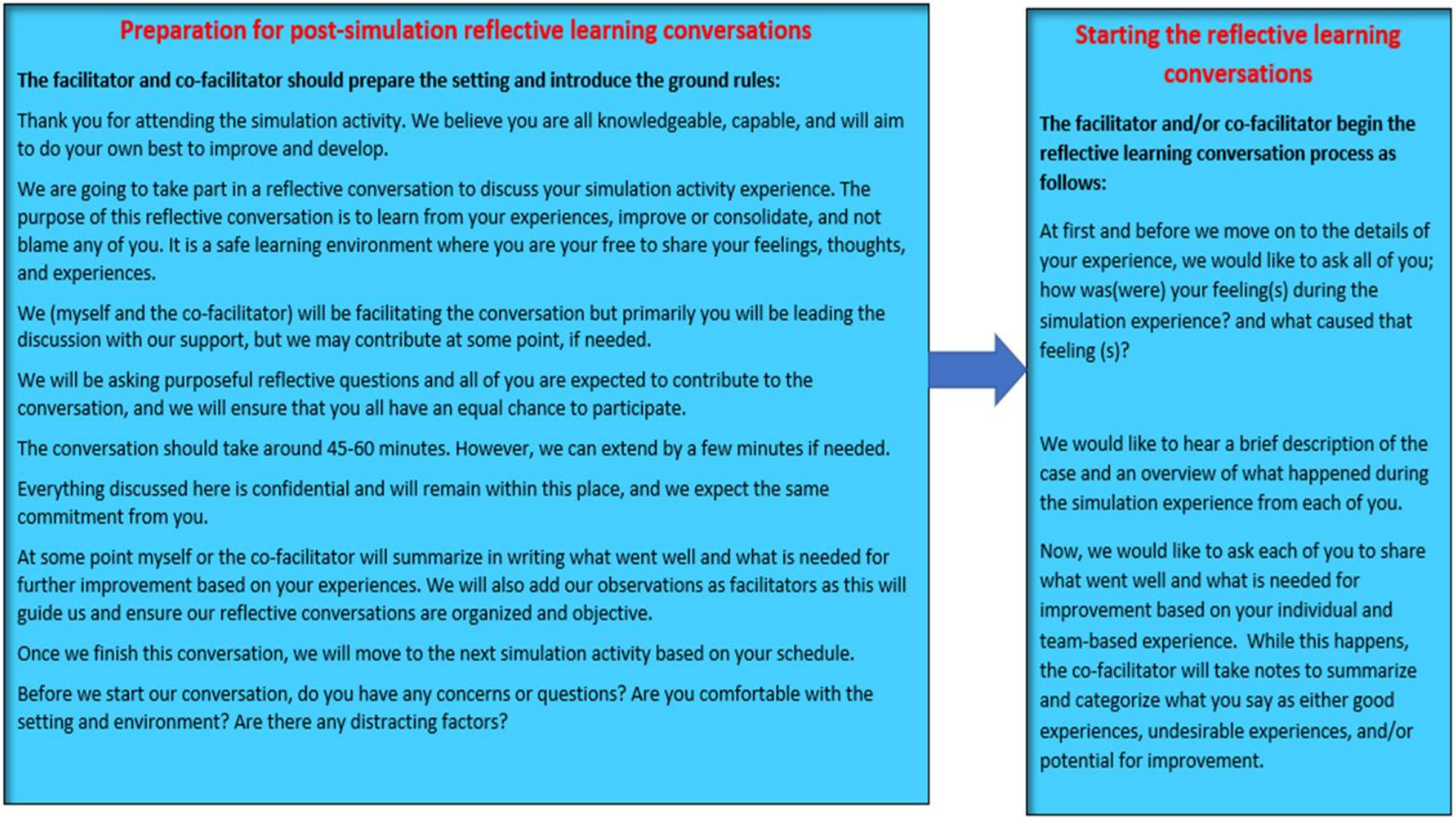
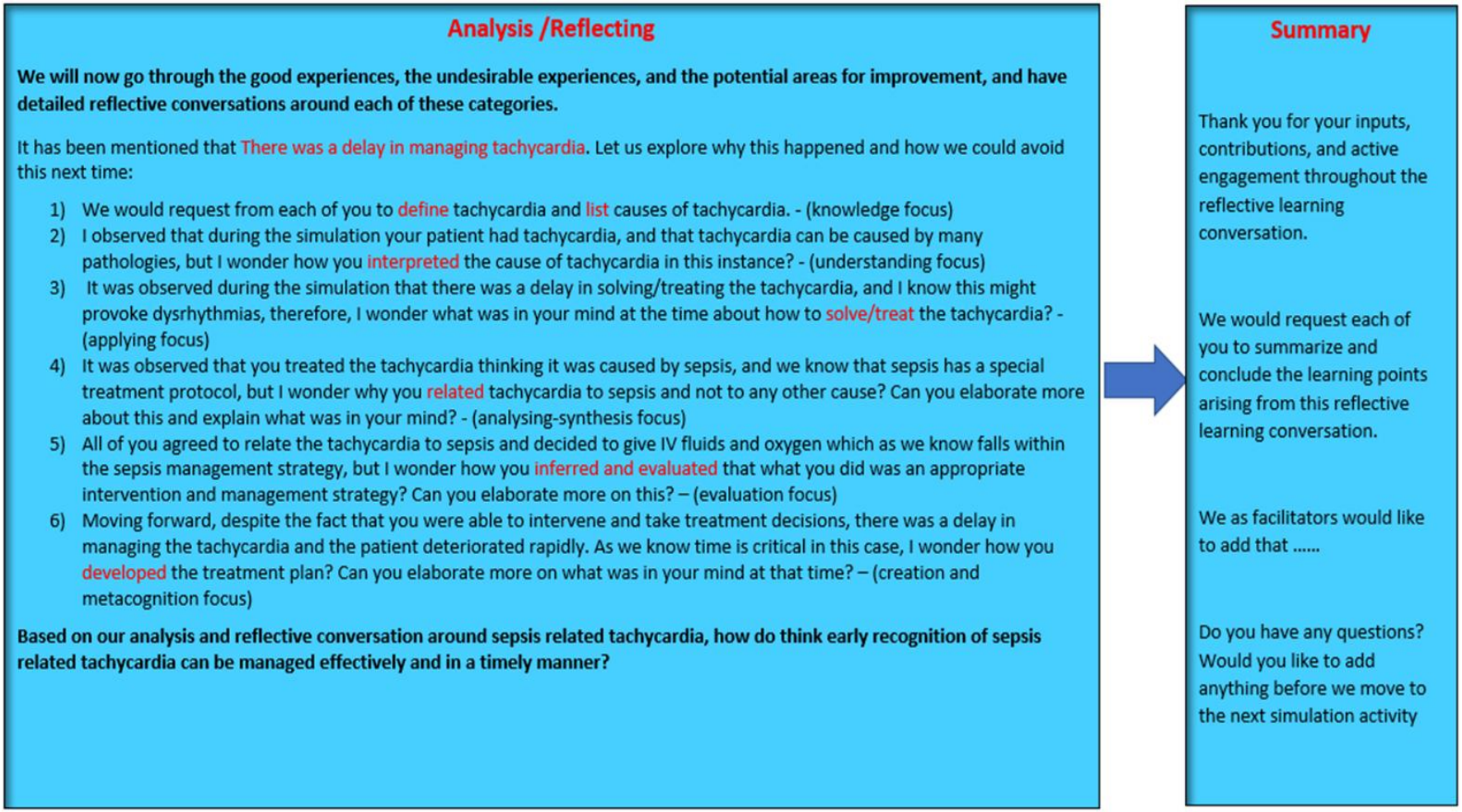


Figure 6: Reflective learning conversation RLC model script, cont



3.4 Conclusion

The conceptual and empirical literature gaps discussed in Chapter Two highlighted the lack of evidence about the availability of an RLC model that enhances and optimises clinical reasoning skills, whilst also considering participants with varying competence, seniority, experience, and exposure to the SBE topic, case complexity, and the amount and flow of information in a multicultural learning environment.

Based on that literature gap, a co-design working group comprising healthcare front-line nurses, educators, researchers, and patients collaboratively worked to co-design an RLC model to enhance and optimise clinical reasoning skills, taking into consideration the most important influencing and contributing factors.

The co-design process was theoretically driven and underpinned by the best available clinical reasoning, simulation debriefing models, and theoretical frameworks. The model's testing, including validity and reliability measures, took place after the co-design phase, and details of the methodology and methodological strategies are discussed in Chapter 6.

CHAPTER 4: METHODS

4.1 Introduction

Chapter 2 outlined what is currently known about this research topic and identified gaps. In this chapter, the choice of the mixed method and pre-test/post-test design are discussed and justified. This includes discussing pragmatism as a research paradigm for this study, in addition to, the epistemological and ontological positions of this research, and how these influenced the design for this study. An overview of each research method is presented with in-depth discussions of the choice of methods, outlining how each approach was used, and how data were collected, analysed, and integrated. First, I will outline the research paradigm and design of the study and the practical implications associated with this research, then data collection methods and the validity process of the used instruments will be discussed, and then the research setting, sample size, and recruitment process will be highlighted. The ethical implications associated with each research data collection method are also discussed, followed by a reflexivity section to elaborate on my role and potential and actual influences in this research. Toward the end of this chapter, the qualitative and quantitative data analysis and frameworks will be discussed, including the thematic analysis process and the associated quality checks.

4.2 Aim

This research study aimed to co-design and test a RLC model used for multicultural critical care SBE in the presence of different simulation participants' experience, seniority, and

competence levels using a range of scenario complexity. The research questions (described in chapter 1, section (1.6) were answered through the systematic literature review described in Chapter 2, the model co-design described in Chapter 3, and a mixed methods pre-test/post-test design described in Chapters 4, 5, 6, and 7. The focus of this chapter is on the research paradigm, methodology, and methods.

4.3 Design

This study adopted a mixed methods pre-test/post-test design to evaluate and test the RLC model.

4.4 Research Paradigms

Denzin and Lincoln (2000.p.110) defined paradigms as "human constructions which construct a meaning embedded in research data". Paradigms are important as they determine what should be studied, how it should be studied, and how the results of the study should be interpreted (Morgan, 2007; Dudovskiy, 2016). Researchers should be able to decide on an appropriate paradigm that fits their proposed research designs and questions (Denzin and Lincoln, 2000; Kivunja and Kuyini, 2017; Kumatongo & Muzata 2021). The literature describes the most used research paradigms which are positivism, interpretivism, and pragmatism (Kivunja & Kuyini, 2017; Kumatongo & Muzata 2021). This next section discusses the underpinning research paradigm of this PhD study.

4.4.1 Pragmatism as A Paradigm

This study used a mixed methods pre-test/post-test research design to answer the research questions. It was critical to use a research paradigm that fitted this research design, as well as aligned with the research questions and aims (Creswell et al., 2003; Cohen, 2016; Stratton, 2019; Ishtiaq, 2019; Kumatongo & Muzata 2021). Pragmatism has been described as the "best paradigm" for this type of research design (Teddlie and Tashakkori, 2009, p. 99). Pragmatism can integrate quantitative and qualitative strands within the scope of a single research study (Kivunja and Kuyini, 2017). Methodologic pragmatism emphasises the shared meanings of research as a multistrand-conversion-concurrent design (Kivunja and Kuyini, 2017). Pragmatism reduces the dissociation between ''complete objectivity'' and ''complete subjectivity'' which acts as a complementarity joint format (Morgan, 2007). It is situated somewhere in the centre of the research paradigm continuum and the effect of integrating the results of quantitative and qualitative methods is the possibility of providing a more complete picture of a research topic (Kivunja and Kuyini, 2017). This research used a mixed methods design incorporating different quantitative and qualitative data collection methods, and this aligns with the principles of pragmatism in relation to multistrand data collection consideration.

Mixed methods research addresses a range of research questions and provides a more complete knowledge that can enhance theory development and practice (Johnson and Onwuegbuzie, 2004; Kivunja and Kuyini, 2017). Adopting pragmatism as an underlying paradigm for both qualitative and quantitative methods can contribute to advancing knowledge to answer research questions with different perspectives and points of view (Plath 2006; Kivunja and Kuyini, 2017). According to pragmatism, knowledge is explicitly linked with experience incorporating physical, psychological, social worlds, and cultural factors

(Dudovskiy 2016; Kivunja and Kuyini, 2017). Taking into consideration that both quantitative and qualitative research use deductive and inductive approaches respectively, the pragmatism paradigm uses realism that relies on abduction to move back and forth between abduction and induction (Johnson and Onwuegbuzie, 2004; Kivunja and Kuyini, 2017). Moreover, Shannon-Baker (2016); Kivunja and Kuyini (2017), Dudovskiy (2016), and Kaushik and Walsh (2019) discussed that the pragmatism paradigm is transferable and flexible to use different data sources. This feature of pragmatism matches the mixed methods design of this study which incorporates different data collection methods including questionnaires, focus group, and subsequent observations (Sharp et al., 2012; Greene, 2007).

Different individuals and groups may experience and understand reality differently based on their contexts and mindsets (Kivunja and Kuyini, 2017; Ramanadhan et al., 2021; Mukumbang, 2021). Pragmatism allows researchers to implement and alternate epistemological positions and integrate the best research methods to achieve rigorous results with multiple realities. That pragmatic epistemological position supported the design of the study using different perceived and unperceived data collection methods (Feilzer, 2010; Collis& Hussey, 2014; Martens, 2015; Kivunja and Kuyini, 2017; Ramanadhan et al., 2021; Mukumbang, 2021; Christensen, 2022). Both perceived and unperceived methods of this study were reliant on data resources that meet the epistemological position of the pragmatism paradigm that multiple coexisting realities are based on human interactions and experiences (Mukumbang, 2021; Christensen, 2022). The ‘perceived’ data in this study were collected through self-reported questionnaires and focus group methods, and the ‘unperceived’ data were collected through direct subsequent observations and video reviews by the educators (details are discussed in the next sections of this chapter). This study's use of perceived and

observational data collection methods aligned with the pragmatism epistemological position of multiple coexisting realities.

This study aimed to test a newly co-designed RLC model in realistic simulated settings considering the most important contributing factors from different resources toward clinical reasoning optimisation. This aligned with the pragmatic paradigm epistemological position that focuses on what works in a real environment for different situations, to bridge the gap using new approaches (Stratton, 2019; Ishtiaq, 2019; Kumatongo & Muzata 2021). This also supports epistemological pragmatic themes of multiple co-existing realities from different sources of information to fill gaps in current practice (Kumatongo & Muzata 2021).

Moreover, pragmatism never considers knowledge as final, universal, or absolute. Instead, knowledge is always in a process that can be revised and improved (Dudovskiy, 2016; Ramanadhan et al., 2021; Mukumbang, 2021; Christensen, 2022). The pragmatist worldview helps in bringing together scientific and humanistic domains of understanding. In pragmatic research, observations, experience, and experiments are all useful ways to accept conflicting issues from different perspectives (Johnson and Onwuegbuzie 2004). It allows researchers to gather evidence from a wide range of sources and to critically evaluate them in terms of their strengths, limitations, and applicability to the practice setting (Plath, 2013). It enables researchers to focus their attention on essential concerns in active practice situations. This fits well with this research methodology to collect data from different sources using different collection methods including questionnaires, direct observations, video reviews, and focus group. Details of these methods will be discussed in the upcoming sections of this chapter.

In the pragmatism paradigm, the *ontology* of realism sits between objectivity and subjectivity (Pawson, 2013). This study aimed to identify the influencing and contributing factors that could be addressed to enhance clinical reasoning while attending SBE sessions through perceived and self-reported methods. However, subjective and human-related factors may influence individual perceptions, therefore, different and complementary perspectives related to objectivity were also addressed by using direct observation assessments of learners' clinical reasoning (Fletcher, 2017; Shannon-Baker, 2016). Moreover, in alignment with the pragmatic ontology, and to avoid theory-driven and context-focused solutions, this study was designed to take subjective and objective perspectives into account towards optimising clinical reasoning. The focus of the study was on what works best to optimise clinical reasoning during different scenario complexities in multicultural SBE learning environments (Pawson, 2013; Fletcher, 2017; Shannon-Baker, 2016).

4.4.2 Mixed Methods Pre-test/Post-test Design

In this study, while both quantitative and qualitative data collection methods were important, the primary sources of data were quantitative using questionnaires, subsequent observations, and video reviews of learners' clinical reasoning, enriched and complemented by the qualitative data using focus group to provide additional and in-depth explorations (Johnson and Onwuegbuzie, 2004; Wilkinson & Staley, 2019). In this research study, mixed methods offered the breadth and depth of understanding required for clinical reasoning optimisation during SBE (Teddlie & Tashakkori, 2011) and informed the RLC model evaluation toward clinical reasoning optimisation.

Mixed methods approaches can be iterative, with researchers constantly examining the data from each strand and adjusting accordingly (Teddlie & Tashakkori, 2011). This PhD study included multiple iterations during the co-design phase of the model, deriving the qualitative data themes and sub-themes, and deciding the domains and subdomains of the questionnaires. One of the driving factors in deciding the mixed methods design in this study was the need to conduct multiple iterations during different levels and phases of the study. However, the interpretation of mixed methods qualitative and quantitative data is complex with possible conflicting findings (Johnson and Onwuegbuzie (2004); Wilkinson & Staley, 2019; Mertens et al. 2016) This limitation was taken into consideration at the early stages of the study design as a potential area for further exploration in case of conflict in the quantitative and qualitative findings or disagreement.

The pre-test/post-test research design allows for the assessment of an intervention applied to a group of study participants (Cohen, 2016; Cranmer, 2017). It is used to determine the effect of a treatment or intervention on a given sample (Kikuta & Denly, 2021; Coopersmith et al., 2022).

In this study, a pre-test/post-test design was used with two groups (experimental and control) , thereby positively influencing the internal validity of the study (Reichardt, 2009; White, & Sabarwal, 2014; Campbell & Stanley, 2015; Rogers & Révész, 2019). The two groups of participants attending critical care SBE sessions were recruited for comparison and data were collected at three points in time (beginning, halfway, at the end). However,

due to institutional and SBE course requirements, the sample participants were assigned to groups and sessions before their SBE activities recruitment; as a result, randomisation of the study sample was not possible.

The *pre-test/post-test* evaluation allows for immediate assessment of intervention and provides a means for rapid refinement of instructor teaching or SBE facilitation techniques. This approach is used frequently in educational research on learners (Alam, 2019), particularly where randomisation is not possible. In addition to being a convenient research method, pre-test/post-test design allows for statistical data analysis to compare the groups and progressively evaluate the research outcomes (Blome & Augustin, 2015; Cranmer, 2017). This *pre-test/post-test* design meets the data analysis requirements of this study by evaluating the clinical reasoning level within each group, comparison between different groups, and progressive assessment of learners' clinical reasoning levels over different points in time.

One of the pre-test/post-test design features is giving the groups the same intervention and exposure (Cranmer, 2017). This could increase the significance of research findings, especially, in the absence of randomised controlled groups (Blome & Augustin, 2015; Cranmer, 2017). In this study, due to an organisational and course requirement, randomisation was not feasible while learners had the same intervention, assessment methods, and overall measures.

Another feature of the *pre-test/post-test* design is linear ordering. This requires the assessment of research variables before and after the intervention with the same comparison

standard (Cranmer, 2017). This is because when the comparison standards differ between *pre-test/post-test,* the responses are no longer a valid index of a person's true change on the construct (Campbell & Riecken, 1968; Blome & Augustin, 2015). In this study, the assessment standards and methods for both experimental and control groups were the same, and that was aligned with the *pre-test/post-test* design in relation to the linear ordering feature described in the next sections. The sample recruitment details are discussed in section 4.10.2.

The pre-test/post-test design has limitations including inherent flaws, such as lack of control and randomisation, maturation, and regression tendency, however, strategies like limiting internal and external bias, and appropriate application of basic statistics allow a researcher to make associations in outcome measures (Cohen, 2016; Kikuta & Denly, 2021). In this study, to reduce group involvement-related biases such as collective response biases (Cohen, 2016) while attending the SBE and debriefing sessions, the learning objectives were the same for both comparative groups. For each simulation group, debriefing methods were applied. The only difference was that the experimental group attended SBE activities in which the newly developed RLC model was used.

Moreover, to avoid bias associated with the assessment process and human-related factors, the clinical reasoning assessment groups of assessors/educators for both comparative groups were the same, the assessment process was anonymous, and evaluating participants' clinical reasoning levels was conducted over three points of time by three different assessors/educators. This is explained in more detail in section 4.6.1.1. This repeated measure

approach was purposefully applied in this study to enhance the internal validity and significance of findings (Cohen, 2016; Kikuta & Denly, 2021; Coopersmith et al., 2022).

The maturation and regression tendency of the *pre-test/post-test* were considered (Marsden & Torgerson, 2012). Regarding the maturation, the greater the time differences between pre-test/post-tests, the greater the potential effects due to maturation. To mitigate that, a six-week interval between the pre-test and post-test questionnaires was applied for the self-reported questionnaire, and the observational clinical reasoning assessments were conducted at three different points over six weeks. This aimed at giving the learners enough time to be exposed to the intervention (Brown et al., 2008; Althubaiti, 2016).

Regarding the regression to the mean which is common with pre-test/post-test design and could affect the pre-test scores (Cook & Campbell, 1979). The pre-test/post-test design testing involves some form of measurement, before and after the intervention, and it is possible that improvements can result from the test itself or be attributed to recall bias (Cook & Campbell, 1979; Baldwin, 2018). One more important factor is that pre-test/post-test design allows for participants to become more familiar with the terminology and allows for ease in taking and scoring higher on a post-test, therefore, there is a negative impact on reliability measures associated with internal validity (Cook & Campbell, 1979). Additionally, the lack of a randomised recruitment of participants represents non-probabilistic sampling and can result in limited generalizability levels and external validity of the findings (Cook & Campbell, 1979; Slack and Draugalis, 2001; Baldwin, 2018).

To mitigate these potential limitations associated with regression, and to assess ongoing and subsequent clinical reasoning assessments over six weeks were applied (Cook & Campbell, 1979; Slack and Draugalis, 2001; Baldwin, 2018). Data collection was conducted at different points in time (beginning, halfway, and at the end) while attending SBE activities (Brown et al., 2008; Althubaiti, 2016; Flannelly et al., 2018; Findley, Kikuta & Denly, 2021; Coopersmith et al., 2022). Moreover, in this study, as described in section 4.6, the study used different data collection methods (questionnaire survey, focus group, and subsequent observational assessments) that aimed at enhancing the internal and external validity level of the findings (Campbell & Riecken, 1968; Slack & Draugalis 2001; Findley, Baldwin, 2018; Kikuta & Denly, 2021; Coopersmith et al., 2022). Before testing the RLC model through the mixed methods pre-test/post-test design, the model validity was evaluated and confirmed. The next section explains the model validity testing process.

4.5 Face and Content Validity of the Model

As discussed in Chapter 3, the co-design working group established the RLC model to be piloted and tested for validity and reliability. The face validity testing of the model occurred in two phases. The first phase was conducted during the co-design process with the co-design working group. The working group members (n=18) provided written feedback on the model regarding appearance, grammatical, and flow-related issues (Turner, 1979; Busquet-Duran et al., 2021; Stribing et al., 2022), (Appendix 7). The second element of face validity was conducted during the piloting phase in the real simulation settings by the simulation educators who used the model during the piloting phase. The simulation educators (n=10) were asked to write feedback about appearance, grammatical aspects, flow, and any other clarity and practicality-related issues to use the new RLC model (Turner, 1979; Busquet-

Duran et al., 2021; Stribing et al., 2022). The piloting phase details are discussed in the next sections of this chapter.

Following face validity review by the co-design group and simulation educators, the content validity was evaluated by eight senior educators certified as planners by the American Nurse Credentialing Centre (ANCC) using the Content Validity Ratio (CVR) and Content Validity Index (CVI). The CVI was assessed using Lawshe's method (Lawshe, 1975), while the Content Validity Ratio (CVR) was assessed using Waltz and Bausell 's method (Waltz & Bausell, 1981). Lawshe provided a table of minimum CVR values based on the number of experts. For example, with five experts, a minimum CVR of 0.99 is typically required for an item to be considered valid. This threshold decreases as the number of experts increases (Lawshe, 1975). The CVR items were classified as essential; useful but not essential; and not essential. The CVI was scored based on a four-point scale to address relevancy, simplicity, and clarity according to the score (1= irrelevant, 2= relatively relevant, 3= relevant, and 4= highly relevant). Ten experts were asked to score with the outcome of CVR=1.00, and CVI=1.00, which revealed appropriate content validity (Lawshe, 1975: Waltz & Bausell, 1981).

As described in Chapter 3, section 3.3 to enhance the usability, clarity, and practicality of the RLC model, each phase was supported by scripted work examples to guide the educators while running simulation debriefing. In addition to the worked examples, the co-design working group conducted an awareness and orientation workshop to the educators who are going to use the model. The education session occurred in different phases. The first was a

Microsoft TEAMS online introductory session to the topic, structure, content, purpose, and the SBE practical applications of the model (Busquet-Duran et al., 2021; Stribing et al., 2022). The second educational session was a hands-on workshop that aimed to get the RLC model put into action in a realistic SBE setting (Busquet-Duran et al., 2021; Stribing et al., 2022). During the workshop, the RLC model co-design working group demonstrated its ideal application followed by a return demonstration by the educators who will use it with their learners.

Following the model orientation sessions and workshops, the model was piloted in three critical care SBE specialty courses, and written feedback was requested from the simulation educators (Appendix 7). The feedback included the educators' experience with the model concerning clarity, usability, and any difficulties, and challenges faced while using it. The feedback from the simulation educators was addressed. After confirming the content and face validity of the model, the model was tested through a mixed methods pre-test/post-test design. The next section explains the data collection methods of this design to test the model.

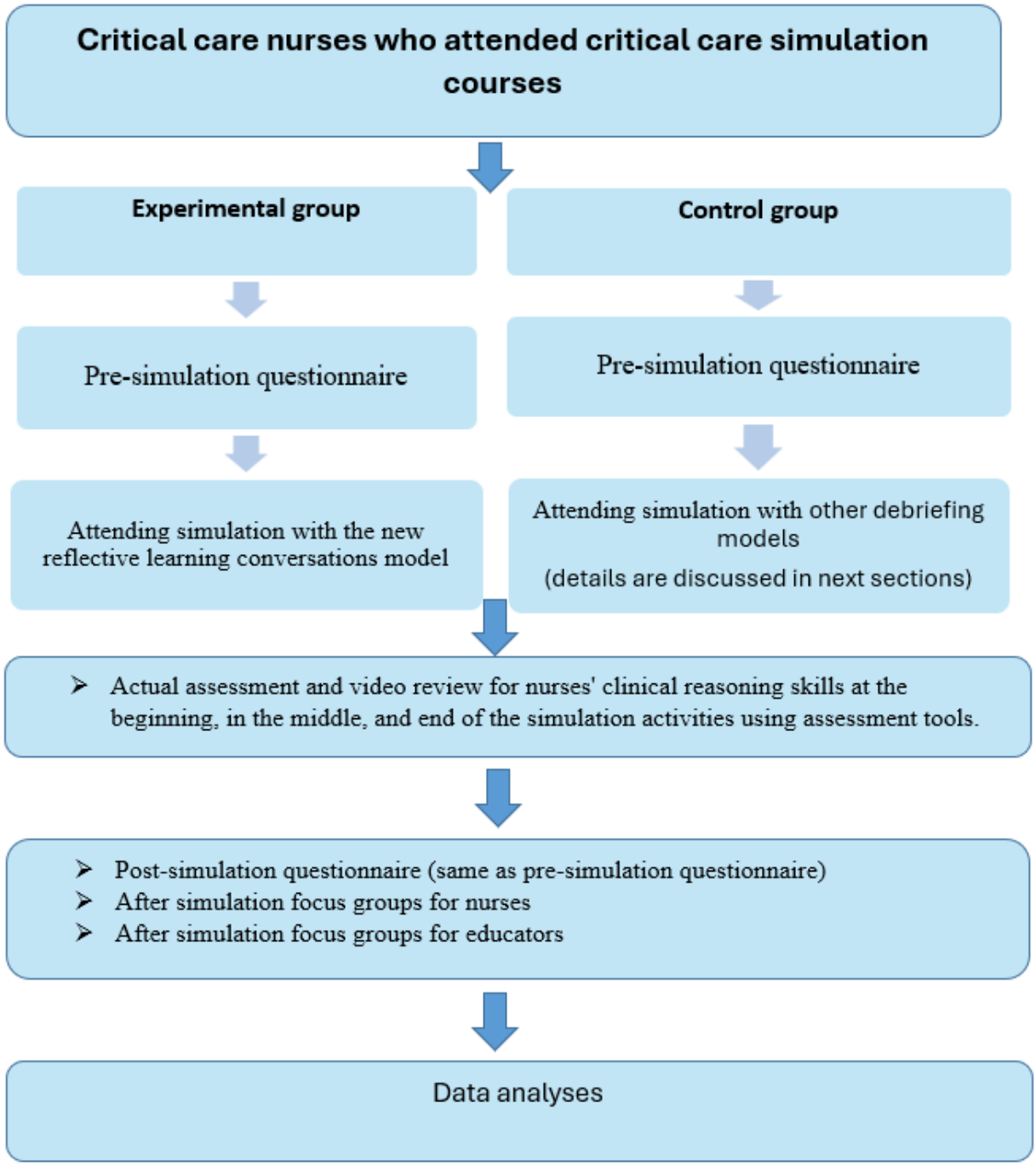
4.6 Overall Data Collection Methods

The critical care nurses' clinical reasoning was evaluated through perceived (descriptive and self-reported) and objective (observed, tool-based) assessment strategies. The perceived assessments included focus group and pre- and post-self-reported questionnaires. The objective assessment was achieved by measuring nurses' clinical reasoning using valid and reliable clinical reasoning tools described in Chapter 2, section 2.7.5 at three points in time (beginning, middle, and end of SBEs), and by a prospective review of learners' videos while

attending SBEs to evaluate their clinical reasoning at three points in time (beginning, middle, and end of SBE activities) described in section (4.6.1.3) (Yong et al., 2021; Ajjawi et al., 2020; Iedema et al., 2018). The integration of the (direct observational and prospective video review assessments) over different points of time aimed at assessing learners' clinical reasoning with deep insights into the behaviours, routines, and experiences of individuals and groups in simulation settings that mimic real-life cases (Yong et al., 2021; Ajjawi et al., 2020), consequently, enhancing the validity of the study findings.

The questionnaire and direct observational and prospective video review assessments of clinical reasoning were conducted before and after attending the critical care SBE for both the experimental and control groups, (kindly refer to Figure 7) to overview the data collection process using different data collection methods described in detail in section 4. 6. 1 and 4. 6. 2. The sample size and recruitment process are going to be discussed in section 4.10 of this chapter and the data analysis methods and strategies will be discussed in section 4.11.

Figure 7: Summary of the quantitative and qualitative data collection methods



4.6.1 Quantitative Data Collection Methods

In this study, the aim was to evaluate the clinical reasoning skills of nurses who attended the critical care SBE using the new RLC model (experimental group), compared to the control group who attended traditional simulation debriefing in which the Diamond debriefing model (Jaye et al., 2015) or GAS debriefing model (Phrampus, & O'Donnell, 2013) were used. These traditional debriefing models were selected based on organisational requirements, as they are usual practice, and are currently in use in the critical care courses of the research site.

To avoid subjective assessment, nurses perceived clinical reasoning levels were evaluated through a questionnaire, direct observations, and video reviews using the Clinical Reasoning Evaluation Simulation Tool (CREST) (Liaw, 2018) and Lasater Clinical Judgment Rubric (LCJR) (Lasater, 2007). The selection process and validity of these tools were discussed in the literature review in Chapter 2, section 2.8, and Chapter 4, section 4.6. The assessment panel included senior educators certified by the ANCC, working as senior nurse educators at HMC. They were independent assessors for this research study.

4.6.1.1 Questionnaire as A Quantitative Data Collection Method for Clinical Reasoning Assessment

To evaluate participants clinical reasoning and self-efficacy in relation to confidence and competence, the General Self-Efficacy (GSE) survey developed by Schwarzer and Jerusalem (1995) and the Nurses Clinical Reasoning Survey (NCRS) developed by Liou et at. (2015) were used as self-reported data collection tools in this study. These questionnaires aimed to self-assess clinical reasoning and self-efficacy for nurses attending critical care SBE, for both

experimental and control group participants, questionnaire details are described in section 4.6.1.1.1. To strengthen the study, before roll-out, it was pilot-tested in the critical care simulation settings of the research site. The pilot aimed at testing and further ensuring the validity and reliability of the survey before using it for the main study data collection. The pilot validity and reliability results are discussed in Chapter 4, sections 4.5 and 4.6. The ethical aspects are discussed in section 4.7. The next section describes the pilot process and procedure of the survey.

4.6.1.1.1 The GSE and NCRS Questionnaires Validity Process

Before using the GSE (Schwarzer and Jerusalem, 1995) and the NCRS (Liou et at., 2015) for the main study, it was piloted with 30 nurses to test reliability and validity within a critical care SBE context and this is reported in Chapter 5, section, 5.2.1. The nurses of the pilot group were excluded from the main study data collection and analysis.

In the pilot phase of the questionnaire, the face validity was assessed by eight educational experts who are certified by ANCC and work as senior nurse educators at HMC. They provided their opinion in writing on the suitability of the surveys in serving their intended purpose regarding placement, scaling, flow of information, grammatical structure, relevancy, clarity, simplicity, and necessity of each item and question. Following modifications related to grammatical and simplicity issues, to ensure and maximise the validity level of these tools, the content validity ratio was assessed using Lawshe's method (Lawshe, 1975; Ayre & Scally, 2014). Lawshe's method was discussed in section 4.5 of this chapter. After the validity assessment, the GSE and NSRS were sent via the HMC email system to the pilot

group (n=30 nurses). The anonymous questionnaires were available via the Qualtrics XM online platform. Ethical aspects are discussed in section, 4.6.1.

A pilot group of nurses who attended the SBE critical care foundation program described in Chapter 1 section 1.5.1 were invited using their HMC email address. This included 15 from the experimental group and 15 from the control group. The ethical implications associated with this invitation are outlined in section 4.7. Once the required responses were collected, the survey's reliability was determined using the following statistical measurements: internal consistency reliability was measured by Cronbach's alpha, and the Inter-rater reliability was measured by Intraclass correlation ICC (Torkian, et al., 2021; Yen & Lo, 2002).

Cronbach's Alpha is a commonly employed and recommended index of test reliability for internal consistency (Cronbach, 1951; Tavakol, & Dennick, 2011; Amirrudin et al., 2021). Internal consistency describes the extent to which all the items in a test measure the same concept or construct, and hence, it is connected to the inter-relatedness of the items within the test, and the inter-relatedness of the items of observed scores (Tavakol, & Dennick, 2011). As discussed in Chapter 4, section 4.6. In this study, reliability was measured by Cronbach's alpha for each questionnaire item in addition to overall Cronbach's alpha and for subsequent nurses' clinical reasoning observational scores assessed by the educators (Cronbach, 1951; Tavakol, & Dennick, 2011; Amirrudin et al., 2021), however, taking into consideration that consistency accuracy reflected by Cronbach's alpha is affected negatively by the short length of time between testing (Cronbach, 1951; Tavakol, & Dennick, 2010), therefore, in this study clinical reasoning was assessed for nurses at three points of time (beginning, middle, and end

of SBEs) by at least three educators.

Inter-rater reliability of the questionnaire and the subsequent clinical reasoning assessments were measured by the percentage of agreements between the raters (n=3) for three different assessments using the Lasater Clinical Judgment Rubric (LCJR) and Clinical Reasoning Evaluation Simulation Tool (CREST) tools, however, percentage agreement alone does not account for the possibility of an agreement that is occurring by chance (Sim & Wright, 2005). Therefore, additionally, the Intra-Class Correlation coefficient (Torkian, et al., 20121; Yen & Lo, 2002) was applied. The ICC uses analysis of variance and allows the calculation of error variances from each source (Yen & Lo, 2002). ICC was calculated with 95% confidence intervals (CI) for the total score and sub-scores of the questionnaire, and the subsequent clinical reasoning observational scores reported by different educators for each participant. Values for ICC were interpreted according to the following categories proposed by Koo and Li (2016): poor; less than 0.50; moderate: 0.51 - 0.75; good: 0.76- 0.90; and excellent: more than 0.90. The ICC measurements were performed using multiple ratings, consistency, and two-way random effects models (McGraw & Wong, 1996). In this study, LCJR and CREST tools were used to evaluate the clinical reasoning score for each learner by six different educators (three educators for direct observations and three educators for the video reviews). The assessment process of each nurse incorporated three direct observational assessments and three video review assessments.

Pilot group data normal distribution checks were conducted using: histogram graphics; Skewness; Kurtosis; Kolmogorov-Smirnov; and Shapiro tests (Demir, 2022). Data were not

normally distributed, therefore non-parametric tests were considered (Demir, 2022). Moreover, Mann-Whitney, Wilcoxon Sum, and Friedman tests were applied to measure the impact of the RLC model on nurses' clinical reasoning (comparative groups) over a period and different points of time of attending critical care foundation program incorporating immersive SBEs (McHugh, 2011; Chen & Zhong, 2019; Liu & Maxwell, 2020; Liu & Wang, 2021). The validity of the surveys was confirmed during the pilot phase before using them for the main study data collection, and the outcomes of the pilot test reliability and validity measures were reported and discussed in Chapter 5, section 5.2.1.

The refined self-reported questionnaire was subsequently circulated online to those attending the SBE critical care foundation program in which the co-designed RLC model was introduced (experimental group), and for critical care nurses who attended in which the RLC model was not introduced (control group) using the GAS and DIAMOND debriefing models (rational discussed in section 4.6.1.1.1). As outlined later in the ethics section 4.7, participation was voluntary. Nurses of comparative groups were sent a link via their password-protected HMC email address to anonymously complete the surveys before attending the SBE critical care foundation program and after completion of the SBE critical care foundation program.

4.6.1.2 Direct Observation as a Quantitative Data Collection Method

Direct observation of learners' clinical reasoning was used to supplement survey findings, providing a more objective measure. Learners' clinical reasoning levels were assessed by senior ANCC-credentialled educators. The eight SBE critical care foundation programme

modules incorporated 25 scenarios, and in each scenario, the critical care nurses were asked to perform a patient assessment using the Airway, Breathing, Circulation, Disability, Exposure (ABCDE) approach (Smith & Bowden, 2017; Peran et al., 2020). The SBE critical care foundation programme design aimed to enhance nurses' critical care competence and associated clinical reasoning skills and critical thinking. At least three educators measured nurses' clinical reasoning concurrently using the CREST and LCJR tools over three points in time (beginning, halfway, and end of SBE activity). This was done with the educators sitting in the simulation control room from where they could see and hear the candidates. The data collection was blinded using codes and those educators were not included in the analysis phase of the study. The ethical implications associated with these observational assessments are outlined in section 4.7. In addition to the direct observation method, the learners were video recorded during the SBE to later evaluate their clinical reasoning skills using a video review process. The next section explains and discusses the video review process.

4.6.1.3 Video Review as A Quantitative Data Collection Method

As a further observation measure, a prospective video review (video reflexive ethnography) was undertaken (Yong et al., 2021; Ajjawi et al., 2020; Iedema et al., 2018). The ethical implications associated with these video recordings and review assessments are outlined in section 4.7. The learners were actively immersed in structured scenarios (the scenario details were discussed in section 4.6.1.2. The performance of nurses during the SBE activities was video recorded for both the experimental and the control groups. The whole participants' participation and engagements during simulation scenarios were recorded using the simulation centre camera systems and password-protected software platforms (Learning Space). The video recording review of each candidate was conducted at different points in

time during the whole SBE at the beginning, middle, and end of SBEs (first day, third day, and the last day of the program). The videos were reviewed and assessed prospectively by a group of independent nurse educators (n=30), who were not involved in the rest of the study. The video assessors objectively measured nurses' clinical reasoning skills using the CREST and LCJR tools (Liaw. 2018; Lasater, 2007). The data collection was blinded, and those educators were not included in the analysis phase of the study.

4.6.2 Focus Group

Focus group formed the qualitative data collection methods. Focus group involves assembling a group of individuals to discuss a specific topic, aiming to draw from the complex personal experiences, beliefs, perceptions, and attitudes of the participants through a moderated interaction (Nyumba et al., 2018). A focus group is a dynamic and efficient format for gaining a range of perspectives on a particular topic or experience (Cyr, 2019; Tritter & Landstad, 2020). It is an insightful way of exploring people's views and how these are shaped by social interactions (Cyr, 2019). Single focus group are commonly used in research and quality improvement projects (Nyumba et al., 2018; Morgan, 2018). Two-way focus group are characterized by having one group actively discussing a topic, whereas the other group observes them and notes the interactions and discussion of the first group without being seen. Hearing and observing what the other group thinks often leads the second group to different conclusions than those it may have reached otherwise (Nyumba et al., 2018; Morgan, 2018). The duelling moderator focus group is characterized by involving two moderators who purposefully take opposing sides. This encourages critical analysis and in-depth disclosure of data and information (Krueger & Casey, 2000; Nyumba et al., 2018). The

respondent moderator focus groups are characterized by asking participants to take up a temporary role of moderator. This encourages participants to be honest and feel a less controlled environment, therefore, a higher and more open engagement on their part (Kamberelis & Dimitriadis, 2005).

In this research study, the duelling moderator focus group method was used (as described in the previous paragraph) and two moderators were included. That was decided to encourage a smooth progression of the session, support opposing sides, and encourage active engagement of participants (Krueger & Casey, 2000; Nyumba et al., 2018). In this research study, it was aimed to create opportunities for active engagement to explore participants' experiences while attending RLC. Therefore, duelling moderator focus groups were deemed a good fit to answer the research questions from different perspectives and to achieve in-depth explorations to expand the findings of the self-reported questionnaire and subsequent clinical reasoning objective assessments.

Focus group on this research provided qualitative research data analysed by a thematic analysis (Xu & Zammit, 2020). The rationale for this is outlined later in section 4.11.1. The focus group was conducted separately for experimental and control group nurses in the clinical simulation and innovation Centre of Hamad Medical Corporation. Based on the findings of the scoping review phase described in Chapter 2 and to answer the research questions, open-ended questions were formulated to explore learners' perceptions of their clinical reasoning abilities while attending critical care SBE courses (Appendix 8).

To ensure the active engagement of participants, each focus group was conducted face-to-face with up to eight participants (Tritter & Landstad, 2020: Nyumba et al., 2018; Guest et al., 2017). This size was determined to allow for effective moderation, ensuring that the discussion stayed on track and that all participants had an equal chance to participate (Tritter & Landstad, 2020). In smaller groups, participants are more likely to engage in detailed discussions, providing richer, more nuanced data, consequently, leading to synergistic discussions, where participants build on each other's ideas, leading to deeper insights (Akyıldız, & Ahmed, 2021).

In this study, the number of focus group was decided based on reaching a data sufficiency level with no new information (Guest et al., 2017), so the exact number of focus group could not be pre-determined, therefore, the need for additional focus group was decided during the (concurrent) analysis phase of the study (Braun & Clarke, 2021). It was expected that at least three focus groups would be needed, and in this study, five focus groups were recruited: two focus groups from the experimental group (n=16), two focus groups from the control groups (n=16), and one group from the educators (n=8) who facilitated the SBE scenarios. The educators' focus group is discussed in the next paragraph.

In addition to focus group involving critical care nurses, a one-focus group with eight nursing educators was conducted to look at the model from a different perspective. These educators were invited from the simulation faculty group (n=30), along with the HMC directors of nursing education, who moderated the discussion process for the educators' focus group. The directors of nursing education were not supervisors for the invited educators to the focus

group and this will be described in the ethical section. The research team invited moderators with at least three previous experiences of focus group moderation.

Focus group for both critical care nurses and educator groups took place immediately after finishing the last SBE session. Participants for the focus group of nurses were selected randomly from the learners who attended critical care SBE, and from the educators who were teaching faculty in the SBE courses in which the new model was applied. Randomisation aimed at ensuring that the sample was more representative of the larger participants' population with minimised risk of selection bias, leading to enhancing the significance and generalisability levels of the results (Tritter & Landstad, 2020). The focus group was piloted to mitigate potential risks of preconceptions and biases, and to be aware of any challenges with the interview schedule (Tritter & Landstad, 2020). One pilot interview was carried out and some revisions were suggested regarding the need to simplify one question for better clarity, otherwise, no major revisions were indicated.

All focus groups were audio recorded and transcribed verbatim, and a copy of the transcript was sent to each participant as a record of the interview. Guest et al. (2017) suggested that it is important that transcripts are checked for validity as an aspect of trustworthiness through verification by the participants. Focus group participants were assigned a code, so the analysis process was conducted anonymously. This permitted the participants to verify accuracy, correct if necessary, and clarify any issues that may have been unclear (Akyıldız, & Ahmed, 2021). Each participant was asked to review their transcripts and to contact the researcher if they had any queries or comments about the transcripts, but no responses were

received, indicating no issues or concerns by the participants. The focus group data were analysed using a thematic analysis approach (Lochmiller, 2021). The thematic analysis method is discussed in section 4.11.1.

4.7 Ethical Considerations

The study obtained approvals from the Institutional Review Board of Hamad Medical Corporation (MRC-01-22-117) as the hosting institution, and from the University of Hertfordshire (HSK/PGR/UH/04728), as the research-related award granting institution (Appendices 1, 2, 3, and 4). All participants expressing their interest in the research were provided with an electronic information sheet detailing the study, what would be expected from them, and their rights. The information sheet highlighted the research aims, the commitment required to participate, the risks and benefits, and how data would be stored. The associated consent forms were sent electronically before the SBE. The details of the consent forms process of different data collection methods are discussed below.

As discussed in section 4.5, the study questionnaires were developed drawing on valid and reliable tools which are the GSE (Schwarzer and Jerusalem, 1995) and the NCRS (Liou et at., 2015). Permissions to use these tools were obtained from their respective authors (appendix 6). The nurses were informed that their data would be stored anonymously, securely (on a secure area of the Hamad Medical Corporations servers – not accessible by other people), and confidentially. Electronic consent to participate via Qualtrics XM platform was collected after which the nurses were guided to an anonymous online survey. In the consent form, the research information sheet was displayed and agreed upon by the nurses who participated in

the study. After ensuring complete consent, the data collected from the anonymous survey were stored in an encrypted hard drive with a password-protected feature. Participants were reassured that withdrawing from the research would not negatively affect them, or any future career prospects and that they could withdraw at any point. In my role, I had no managerial responsibilities over any of the participants. For data analysis, I anonymously (de-identifying at source) extracted the data in Excel sheet format and shared it securely with the statistician and study supervisors to advise on the descriptive and inferential data analyses.

Regarding the observational clinical reasoning assessment method, before nurses were observed, electronic consent to be observed while attending SBE was collected from participants via Qualtrics XM, and an online research information sheet was displayed and provided. To mitigate the potential risk of assessment bias, each participant was given a code, and confidentiality was ensured. The direct observation paper-based sheets for nurses' clinical reasoning conducted by the educators were anonymously collected by me and one of the co-investigators. It was ensured that one of us was available for each session. Nurses were informed that their paper-based observational sheets would remain anonymous thanks to the use of their individually allocated code and stored in a locked cabinet under camera surveillance and security monitoring. After extracting the data from the observational sheets, data were stored securely (on a secure area of the Hamad Medical Corporations servers – not accessible by other people) and confidentially.

For the video reviews, before nurses were video recorded using the simulation centre's advanced camera systems, electronic consent to be video recorded while attending SBE was

collected from nurses via Qualtrics XM, and an online research information sheet was displayed and provided to participants. Although it is routine practice to record videos in this training facility, because these videos were being used as data for research purposes, we sought individual consent for that specific use. The educators conducted video reviews of nurses' clinical reasoning while attending SBEs anonymously and blinded with codes. The video review was performed in the presence of either me or one of the co-investigators with secure access to the learning management system of the simulation centre. One of us was available for each video review, to access the video file, open it to the assigned educators through the simulation centre learning management system, and close the video after each review process. Each participant's video review was given a blind anonymous code, and confidentiality was ensured during the video review process. Nurse participants were informed that their paper-based video review observational sheets conducted by the educators would remain anonymous and stored in a locked cabinet under camera surveillance and security monitoring. After extracting the data from the video review observational sheets, data were stored securely (on a secure area of the Hamad Medical Corporations servers – not accessible by other people) and confidentially. The collected data from the video reviews were stored in an encrypted hard drive with a password-protected feature. After completing the data analysis process, the videos were deleted as per the simulation centre policy.

For the focus group, further verbal consent was obtained to audio-record the sessions. Similar assurances were given regarding securely holding their data. The anonymised transcriptions were coded and thematically analysed using NVivo 12 (Appendix 11) with a protected password on a secure server. The thematic analysis process is described in section 4.11.1. To avoid any risk of psychological harm, as some of the topics raised in the focus group could

potentially cause psychological distress to participants, alongside ensuring de-identification and confidentiality, participants were also signposted for additional support as needed.

4.8 Reflexivity

Embracing reflexivity enables researchers to produce more nuanced and contextually rich findings (Finlay, 2002; Jamieson et al., 2023). By being aware of their positionality, researchers can contribute to a more ethical, transparent, and effective research process (Jamieson et al., 2023). Reflexivity in research refers to the process by which researchers critically examine their role in the research process, including their biases, beliefs, and the impact of their presence on the research outcomes (Finlay & Gough, 2008). Researchers often bring their perspectives into their work, which can influence data collection, analysis, and interpretation. Reflexivity encourages acknowledging these biases to ensure more valid and reliable results. Researchers must be aware of how their actions and relationships with participants affect the research and strive for transparency and integrity (Jamieson et al., 2023). By reflecting on positionality and the dynamics within the research setting, researchers can enhance the credibility and trustworthiness of their findings (Denzin et al., 2023). To achieve transparency, integrity, credibility, and trustworthiness, in this PhD study, as a job requirement for me as a critical care educator, I was engaged in the critical care courses' design and quality assurance, however, I was not managing any of the nurses or researchers who were involved in this research study. There were some meeting points with some of the participating critical care nurses such as attending clinical teaching activities as scientific and planning committee members and attending the annual critical care departmental meetings. Those general meetings were not influential in impacting the research findings as I was not in

a position to decide individual futures or professional development pathways for any participant.

Moreover, the educators involved in the study were colleagues working with me in the same department and I was not supervising any of them; we were under different directors of education, but we used to meet in the departmental meetings and work together in the projects assigned to us by the Education Department Executives. There was no direct influence from me on any of the educators and we just had mutual respect and collaboration where our professional relationship and credibility were maintained. I felt that knowing the educators was very helpful in easing the model implementation and the data collection process, which could stand as a contributing factor to encouraging educators to feel safe and comfortable approaching me when there was a need to clarify doubts and raise any concerning issues. The focus group facilitators were not managing any of the research participants or research team members.

Engaging in reflexivity throughout my PhD research allowed me to maintain transparency, integrity, credibility, and trustworthiness. By critically examining my own positionality, biases, and potential influences on the research process, I was able to approach each stage with greater self-awareness and openness. This practice not only enhanced the transparency of my methods and decisions but also upheld the integrity of the study, ensuring that my findings were grounded in thoughtful, conscious reflection. Furthermore, reflexivity strengthened the credibility of my research by revealing the thoughtful consideration I brought to both the data collection and analysis processes. Ultimately, this reflective

approach fostered trustworthiness, as I remained accountable to both my research participants and the scholarly community, validating the robustness and reliability of my findings

4.9 Setting

In Chapter 1 (section 1.5.1), the research site and the critical care courses of HMC were described. The Critical Care Foundation Program (CCFP) is a modular basis programme incorporating SBE. The SBE CCFP is a mandatory requirement for all HMC critical care nurses (N=1,050). The programme consists of seven modules run over 8 days rolled over 6-8 weeks. These modules are respiratory, cardiology, neurology, genitourinary, gastrointestinal, tracheostomy care, advanced monitoring, and mechanical ventilation modules. In each module, there is an introduction to theoretical content through interactive presentations followed by a faculty demonstration and participants' return demonstration. During the return demonstration, immediate feedback is given using a deliberate practice model (Higgins et al., 2021). These deliberate practices are followed by immersive scenarios in which the primary and secondary assessment approaches are applied using the ABCDE method (A: Airways; B: Breathing; C: Circulation; D: Disability; E: Exposure) (Schoeber, et al., 2022), after which the simulation debriefing sessions took place.

Despite the availability of various debriefing models, current HMC critical care courses use only the Diamond debriefing model (Jaye et al., 2015) and the GAS debriefing model (Phrampus, & O'Donnell, 2013). In addition to those debriefing models that were in practice, in this study, the RLC model was introduced as a new simulation debriefing model to be tested in HMC's critical care courses.

4.10 Sample

The study sample was a cohort of critical care nurses and advanced nurse practitioners (a convenience sample) from one large medical corporation in Qatar consisting of twelve tertiary hospitals described in Chapter 1, section 1.5.1. The sample was selected to provide a wide overview of the different levels of experience and competence of the critical care nurses. This was a pragmatic decision based on feasibility, frequency of courses, and availability of the educators and other SBE resources within a relatively short timeframe (the three-year PhD). As described and rationalised in section 4.6 of this chapter, the sample was distributed into two comparative groups (experimental and control). The sample size decision is described in the next section.

4.10.1 Sample Size

The sample size was chosen to avoid presumed bias from self-selection and to meet quasi-experimental design criteria (Rogers & Révész, 2019; Chaokromthong & Sintao, 2021). As described in Chapter 1, section 1. 5. 2, the study sample was a set of convenience samples (Thompson, 2002; Rahi, 2017) of the critical care nurses who attended the SBE Critical Care Foundation Program. To decide the sample size of this study, three approaches were applied: reviewing the previously published studies with the same research design (quasi-experimental, mixed methods pre-test/post-test design, performing a sample size calculation by using the valid and reliable software program G*Power analysis (Faul et al., 2009), and

seeking statistician's input to decide the most appropriate sample size to achieve optimal statistical analyses significance and validity.

The minimum reported sample size in the literature for experimental pre-test/post-test design, powered against a 0.5 sample size confidence effect (Cohen, 1988) is described in Table 7.

Table 7: Reported sample size for experimental pre-test/post-test design

Study	Design	Aim	Sample size details
Tawalbeh et al. (2019)	Experimental pre-test/post-test design.	To assess the relationships between knowledge and infection control compliance and examine the effect of infection control teaching courses on knowledge of and compliance with universal precautions among university nursing students.	To achieve a sample power level of 0.80, and a sample size confidence effect of 0.5, the experimental group of that study was 60 third-year nursing students who registered for an infection control clinical course, and the control group was 70 students.
Noh, & Kim (2019).	Quasi-experimental, pre-test/post-test	To evaluate the effectiveness of a self-directed learning program using blended coaching among nursing students in clinical practice.	The sample power level of 0.80 and a sample size confidence effect of 0.5 were reported with a sample of 91 nursing students, divided into an experimental group (n = 44) and a control group (n = 47).
Yu, & Kang (2017)	Mixed methods, experimental, pre-test/post-test	To explore the effectiveness of a role-play SBE program on communication skills.	To achieve a sample size confidence effect of 0.5 and a sample power level of 0.80, a convenience sample of 62 senior nursing students from two Korean universities was recruited. The experimental group included 31 nursing students, and the control group included 31 students.

Siedlecki, (2020)	Systematic review	To report on the minimum sample size for experimental pre-test/post-test designs.	The review revealed that to achieve a sample confidence effect size of 0.5, a minimum of 34 participants per comparative group would be needed

In reference to the previously published literature using quasi-experimental pre-test/post-test designs, the minimum reported sample size to achieve a sample size confidence effect of 0.05 was 31 participants in each comparative group.

In addition to exploring the reported sample size by the previously published studies of the same research design as this study, the a *priori* desired sample size has been determined according to Lipsey and Aiken (1990, p.94), and confirmed using G*Power analysis (Faul et al., 2009). Based on the recommendations by Lipsey and Aiken (1990), the alpha or significance level was set at p = .05 and the beta or type 2 error at .20 (Power of 80%). The G*Power analysis (Faul et al., 2009) reported that a total of 74 subjects would be necessary with 37 in each group for a medium confidence effect size of d=0 .5 to achieve 80% sample power (Cohen 1988). Lipsey and Aiken (1990) and Faul et al. (2009) reported for a sample power of 90% and effect size of d= 0 .5, the total sample size should be 106 subjects divided as 53 in each group, and for a sample power of 99% and sample confidence effect size of d= 0 .5, the total sample size should be 210 subjects divided as 105 in each group. In this study based on Faul et al. (2009); Lipsey and Aiken (1990); and Cohen (1988), a sample confidence effect size of $d = 0.5$ with a power of 90% and significance of $\alpha = 0.05$ was decided, hence, a minimum of 53 subjects were recruited in each comparative group.

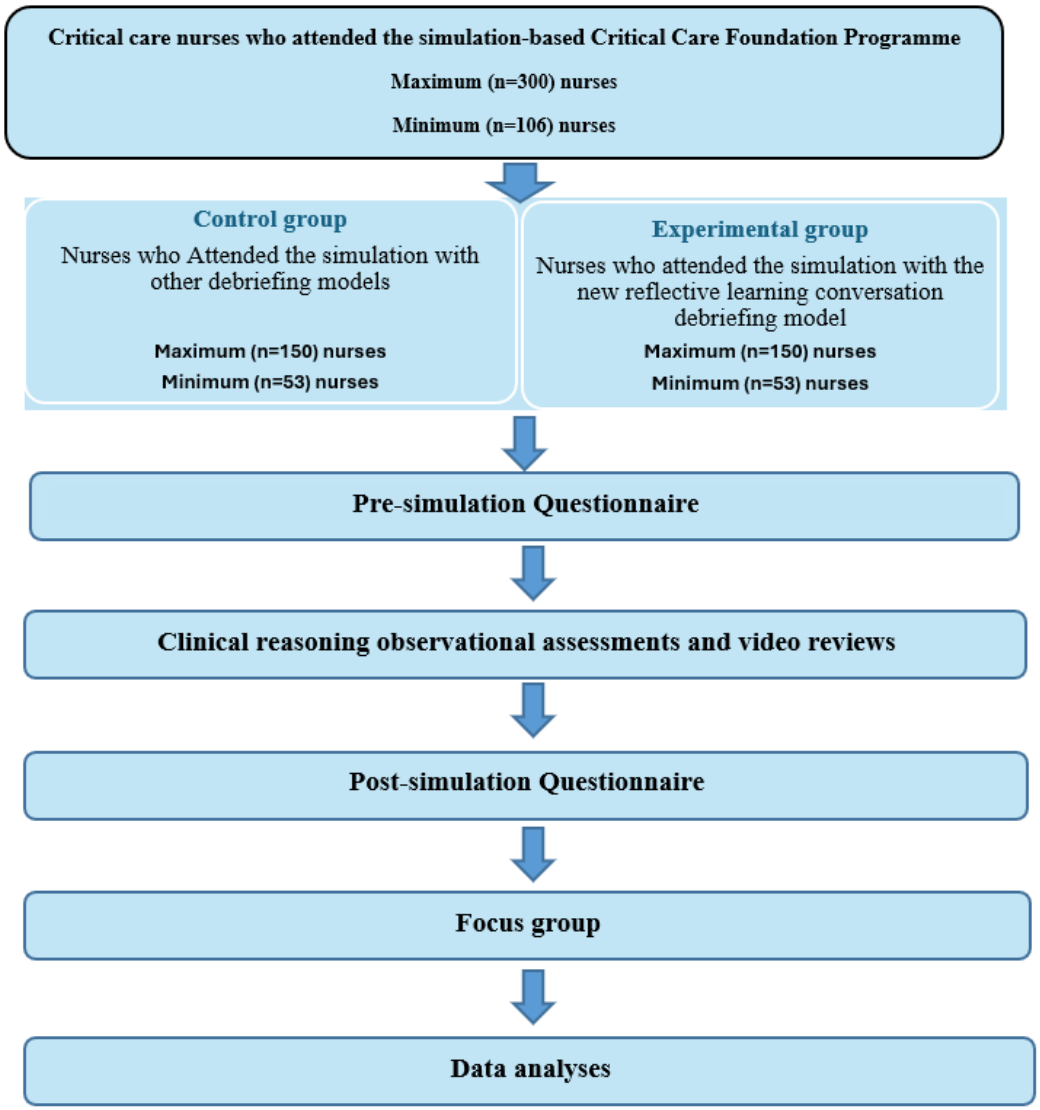
In addition to the literature review and using the G*Power analysis to decide the sample size of this study, the University of Hertfordshire doctoral college senior statistician (*Mr. Nigel Smeeton*) reviewed the study methods and confirmed that to achieve a sample confidence effect size of $d = 0.5$ with a sample power of 90% at a significance level of $\alpha = 0.05$, the minimum sample size to be N=106 divided into an experimental group of 53 nurses and control group of 53 nurses.

The higher than minimal recruitment sample will increase power, further enhancing the generalizability, internal consistency, and validity of the findings (Campbell & Riecken, 1968; Slack & Draugalis 2001; Findley, Baldwin, 2018; Kikuta & Denly, 2021; Coopersmith et al., 2022). This study aimed for a sample confidence effect size of $d = 0.5$ with a power of 90% and significance of ($\alpha = 0.05$) on attitudes and perceptions measured between the nurses' comparative groups (Cohen, 1988). Although a minimum sample size of 53 nurses was necessary for each group, a total of 300 nurses were recruited considering a minimum dropout and attrition rate of 25% at each stage of participation (Taherdoost, 2016; Ali et al., 2021), in addition to the questionnaire pilot group of 30 nurses who were excluded from the main part of the study (Taherdoost, 2016; Williams-McBean, 2019; Asano et al., 2021). Recruiting more participants than needed to account for potential attrition would help achieve a targeted sample power of 90 %, a confidence effect size of $d = 0.5$, and allow for an attrition rate of 25% in several stages.

4.10.2 Sample Recruitment

The intervention group was critical care nurses who attended the SBE Critical Care Foundation Program in which the RLC model was introduced as a debriefing model. The control group was critical care nurses who attended the SBE Critical Care Foundation Program in which the Diamond debriefing model (Jaye et al., 2015) or GAS debriefing model (Phrampus, & O'Donnell, 2013) was used (Figure 8). Equal sample distribution between experimental and control groups was applied. The participants of the comparative groups were pre-assigned dates and times for SBE sessions; therefore, randomization was not possible, and the participants were chosen according to their availability and nominations by their clinical managers to attend the programme. The participants in the study were selected because they were involved in the SBE Critical Care Foundation Program as a mandatory program for all Hamad Medical Corporation critical care nurses as described in Chapter 1 (section 1.5). The involvement in either the experimental or control group was planned to achieve learning objectives for both groups. The SBE modalities were the same for both experimental and control groups except that the experimental group participants attended the debriefing sessions using the RLC model and the control group participants attended the debriefing sessions using the Diamond debriefing model (Jaye et al., 2015) and GAS debriefing model (Phrampus, & O'Donnell, 2013). The debriefing models' selection details and rationale were discussed in section 4.6. The sample recruitment process and pathway are summarised in Figure 8. As described in section 4. 10. 1, The maximum participants' number (n=300) was decided in consideration of to drop-out rate of 25%. To achieve a sample confidence effect size of d = 0.5 with a sample power of 90% at a significance level of α = 0.05, the minimum sample size is N=106 divided into an experimental group of 53 nurses and a control group of 53 nurses.

Figure 8: Sample recruitment process and pathway



4.11 Data Analyses

SPSS version 23 was used to conduct descriptive and inferential data analysis of the surveys and subsequent objective assessments and video reviews. NVivo version 12 was used for the thematic analysis. Details of each are described in the next sections of this chapter.

Certain demographics may differently influence and contribute to the comparative groups'

clinical reasoning scores (Nick, 2007; Padden, 2011; Somasundaran, 2022). In this research, the descriptive analysis included measures of categorical data for both percentages and frequencies of collected data (Nick, 2007; Polit & Beck, 2008; Padden, 2011). This is important because descriptive analysis reveals the distribution patterns of the data and helps in summarising large amounts of data into a more understandable format, using measures such as mean, median, mode, range, and standard deviation (Siedlecki, 2020). It provides a foundation to clean data, decide on advanced inferential analyses, and choose appropriate statistical tests (Siedlecki, 2020).

The survey quantitative data normal distribution checks were conducted using histograms; Skewness; Kurtosis; Kolmogorov-Smirnov; and Shapiro tests. The outcomes revealed that survey data were not normally distributed; therefore, non-parametric tests were considered. This is described and reported in Chapter 5, section 5.2.1. The non-parametric measures were conducted to compare clinical reasoning scores between the experimental and control groups using Mann-Whitney/ Wilcoxon Sum tests (Somasundaran, 2022) and repeated measurements were performed to evaluate the clinical reasoning development progression within the same group over time using the Friedman test (Polit & Beck, 2008; Mishra, 2019; Somasundaran, 2022). This is described and reported in Chapter 5, section 5.3.5.3.

Mann-Whitney/ Wilcoxon Sum tests and Friedman tests were used to measure the impact of the RLC model application on nurses' clinical reasoning (comparative groups within the experimental group) over a period and different points of time of attending CCFP (McHugh, 2011; Chen & Zhong, 2019; Liu & Maxwell, 2020; Liu & Wang, 2021). The aim was to

compare the clinical reasoning scores between the comparative groups and evaluate the clinical reasoning progress within each comparative group.

4.11.1 Thematic Analysis

Thematic analysis can summarise the key features of large sets of data, offering a thick description of the data, as well as, offering unanticipated insights and highlighting similarities and differences across a data set (Boyatzis, 1988; Braun & Clarke, 2006; Varpio et al., 2017). It facilitates the exploration of patterns and the development of themes in response to broad, descriptive research questions, particularly when a flexible, data-driven approach is appropriate (Varpio et al., 2017). It supports the active identification and construction of themes through iterative engagement with the data, rather than relying on predefined categories (Varpio et al., 2017). Despite the limitations of thematic analysis to retain a sense of continuity or contradiction from an individual account, themes are presented ‘cross-case’, across participants (Braun & Clarke, 2006; Morgan & Nica, 2020), but compared to other qualitative methods such as narrative and concept analysis, thematic analysis is used when the research questions are open-ended and exploratory, aiming to understand participants' experiences, perceptions, or behaviours (Morgan & Nica, 2020), while other methods, are primarily based on literature review and secondary data sources, and are used to clarify and define key concepts that are central to the research but are not well defined (Morgan & Nica, 2020; Byrne, 2022). For that, thematic analysis was deemed a good fit for this study which aimed to explore collective nurses' and educators’ experiences from a variety of SBE experiences and points of view using open-ended questions and a data-driven approach.

As described in section 4.4.1, this study was underpinned by a pragmatism research paradigm, and mixed methods design and thematic analysis fit well with the epistemological and ontological principles of pragmatism as no single reality and source of knowledge, and data can be collected after multiple iterations from various sources (Creswell, 2007; Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). Creswell (2007) and Teddlie & Tashakkori (2009) reported thematic analysis as a key qualitative analysis approach in mixed methods research. Boyatzis (1998) described thematic analysis as a tool for translation between qualitative and quantitative languages, and therefore suited to the pragmatism paradigm and mixed methods design of this study (Boyatzis, 1998; Nowell et al., 2017).

The thematic analysis supported the pragmatic aims of this study, where qualitative data contribute to an overall picture of how to optimise clinical reasoning while attending SBE activities in which the debriefing RLC model was used. In alignment with the epistemological stance of the pragmatism approaches, this study aimed to provide multiple perspectives to optimise the clinical reasoning process by developing a universal and multidimensional debriefing model in which the most important contributing and influencing factors were investigated and comprehensively incorporated. This approach fits with the epistemology of the research; enabling the synthesis of multiple perspectives to explore a more complex, yet still partial, understanding of the data, without the need to search for a single valid truth. Furthermore, the thematic analysis of this study was conducted in consideration of the prevalence and centrality of the research questions (Braun & Clarke, 2006; Nowell et al., 2017), and therefore, theoretically driven using the research question to guide analysis rather than inductively developing themes across the data (Boyatzis, 1998; Braun & Clarke, 2006; Nowell et al., 2017).

As described in section 4.6, the qualitative data of this research were derived and extracted from the focus group method. The focus group data were audio recorded, transcribed verbatim, and iteratively analysed. The analysis incorporated several steps to ensure trustworthiness, following Braun and Clarke's (2006) six-step approach. This included: *familiarity with the data; generating initial codes; generating themes; reviewing potential themes; defining and naming themes; and producing the report*. The following sections describe how these steps were implemented and achieved.

Phase 1: Familiarity with the data: In this phase, the research team consisting of three members listened at least twice to the audio recordings of the focus group and reviewed the transcripts that were transcribed using the dictate option of Microsoft Office Word 2021. During this phase, general notes were written down by the team highlighting potential points of interest. That phase was the starting point for initiating the coding process (Braun & Clarke, 2012; Byrne, 2022).

Phase 2: Generating initial codes: Transcripts were coded line-by-line using NVIVO version 12 to generate the initial codes. The coding was done by the three team members. Initial codes were revised and grouped into a coding tree applied to the NVIVO node's structure (Appendix 10). That produced nine overarching codes, with 750 lower-level codes. For an accurate and credible coding process, the team met multiple times over six weeks to discuss the agreed codes. Any disagreements were treated fairly by having reflective discussions in the presence of the whole team and voting on the final decisions. The initial overarching

codes are described in Table 8 Initial themes were derived and incorporated into mind maps and coding trees (Appendix 11). The initial ideas for potential themes included are described in Table 8. The code generation approach in this phase of thematic analysis fits with this research epistemology that there is no single reality and data can be collected, analysed, and synthesized using different perspectives and iterations (Tracy, 2010; Byrne, 2022).

Phase 3: Generating themes. This phase captured the important aspects of the data to generate and construct the research themes from the codes (nodes in Nivivo) and connect them with the research questions (Braun & Clarke, 2012). The initial themes and subthemes were generated by coding grouping and creating thematic mind maps. After grouping the codes, the team agreed on the initial themes and subthemes. The nine overarching codes were reduced to seven, with over 750 total codes in the final coding tree. Updated thematic mind maps were drawn and discussed with the team and the study supervisors. The process evolved developing an initial 32 subthemes and four themes. These four themes included: Patient data collection; Intervention and evaluation; Staff experiences; and Influencing factors on clinical reasoning (Table 8).

Phase 4: Reviewing potential themes. This phase involved a dynamic review process of the initial codes, themes, and subthemes. During this phase, some codes and themes were regrouped and relocated to ensure that they were reflective of the focus group datasets and able to answer the research questions (Braun & Clarke, 2012). Multiple iterations and refinements (Three rounds) took place in this phase, and the grouping of some codes to represent the themes was amended to avoid themes overlapping. The multiple iterations

and review process aimed at ensuring that themes and subthemes were overarched, coherent, and developed from each other (Table 8). After multiple iterations to avoid themes and subthemes overlapping, and to comprehensively answer the research questions, themes were reduced from four to two, and subthemes were reduced from 32 to 12.

Table 8: Theme and subthemes iterations phases

Initial review	2nd review	3rd review	Final themes/subthemes
Patient data collection -Data collection process -Patient assessment -Data accuracy -Importance of data -Relevancy of data -Sources of data -Prioritisation -Data communication -Data sharing -Problem identification	**Patient data for effective clinical reasoning** -Collecting the most important patient information -Collecting the most relevant patient information -Structuring patient data collection -Identifying patient problems	**Patient data for effective clinical reasoning** - Patient information accuracy, relevancy, and importance. -Patient Problem identification	**The impact of RLC on the clinical reasoning process and skills** -Data collection and problem identification -Prioritised interventions -Outcome evaluation -Self-efficacy
Initial review	**2nd review**	**3rd review**	**Final themes/subthemes**
Intervention and evaluation -Timely intervention -Accurate intervention -Relevant intervention -Evidence-based intervention - Continuous assessment	**Patient intervention and outcome evaluation** -Prioritised interventions - Continuous evaluation	**Patient intervention and outcome evaluation for effective clinical reasoning** - Prioritised interventions - Patient progress evaluation	

Staff experiences -Competency level -Confidence level -Effective performance -Independence -Self-direction -Communication skills	**Self-efficacy** -Competence -Confidence -Performance - Problem-solving	**Self-efficacy for effective clinical reasoning** -Confidence -Competence	**The influencing and contributing factors to clinical reasoning** -Previous exposure to the SBE topic -Competence and seniority -Case complexity -Multicultural learning environment -Cognitive load -Questioning technique -Reflective discussions -Psychological safety
Influencing factors on clinical reasoning -Specialty -Previous exposure -Years of experience -Patient severity level -Working environment -Culture -Readiness -Preparedness -Reflection -Safety -Engagement	**Influencing factors on clinical reasoning** -Learning and working environment -Seniority -Experience -Severity level -Metacognition -Reflective practice -Simulation facilitator -Competence - Active learning	**The influencing and contributing factors to clinical reasoning** -learners' background -Seniority -Competence -Case complexity - Multicultural learning environment -Cognitive load -Reflective discussion -Reflective questioning -Psychological safety checks	

Phase 5: Defining and naming themes. The final code groupings were agreed to formulate themes and subthemes with a clear focus that could distinctly and relatively address the research questions (Braun & Clarke, 2012). To address qualitative notions of rigor, credibility, and dependability (Denzin et al., 2023; Enworo, 2023), the team (n=3) met regularly every week to refine the themes and subthemes and agree on the final theme and

subthemes names, and the thematic map (Appendix, 16). This took around three months to be completed and to agree on the final themes. These final themes were the impact of RLC on the clinical reasoning process and skills; and the influencing and contributing factors to clinical reasoning. The final subthemes were data collection and problem identification; *Prioritised interventions; Outcome evaluation; Self-efficacy; Working specialty* and previous exposure to learning topics; Competence and seniority; Case complexity; Multicultural learning environment; Cognitive load; Learner-centred reflective discussions; Questioning technique; Psychological safety.

Phase 6: Producing the report. This is discussed in detail in Chapter 6 in which the qualitative findings were reported. The report highlighted the connections between themes and subthemes to answer the research questions. The thematic analysis quality assurance was checked against the criteria for good thematic analysis developed by Braun & Clarke (2006) and is presented in Table 9.

Table 9: Checklist of criteria for good thematic analysis adapted from Braun & Clarke (2006)

Process	No.	Description	Study considerations
Transcription	1	Data have been transcribed to an appropriate level of detail, and the transcripts checked against recordings for "accuracy".	Verbatim transcription was undertaken. Recordings were listened to at least two times to check accuracy and relevancy. Transcripts were transferred to Microsoft Word using the "dictate" feature.
Coding	2	Each data item has been given equal attention in the coding process.	line by line fully coded was applied using NVIVO 12™.
	3	Themes have not been generated from a few vivid examples instead the coding process has been thorough, inclusive, and comprehensive.	Codes were generated using the line-by-line review approach, and then a conceptual map was used to generate themes and subthemes.
	4	All relevant extracts for each theme have been collated.	The iterative coding process collated codes into the main themes and subthemes. NVIVO 12™ used extensively to run queries, matrix coding, and crosstabulation checks.
	5	Themes have been checked against each other and back to the original data set.	Matrix and cross-tabulation functions were used to check coding.
	6	Themes are internally coherent, consistent, and distinctive.	Themes reflect the research aims and topics that were being explored in relation to the impact of the reflective learning conversation model on the clinical reasoning elements.
Analysis	7	Data have been analysed – interpreted, made sense of - rather than just paraphrased or described.	Analysis began with the writing of field notes related to clinical reasoning cycle elements taken at the time of the interviews; these have informed the analytical and interpretative phases.
	8	Analysis and data match each other – the extracts illustrate the analytic claims.	Coding quotations havebeen established to reflect themes and subthemes analysed and discussed.
	9	Analysis tells a convincing and well-organised story about the data and topic.	The analysis follows the impact of the reflective learning conversation on the clinical reasoning cycle elements (Levett-Jones et al., 2010)
	10	A good balance between analytic narrative and illustrative extracts is provided.	In addition to line-by-line coding, a clinical reasoning cycle framework was utilized to decide the illustrative extracts.

Overall	11	Enough time has been allocated to complete all phases of the analysis adequately, without rushing a phase or giving it a once-over-lightly.	Iterative reviews were applied during the coding and analysis phases over three months.
Written report	12	The assumptions about, and specific approach to, thematic analysis are explicated.	It is mentioned in the methodology (Chapter4, section 4.11.1)
	13	There is a good fit between what you claim you do, and what you show you have done.	Completed and described in the results chapters (Chapters 5 and 6)
	14	The language and concepts used in the report are consistent with the epistemological position of the analysis.	The epistemological position of the research sits within the social pragmatism paradigm which was discussed in the methodology (Chapter 4, section 4.1.1).
	15	The researcher is positioned as *active* in the research process; themes do not just "emerge".	The coding process was iterative and repetitive. Epistemological and ontological aspects were considered for the final decision among research team members as described (Chapter 4, section 4.11.1)

4.12 Data Integration

In this section, only the data integration methodology and the underpinning theoretical frameworks are discussed. There is a separate chapter that reports the data integration of the qualitative and quantitative findings (Chapter 7). Data integration can add depth and breadth to the data collected (Brannen, 2005), increasing the trustworthiness and validity of findings (Denzin, 2011) enabling cross-checking of findings, and increasing the generalisability levels (Denzin, 2017). In this study, triangulated integration was used to seek convergence of results from different methods supported by the diversity of views with a comparative-and-description drive (Creswell et al., 2003; Cohen, 2016; Åkerblad et al., 2021; Coe et al., 2021). Triangulation was used here to optimise clinical reasoning while attending critical care SBE using RLC as a debriefing method, highlighting all the landmarks toward clinical reasoning

optimisation, and capturing all the layers of complexities that exist due to the multidimensional nature of clinical reasoning.

The use of a parallel exploratory mixed methods design aimed at concurrent data collection from multiple perspectives and data collection methods and sources. This is aligned with the epistemological position of this research that there are always various realities and sources of knowledge (Creswell & Plano Clark, 2011). This design allowed answering the research questions and integration of the data collected from numerous quantitative and qualitative methods including questionnaires, direct observations, video reviews, and focus group methods (Creswell & Plano Clark, 2011 Cohen, 2016; Åkerblad et al., 2021; Coe et al., 2021). Using parallel exploratory mixed methods helps mitigate concerns that qualitative data may be regarded as of less importance than quantitative data (Teddlie & Tashakkori, 2011). In this study, despite that data were primarily quantitative, both qualitative and quantitative methods were used through an active integration process and relied on data produced by each other and given significance and importance to impact the findings (Creswell et al., 2006; Azungah, 2018).

One of the challenges of using parallel mixed design lies in developing and integrating findings into a coherent output (Teddlie & Tashakkori, 2011; Åkerblad et al., 2021; Coe et al., 2021). However, to answer all the research questions concerning the clinical reasoning complexity and multidimensionality, and in alignment with the epistemological and ontological position of this research that there is no single reality and source of knowledge, the integration of the data collected from a mixed methods design fits well for this research.

As described in Chapter 7, the quantitative phase provided a basis to explore the clinical reasoning-related factors. The descriptive and inferential analyses were generated from multiple data sets and tested within and across sources so that the study findings were not fully based on a qualitative data set but expanded and enriched using multiple sources and perspectives (Creswell, 2007; Mason, 2017).

Moreover, one of the potential risks in deciding the parallel/concurrent mixed design is that the resulting knowledge is fragmented. However, to overcome that, the data collection and integration of analysis were planned at the start of this study, and aimed to mitigate against this challenge, therefore, multiple methods were not decided to verify findings but to best answer the research questions (Creswell, 2007; Teddlie & Tashakkori, 2011; Mason, 2017), with an anticipation of differences in findings across the datasets. These anticipated differences were as important as the similarities, reflecting the complex, multi-faceted, and multidimensional nature of the clinical reasoning process, consequently, confirmation across different datasets indicates increased validity. On the other hand, divergence may offer rich insights into the complexity of the setting being explored (Creswell, 2007; Teddlie & Tashakkori, 2011; Mason, 2017). The data integration matrix and the finding reports of the multiple data collection methods are described in the data integration, Chapter 7. For a practical and feasible data integration process, and to answer the research questions effectively and comprehensively, in this study, the self-reported questionnaire elements (Appendix 9) were classified into three domains and 25 subscales. The domains included data collection and problem identification; Prioritised intervention and outcome evaluation; and self-efficacy (Table 10).

Table 10: Self-reported questionnaire domains and subscales.

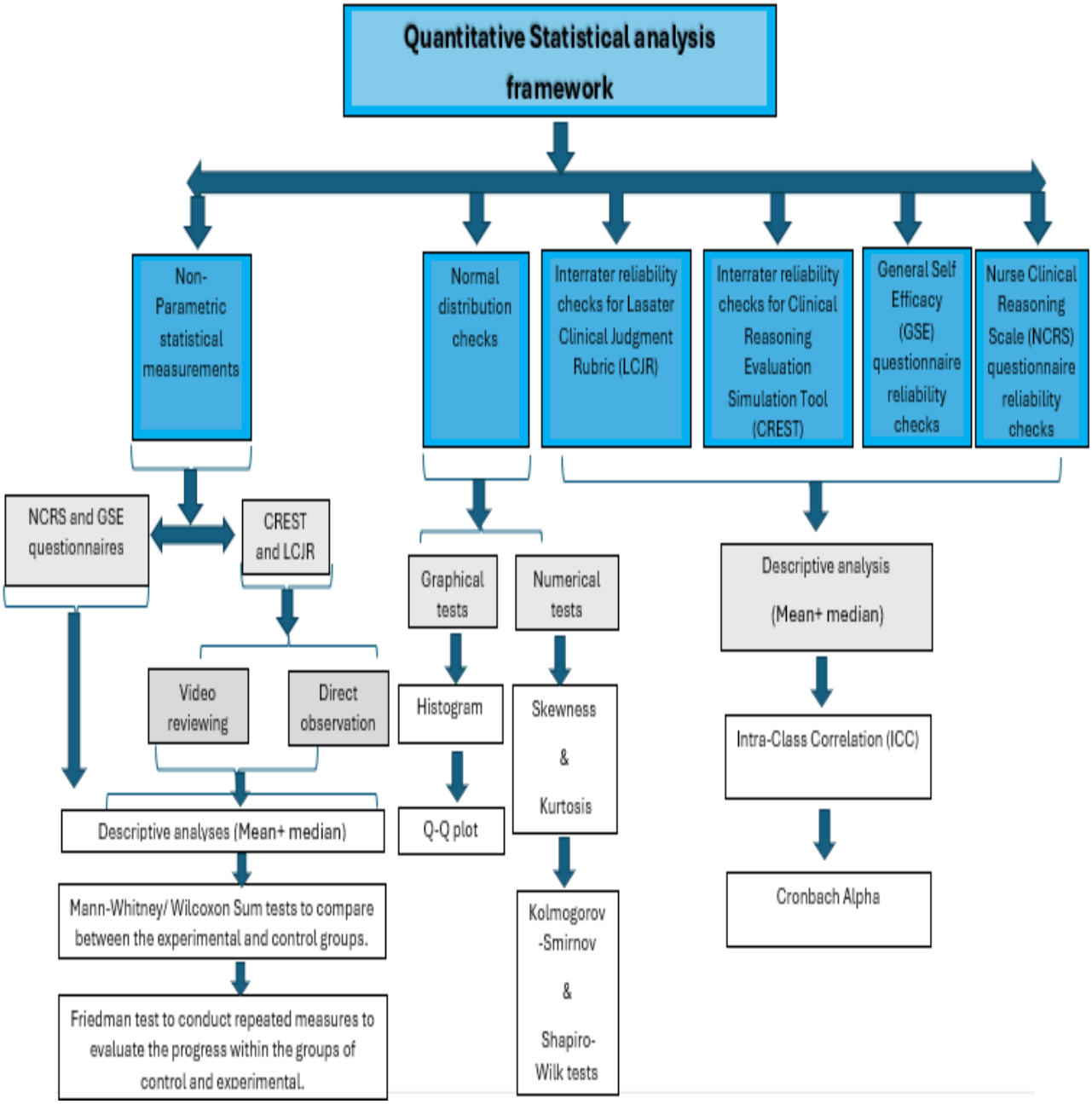
Domain 1: Data collection and problem identification
Subscales
1. I know how to collect an admitted patient's health information quickly.
2. I can apply proper assessment skills to collect a patient's current information.
3. I can identify abnormalities from the collected patient information.
4. I can identify a patient's health problems from the abnormalinformation collected.
5. I can recognize possible early signs or symptoms when apatient's health deteriorates.
6. I can explain the mechanism and development associated withthe early signs or symptoms when a patient's health deteriorates.
7. I can accurately prioritize and manage any identifiable patient problems.
8. I can correctly explain the mechanism behind a patient'sproblems.
9. I can set nursing goals properly for the identified patientproblems.
Domain 2: Prioritised intervention and outcome evaluation
Subscales
10. I can provide appropriate nursing intervention for the identified patient problems.
11. I am knowledgeable of each nursing intervention provided.
12. I can identify and communicate vital information clearly to thedoctors based on the patient's current condition.
13. I can anticipate the prescription ordered by the doctoraccording to the patient information provided.
14. I can accurately evaluate and identify whether a patient's condition is improved.
15. I know the follow-up steps to take if the patient's condition does not improve.

Domain 3: Self-Efficacy
Subscales
16. I can always manage to solve difficult problems if I try hard enough
17. If someone opposes me, I can find the means and ways to get what I want.
18. It is easy for me to stick to my aims and accomplish my goals.
19. I am confident that I could deal efficiently with unexpected events.
20. Thanks to my resourcefulness, I know how to handle unforeseen situations.
21. I can solve most problems if I invest the necessary effort.
22. I can remain calm when facing difficulties because I can rely on my coping abilities.
23. When I am confronted with a problem, I can usually find several solutions.
24. If I am in trouble, I can usually think of a solution
25. I can usually handle whatever comes my way.

The quantitative data analysis framework used in this study is presented in Figure 9. Normal distribution checks of the pilot group (N=30) and the main study comparative groups (N=106) were conducted using; histograms; Skewness; Kurtosis; Kolmogorov-Smirnov; and Shapiro tests. The study data were non-normally distributed; therefore, non-parametric tests were considered. The reliability measures of the pilot group (N=30) and main study groups (N=106) for the Nurse Clinical Reasoning Scale (NCRS) and General Self Efficacy (GSE) survey, Clinical Reasoning Evaluation Simulation Tool (CREST), and Lasater Clinical Judgment Rubric (LCJR) were conducted using Cronbach alpha (Cronbach, 1951; Tavakol, & Dennick, 2011; Amirrudin et al., 2021), and ICC (Torkian, et al., 20121; Yen & Lo, 2002).

Non-parametric Mann-Whitney/ Wilcoxon Sum and Friedman tests were applied to measure the impact of the RLC model on nurses' clinical reasoning (comparative groups) over a period and at different points of time (Figure 9) (McHugh, 2011; Chen & Zhong, 2019; Liu & Maxwell, 2020; Liu & Wang, 2021). This chapter described only the quantitative data analysis process and framework (Figure 9). The quantitative results are separately discussed and presented in Chapter 5 and the data integration in Chapter 7.

Figure 9: Quantitative analysis framework



4.13 Conclusion

In summary, this chapter discussed the pragmatism paradigm as a philosophical foundation for this research. The epistemological and ontological positions of pragmatism were also discussed and justified to support the research paradigm, design, and data collection methods.

A mixed-method pre-test/post-test design was discussed and deemed appropriate to inform the pragmatism paradigm and answer the research questions. The sample setting, size, and recruitment process were also described and discussed.

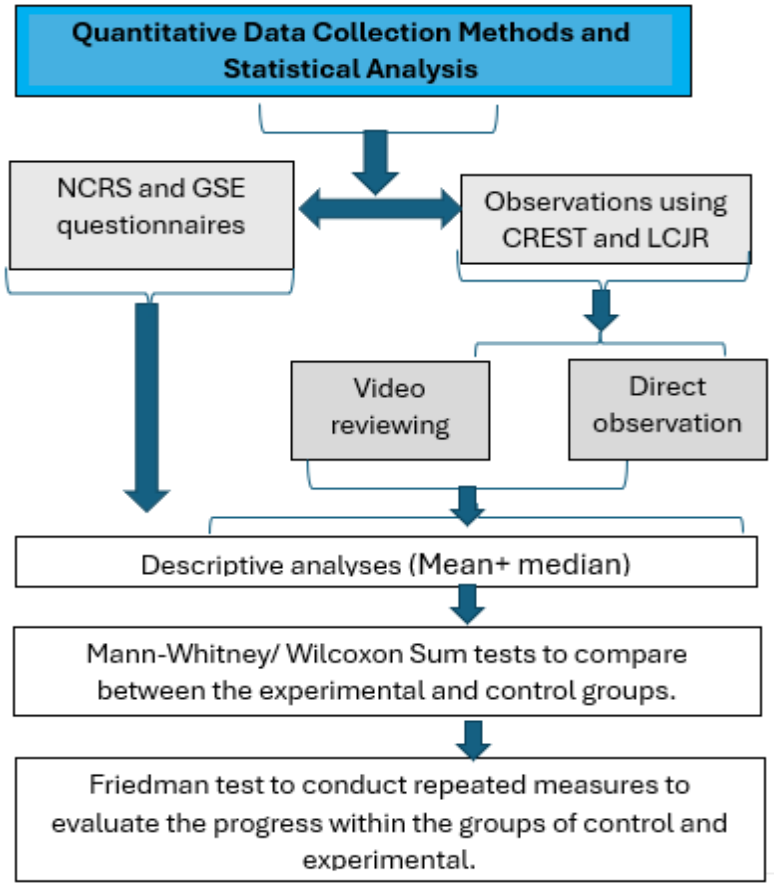
The justifications for the quantitative and qualitative data collection methods to meet the research design and paradigm were discussed. The data analysis frameworks and data integration processes of the quantitative and qualitative data sets were discussed and justified. The quantitative and qualitative data analyses and results are presented in Chapters 5 and 6. In this chapter, only the analysis processes and frameworks were higlighted.

CHAPTER 5: QUANTITATIVE RESULTS

5.1 Introduction

In this chapter, the demographics, descriptive, and inferential findings of the quantitative (survey data) are presented. These include the pilot group and main study normal distribution checks, reliability and measures of the clinical reasoning assessment tools, and the RLC model (Figure 10). The comparative clinical reasoning findings between the experimental and control groups, and the repeated measures within each study group are also reported in this chapter.

Figure 10: Overview of the quantitative data sets and analysis pathway



5.2 Pilot Group

5.2.1 Pilot Reliability Measures

As described in section 4.10, the pilot group data normal distribution checks were conducted using; histograms; Skewness; Kurtosis; Kolmogorov-Smirnov; and Shapiro tests. Data were *not* normally distributed; therefore, non-parametric tests were considered. The reliability measures of the pilot group for Nurses Clinical Reasoning Scale (NCRS), General Self Efficacy (GSE), Clinical Reasoning Evaluation Simulation Tool (CREST), and Lasater Clinical Judgment Rubric (LCJR) were conducted. Cronbach alpha and ICC for The NCRS and GSE were α=0.973, ICC=0.973, α=0.956, and ICC=0.956 respectively. Inter-rater reliability for the CREST and LCJR ICC was reasonable with Cronbach alpha and ICC of α=0.766, ICC=0.766, α=0.658, and ICC=0.658 respectively (Table 11).

Table 11: Pilot group reliability findings for NCRS, GSE, CREST, LCJR

Items	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Intra-class Correlation ICC	Number of Items
Nurses Clinical Reasoning Scale (NCRS), (Liou et al., 2016)	.973	.970	.973	15
General Self Efficacy (GSE), (Schwarzer, 1995)	.956	.950	.956	10
Clinical Reasoning Evaluation Simulation Tool (CREST), (Liaw, 2018)	.766	.804	.766	6
Lasater Clinical Judgment Rubric (LCJR), (Lasater, 2007)	.658	.624	.658	6

5.3 Study Results (Questionnaires)

5.3.1 Demographics

A total of 300 critical care nurses were invited out of which 110 were recruited. They were divided into the experimental group (n=55) and the control group (n=55). Most participants were female (n=89, 80.9%), held a bachelor's degree (n=107, 97.3%), and were employed as bedside staff nurses (n=102, 92.7%). The participants' years of experience ranged between 3 to 6 years (n=64, 58%), and all the study participants perceived and self-reported themselves as competent and above (n=110, 100%), (Table 12).

Table 12: The demographics of the study sample participants

Groups	Frequency	Percent	Cumulative Percent
Control group	55	50.0	50.0
Experimental group	55	50.0	100.0
Total	110	100.0	
Gender	Frequency	Percent	Cumulative Percent
Male	21	19.1	19.1
Female	89	80.9	100.0
Total	110	100.0	
Place of work	Frequency	Percent	Cumulative Percent
Medical ICU	27	24.5	24.5
Surgical ICU	40	36.4	60.9
Trauma ICU	24	21.8	82.7
Cardiac ICU	19	17.3	100.0
Total	110	100.0	
Years of experience	Frequency	Percent	Cumulative Percent
3.00	25	22.7	22.7
4.00	3	2.7	25.5
5.00	22	20.0	45.5
6.00	14	12.7	58.2
7.00	3	2.7	60.9

8.00	3	2.7	63.6
9.00	8	7.3	70.9
10.00	3	2.7	73.6
11.00	8	7.3	80.9
12.00	10	9.1	90.0
13.00	3	2.7	92.7
15.00	3	2.7	95.5
16.00	5	4.5	100.0
Total	110	100.0	
Qualifications	Frequency	Percent	Cumulative Percent
Bachelor	107	97.3	97.3
Masters	3	2.7	100.0
Total	110	100.0	
Position	Frequency	Percent	Cumulative Percent
Staff Nurse	102	92.7	92.7
In charge Nurse	8	7.3	100.0
Total	110	100.0	
Perceived competence level	Frequency	Percent	Cumulative Percent
Competent	62	56.4	56.4
Proficient	40	36.4	92.7
Expert	8	7.3	100.0
Total	110	100.0	
Previously exposed to the SBE topic	Frequency	Percent	Cumulative Percent
Yes	80	72.7	72.7
No	30	27.3	100.0

5.3.2 Numerical Normal Distribution Checks

Data normal distribution checks were conducted using; histograms; Skewness; Kurtosis; Kolmogorov-Smirnov; and Shapiro tests. Data were *not* normally distributed; therefore, non-parametric tests were considered (Tables 13 and 14) and (Figures 11 and 12).

Table 13: Normal distribution checks using Skewness and Kurtosis Tests

	N	Mean	Std. Deviation	Skewness			Kurtosis		
				Statistic	Std. Error	Z- Value	Statistic	Std. Error	Z- Value
First observation using CREST	110	2.163	.371	1.844	.230	8.017	1.425	.457	3.118
Second observation using CREST	110	2.627	.485	-.534	.230	-2.321	-1.747	.457	-3.822
Third observation using CREST	110	3.900	.648	.098	.230	0.436	-.603	.457	1.319
First observation using LCJR	110	1.872	.490	-.298	.230	-1.295	.854	.457	1.868
Second observation using LCJR	110	2.663	.474	-.702	.230	-3.052	-1.535	.457	-3.358
Third observation using LCJR	110	3.363	.483	.575	.230	2.500	-1.701	.457	-3.722
Valid N (listwise)	110								

Table 14: Experimental and control groups normal distribution checks using Kolmogorov-Smirnov and Shapiro-Wilk tests

		Statistic	P-Value	Statistic	P-Value
First observation using CREST	Control	.513	<.001	.420	<.001
	Experimental	.498	<.001	.469	<.001
Second observation using CREST	Control	.363	<.001	.634	<.001
	Experimental	.490	<.001	.490	<.001
Third observation using CREST	Control	.333	<.001	.733	<.001
	Experimental	.464	<.001	.543	<.001
First observation using LCJR	Control	.376	<.001	.718	<.001
	Experimental	.441	<.001	.580	<.001

Second observation using LCJR	Control	.428	<.001	.592	<.001
	Experimental	.419	<.001	.601	<.001
Third observation using LCJR	Control	.513	<.001	.420	<.001
	Experimental	.381	<.001	.627	<.001

5.3.3 Graphical normal distribution checks (Histogram and Q-Q plots)

Figure 11: Graphical checks for assessments using the CREST tool

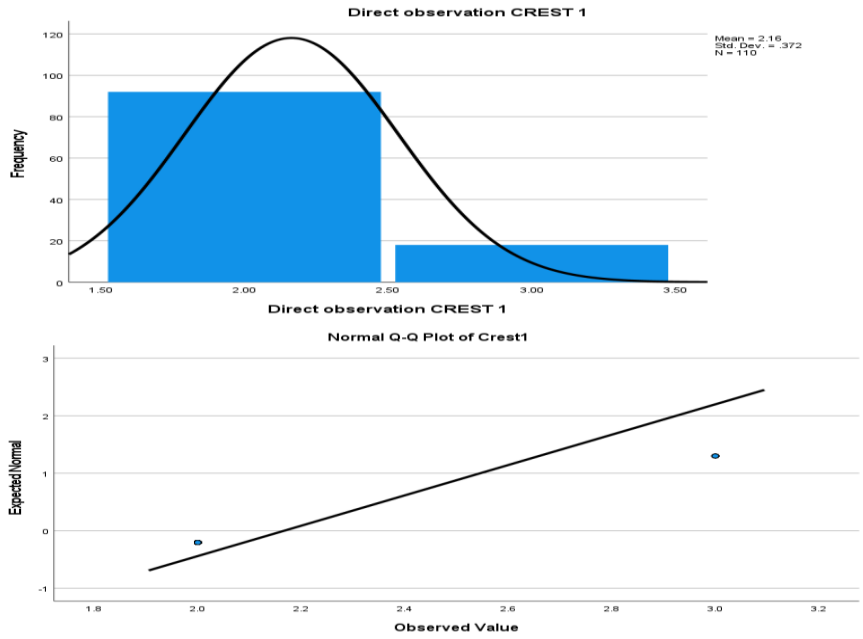
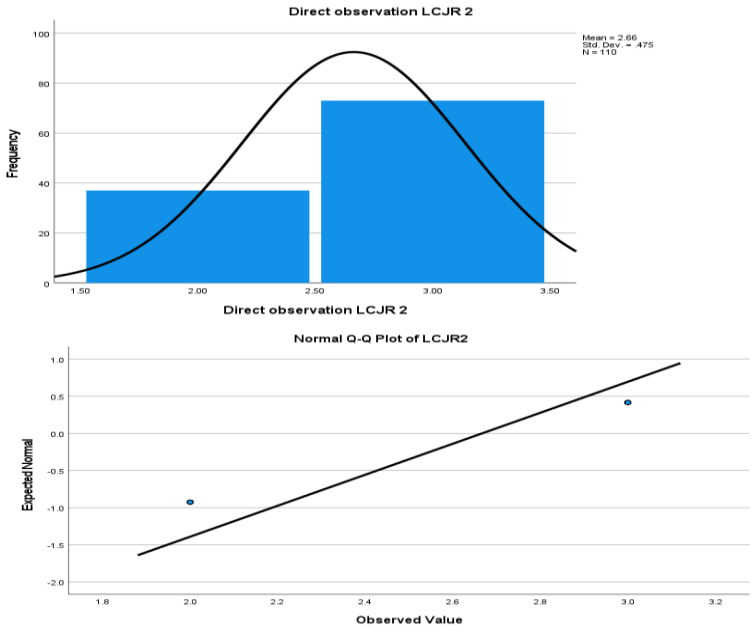


Figure 12: Graphical checks for assessments using the LCJR Tool



5.3.4 Reliability Measures

As described in Chapter 4, section 4.6, after confirming and ensuring the reliability measures of the study's assessment tools during the pilot phase of this study, the reliability measures of the main study for NCRS, GSE, CREST, and LCJR were conducted. The NCRS and GSE demonstrated a Cronbach alpha and ICC of α=0.968, ICC=0.972, α=0.953, and ICC=0.959 respectively, suggesting good reliability. CREST and LCJR ICC reflected a good Inter-rater Reliability with Cronbach alpha and ICC of α=0.712, ICC=0.716, α=0.691, and ICC=0.699 respectively (Table 15), which is acceptable but not high. The possible reasons for this will be discussed in Chapter 8.

Table 15: Reliability findings for the NCRS, GSE, CREST, LCJR

Tool	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	Intra-class Correlation ICC	Number of Items
Nurses Clinical Reasoning Scale (NCRS), (Liou et al., 2016)	0.972	0.968	.972	15
General Self Efficacy (GSE), (Schwarzer, 1995)	.959	.953	.959	10
Clinical Reasoning Evaluation Simulation Tool (CREST), (Liaw, 2018)	.716	.712	.716	6
Lasater Clinical Judgment Rubric (LCJR), (Lasater, 2007)	.699	.691	.699	6

5.3.5 The Clinical Reasoning Descriptives and Inferential Findings

Non-parametric tests were conducted, as data were not normally distributed, using descriptive and Mann-Whitney/ Wilcoxon Sum Tests to compare clinical reasoning scores between the experimental and control groups for the direct observation and video review methods and the NCRS and GSE tools (Table 16).

5.3.5.1 Direct Observations

The descriptive findings presented in Table 16 indicated that the experimental group had a greater mean rank than the control group for the direct observations and video review methods; therefore, this indicated a positive impact of the RLC model on learners' clinical reasoning and judgment skills. The inferential findings from observations using judgment tools indicated that the experimental group had a significantly higher level of clinical reasoning and judgment than the control group, respectively for first, second and third direct observations using the CREST tool: p= [.608, <.001, <.001] z= [-.513, -3.729, -5.850], and, and for first, second and third direct observations using LCJR p= [.214, .841, <.001], z= [-1.242, -.201, -4.735].

These findings suggest a positive impact of the RLC model on learners' clinical reasoning and judgment skills; however, the positive impact only became statistically significant after the first direct observation using CREST and after the second direct observation using LCJR.

5.3.5.2 Video Review – Clinical Reasoning Scores

For the video review findings, the experimental group had a significantly higher level of clinical reasoning and judgment than the control group, p= [.608, <.001, <.001], z= [-.513, -5.268, --7.223], respectively for 1st, 2nd, and 3rd video reviews using CREST, and p= [.002, .195, <.001], z= [-3.038, -1.296, -6.767], respectively for the 1st, 2nd, and 3rd video reviews using LCJR. These findings reflect a positive impact of the RLC on learners' clinical reasoning and judgment skills; however, the positive impact became statistically significant after the first video review using CREST and from the first video reviews using LCJR (Table 16).

Table 16: Descriptive and inferential tests for direct observation and video review using the CREST and LCJR

Assessment method	Group (n=55 in each)	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	p-Value
1st direct observation using CREST	Control	54.50	1457.500	2997.500	-.513	.608
	Experimental	56.50				
2nd direct observation using CREST	Control	46.00	990.000	2530.000	-3.729	<.001
	Experimental	65.00				
3rd direct observation using CREST	Control	39.69	643.000	2183.000	-5.850	<.001
	Experimental	71.31				
1st direct observation using LCJR	Control	52.63	1354.500	2894.500	-1.242	.214
	Experimental	58.37				
2nd direct observation using LCJR	Control	56.00	1485.000	3025.000	-.201	.841
	Experimental	55.00				
3rd direct observation using LCJR	Control	43.50	852.500	2392.500	-4.735	<.001
	Experimental	67.50				
1st video review using CREST	Control	54.50	1457.500	2997.500	-.513	.608
	Experimental	56.50				
2nd video review using CREST	Control	41.41	737.500	2277.500	-5.268	<.001
	Experimental	69.59				
3rd video review using CREST	Control	35.81	429.500	1969.500	-7.223	<.001
	Experimental	75.19				
1st video review using LCJR	Control	47.40	1067.000	2607.000	-3.038	.002
	Experimental	63.60				
2nd video review using LCJR	Control	52.08	1324.500	2864.500	-1.296	.195
	Experimental	58.92				
3rd video review using LCJR	Control	37.27	510.000	2050.000	-6.767	<.001
	Experimental	73.73				
Total						

As described in the methodology Chapter 4, section 4.5, the survey elements (Appendix 9) were classified into three domains and 25 subscales. The domains included: data collection and problem identification; Prioritised intervention and outcome evaluation; and Self-efficacy. For domain 1 of the survey "*Data collection and problem identification*", findings

indicated that the post-test group had a significantly higher level of "*Data collection and problem identification"* than the pre-test group, with p= [<.001, .005, <.001, <.001], z= [-.513, -2.816, -5.316, -5.316] respectively for the subscales of domain one (Table 17).

For domain 2, "*Prioritised intervention and outcome evaluation*", findings indicated that the experimental group had a significantly higher level of "*Prioritised intervention and outcome evaluation"* than the control group, with p= [<.001, .005, <.001, .005, <.001, <.001, <.001, .005, <.001, <.001, <.001], z= [-5.316, -2.816, -5.316, -2.816, -5.316, 5.316, -2.816, -5.316, -5.316, -5.316, -5.316]respectively for the subscales of domain 2 (Table 17).

For domain 3, "*Self-Efficacy"* findings indicated that the experimental group had a significantly higher level of "*Self-Efficacy"* than the control group, with p= [.002, .002, .002, .002, .002, .002, .005, .002, .002, .002], z= [-3.067, -3.067, -3.079, -3.067, -3.079, -3.067, -2.807, -3.079, -3.067, -3.067] respectively for the subscales of domain 3 (Table 17).

Table 17; Descriptives and Mann-Whitney/ Wilcoxon sum tests for pre-test/post-test questionnaires using the NCRS and GSE

Domain 1: Data collection and problem identification							
Subscales	Group	N	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	p-Value
1. I know how to collect an admitted patient's health information quickly.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
2. I can apply proper assessment skills to collect a patient's current health information.	Control	55	49.99	1209.50	2749.50	-2.816	.005
	Experimental	55	61.01				
3. I can identify abnormalities from the collected patient information.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
4. I can identify a patient's health problems from the abnormal information collected.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
Domain 2: Prioritised intervention and outcome evaluation							
Subscales	Group	N	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
5. I can recognize possible early signs or symptoms when a patient's health deteriorates.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
6. I can explain the mechanism and development associated with the early signs or symptoms when a patient's health deteriorates.	Control	55	49.99	1209.50	2749.50	-2.816	.005
	Experimental	55	61.01				
7. I can accurately prioritize and manage any identifiable patient problems	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
8. I can correctly explain the mechanism behind a patient's problems.	Control	55	49.99	1209.50	2749.50	-2.816	.005
	Experimental	55	61.01				
9. I can set nursing goals properly for the identified patient problems.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
10. I can provide appropriate nursing intervention for the identified patient problems	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
11. I am knowledgeable of each nursing intervention provided.	Control	55	49.99	1209.50	2749.50	-2.816	.005
	Experimental	55	61.01				

12. I can identify and communicate vital information clearly to the doctors based on the patient's current condition.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
13. I can anticipate the prescription ordered by the doctor according to the patient information provided.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
14. I can accurately evaluate and identify whether a patient's condition is improved.	Control	55	49.99	709.50	2249.50	-5.316	<.001
	Experimental	55	61.01				
15. I know the follow-up steps to take if the patient's condition does not improve.	Control	55	40.90	709.50	2249.50	-5.316	<.001
	Experimental	55	70.10				
Domain 3: Self-Efficacy							
Subscales	Group	N	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
16. I can always manage to solve difficult problems if I try hard enough	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				
17. If someone opposes me, I can find the means and ways to get what I want	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				
18. It is easy for me to stick to my aims and accomplish my goals.	Control	55	47.70	1083.50	2623.50	-3.079	.002
	Experimental	55	63.30				
19. I am confident that I could deal efficiently with unexpected events.	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				
20. Thanks to my resourcefulness, I know how to handle unforeseen situations.	Control	55	47.70	1083.50	2623.50	-3.079	.002
	Experimental	55	63.30				
21. I can solve most problems if I invest the necessary effort.	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				
22. I can remain calm when facing difficulties because I can rely on my coping abilities.	Control	55	47.48	1071.50	2611.50	-2.807	.005
	Experimental	55	63.52				
23. When I am confronted with a problem, I can usually find several solutions.	Control	55	47.70	1083.50	2623.50	-3.079	.002
	Experimental	55	63.30				
24. If I am in trouble, I can usually think of a solution	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				
25. I can usually handle whatever comes my way.	Control	55	46.72	1029.50	2569.50	-3.067	.002
	Experimental	55	64.28				

5.3.5.3 Repeated Measures

As described previously in section 4.12, the non -parametric Friedman test was performed to determine whether clinical reasoning scores differ after three direct observations and three video reviews within the same group (experimental and control) at the beginning, midway, and end of SBE activities using CREST and LCJR tools for both the control and experimental groups.

Despite that, both the control and experimental groups had significant improvements in the clinical reasoning levels over time, but the experimental group's clinical reasoning scores were higher compared to the control group (Table 18). For the control group, the results show a significant difference in directly observed clinical reasoning over time using *CREST and LCJR*, $\chi 2(2) = 86.168$, $p = <.001$ and $\chi 2(2) = 85.750$, $p = <.001$ respectively, and for video review, there was a significant difference in clinical reasoning scores over time for the control group using *CREST and LCJR*, $\chi 2(2) = 87.682$, $p = <.001$ and $\chi 2(2) = 93.030$, $p = <.001$ respectively. For the experimental group, the results show a significant difference in directly observed clinical reasoning over time using *CREST and LCJR*, $\chi 2(2) = 98.850$, $p = <.001$ and $\chi 2(2) = 91.132$, $p = <.001$ respectively, and for the video review, there was a significant difference in clinical reasoning scores over time for the experimental group using *CREST and LCJR*, $\chi 2(2) = 100.701$, $p = <.001$ and $\chi 2(2) = 102.151$, $p = <.001$ respectively (Table 18).

Table 18: Repeated measures using Friedman test for the direct observation and video review using the CREST and LCJR

	Control Group				Experimental Group			
	Three direct observations using CREST for the control group	Three video reviews using CREST for the control group	Three direct observations using LCJR for the control group	Three video reviews using LCJR for the control group	Three direct observations using CREST for the experimental group	Three video reviews using CREST for the experimental group	Three direct observations using LCJR for the experimental group	Three video reviews using LCJR for the experimental group
N	55	55	55	55	55	55	55	55
Chi-Square	86.168	87.682	85.750	93.030	98.850	100.701	91.132	102.151
df	2	2	2	2	2	2	2	2
p Value	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

5.4 Conclusion:

The NCRS and GSE were deemed reliable in the context of multicultural critical care immersive SBE, incorporating a range of case complexities with variations in participants' competence, experience, seniority, and previous exposure to SBE topics.

The findings indicated that the experimental group had significantly higher levels of data collection and problem identification, prioritised intervention and outcome evaluation, and self-efficacy compared to the control group. The experimental group also demonstrated significantly higher levels of clinical reasoning and judgment than the control group, with p =

[.608, <.001, <.001], z = [−.513, −3.729, −5.850] respectively for the 1st, 2nd, and 3rd direct observations using CREST, and p = [.214, .841, <.001], z = [−1.242, −.201, −4.735] respectively for the 1st, 2nd, and 3rd direct observations using LCJR.

The experimental group's clinical reasoning scores were higher compared to the control group. For the experimental group, the repeated measures results showed a significant difference in directly observed clinical reasoning over time using CREST and LCJR, χ^2 (2) = 98.850, $p < .001$ and χ^2 (2) = 91.132, $p < .001$, respectively. For the video review, there was also a significant difference in clinical reasoning scores over time for the experimental group using CREST and LCJR, χ^2 (2) = 100.701, $p < .001$ and χ^2 (2) = 102.

CHAPTER 6: QUALITATIVE RESULTS

6.1 Introduction

This chapter presents the qualitative findings from the focus group method, providing an overview of the themes identified and their related subthemes. In Chapter 4, section 4.11.1, the thematic analysis process for the focus group was described. In this study, as mentioned in Chapter 4 section 4.9, the focus group for critical care nurses and educator groups took place immediately after finishing the last SBE session. Participants of the focus group were nurses selected randomly from the learners who attended critical care SBE activities, and from the educators who were teaching faculty in the SBE sessions in which the RLC model was applied. In this study, five focus groups were recruited in total, comprising two focus groups from the experimental group (n=16), two focus groups from the control groups (n=16), and one group from the educators (n=8) who facilitated the SBE activities (the control and experimental groups were described in Chapter 4 section 4.6. In each focus group, there was a variation in the participants' experience, seniority, and competence levels, which enhanced the validity and significance of the findings in relation to study aims (Robinson, 2020).

The focus group data were analysed using a thematic analysis approach described in Chapter 4, section 4.11.1. The focus group data were audio recorded, transcribed verbatim, and iteratively analysed. The analysis incorporated several steps to ensure trustworthiness, following Braun and Clarke's (2006) six-step approach. That included: *familiarity with the data; generating initial codes; generating themes; reviewing potential themes; defining and*

naming themes; and producing the report. These steps to formulate and derive the focus group themes and subthemes were discussed in detail in Chapter 4, section 4.11.1. Analysis of the focus group findings aimed at answering the research questions:

- How does a co-designed reflective learning model enhance the clinical reasoning skills of adult critical care nurses attending the RLC sessions of SBE?
- How do RLC affect individuals' clinical reasoning skills when participating in adult critical care SBE?

The themes and subthemes derived from the thematic analysis of the study are presented in Table 19.

Table 19: Themes and subthemes derived from the focus group

Theme 1: The influencing and contributing factors to clinical reasoning
Subthemes:
Previous exposure to the SBE topic
Learner's competence before attending SBE
Learner's seniority and experience
Case complexity
Multicultural SBE learning environment
Learner-centred reflective discussions
Cognitive overload
Theme 2: The impact of post-simulation reflective learning conversation on clinical reasoning
Subthemes:
Data collection and problem identification

Prioritised interventions
Outcome evaluation
Self-efficacy

In the next sections of this chapter, each theme and subtheme will be explored and discussed to answer the research questions. For further clarity about the focus groups, the below reflect the participants of each group.

- Group 1: 1st focus group from the experimental group
- Group 2: 2nd focus group from the experimental group
- Group 3: 1st focus group from the control group
- Group 4: 2nd focus group from the control group
- Group 5: The educators' focus group

6.2 Focus Group Themes and Subthemes

6.2.1 Theme 1: The Influencing and Contributing Factors to Clinical Reasoning

Most participants felt that clinical reasoning enhancement was affected by multiple contributing and influencing factors while attending the SBE activities and debriefing sessions. Many participants expressed the importance of considering those contributing and influencing factors that were related to environmental, individual, and simulation group issues.

"Attending simulation with debriefing sessions was a good experience but I felt developing and enhancing my clinical reasoning was not straight, it was affected by many factors". (participant 1 in focus group 2)

"My clinical reasoning effectiveness varied based on the nature of the simulation scenario, my engagement, and many other individual and group related factors, which I believe the educators need to consider" (participant 6 in focus group 4)

All educators who participated in the focus group expressed the positive impact of the SBE activities and debriefing sessions on learners' clinical reasoning skills. Those educators expressed that there were various influencing and contributing factors that affected learners' clinical reasoning skills. Most educators spoke about the importance of considering those influencing and contributing factors to enhancing and advancing learners' clinical reasoning while attending SBE activities and debriefing sessions.

"Facilitating critical care simulation scenarios and debriefing sessions with the focus on the clinical reasoning enhancement was challenging, it was interconnected with several influencing and contributing factors". (participant 3 in focus group 5)

The next sections report the subthemes of "the influencing and contributing factors to clinical reasoning" theme.

6.2.1.1 Subtheme (1): Previous Exposure to the SBE Topic

Many participants expressed that previous clinical or SBE exposure to the learning topic had positively impacted their clinical reasoning skills while attending SBE activities and

debriefing sessions. Those participants felt that the previous exposure to the SBE topic encouraged a dynamic learning process and active engagement during the scenarios and debriefing sessions. Many participants with previous clinical exposure to the SBE topic described that applying the pre-existing knowledge and skills made their learning experience more relevant and impactful. Those felt that with a solid foundation in the topic before attending the SBE activities, they were able to quickly grasp new concepts and skills, and in turn, advance their clinical reasoning skills.

> "*My previous knowledge and exposure to the ABCDE assessment approach helped me to identify the patient's problem during the simulation scenarios and decide what to be done promptly". (participant 5 in focus group 3)*

"…. prior exposure to the patient assessment in my practice helped me to approach simulations actively and think advance". (participant 4 in focus group 1).

Most participants expressed that with previous exposure to the SBE topic, concepts and procedures were more likely to be stored in long-term memory, encouraging quicker recall of the relevant knowledge and skills, and leading to more effective clinical reasoning skills. Many participants felt that familiarity with SBE topics provided a deeper understanding of the clinical context, and that helped apply theoretical knowledge to practical situations. Some participants with previous exposure and clinical backgrounds around the SBE topic felt confident in handling complex and nuanced scenarios, leading to enhanced and advanced clinical reasoning skills.

"*…because I was previously exposed to the simulation topic in my clinical practice, it was easy to recall what was needed for the simulation scenario*" *(participant 2 in focus group 4).*

Conversely, opinions differed about the importance of the previous exposure to SBE topics. A small number of participants felt that effective educators' facilitation enhanced their clinical reasoning skills, despite having those participants having no prior exposure to the SBE topic. Those expressed that effective scenario and debriefing facilitation overcame the challenge of not having previous exposure to the SBE topics and enabled them to achieve the learning objectives with enhanced clinical reasoning skills.

"I attended the simulation course with no background about the ABCDE assessment approach, but with the instructor's support and continuous feedback in addition to the after-simulation debriefing discussion, I was able to come up with the required knowledge and skills and the required clinical reasoning skills". (participant 6 in focus group 2)

Some participants held a different perspective, those participants who did not feel the critical importance of the previous exposure to the SBE topic described the critical role of deliberate practice to master the required skills and achieve the relevant learning objectives. They felt that the approach was effective in enhancing their clinical reasoning skills even without having previous exposure to the SBE topic.

"For me, I attended the simulation without background about the topic but the exposure to multiple and repeated practices with debriefing sessions helped me to achieve the learning objectives". (participant 3 in focus group 4)

"....., I see the debriefing with repetitive practice as a useful method for clinical reasoning enhancement even without previous exposure to the learning topic". (participant 4 in focus group 4).

Many participants from the educators' focus group felt that learners with previous clinical backgrounds were mostly confident in sharing their expertise and insights with peers in the simulation group, which in turn, enriched the learning experience for the entire SBE learning group. Those educators expressed the importance of having skills mixed within the SBE learning group to achieve effective peer learning and group dynamics, leading to active learning with enhanced clinical reasoning skills.

"In the simulation activities and debriefing sessions I facilitated, I observed that learners with previous clinical backgrounds gave energy to the group and enriched the discussions with valid inputs. That helped the whole group to expand their understanding with promoted insights and clinical reasoning skills" (participant 4 in focus group 5).

The educators' view was supported by many nurse participants who felt that having learners with previous exposure to the SBE topic in their learning group was helpful to think differently and look at all associated clinical reasoning aspects. They felt that previous exposure to the SBE topic was helpful to enhance and advance learners' clinical reasoning skills.

"In our group, there were two nurses with a clinical background related to the simulation topic, the presence of those nurses helped the whole group to think broader and advanced" (participant 7 in focus group 3).

In this subtheme, many participants expressed that previous exposure to the learning topic positively impacted their clinical reasoning skills while attending the SBE activities and debriefing sessions. Some participants expressed different opinions and felt that the scenario through deliberate practice and debriefing facilitation helped them overcome the challenge of not having previous exposure to the SBE topics. Many participants described that their clinical reasoning skills were promoted and enhanced by having learners with previous exposure to the SBE topic within their simulation group. They felt that it helped them to broaden their learning experience from different perspectives and enhanced the learning experience for the whole group, leading to enhanced clinical reasoning skills. These findings are critically discussed in the discussion Chapter 8.

6.2.1.2 Subtheme (2): Learners' Competence, Seniority, and Experience

Many participants described that inadequately trained and less experienced nurses often have limited, slower, and less accurate clinical reasoning skills. A common view amongst participants from both experimental and control groups was that those less experienced and non-senior nurses relied more on theoretical knowledge and guidelines, making their clinical reasoning process more rule-based and less intuitive. Some less experienced participants from both experimental and control groups expressed that they struggled with prioritising information and recognising patterns. Many participants' views from the experimental and control groups in addition to the educators' focus group surfaced mainly that experienced and competent nurses were more adept at applying their knowledge and skills, and their clinical reasoning was faster and more accurate. Those participants expressed that competent, and

experienced nurses were adapting to unexpected situations in the scenarios and were able to reasonably judge under pressure and time constraints.

"As non-experienced nurse, during the simulation scenarios, I struggled at some points in quickly recognising the critical cues or changes in a patient's condition. I was able to do that with the help of the educator's prompting and feedback. I felt the need for more time and exposure to be on the same page with the senior nurses in the same simulation group". (participant 6 in focus group 2)

".....compared to less experienced and non-senior nurses, senior and experienced nurses had a wealth of clinical experience to draw upon. Their clinical reasoning tended to be more intuitive and autonomous. They were able to quickly identify relevant information, made accurate diagnoses, and decided appropriate interventions". (participant 3 in educators focus group 5)

Few participants raised a concern about whether seniority, experience, and competence together are always factors in achieving effective and enhanced clinical reasoning skills. Those participants expressed that in the SBE learning group, there were fewer experienced and non-senior nurses compared to others who were seniors and experienced, however, at some points, those with less experience and seniority were competent in certain areas with adequate clinical reasoning skills. Although some nurses with limited clinical experience performed competently in certain areas, there was a common view among most participants that the availability of competence, experience, and seniority together at the same time in one person complement each other to foster optimal clinical reasoning skills.

"……. despite that some less experienced and non-senior nurses performed competently in some areas for specific skills. I believe that the presence of seniority, experience, and competence at the same time contributed to improved and optimal clinical reasoning while attending simulation and reflective learning conversation". (participant 8 in focus group 1).

Conversely, many participants expressed the importance of simulation debriefing sessions disregarding their experience, competence, and seniority levels. Those felt that debriefing sessions were very important to put nurses with different seniority, experience, and competence on the same page with a shared mental model. Most participants expressed that during the debriefing sessions, there were opportunities for all learners to learn from each other and share thoughts and ideas from different perspectives, and in turn, helped all of them to enhance and optimise their clinical reasoning skills.

"……..regardless of seniority, experience, and competence, debriefing after simulation exercises was crucial to enhance and advance our clinical reasoning skills" (participant 7 in focus group 2)

" …….despite the importance of seniority and competence, debriefing sessions helped me to review my performance, identify areas for improvement, and integrate new insights into clinical practice. That was important to boost my clinical reasoning skills". (participant 6 in focus group 3)

In this subtheme, most participants felt the importance of competence, experience, and seniority to foster, advance, and optimise their clinical reasoning skills while attending simulation debriefing sessions. A common view among participants was that the presence of

competence, experience, and seniority factors at the same time complement each other to foster, optimise, and advance their clinical reasoning skills. however, many participants felt that attending the debriefing sessions positively fostered their learners' clinical reasoning skills disregarding their competence, experience, and seniority levels before attending the SBE activities. These findings are critically discussed in the discussion Chapter 8.

6.2.1.3 Subtheme (3): Scenario Complexity

Some participants from experimental and control groups felt that the scenario's complexity was a positive influencing factor on their clinical reasoning skills. Those participants described the required level of clinical reasoning skills and associated cognitive process to meet the demands of complex and multidimensional scenarios compared to less complex scenarios. Most of those participants described those complex scenarios needed a higher level of clinical reasoning skills associated with advanced thinking and cognitive processes. They felt that the scenario complexity positively challenged their cognitive process of clinical reasoning skills in relation to the associated complexity of gathering patient information and assessment findings, analysing them, and evaluating the outcomes.

"More complex simulation cases required a higher level of clinical reasoning skills and advanced thinking process. That was positively challenging to advance our clinical reasoning skills.". (participant 2 in focus group 3)

Those participants who reported the positive impact of the scenario complexity on their clinical reasoning enhancement felt that the complex scenarios that incorporated teamwork and collaboration had positively enhanced their clinical reasoning skills to work in teams.

Those participants felt that complex scenarios that required teamwork followed by group-based debriefing sessions gave them a chance to collaboratively think, analyse, and prioritise all related possibilities with other group members, consequently, positively impacting on their clinical reasoning abilities to function in team-based healthcare settings.

"……Having complex scenarios was a good challenge to deeply think, differentiate the causes, and priotrise the interventions collaboratively with the team members". (participant 5 in focus group 2)

Opinions differed among a few participants who felt that the scenario complexity negatively affected their clinical reasoning development and enhancement. Those participants were from the experimental and control groups. They described that the negative effect of case complexity on their clinical reasoning skills was associated with cognitive overload, overwhelming, and stress-related factors.

"The complexity of the case caused cognitive load and stress, and negatively affected my clinical reasoning". (participant 7 in focus group 4)

P5: "The stress and cognitive load associated with complex cases negatively impacted my clinical reasoning enhancement". (participant 5 in focus group 3)

The few participants who felt stress and cognitive overload to be associated with case complexity expressed the importance of having minimum environmental and physical fidelity so they place their focus on the patient assessment and findings without being distracted. Those participants felt that the presence of physical and environmental distractions such as

monitor and mechanical ventilation alarms caused them to be distracted, stressed, and cognitively overloaded. In turn, this negatively impacted their clinical reasoning by adding undue stress and pressure..

"The multiple environmental and physical distractions put me under pressure, stress, and cognitive overload". (participant 7 in focus group 1)

However, opinions differed about the environmental and physical fidelity negative impact on clinical reasoning skills, and many participants expressed the importance of having the necessary physical and environmental simulation fidelity to mimic and reflect the real critical care clinical environment. Those felt the importance of that fidelity to challenge their clinical reasoning skills to function in critical care settings which are normally full of noise, alarms, and other types of distractions, leading to enhanced and promoted clinical reasoning skills.

"Having an appropriate level of physical and environmental distractions was very helpful in stimulating and enhancing my clinical reasoning skills. That was what we normally face in real critical care practice. Facing that during simulation scenarios prepared me to face the difficult clinical encounters" (participant 7 in focus group 3)

"Real environmental and physical simulation distraction positively triggered my clinical reasoning skills that I need in the real critical care practice" (participant 5 in focus group 2)

Many participants expressed the positive impact of facilitators' competence and experience to mitigate the potential risk of stress and cognitive overload associated with case complexity. Those participants expressed the importance of the educators' consideration to facilitate and

debrief incrementally, from basic to advance concepts. That approach helped them to have constructive and progressive learning experiences while maintaining manageable levels of stress and avoiding cognitive overload, leading to enhanced clinical reasoning skills.

P4-2: "It was very important that the educator started with basic and simple scenarios and gradually advanced to more complex ones, so we were able to construct learning with minimum stress and without feeling overloaded. That progressive approach allowed for a smooth development of our clinical reasoning skills". (participant 8 in focus group 2)

"Complex cases provided valuable opportunities for in-depth discussions during the reflective learning conversation, and attending the debriefing sessions helped me to gradually and incrementally understand and take the most appropriate actions". (participant 4 in focus group 3)

In this subtheme, some participants felt a positive impact of the scenario complexity on their clinical reasoning enhancement and advancement while attending the SBE activities and debriefing sessions. On the other hand, few participants felt the negative impact of scenario complexity on their clinical reasoning skills. That negative effect was associated with cognitive overload, overwhelming, and stress-related factors. To mitigate that, most participants felt the need for an experienced educator who can facilitate gradual and incremental scenarios and debriefing sessions, and in turn, develop enhanced and optimised clinical reasoning skills.

6.2.1.4 Subtheme 4: Multicultural Learning Environment

Many participants from both experimental and control groups described cultural variation as an influencing factor in the learning process while attending SBE activities and debriefing sessions. Most participants of both experimental and control groups felt that having learners with different cultural backgrounds challenged them to be actively engaged. Those participants expressed the importance of effective SBE and debriefing facilitation to encourage active and dynamic engagement, and therefore, mitigate a potential negative impact of the multicultural learning environment on their clinical reasoning development and advancement.

"*In our simulation group, we had about four different nationalities. I think considering the cultural variation of the simulation group by the educator was very important to keep us interacting and engaging in the learning and developing effective clinical reasoning skills*". *(participant 1 in focus group 4)*

"To enhance the clinical reasoning skills, I think the educators must consider the cultural variation among the simulation learning groups". (participant 7 in focus group 3)

Most participants felt that the group-based immersive SBE design helped them in broadening learning experience and exposed them to a wide range of cultural perspectives, beliefs, and communication skills. A common view among participants was that the multicultural simulation experience equipped them to be open-minded, flexible, adaptable, and respectful of other opinions.

" ....., the engagement in the simulation scenarios with learners from different cultures required us to be open-minded and flexible". (participant 8 in focus group 4)

All participants from both experimental, control, and educator groups described that having a multicultural SBE learning environment reflected and mimicked real clinical environment. This was highlighted while discussing participants' critical care working environment where multiple groups of healthcare professionals and nurses from around the world work together. Participants' views surfaced mainly about the importance of a multicultural learning environment in SBE to enhance their abilities and prepare them to work and collaborate with healthcare professionals from different cultures in their clinical settings, leading to collaborative and enhanced clinical reasoning skills.

"I think what we did during the simulation scenarios by working in groups from different cultures was reflective of our working environment where we have many healthcare professionals from different countries and cultures". (participant 6 in focus group 3)

"The group-based simulation scenarios and debriefing sessions were helpful to mimic our real practice of working with many health professionals from different countries and cultures. That positively enhanced developing our clinical reasoning skills to work in that environment". (participant 7in focus group 1)

Most participants from experimental, control, and educator groups spoke about the importance of multicultural group-based SBE to enhance patient-centred care, and in turn, enhance their clinical reasoning skills to function in multicultural settings. A common view among participants was about the importance of exposure to different cultural norms from different points of view in a simulated setting to reinforce patient-centred care and team-working. This view arose while discussing that the group-based scenarios and the debriefing sessions provided the opportunity to elaborate on a wider range of diagnostic and treatment

options in collaboration with participants presenting different cultural perspectives and thoughts. Most participants felt that multicultural SBE and debriefing interactions enhanced their clinical reasoning for multicultural learning and clinical environments.

"……by interacting with diverse patient scenarios in a multicultural learning environment, we collaboratively worked to analyse the problem from different points of view, leading to more objective and effective clinical reasoning skills". (participant 5 in focus group 4)

"During the simulation scenarios and debriefing sessions, the exposure to multiple thoughts from different cultures was reflective of our real practice of dealing with patients and colleagues from different cultures. I think that was helpful to enhance my clinical reasoning for multicultural working environments" (participant 4 in focus group 3)

Many participants expressed that the multi-cultural nature of the scenarios and debriefing sessions enhanced their emotional intelligence. Those participants were concerned about the negative effect of stress, pressure, and emotions on their clinical reasoning skills development and enhancement. Most of those participants' views surfaced mainly that engagement in scenarios with learners from different cultures encouraged them to utilise and enhance their emotional intelligence skills. They felt that being emotionally intelligent in the scenarios with participants from different cultures positively impacted their clinical reasoning skills to function in multicultural settings.

"...., during the simulation scenarios and debriefing sessions, we needed to practice emotional intelligence skills to reach and achieve a shared mentality with the simulation group and educators. That positively impacted my clinical reasoning enhancement for to function in multicultural environments". (participant 1 in focus group 4)

Conversely, few participants had a different opinion about the effect of personal variations, beliefs, and adaptation ability on clinical reasoning development. Those participants were concerned about the impact of individual abilities and variations in emotional intelligence skills and cultural competence. Those participants mainly discussed individual abilities to adjust and adapt in alignment with the encountered multicultural influences and biases. Concerns were expressed by many participants about the potential risk of failure to be emotionally intelligent and culturally competent, and therefore, the potential negative impact on the clinical reasoning enhancement in a multicultural SBE learning environment, especially in scenarios that involve participants from different cultures.

"....., personal beliefs and biases can negatively influence the clinical reasoning advancement. This happens in case of lack of cultural competence in the presence of failure to adapt and adjust to meet the multicultural needs". (participant 5 in focus group 2)

"Some of us may have a greater ability to adapt and adjust our cultural and personal beliefs, while others may struggle to adjust. This variation in cultural competence affects the effectiveness of clinical reasoning development and advancement in the multicultural simulation learning environment". (participant 6 in focus group 3)

To address learners' cultural competence variations and adaptation abilities, most participants referred to the importance of tailored pre-training online modules, establishing a culturally sensitive and inclusive environment, and a well-detailed pre-briefing session.

"....., the online modules can prepare us to recognise the concept and goals of the training, so we become mentally prepared and focused, and this can mitigate the negative impact of

different cultural competence within the same group on clinical reasoning skills development". (participant 1 in focus group 2).

"...., I think effective pre-briefing sessions were very important to put the simulation group learners from different cultures together and unify the focus". (participant 2 in focus group 3)

In addition to the potential negative impact of personal beliefs and cultural variations on the clinical reasoning development, most participants from the experimental and control groups described communication skills ability in multicultural learning environments as a challenge. Those participants concerned that the clinical reasoning development and enhancement in multicultural learning environments need effective communication skills. Many participants felt that language barriers were one of the common communication challenges within multicultural learning environments.

"Cultural variations and language proficiency influenced how we interpret and communicate clinical information. Misunderstandings or misinterpretations may occur and negatively impacting the accuracy of clinical reasoning. (participant 3 in educators focus group 5)

"*Communication skills in multicultural environments were challenging. That impacted the ability to collect patient information and assess the patient as a team. Those were important elements for clinical reasoning enhancement". (participant 3 in focus group 2)*

Many participants from both experimental and control groups felt that exposure to diverse populations of learners and simulation facilitators in a multicultural simulation environment needs cultural competence. A common view among participants was about the importance of engagement in scenarios in multicultural learning environments in the presence of culturally competent learners and educators. Participants felt that the cultural competence of learners and educators had positively impacted their clinical reasoning enhancement. Those views surfaced mainly about the influence of cultural competence during SBE activities and debriefing sessions to neutralise simulation groups' cultural variations, create joint understanding and a shared mental model, and enhance the team to work toward the same goal, and as a result, enhance and optimise the clinical reasoning skills.

"The cultural competence of learners and educators was important to understand and address the unique needs and preferences of the simulation group (participant 6 in focus group 3).

".....the simulation educators must be culturally competent, as there is no guarantee that all of us are culturally competent, so the educator can buffer any cultural variation related to arising issues". (participant 8 in educators focus group 2).

Conversely, few participants expressed concerns about the negative impact of cultural incompetence on their clinical reasoning development and enhancement. Those views surfaced mainly about the negative influence of cultural incompetence during SBE activities and debriefing sessions on teamwork, engagement, respect, collaboration, and shared mental model.

"Having cultural incompetence learners had a negative impact on our clinical reasoning development. That affected the teamwork, respect, and being on the same page". (participant 3 in focus group 3)

"With some educators, there was difficulty to reach an agreement with simulation group members and there were gaps and variations in opinions. That somehow negatively impacted my clinical reasoning recruitment" (participant 2 in focus group 1)

In this subtheme, most participants felt that the SBE design and debriefing sessions helped broaden their learning experience and exposed them to various cultural perspectives. Many participants felt that having learners with different cultural backgrounds challenged them to engage with the SBE learning group during scenarios and debriefing sessions. Participants felt that different personal beliefs, variations in communication skills, language barriers, and cultural incompetence negatively impacted their clinical reasoning skills development and enhancement. Most participants expressed the importance of learners' and educators' cultural competence to advance and enhance their clinical reasoning skills in multicultural learning environments.

6.2.1.5 Subtheme 5: Cognitive Overload

Few participants from the control group felt that cognitive overload negatively affected their clinical reasoning development and enhancement while attending the group-based immersive SBE activities and debriefing sessions. Those participants commented on the negative impact of cognitive overload on their ability to process, analyse, synthesise, and integrate information as part of the clinical reasoning process.

"……., with a feeling of cognitive overload, my ability to correctly collect patient findings, analyse, and synthesise them for informed decisions were affected. That somehow negatively affected my clinical reasoning development". (participant 5 in focus group 3)

"……., I felt sort of cognitive overload which affected my confidence to reasonably judge to make timely decisions. Those timely actions were important for simulation scenarios with patient complexity and critically ill cases". (participant 7 in focus group 4)

A common view among participants of the control group was about the negative effects of cognitive overload to cause emotional stress and anxiety. Those views surfaced mainly in relation to being led to a tunnel vision effect and one-way focus. Many participants felt that because of stress associated with cognitive overload, they focused on one aspect of a patient's condition and deviated from the critical information. Those participants described that cognitive overload, and the associated stress negatively affected their clinical reasoning development and enhancement.

"Cognitive overload in the advance scenarios led to heightened stress and anxiety levels. That emotional state distracted my focus on the critical elements and my clinical reasoning skills enhancement". (participant 3 in focus group 2)

"……., in the difficult simulation scenarios, with a feeling of cognitive overload, it was challenging to recall the important information from my memory and my focus on all critical items was affected. That at some point affected my ability to reason and make informed decisions". (participant 5 in focus group 4).

Many participants from the experimental group described that metacognition relies on self-awareness which can be hindered by cognitive overload. Those participants felt the importance of comprehensive understanding and metacognition to enrich the analysis and synthesis for an effective clinical reasoning process. Conversely, few participants from the control group felt that during the SBE activities and debriefing sessions, the cognitive overload led to inappropriate self-awareness, a distraction from the main focus, and therefore, struggling to analyse and synthesise essential patient information and assessment findings to make appropriate clinical reasoning and timely decisions.

"....., feeling cognitive overload affected my comprehensive and full understanding of the critical elements of patient cases. That led to focus on less critical information and neglect the most critical patient information and assessment findings". (participant 8 in focus group 4)

Concerns were expressed by a few participants from the control and experimental groups about the influence of the volume and bulk amount of information on their cognitive processes while attending SBE and debriefing sessions. Six participants from the simulation group where the RLC model was not used and two from the group where the RLC model was used felt cognitive overload because of the high volume, and amount of information to be processed in a short period. Participants described that constantly analysing vast amounts of interconnected data led to a less focused reasoning process.

"In the complex simulation scenarios, there was a huge bulk of information and interconnectivity. That was challenging and I felt cognitively overloaded and distracted". (participant 5 in focus group 3)

Many participants spoke about the significant roles of the SBE design in avoiding the risk of cognitive overload. They described the tendency of some learners to think slowly using the slow-track thinking process compared to the tendency of others to use the fast-track thinking process. Those participants discussed the relationship between learners' background and experience and their preferred thinking process. Three participants from the control group and one from the experimental group felt the need to have more time during the scenarios and debriefing sessions, so they had enough time to think and grasp all aspects of the clinical reasoning.

"I felt that the given time during the advance simulation scenarios and debriefing sessions was not enough to catch up with all clinical reasoning aspects. I was a bit cognitively loaded". (participant 2 in focus group 3)

"To avoid cognitive overload during the simulation scenarios and debriefing, I felt the need to have more time to learn and reflect and receive feedback from the facilitators and peers". (participant 6 in focus group 1)

Conversely, opinions differed about the need for more time during the scenarios and debriefing sessions. Many participants felt that having more time during the scenarios does not reflect real critical care practice. However, they felt the importance of more time to reflect and discuss their scenario experience during the debriefing sessions. Those participants felt the need to be challenged during the scenarios in real-time to reflect the clinical need for quick and timely reasoning and decision-making.

"I think the given time during the simulation scenarios and debriefing was appropriate to challenge us with the time factor. Keeping in mind that, in our real clinical practice quick and timely reasoning and decision-making is very critical for patient safety." (participant 7 in focus group 3).

"The timing of the simulation scenarios mimicked the clinical reality and real-time constraints. Sometimes we deal with critically ill patients, and we do not have much time to think. I think the time we spent in the debriefing sessions was helpful with appropriate to build and empower my clinical reasoning skills" (participant 2 in focus group 3).

To mitigate the risk of cognitive overload, most participants from the experimental and control groups who faced and struggled because of cognitive overload expressed the importance of the flow and amount of information. Those felt that educators need to deliver and facilitate learning information gradually and incrementally from basic to advanced. Many participants from experimental, control, and educator groups described this gradual and incremental learning as important to give them a chance to be actively involved, construct learning, and reduce the potential risk of being cognitively overloaded.

"To avoid the risk of being cognitively overloaded, incremental and progressive facilitation methods could help to build and construct learning" (participant 5 in focus group 5)

"……, I believe the gradual and progressive flow of information applied during the simulation activities and debriefing sessions was very important to mitigate the risk of cognitive overload". (participant 3 in focus group 2)

Moreover, to meet the individual variations concerning experience, seniority, confidence, and competence levels, many participants from experimental and control groups spoke about the importance of considering gradual and incremental facilitation, and therefore, enhancing clinical reasoning skills development and advancement.

"I think the progressive and gradual simulation facilitation and debriefing were very important to consolidate and construct learning. That gave everyone a chance to learn disregarding our different seniority and competence levels" (participant 3 in focus group 5).

In this subtheme, most participants expressed concerns about the negative impact of cognitive overload on their clinical reasoning skills enhancement. Many participants reported that cognitive overload led to emotional stress and anxiety, which in turn, affected their clinical reasoning development and enhancement. A few participants described their cognitive overload tendency as being linked to a high volume of information being received within a short time. They discussed the importance of incremental and progressive simulation debriefing facilitation to mitigate the potential risk of cognitive overload. Many participants expressed the need to have real-time scenarios to reflect real clinical practice but with adequate time for debriefing to achieve the learning objectives and address all their concerns, and in turn, enhance and advance their clinical reasoning skills

6.2.1.6 Subtheme (6): Learner-Centred Reflective Discussions

Most participants of the experimental group expressed the importance of debriefing through reflective discussions to encourage learner-centredness and active learning. Participants'

views surfaced mainly on the positive impact of the reflective discussions on their active and dynamic participation, taking ownership of their learning process, and making meaningful connections between theory and practice. Many participants of the experimental group felt that they were at the centre of the learning process and the learning process was driven based on their needs. They felt that helped them construct learning for effective and enhanced clinical reasoning skills.

"....., reflective debriefing discussions provided an opportunity for active engagement with constructive feedback from simulation educators and peers. I felt the learning took place based on my needs and I was able to effectively recruit my clinical reasoning skills". (participant 3 in focus group 1)

" ……, the reflective discussions formed dynamic constructive feedback without feeling criticised. The discussions were centred around my needs, and that helped me to correct errors, develop a deeper understanding, and enhance my clinical reasoning skills". (participant 5 in focus group 2)

To enhance and advance clinical reasoning skills, all participants of both experimental and control groups expressed the importance of self-awareness in a safe, supportive, and reflective learner-centred learning environment. Most participants of the experimental group felt that the debriefing reflective discussions positively impacted their clinical reasoning skills by enabling them to be self-aware, reflect on mistakes, promote a broad mindset, foster a deeper understanding of the topic and its related practices, and explore technical and non-technical and human factors-related aspects including, but not limited to, team dynamics, collaboration, and communication skills.

"Simulation debriefing reflective discussions encouraged us to reflect on our practices to be self-aware. This self-awareness helped us to build our clinical reasoning skills" (participant 7 in focus group 2)

"……, and the debriefing reflective discussions helped us to analyse the information and patient findings for deeper understanding. The discussions centred around technical and non-technical skills. That was very helpful to improve my clinical reasoning skills". (participant 5 in focus group 1)

Many participants of the experimental group expressed that the reflective discussions led to better retention of knowledge, skills, and performance. Those participants described that the open reflective discussions encouraged them to achieve comprehensive understanding and metacognition around the learning topic. That metacognition was felt by most participants to be essential for continuous improvement of their clinical reasoning skills and clinical practices.

"……, attending the debriefing reflective conversation fostered a culture of active learning and engagement for comprehensive understanding and performance. That helped me to retain good knowledge and skills". (participant 6 in focus group 2).

Many participants of the experimental group felt that their active and dynamic engagement in the debriefing through reflective discussions positively enhanced their ability to actively remember and recall the case-related information. Those participants described that the reflective discussions helped them to connect and bridge the theoretical aspects gained during

the SBE activities and debriefing session with their real-life clinical practice, and in turn, enhanced their clinical reasoning skills.

"Ultimately, the impact of reflective learning discussions on my clinical reasoning was positive. It helped me to recall the most important issues related to the simulation scenario experience and discuss them with the group members during the debriefing to get their insights, That helped me to promote my clinical reasoning skills". (participant 3 in focus group 1).

Most participants in educator, experimental, and control groups described the importance of reflecting on their feelings and emotions during the debriefing conducted in the form of reflective discussions. Participants felt that their stress was reduced and controlled when the educators asked them to reflectively discuss their feelings during the SBE experience. Many participants of the experimental group described those open reflective discussions about emotions encouraged peer support and mitigated the risk of feeling isolated. Those participants expressed that being given a chance to reflect on emotions at the early stages of the debriefing sessions encouraged them to ask questions, seek clarification, and participate actively in the debriefing discussions. Many participants of the experimental and control groups expressed that sharing and reflecting on their emotional experiences helped guide the educators to provide more personalized and meaningful feedback, and in turn, enhanced their clinical reasoning skills.

"The reflective discussions in which I was asked about my feelings were very useful and beneficial to control my stress and develop confidence". (participant 1 in focus group 2)

"I appreciate that the facilitators during the reflective learning conversation asked me to reflect on my feelings. This was important to reduce the stress level and ventilate. (participant 2 in focus group 4)

Most participants from the educator, experimental, and control groups expressed their views concerning the importance of gradual and incremental reflective discussions during debriefing. Those participants felt the critical role of initiating the debriefing through reflective discussions with basic and foundational learning aspects moving toward higher levels. Many participants of the experimental group described the positive impact of this incremental approach to consolidate and construct learning with all possibilities from various experience and seniority perspectives. Those learners felt that they were able to gain a comprehensive understanding and critical analysis of the most important aspect related to the scenario's experiences, and in turn, build and construct enhanced clinical reasoning skills.

"……., during the debriefing conversation, there was gradual and progressive case exploration, and the input about the scenarios came from different perspectives, backgrounds, and experiences. That was great to have the full picture of the simulation case and gain a comprehensive understanding". (participant 4 in focus group 3)

"The way the educators operated the discussions by engaging everyone and having input from each of us disregarding the seniority and experience was effective. We were able to think as a group about all case-related possibilities". (participant 5 in focus group 1)

Many participants in the educator, experimental, and control groups described the importance of reflectively discussing their technical and non-technical and human factors-related aspects

during the debriefing sessions to foster effective and enhanced clinical reasoning skills. Opinions differed about the most important non-technical and human factors-related aspects to be discussed during debriefing sessions and most participants highlighted the communication and teamwork skills as most important. Many participants in the experimental group reported that the reflective discussions enhanced their clinical reasoning abilities associated with non-technical and human factors-related aspects in relation to ensuring an accurate understanding of patient symptoms and concerns, accurately communicating medical information to patients and colleagues, and ensuring team members are on the same page.

"It was excellent that the educators asked and reflectively discussed technical and non-technical skills during the debriefing sessions. That was very useful to achieve a deep understanding of the topic". (participant 3 in focus group 1)

"...., and when the facilitators discussed the non-technical skills such as communication and teamwork, it was good to have a comprehensive performance review instead of keeping the focus on the technical skills only". (participant 2 in focus group 2)

"I believe reflectively discussing the non-technical skills were equally important as technical skills. That helped improve my clinical reasoning skills". (participant 2 in focus group 4).

Many participants from the experimental group spoke about the reflective questioning technique used by the educators during the RLC and their impact on clinical reasoning skills. Those participants felt that the reflective and Socratic debriefing questioning techniques enabled them to self-reflect and deeply explore all associated possibilities. Most experimental group participants described the questioning technique used during the debriefing session as

important to address the cognitive, affective, and psychomotor domains of learning and clinical reasoning skills. Participants' views surfaced mainly about the importance of the reflective questioning technique to expand beyond simple knowledge to deeper understanding, analysis, and synthesis. Most participants felt the positive impact of the debriefing reflective questioning technique on their learning experience and clinical reasoning development and enhancement.

" The incremental and reflective questioning techniques the educators used were useful to keep all of us actively engaged, get a deep understanding of the topic, and develop advanced clinical reasoning skills". (participant 7 in focus group 1)

"....., and the Socratic and incremental questioning method enhanced us to think and participate in the discussions, that was an inclusive and effective way of learning to develop clinical reasoning skills". (participant 6 in focus group 3)

Conversely, few participants in the experimental group felt that even with the importance of using reflective and incremental questioning techniques to enhance clinical reasoning skills, it is also important that the debriefing facilitator use effective communication skills and offer equal chances for all group participants to engage, highlighting the importance of debriefer competence to achieve enhanced clinical reasoning skills.

"....., despite the importance of reflective questioning methods to develop clinical reasoning skills, for me it is more important the way the facilitator communicates to ask the questions while keeping everyone listening and engaging". (participant 2 in focus group 2)

In this subtheme, most participants felt the positive impact of the debriefing through reflective discussions in enhancing their knowledge and skills retention. Many participants expressed the importance of learner-centred, gradual, progressive reflective discussions and Socratic questioning techniques to achieve enhanced and optimal clinical reasoning skills. Most participants stressed the importance of reflecting on feelings, emotions, technical, and non-technical and human factors-related kills during the debriefing sessions to develop enhanced and advanced clinical reasoning skills.

6.2.1.7 Subtheme (8): Psychological Safety

All participants reported that feeling psychologically safe was essential to foster their clinical reasoning skills while attending the SBE activities and debriefing sessions. Many participants expressed that because they felt psychologically safe, they took risks, shared their thoughts, asked questions, and expressed their concerns without fear of negative consequences. A common view among participants was that psychological safety promoted constructive, active, and blame-free learning environments, and in turn, positively enhanced their learning experience to foster solid-based clinical reasoning skills.

"....., in a psychologically safe simulation, we were more likely to take risks and tried new approaches and different strategies. That led to enhanced and improved clinical reasoning skills". (participant 7 in focus group 3)

"……, with a feeling of psychologically safe during the simulations, I communicated openly and shared my insights, which led to a better understanding of the patient's condition and better clinical reasoning skills". (participant 5 in focus group 2).

Most participants in the experimental and control groups felt that in a psychologically safe SBE learning environment, they were acknowledged and learned from their mistakes. Many participants of the experimental and control groups felt the importance of the multidimensional feedback received during the debriefing sessions about their performance, without feeling threatened or uncomfortable discussing their mistakes either with colleagues or educators, leading to improved clinical reasoning skills.

" When I felt psychologically safe, I was open to receiving feedback from anyone in the group, comfortably discussing my mistakes, and actively participating in the reflective discussions". (participant 4 in focus group 2)

"...., and with feeling psychological safety, I mentioned and discussed critical things which mostly would avoid if I didn't feel safe". (participant 5 in focus group 1)

Many participants of the experimental and control groups expressed that a psychologically safe learning environment encouraged their honest self-reflection and self-awareness. Those participants felt safe to share, critically discuss, and evaluate their performance, leading to deeper insights and enhanced clinical reasoning development.

"In a psychologically safe environment, we became self-aware and that helped us to self-reflect and be open to learning from mistakes.". (participant 6 in focus group 3)

"....., while attending the simulation scenarios and debriefing sessions of the reflective learning conversation, with a psychological safety, I was self-aware to reflect on my performance and listen to others opinions". (participant 8 in focus group 1)

Most participants of the experimental and control groups reported on the importance of SBE pre-briefing to enhance their psychological safety. Many participants described the role of pre-briefing to address the ground rules, overall aim and learning objectives, introducing educators and participants with respects to their backgrounds, roles and responsibilities, expectations from each learner, confidentiality assurance, timelines of the scenario and debriefing sessions, and the environment and equipment orientation, leading to enhancing psychological safety and facilitating clinical reasoning development.

"....., Pre-briefing was a great starting point to feel psychologically safe. That was because the expectations from me as a learner, the learning group, and the facilitators were established and agreed". (participant 6 in focus group 3)

"The way the facilitators conducted the pre-briefing was useful to feel psychologically safe. They addressed the learning objectives, time frames, expectations, and highlighted that it is a free blamed and confidential learning environment". (participant 5 in focus group 1)

Conversely, despite the agreement on the importance of pre-briefing to foster psychological safety by most of the experimental and control group participants, many of them felt that reflecting on feelings and emotions is more important to foster psychological safety, especially, for emotionally engaging scenarios. Those participants described that reflection on feelings and emotions was important to normalise anxiety, stress, and uncertainty, and therefore, feeling psychologically safe to openly communicate and actively engage in the debriefing. Some of those participants reported that reflecting on emotions was effective in enhancing their psychological safety, leading to fostering empathy and shared understanding

among the SBE learning group, and in turn, promoting the opportunity to enhance and optimise their clinical reasoning skills.

"I agree on the importance of pre-briefing to psychological safety but also the reflection on emotions for complex scenarios was more important for my psychological safety".
(participant 3 in focus group 4)

In this subtheme, most participants felt that the pre-briefing played a crucial role in fostering and enhancing their psychological safety while attending SBE activities and debriefing sessions. Many participants expressed that feeling psychologically safe fostered conducive learning where they were able to explore different options, make mistakes, take risks, and actively participate. Most participants described that psychological safety promoted constructive, active, and blame-free learning environments, and in turn, positively enhanced their clinical reasoning skills. Many participants perceived reflection on emotions and feelings as important to feel psychologically safe and actively engaged in the scenarios and debriefing discussions, and in turn, fostering their clinical reasoning skills.

6.2.2 Overarching Theme 2: The Impact of Post-Simulation Reflective Learning Conversation on Clinical Reasoning

Most participants described the impact of RLC as a debriefing method on their clinical reasoning skills. They felt that their clinical reasoning was affected by multiple contributing and influencing factors interconnected with the RLC.

"The attendance of the reflective learning conversation had an impact on my clinical reasoning skills in many ways" (participant 5 in focus group 2)

The next sections report and discuss the subthemes of the impact of RLC on clinical reasoning.

6.2.2.1 Subtheme (1): Data Collection and Problem Identification

Most participants who attended the experimental group perceived the RLC as an effective debriefing method to optimise and develop their clinical reasoning skills in relation to data collection and problem identification. Many of those participants felt that the RLC provided an opportunity to focus on the most important and relevant patient data and assessment findings, leading to enhanced clinical reasoning skills.

"The reflective learning conversation helped me in developing skills and strategies to collect the most important and relevant patient information, so I was able to reason, judge, and take decisions appropriately". (participant 8 in focus group 1)

Many participants of the experimental group described how the debriefing using RLC helped them develop a systematic and structured approach to collecting the most important and relevant data. They felt that it enabled them to have a complete picture of the patient's medical background, current symptoms, assessment findings, and relevant personal information, which in turn, helped them to accurately identify the patient's problem, reason, intervene, and take the most appropriate decisions. Most of the participants felt that attending

the RLC positively impacted their skills to structurally and objectively collect patient data, reducing the chances of missing critical patient information.

"The reflective learning conversation helped us to think about using structured and systematic data collection methods. That was very beneficial to collect the critical information and patient findings for accurate and reliable reasoning skills". (participant 4 in focus group 1).

"The reflective learning conversation opened my eyes to how to be systematic and structured in collecting patient data, and that was very helpful to avoid missing critical patient information and assessment findings, and therefore, having accurate and focused clinical reasoning skills". (participant 6 in focus group 2).

Many of the experimental group and educator participants commented on the positive impact of the RLC on the group-think power. Those participants felt the importance of thinking in a group with different views to find out and collect the most important and relevant patient data and assessment findings. Many participants reported that RLC enabled them to learn from peers and educators with broader views from multiple perspectives and that it helped them enhance and improve their clinical reasoning skills.

"Reflective learning conversation helped me to collaborate and think with the team about the most important patient data and findings to reason and intervene. That was very helpful to enhance my clinical reasoning skills". (participant 3 in focus group 2)

"The group discussions and thinking during the reflective learning conversation sessions helped me expand my skills to have patient-centric and focused data collection strategies. That effectively fed my clinical reasoning skills". (participant 6 in focus group 1)

In this subtheme, most participants felt that the RLC played a vital role in developing skills and strategies to collect the most important and relevant patient data and assessment findings using structured and systematic approaches. Many participants described that with the ability to collect the most important and relevant patient data and assessment findings, they were able to construct reliable, focused, accurate, ethical, and patient-centred clinical reasoning skills.

6.2.2.2 Subtheme (2): Prioritised Interventions

Most participants in the experimental group reported a positive impact of the RLC on their abilities to prioritise patient interventions, which in turn was beneficial for patient safety and treatment outcomes. Most participants felt that the RLC provided an opportunity to focus on the interventions that were most relevant to and interconnected with the patient data and assessment findings. There was a common view among participants that attending the RLC enhanced their skills to closely mirror the prioritised intervention strategies they mostly need in their clinical practices to reason, judge, and make informed decisions.

"The after-simulation reflective learning conversation encouraged me to reflect and consider the most efficient ways and strategies to prioritise patient intervention against the patient assessment findings". (participant 4 in focus group 2).

Many participants reported on the importance of peer and educator inputs during the RLC to enhance their prioritisation skills. Participants' views surfaced mainly about the importance of

thinking in groups to reason and decide on the most important, relevant, and priority interventions that were aligned with the patient's condition and assessment findings. Participants raised that while discussing the complex scenarios where prioritization was complex and having input from different people in the simulation group helped establish robust and well-rounded prioritised interventions associated with effective clinical reasoning skills. Participants of the experimental group felt that attending the RLC was useful in establishing strategies and skills to prioritise interventions for such complex cases, leading to enhanced and optimised clinical reasoning skills.

" The debriefing reflective discussions with the simulation group about the prioritised interventions and receiving input from them were very helpful. Those inputs enabled me to make informed interventions that meet the patient's needs". (participant 3 in focus group 2)

"Attending the post-simulation reflective learning conversation was helpful to revisit the prioritisation approaches by looking at the critical and life-threatening issues at first and moving to less life-threatening issues. That helped me to build and enhance my clinical reasoning skills for critically ill patients and complex cases" (participant 2 in focus group 1)

Conversely, some participants raised concern about the drive for prioritised interventions as to whether the patient data and assessment findings or patient preferences and requests. Few participants referred to the importance of considering the patient's preferences, values, and concerns when prioritising interventions in addition to patient information and assessment findings. That was raised as an example of patient-centred care in which it was critical to ensure that patient concerns and preferences were addressed. Those participants felt that

considering patient preferences in the scenarios and RLC helped them to enhance their clinical reasoning skills in consideration of whole patient and patient-centred care.

"I strongly believe in the importance of taking into account the patient preferences and concerns to prioritise the interventions. During simulation, that was important to develop our clinical reasoning skills considering patient-centred care". (participant 7 in focus group 1)

In this subtheme, many participants said that the positive impact of RLC was in relation to systematically prioritising patient interventions starting with life-threatening to less critical issues and associated human factors. Most participants felt that the RLC provided an opportunity to focus on the interventions that were most relevant to patient data and assessment findings. However, in addition to that, some participants expressed concern about patient-centred care considerations and considering patient preferences and requests in their treatment plans. Those participants felt that the RLC helped them enhance their clinical reasoning skills associated with prioritised interventions in consideration of the patient-centred care approach.

6.2.2.3 Subtheme 3: Outcome Evaluation

Most participants of the experimental group commented that evaluating patient outcomes helped them identify the success of the clinical reasoning process. It indicates the appropriateness of the data collection, problem identification, and prioritised interventions. Many participants felt that attending the RLC positively enhanced their outcomes evaluation abilities as a final phase of the clinical reasoning process. Participants expressed that RLC helped them assess the appropriateness and effectiveness of treatment plans and

interventions, reflect on actions, understand the consequences of decisions, gauge their abilities to analyse clinical data to make informed decisions and evaluate the approaches used to solve patient problems. That in turn, helped them enhance and advance their clinical reasoning skills.

"For effective clinical reasoning, we need to collect patient information, process it, understand patient problems, plan and implement interventions, and evaluate outcomes. The reflective learning conversation helped enhance my clinical reasoning skills against that process". (participant 6 in focus group 2)

A common view among participants was about the positive role of the RLC to reflectively discuss the outcomes of the data collection and interventions and their impact on the patient outcome. Those participants described what was achieved during the RLC by analysing with the learning group and educators any discrepancies between expected and actual outcomes and identifying underlying related issues and possible alternative treatment options for better outcomes. Most participants felt the reflective and analytical discussions of the RLC helped highlight strengths and areas for improvement concerning the outcome evaluation of the clinical reasoning process, and in turn, gained enhanced and advanced clinical reasoning skills.

"During the reflective learning conversation, the reflective discussions about the outcome evaluation helped me advance my clinical reasoning skills in this perspective of the clinical reasoning process". (participant 3 in focus group 2)

Many participants reported that the RLC positively enhanced their clinical reasoning by understanding why certain decisions were made and their outcomes. A common view among participants was about the importance of connecting clinical interventions to patient outcomes, including but not limited to improvement in symptoms, stabilization of vital signs, and overall health status. Participants expressed that reflectively discussing the connection between interventions and outcomes during the RLC helped them see the direct impact of their clinical reasoning skills on patient care, and analysing how the clinical reasoning process of data collection and problem identification led to those outcomes, identifying both effective and ineffective clinical reasoning outcomes, and in turn, refining their clinical reasoning skills to enhance and optimise their clinical reasoning skills.

"*Attending the simulation reflective learning conversation was very useful in enhancing my clinical reasoning skills concerning the outcomes resulting from patient data collection process and interventions*". *(participant 1 in focus group 1)*

In this subtheme, most participants felt that attending the RLC positively enhanced their outcomes evaluation abilities as part of the clinical reasoning process. Many participants described that reflecting and analysing the connection and relationship between interventions and outcomes during the RLC helped them see the direct impact of their clinical reasoning skills on patient care and safety. Most participants felt that the reflective and analytical discussions of the RLC helped them to highlight strengths and areas for improvement concerning the outcome evaluation of the clinical reasoning process, and in turn, gained enhanced and advanced clinical reasoning skills

6.2.2.4 Subtheme 4: Self-Efficacy

Many participants of the experimental group described the positive impact of the RLC on their clinical reasoning self-efficacy in relation to confidence and competence. Most participants expressed that RLC encouraged their self-awareness. Those participants felt that self-awareness enabled them to explore their strengths and weaknesses during the reflective discussions, and in turn, encouraged their self-efficacy in relation to confidence and competence with enhanced clinical reasoning skills.

"Reflective learning conversation encouraged me to analyse actions, decisions, and performance. This process of self-examination helped me identify strengths and weaknesses, leading to greater self-awareness and confidence to judge and reason". (participant 1 in focus group 2)

" Attending the reflective conversation enabled us to have a better understanding of our abilities and areas for improvement, which was great to boost confidence and competence, and therefore, clinical reasoning enhancement as a result of it". (participant 7 in focus group 2)

Most participants felt that RLC provided opportunities to reflect on their actions and consider alternative strategies. Through this process, participants expressed that they were able to recognise their achievements and acknowledge their progress. Many participants felt that as they saw themselves acquiring and improving knowledge and skills, their confidence in their abilities has grown. Those participants reported on the positive impact of RLC on their self-efficacy, confidence, and in turn, on their clinical reasoning skills.

"Reflective learning conversation allowed me to view mistakes as opportunities for learning and growth rather than as failures, and that made me more confident. Confidence led to better clinical reasoning abilities "(participant 5 in focus group 1)

"The discussions of mistakes during the reflective learning conversation encouraged my confidence. I felt that I became more resilient and less fearful of errors, and I was able to reason my decisions more confidently". (participant 3 in focus group 2)

Many participants commented on the importance of constructive feedback while attending the RLC. They felt that the constructive feedback through the reflective discussions affirmed their accomplishments and helped them appreciate their achievements. Most of those participants felt that such positive reinforcement significantly impacted on their self-esteem, efficacy, and confidence and, consequently, enhanced their clinical reasoning skills.

"The reflective discussions with the team and instructors were very helpful in building my self-efficacy to feel confident. It was positive to encourage me to correct knowledge and skills and become more confident in my clinical reasoning skills". (participant 4 in focus group 2)

"As an educator, I think the constructive feedback during the post-simulation reflective learning conversation encouraged learners to actively engage, master the learning topic, and consequently gain confidence. That confidence encouraged learners to effectively reason and make decisions". (participant 6 in educators focus group 5)

Many participants expressed the positive impact of establishing specific goals for improvement and charted their progress over time on their self-efficacy to feel confident. As

they accomplished targeted goals and witnessed their growth, their confidence increased. A common view among many participants was that achieving goals provided a sense of control and empowerment, and therefore they achieved higher self-efficacy associated with increased confidence and enhanced clinical reasoning skills.

"The debriefing sessions using the reflective learning conversation were goal-directed, and I was clear at the early stages what I needed to achieve. That was very helpful to reason and judge with confidence". (participant 6 in focus group 2)

"With clear goals to be achieved while attending the reflective learning conversation, my self-efficacy and confidence increased as well as my clinical reasoning skills". (participant 2 in focus group 2)

Most participants felt that reflecting on emotions during SBE helped them to critically analyse their experiences, identify areas for improvement, and develop a deeper understanding of scenario concepts and critical elements. Those participants felt that attending the RLC helped them manage their emotions and overcome the associated stress and anxiety. Many participants felt that managing emotions and stress encouraged them to have emotional resilience and created lasting memories. Those participants expressed that emotional resilience boosted their active engagement and their ability to handle challenging situations with self-awareness, leading to feeling more confident and with enhanced clinical reasoning skills.

"During the debriefing sessions, I was able to truly reflect on the experienced emotions which was very helpful to manage and control my stress and anxiety. That helped me feel

confident in constructing learning and building up robust clinical reasoning skills". (participant 5 in focus group 1)

Most participants reported the positive impact of the RLC on their self-efficacy associated with competence and enhanced clinical reasoning skills. Participants said that having repetitive deliberate practice during the SBE activities followed by debriefing through RLC enabled them to construct competence. That was raised while discussing that SBE provided a controlled environment to practice skills, reason, and judge to make decisions without real-world consequences. Many participants felt that the RLC helped them make sense of experiences and extract valuable insights, turning them into practical knowledge, which in turn, helped them to construct competence with higher self-efficacy and enhanced clinical reasoning skills:

"After simulation experiences, attending the reflective learning conversation enabled me to retrospectively analyse actions and decisions associated with targeted skills, which was helpful to gain competence with self-efficacy and build effective clinical reasoning skills". (participant 2 in focus group 1)

"The reflective conversation allowed us to dissect problems and evaluate solutions through a practice repetitively and deliberately. That was very helpful to enhance clinical reasoning and develop competence". (participant 6 in focus group 2).

Most participants commented on the fact that the RLC helped them to bridge the gap between theoretical knowledge and practical application. They felt that attending the SBE activities and debriefing sessions helped them to connect the concepts they had learned with real-world

scenarios, making their understanding more comprehensive and practical. Many participants felt that reflecting on their SBE experiences helped them identify areas for improvement and set goals for enhancing their clinical reasoning skills to achieve competence with higher self-efficacy.

"Attending simulation with repetitive practice and debriefing sessions helped me to bridge the gap between knowledge and application. That was very useful to effectively practice and refine clinical reasoning skills and develop competence". (participant 5 in focus group 1)

Opinions differed about confirming competence using SBE. Five participants felt the need for real patient experience in real clinical settings over a period with different patient encounters incorporating compassionate and holistic care approaches to confirm competence and construct expertise. A common view among those five participants was about the critical role of SBE and debriefing sessions in building up and enhancing competence, but they expressed that real-life experiences would consolidate expertise and confirm competence with effective and actual clinical reasoning application.

"Simulation and debriefing were very crucial to develop clinical reasoning and competence. However, we cannot ignore the importance of real patient experience to confirm and consolidate competence". (participant 4 in focus group 1)

"Communication with patient and compassionate care are important parts of achieving competence. In the simulation, there were simulated patients to voice the patient responses and emotions but when you deal with real patients those emotions and associated clinical reasoning considerations could be addressed realistically. (participant 7 in focus group 2)

In this subtheme, most participants felt that RLC contributed positively to their self-efficacy concerning confidence and competence. Many participants expressed that self-awareness, skills development through deliberate practice, goal achievement and acknowledgment, and emotional resilience fostered their self-efficacy associated with confidence and competence. Opinions differed by a few participants as to whether SBE can confirm competence. Most participants reported that SBEs were beneficial to building and enhance competence but ideally confirming competence and constructing expertise needs to take place over a period with different and multiple patient encounters incorporating a holistic care approach. Overall, most participants felt the positive impact of RLC on their self-efficacy in the sense that it was associated with a perceived higher level of confidence and competence, leading to enhanced clinical reasoning skills.

6.3 Summary

In this chapter, the qualitative findings of the focus group method with an overview of the themes that identified, and their related subthemes were discussed. The summary of those themes and subthemes findings is described below:

Previous exposure to the simulation topic: Many participants reported that previous exposure to the learning topic positively impacted their clinical reasoning skills while attending the SBE activities and debriefing sessions. Most participants described that their clinical reasoning skills were promoted and enhanced by having learners with previous exposure to the SBE topic within their simulation group.

Competence, seniority, experience: Most participants commented on the importance of competence, experience, and seniority to foster, advance, and optimise their clinical reasoning skills while attending simulation debriefing sessions. A common view among participants was that the presence of competence, experience, and seniority factors at the same time complement each other to foster, optimise, and advance their clinical reasoning skills.

Scenario complexity: Some participants felt a positive impact of the scenario complexity while attending the SBE activities and debriefing sessions on their clinical reasoning. On the other hand, a few participants felt a negative impact of the scenario complexity on their clinical reasoning skills. That negative effect was associated with cognitive overload, feeling overwhelmed, and stress-related factors. To mitigate that, most participants felt the need for experienced educators who can facilitate gradual and incremental scenarios and debriefing sessions, and in turn, develop enhanced and optimised clinical reasoning skills.

Multicultural learning environment: Many participants felt that having learners with different cultural backgrounds challenged them to engage with the SBE learning group, scenarios, and debriefing sessions. Participants felt that different personal beliefs, variations in communication skills, language barriers, and cultural incompetence negatively impacted their clinical reasoning skills development and enhancement. Most participants expressed the importance of learners' and educators' cultural competence to advance and enhance their clinical reasoning skills in multicultural learning environments.

Cognitive overload: Most participants expressed the negative impact of cognitive overload on their clinical reasoning skills enhancement. Many participants expressed that cognitive overload led to emotional stress and anxiety, which in turn, affected their clinical reasoning development and enhancement. Those reported the importance of incremental and progressive simulation facilitation to mitigate the potential risk of cognitive overload, and in turn, enhance and advance their clinical reasoning skills.

Learner-centred reflective discussions: Most participants felt the positive impact of the debriefing through reflective discussions in enhancing their knowledge and skills retention. Many participants expressed the importance of learner-centred, gradual, progressive reflective discussions and Socratic questioning techniques to achieve enhanced and optimal clinical reasoning skills. Most participants stressed the importance of reflecting on feelings, emotions, and technical and non-technical and human factors-related skills during the debriefing sessions to develop enhanced and advanced clinical reasoning skills.

Psychological safety: Most participants felt that the pre-briefing played a crucial role in fostering their psychological safety while attending SBE activities and debriefing sessions. Many participants expressed that feeling psychologically safe fostered a conducive learning environment where they were able to explore different options, make mistakes, take risks, and actively participate. Most participants described that psychological safety promoted constructive, active, and blame-free learning environments, and in turn, positively enhanced their clinical reasoning skills. Many participants perceived reflection on emotions and

feelings as important to feel psychologically safe and actively engaged in the scenarios and debriefing discussions, and in turn, fostering their clinical reasoning skills.

Data collection and problem identification: Most participants felt that RLC played a vital role in developing skills and strategies to collect the most important and relevant patient data and assessment findings using structured and systematic approaches. Many participants described that with the ability to collect the most important and relevant patient data and assessment findings, they were able to construct reliable, focused, accurate, ethical, and patient-centred clinical reasoning skills.

Prioritised interventions: Many participants expressed the positive impact of RLC to systematically prioritise patient interventions starting with life-threatening to less critical issues. Most participants felt that the RLC provided an opportunity to focus on the interventions that were most relevant to the patient assessment findings.

Outcome evaluation: Most participants felt that attending the RLC positively enhanced their patient evaluation and assessment skills as part of the clinical reasoning process. Many participants described that reflecting and analysing the connection and relationship between interventions and outcomes during the RLC helped them see the direct impact of their clinical reasoning skills on patient care and safety. Most participants felt that the reflective and analytical discussions of the RLC helped them to highlight strengths and areas for improvement concerning the outcome evaluation of the clinical reasoning process, and in turn, gained enhanced and advanced clinical reasoning skills.

Self-efficacy (confidence and competence): Most participants felt RLC contributed positively to their self-efficacy concerning confidence and competence. Many participants expressed that self-awareness, skills development through deliberate practice, goal achievement and acknowledgment, and emotional resilience fostered their self-efficacy associated with confidence and competence. Most participants expressed that SBE was beneficial to building and enhancing competence but ideally confirming competence and constructing expertise needs to take place over a period with different and multiple patient encounters incorporating a holistic care approach. Overall, most participants felt the positive impact of the RLC on their self-efficacy associated with confidence and competence, leading to enhanced clinical reasoning skills.

CHAPTER 7: DATA INTEGRATION

7.1 Introduction

To summarise, the data collection methods were i) questionnaires obtained from the control and experimental group participants (GSE and NCRS), ii) focus group conducted for the nurses who attended the SBE courses, and for the simulation educators, iii) direct subsequent objective observation of nurses' clinical reasoning, with subsequent video review to evaluate nurses' clinical reasoning during critical care SBE courses (LCJR and CREST). This chapter presents an integration of data from these data sets.

Data integration in this PhD mixed methods research involves combining and synthesising data from quantitative and qualitative research approaches to comprehensively understand and answer the research questions, increasing the robustness of the conclusions and generalisability level. As discussed in Chapter 4, section 4.12, data integration was employed to enhance validity and reliability by cross-verifying findings from different research methods after the data collection and analysis phases. During the initial development of the study, data from each set were tabulated to facilitate comparison. Key factors were drawn out and developed through discussion with the supervisory team.

In this study, data triangulation was used to seek convergence of results from different methods supported by the diversity of views with a comparative-and-description drive (Creswell et al., 2003; Cohen, 2016; Åkerblad et al., 2021; Coe et al., 2021). It was also used

to highlight key landmarks toward clinical reasoning optimisation and capture layers of complexities that exist due to the multidimensional nature of clinical reasoning. The use of a parallel exploratory mixed methods design aimed at the concurrent collection of data sets to analyse them to comprehensively answer the research questions (Creswell & Plano Clark, 2011). This design allowed iterative analysis of the data, with themes being developed from the co-design phase of the RLC model and further explored in subsequent objective observations and focus groups. (Creswell & Plano Clark, 2011 Cohen, 2016; Åkerblad et al., 2021; Coe et al., 2021). Using parallel exploratory mixed methods helped mitigate concerns that qualitative data may be regarded as of less importance than quantitative data (Teddlie & Tashakkori, 2011). In this study, qualitative and quantitative arms were integrated and relied on data produced by each other (Creswell et al., 2006; Azungah, 2018). The research questions were answered by different datasets of quantitative and qualitative methods presented in (Table 20).

Table 20. Research questions matrix with qualitative and quantitative research methods

Research questions	Literature review	RLC co-design	Focus group	Questionnaire	Direct observation	Video review
What is the current evidence for RLC debriefing models to be used in critical care SBE?	✓✓✓					
What are the valid and reliable clinical reasoning assessment tools or models for RLC that can be used in adult critical care SBE?	✓✓✓					
What should a co-designed RLC model incorporate?	✓✓	✓✓✓	✓✓			
How valid and reliable is the newly designed RLC model for use in adult critical care SBE?			✓	✓✓✓	✓✓✓	✓✓✓
How does a co-designed RLC enhance the clinical reasoning skills of adult critical care nurses attending the RLC sessions of SBE?			✓✓✓	✓	✓	✓
How do RLC affect individuals' clinical reasoning skills when participating in adult critical care SBE?			✓✓✓	✓	✓	✓

Identified in data sets: (✓). More (✓) indicates a higher level of strength and weight

To answer the questions, the domains and sub-domains of the quantitative methods in addition to themes and sub-themes of the qualitative methods were clustered and presented in (Table 21)

Table 21: Data integration matrix

Contributing and influencing factors to clinical reasoning skills						
Elements	**Literature review**	**RLC co-design**	**Focus group**	**Questionnaire**	**Direct observation**	**Video review**
Previous exposure to the SBE topic	✓	✓✓	✓✓✓			
Learner's competence before attending SBE	✓	✓✓	✓✓✓	✓	✓	✓
Learner's seniority and experience	✓	✓✓	✓✓✓	✓	✓	✓
Case complexity	✓	✓✓	✓✓✓		✓	✓
Multicultural SBE learning environment	✓	✓✓	✓✓✓		✓	✓
Learner-centred reflective discussions	✓	✓✓	✓✓✓		✓	✓
Cognitive overload	✓	✓✓	✓✓✓			
Psychological safety	✓	✓✓	✓✓✓			
The impact of post-simulation reflective learning conversation on clinical reasoning skills						
Elements	**Literature review**	**RLC co-design**	**Focus group**	**Questionnaire**	**Direct observation**	**Video review**
Data collection and problem identification	✓		✓✓	✓✓✓	✓✓✓	✓✓✓
Prioritised interventions	✓		✓✓	✓✓✓	✓✓✓	✓✓✓
Outcome evaluation	✓		✓✓	✓✓✓	✓✓✓	✓✓✓
Self-efficacy	✓		✓✓	✓✓✓	✓✓✓	✓✓✓

RLC: Reflective Learning Conversation; Identified in data sets: (✓). More (✓) indicates a higher level of strength and weight

7.2 The Impact of Reflective Learning Conversation on Clinical Reasoning Skills

7.2.1 Data Collection and Problem Identification

According to the literature review findings, the clinical reasoning process is partially dependent on collecting the right patient information at the right time for the right purpose (Levett-Jones et al., 2010). The literature highlighted a generic positive effect of appropriate data collection and problem identification on learners' clinical reasoning development and enhancement while attending SBE and debriefing sessions.

In Chapter 3, it was highlighted that the model was co-designed to enable learners to collect the most relevant and important patient information to identify the underlying issues. That was achieved through deliberate practice incorporating inclusive and reflective discussions and incremental questioning techniques. Attending the RLC was seen in the focus group in Chapter 6, section 6.2.2.1 to positively impact clinical reasoning development and enhancement by guiding learners to focus on the most important and relevant patient data.

The quantitative findings (Chapter 5, section 5.3.5) of the self-reported questionnaire (GSE, NCRS), and direct observation and video review methods (LCJR, CREST) reflected a positive impact of the RLC on the experimental and control groups' clinical reasoning levels and their ability to collect the most important and relevant data and identify patient problems.

As described in Chapter 5, section 5.3.5, the inferential findings (GSE, NCRS, LCJR, and CREST) indicated that the experimental groups showed a significantly higher level of clinical

reasoning in relation to data collection and problem identification according to Levett-Jones et al. (2010) clinical reasoning cycle than the control groups, additionally, both the control and experimental groups had significant improvements in the clinical reasoning levels in relation to data collection and problem identification over time, but the experimental groups' scores were higher compared to the control groups. This suggests the positive impact of RLC on enhancing and optimising clinical reasoning through collecting the most important and relevant data and identifying patient problems as per Levett-Jones et al. (2010) clinical reasoning cycle.

7.2.2 Prioritised Interventions

In the literature review Chapter 2, section 2.6, it was highlighted that the clinical reasoning process includes prioritising the interventions (Levett-Jones et al., 2010). The literature reflected a generic positive effect of the ability to prioritise patient interventions on learners' clinical reasoning development and enhancement while attending SBE and debriefing sessions (Dieckmann et al., 2023).

The focus group data of Chapter 6, section 6.2.2.2 highlighted that attending the RLC can positively impact clinical reasoning development and enhancement by guiding learners to prioritise interventions and clinical actions as per Levett-Jones et al. (2010) clinical reasoning cycle.

Questionnaire data (NCRS and GSE) in Chapter 5, section 5.3.5 reflected improved learners' clinical reasoning levels with the ability to prioritise and intervene. Direct observation and video review findings (LCJR and CREST) reflected a positive impact of RLC on learners' clinical reasoning skill levels and ability to prioritise actions and intervene appropriately as per Levett-Jones et al. (2010) clinical reasoning cycle. The learners' ability to prioritise and intervene with a progressive improvement in the learners' clinical reasoning levels was significant at the middle, and end of the SBE. As reported in Chapter 5, section 5.3.5, the inferential findings of direct observation and video review using LCJR and CREST indicated that the experimental group showed a significantly higher level of clinical reasoning in relation to prioritised interventions than the control group, additionally, both the control and experimental groups had significant improvements in the clinical reasoning levels in relation to prioritised interventions over time, but the experimental groups' scores were higher compared to the control groups. This suggests the positive impact of RLC on enhancing and optimising clinical reasoning through priotrised interventions as per Levett-Jones et al. (2010) clinical reasoning cycle.

7.2.3 Outcome Evaluation

In the literature review Chapter 2, section 2.6 outcome evaluation was highlighted as a clinical reasoning critical element as per Levett-Jones et al. (2010) clinical reasoning cycle. The literature reflected a generic positive effect of the ability to evaluate patient outcomes on nurses' clinical reasoning development and enhancement while attending SBE and debriefing sessions (Dieckmann et al., 2023).

The quantitative findings of the self-reported questionnaire (NCRS and GSE) in Chapter 5, section 5.3.5 reflected an improvement in learners' clinical reasoning level with the ability to evaluate the outcomes of interventions and actions as per Levett-Jones et al. (2010) clinical reasoning cycle. The quantitative findings of the direct observation and video review methods (LCJR and CREST) in Chapter 5, section 5.3.5 showed progressive development and enhancement in participants' outcome evaluation ability. The learners' ability to evaluate the outcome with a progressive improvement in the learners' clinical reasoning levels was statistically significant at the middle, and end of the SBE. The inferential findings of the direct observation and video review (LCJR and CREST) indicated that the experimental group showed a significantly higher level of clinical reasoning than the control groups in relation to patient outcome evaluation (Chapter 5, section 5.3.5), additionally, both the control and experimental groups showed significant improvements in the clinical reasoning levels in relation to patient outcome evaluation over time, but the experimental groups' scores were higher compared to the control groups (Chapter 5, section 5.3.5). This suggests the positive impact of the RLC model on enhancing and optimising learners' clinical reasoning through continuous outcomes evaluation as per Levett-Jones et al. (2010) clinical reasoning cycle.

7.2.4 Self-Efficacy

The literature in Chapter 2, section 2.8.3 highlighted a generic positive effect of self-efficacy during SBE and debriefing sessions on nurses' clinical reasoning levels (Stoodley et al., 2020). The quantitative findings (Chapter 5, section 5.3.5) of the self-reported questionnaire (GSE) reflected a positive impact of the RLC on the participants of the experimental and control groups' perceived self-efficacy levels in relation to competence and confidence in

their clinical reasoning skills. As reported in Chapter 5, section 5.3.5, the inferential findings (GSE) indicated that the experimental groups showed a significantly higher level of self-efficacy in relation to clinical reasoning confidence and competence than the control groups. This suggests the positive impact of RLC on nurses' self-efficacy regarding clinical reasoning competence and confidence.

7.3 Contributing and Influencing Factors to Clinical Reasoning

7.3.1 Previous Exposure to the SBE Topic

The literature review Chapter 2, section 1.6 indicated previous exposure to learning and SBE topics as a positive contributing factor to clinical reasoning development while attending SBE (Almomani et al., 2023). The literature highlighted that learners with previous clinical exposure to the learning topics would develop clinical reasoning faster and more effectively than those without previous clinical exposure. In Chapter 3, the co-design working group identified prior exposure to SBE topics as an important contributing factor to enhancing clinical reasoning development while attending critical care SBE, therefore, the model was designed for learners with different critical care specialty backgrounds and previous exposures to the SBE topic.

The qualitative findings of the focus group method of the experimental and control groups were discussed in Chapter 6, section 6.1.1.1, and highlighted that having a previous background and exposure to the SBE topic is a positive contributing factor in enhancing clinical reasoning skills. This suggests the need to develop a balanced curriculum and

debriefing sessions that meet the needs of group-based SBE with exposure variations to the learning topic.

7.3.2 Learner's Competence Before Attending SBE

In the literature review Chapter 2, section 2.7, prior competence was indicated as a positive contributing factor to clinical reasoning development. The literature highlighted that clinically experienced competent nurses would develop clinical reasoning skills more effectively and faster compared to less experienced nurses. This suggested the need to develop a SBE design and debriefing method that meets the needs of different learning groups with various competence and experience levels.

The focus group findings were discussed in Chapter 6, section 6.2.2.4. It was highlighted that competence related to the learning topic is a positive contributing factor to enhancing clinical reasoning development and enhancement. As described in Chapter 5, sections 5.3.1 and 5.3.5, despite the learners' variations in competence levels in both experimental and control groups (Chapter 5, table 12), the questionnaire inferential findings (GSE, NCRS) indicated that the post-test groups showed a significantly higher level of clinical reasoning than the pre-test groups for experimental and control groups (Chapter 5, table 17). Additionally, both the control and experimental groups showed significant improvements in the observed clinical reasoning levels (LCJR, CREST) over time, but the experimental group's clinical reasoning scores were higher compared to the control groups described in Chapter 5, section 5.3.5. This suggests the positive impact of RLC on enhancing and optimising clinical reasoning

skills in the presence of different nurses' competence levels within the same simulation group.

7.3.3 Learner's Seniority and Experience

In the literature review Chapter 2, section 2.6.1, professional seniority and experience were indicated as a positive contributing factor to enhancing clinical reasoning development (DiPierro et al., 2022). The literature highlighted that senior and experienced nurses are mostly autonomous and would use intuitive clinical reasoning skills compared to less experienced nurses who could use analytical reasoning skills; hence, with higher seniority and experience nurses could develop and enhance clinical reasoning faster (DiPierro et al., 2022). This suggests the need to develop a SBE design and debriefing method that meets the needs of different learning groups with various seniority and experience levels. In Chapter 3, the co-design phase of the study identified that learners' professional seniority and experience were positive contributing factors to enhancing clinical reasoning development during critical care SBE, and the model was designed for learners with different seniority (different grades) and experience levels.

The focus group findings in Chapter 6, section 6.2.1.2 highlighted that seniority and experience were positive contributing factors for enhanced clinical reasoning development. As described in Chapter 5, sections 5.3.1 and 5.3.5, despite the learners' variations in professional seniority and experience in both experimental and control groups, the questionnaire inferential findings (GSE, NCRS) indicated that the post-test groups showed a significantly higher level of clinical reasoning than the pre-test groups for the experimental

and control groups. Additionally, both the control and experimental groups had significant improvements in the observed clinical reasoning levels (LCJR, CREST) over time, but the experimental group's clinical reasoning scores were higher compared to the control groups described in Chapter 5, section 5.3.5. This suggests the positive impact of RLC on enhancing and optimising clinical reasoning skills considering different learners' professional seniority and experience levels.

7.3.4 Scenario Complexity

In the literature review Chapter 2, section 2.6.1, a well-designed and objective scenario complexity was indicated as a contributing factor to achieve the learning objectives (Dieckmann et al., 2020). Scenario complexity during the scenario design phase could lead to cognitive overload and underdeveloped clinical reasoning (Cheng et al., 2020). The literature findings suggested the need to develop a SBE curriculum incorporating debriefing methods that meet the need for case complexity to achieve the learning objective while mitigating the risk of cognitive overload and underdeveloped clinical reasoning.

The focus group findings in Chapter 6, section 6.2.1.2 highlighted a negative effect of scenario complexity on nurses' clinical reasoning development and optimisation. The focus group participants of both experimental and control groups indicated that the negative effect was associated with cognitive overload, feeling overwhelmed, and stress-related factors. To mitigate that, most focus group participants felt the need for experienced and competent educators who can facilitate gradual and incremental scenarios and debriefing sessions, and in turn, develop enhanced and optimised clinical reasoning skills.

All participants (experimental and control groups) attended level two and three critical care scenarios, patient severity levels were discussed in Chapter 1, section 1.4. With participants' attendance to various case complexity scenarios, the questionnaire inferential findings of (GSE and NCRS) indicated that the post-test groups had a significantly higher level of clinical reasoning than the pre-test groups for the experimental and control groups. As reported in Chapter 5, section 5.3.5, both the control and experimental groups showed significant improvements in the observed clinical reasoning levels (LCJR, CREST) over time, but the experimental group's clinical reasoning scores were higher compared to the control group. This suggests the positive impact of RLC on enhancing and optimising clinical reasoning skills considering variations in case complexity.

7.3.5 Multicultural SBE Learning Environment

In the literature review Chapter 2, section 2.6, learning in a multicultural learning environment was indicated as a challenge to overcome while attending group-based SBE (Rana et al., 2023). It highlighted the potential negative effect of personal variations, beliefs, and adaptation ability within the SBE learning group on clinical reasoning development (Rana et al., 2023). This suggests developing a SBE curriculum incorporating debriefing methods that meet learners' cultural variations.

The qualitative findings of the focus group method section were discussed in Chapter 6, section 6.2.1.4, and highlighted that a multicultural SBE learning environment can have both

positive and negative impacts on clinical reasoning development. Collaboratively working in teams during SBE activities in a multi-cultural learning environment could provide a chance to develop clinical reasoning, however, different personal beliefs and variations in communication skills could also negatively impact clinical reasoning development. The focus group findings suggested the need to foster an inclusive and culturally sensitive learning environment that can promote effective clinical reasoning across a diverse group of learners.

With the presence of participants from different cultures in each simulation group, the inferential findings of the (GSE and NCRS) indicated that the post-test groups had a significantly higher level of clinical reasoning than the pre-test groups for the experimental and control groups (Chapter 5, section 5.3.5). Both control and experimental groups showed significant progressive improvements in the clinical reasoning levels using LCJR and CREST (Table 18). This suggests the positive impact of the RLC model on enhancing and optimising clinical reasoning considering multicultural SBE learning environments.

7.3.6 Cognitive Load

The literature review (Chapter 2, section 2.6) indicated that cognitive overload is an influencing factor and barrier to effective clinical reasoning development while attending SBE and RLC as a simulation debriefing method (Yong et al., 2021). This suggests developing a SBE curriculum incorporating debriefing methods that mitigate the potential risk of cognitive overload, which was subsequently incorporated as incremental and reflective

questioning into the co-design process. The focus group findings in Chapter 6, section 6.2.1.5 highlighted that cognitive overload can negatively impact clinical reasoning development. The focus group findings suggest that cognitive overload could lead to emotional stress and anxiety, which could affect clinical reasoning and metacognition development.

7.3.7 Psychological Safety

The literature review Chapter 2, section 2.6 indicated that psychological safety was a positive contributing factor to effective clinical reasoning development and enhancement during SBE (Oriot and Alinier, 2018) The model in Chapter 3, section 3.5 was designed to start with pre-briefing to foster learners' psychological safety while attending RLC. Focus group findings Chapter 6, section 6.2.1.7 highlighted that fostering psychological safety could positively impact clinical reasoning development and could lead to better clinical reasoning and metacognition development, achieved with effective pre-briefing sessions before the scenarios and RLC.

7.4 Putting all together

To summarise the findings from the different quantitative and qualitative datasets, the literature indicated that existing clinical reasoning and debriefing models and tools were not explicitly developed to account for variations in learners' competence and seniority, prior experience and exposure to learning topics, case complexity, and multicultural learning environments as contributing and influencing factors in SBE clinical reasoning. There was no

agreement in the literature on which clinical reasoning and debriefing models were best for practising and pre-registration nurses, for clinical and educational settings, or either critical care or non-critical care SBE.

The *quantitative findings* of the questionnaire reflected an improvement in learners' clinical reasoning in relation to appropriate data collection and problem identification, prioritising interventions, outcome evaluation, and self-efficacy associated with confidence and competence. The experimental group had a significantly higher level of clinical reasoning than the control group. The repeated measures of learners' clinical reasoning scores after three direct observations and three video reviews within the same group at (the beginning, midway, and end of SBE activities) for both control and experimental groups, reflected a progressive clinical reasoning improvement. The experimental group's clinical reasoning scores were higher compared to the control group. There was a progressive development and enhancement of clinical reasoning regarding appropriate data collection and problem identification, prioritising interventions, and outcome evaluation (Chapter 5, Tables 16, 17, and 18).

The *Focus group* findings in Chapter 6 revealed that in a multicultural learning environment, different personal beliefs, variations in communication skills, language barriers, and cultural incompetence negatively impacted nurses' clinical reasoning skills development and enhancement. Cognitive overload resulted from a high volume of information at once associated with emotional stress and anxiety that negatively impacted learners' clinical

reasoning skills development and enhancement. Reflecting on feelings, emotions, and technical and non-technical and human factors-related skills during the debriefing sessions positively enhanced learners' clinical reasoning skills. Experiencing psychological safety promoted constructive, active, and blame-free learning environments, and in turn, positively enhanced nurses' clinical reasoning skills. RLC helped the participants to collect the most important and relevant patient data and assessment findings, prioritise patient interventions, and evaluate the outcomes.

Moreover, the focus group reported that the RLC positively enhanced learners' self-efficacy concerning confidence and competence. The focus group indicated that previous exposure to the SBE learning topic positively impacted their clinical reasoning skills. A higher level of competence, greater experience, and increased seniority positively impacted nurses' clinical reasoning skills. Scenario complexity negatively impacted nurses' clinical reasoning skills by causing cognitive overload, overwhelming, and stress-related factors. Most focus group participants expressed the need for gradual and incremental scenarios and debriefing facilitation.

7.5 Conclusion:

Data from the questionnaires explored learners' self-perceived clinical reasoning levels (NCRS) and self-efficacy (GSE). Direct observation and video review, using the LCJR and CREST tools, assessed learners' progress in clinical reasoning development over time while

engaging with the RLC. The focus groups provided further insight into the contributing and influencing factors shaping clinical reasoning and how these were mediated through SBE.

Integration of the quantitative and qualitative datasets revealed the key factors influencing clinical reasoning during RLC in SBE, as well as their overall impact on participants' reasoning development. The findings demonstrated that debriefing through the RLC positively influenced learners' clinical reasoning by strengthening patient data collection and problem identification, prioritisation of interventions, outcome evaluation, and self-efficacy. The next chapter will critically discuss the most significant findings of this research.

CHAPTER 8: DISCUSSION, LIMITATIONS AND CONCLUSIONS

8.1 Introduction

The previous chapters have presented the related literature, the co-design of the RLC, the methods, and the results of this mixed-method pre-test/post-test study, which aimed to answer the primary research questions (Chapter 1, Section 1.) concerning the validity and reliability of the co-designed RLC model and how it enhances nurses' clinical reasoning skills during SBE.

This chapter critically discusses the key findings in relation to current literature, highlights the strengths and limitations of this PhD study, and summarises the overall contribution to knowledge and implications for practice.

Summary of Key Findings

The experimental group demonstrated significantly higher levels of clinical reasoning than the control group. Improvements were observed across repeated measures of learners' clinical reasoning scores after three direct observations and three video reviews (at the beginning, midway, and end of SBE activities) in both groups.

Focus group findings revealed that previous exposure to the SBE learning topic positively influenced nurses' clinical reasoning skills. Higher competence, greater experience, and increased seniority also positively contributed to clinical reasoning development. In contrast, scenario complexity, when perceived as excessive, was associated with cognitive overload, stress, and reduced performance. The RLC model played a vital role in supporting the development of skills and strategies to collect relevant patient data, prioritise interventions systematically, and evaluate outcomes. The following sections present a critical discussion of these findings

8.2 The Impact of the SBE and RLC Model Designs on Learning Outcomes

While the findings that the experimental group demonstrated significantly higher levels of clinical reasoning than the control group suggest that the RLC model offers a structured and effective approach to supporting learning outcomes, it is important to recognise that the effectiveness of debriefing is shaped by multiple interacting factors beyond the model itself.

One explanation for the experimental group’s higher clinical reasoning scores may be the RLC model’s ability to help facilitators manage the complexities of debriefing through a clearly defined structure. This framework guided discussions, encouraged active participation, and supported incremental cognitive engagement (Eppich and Cheng, 2016;

Sawyer et al., 2016). Its scaffolding approach can enable learners to progress through increasingly complex reasoning processes in a supportive environment (Rudolph et al., 2014; Jaye et al., 2015), aligning with Vygotsky's Zone of Proximal Development (ZPD), which emphasises the importance of structured facilitation in advancing cognitive growth (Masava, et al., 2023).

The RLC model's multimodal questioning techniques represent another contributing factor (Levin et al., 2019; Cheng et al., 2020; Duff, et al., 2024). By integrating Bloom's Taxonomy, Appreciative Inquiry, and the Plus/Delta approach (Bloom et al., 1956; Cooperrider and Srivastva, 2005; Cheng et al., 2021), the model established a reflective environment that was constructive, strengths-based, and inclusive. Appreciative Inquiry, in particular, repositioned performance gaps as opportunities for growth, encouraging deeper reflection (Cooperrider and Srivastva, 2005). The progressive questioning strategy from foundational knowledge to higher-order analytical thinking may have engaged less experienced participants while simultaneously challenging more advanced learners. This design is consistent with literature advocating Bloom's framework to support cognitive scaffolding (Levin et al., 2019; Cheng et al., 2020; Duff et al., 2024; Nascimento et al., 2021). Furthermore, the incremental can help reduce risks of cognitive overload by breaking down complex tasks into smaller, manageable components (Duff et al., 2024; Nascimento et al., 2021).

The RLC progressive and incremental approach intent was to encourage self-assessment and reflection, enabling learners to develop self-awareness with mitigated cognitive overload. Focus group findings supported this, with participants emphasising the value of gradual facilitation in creating a safe and supportive environment for reflection. This aligns with Sawyer et al. (2016), who identified progressive case exploration as a means of promoting self-awareness and deeper understanding. Segmenting debriefing into phases allowed learners to focus on discrete actions and decisions, while inclusive discussions gradually increased in complexity according to learner competence. Eppich et al. (2015) and Rudolph et al. (2014) similarly emphasised that incremental guided reflection promotes balanced participation, particularly by encouraging quieter learners to contribute. A systematic review by Kainth & Reedy (2024) further showed that gradual debriefing supports smoother cognitive flow and reduces overload, while Sobeck (2020) demonstrated that chunking debriefing information improved focus, contextual understanding, and active learning. The multiphasic, multimodal, and incremental structure of the RLC model may therefore have contributed to the experimental group's enhanced clinical reasoning, although not as the sole factor.

Another important dimension of the RLC model's impact is its deliberate design to foster psychological safety, particularly through its structured pre-briefing phase. Psychological safety has consistently been identified as a contributing factor for effective group-based learning (Kolbe et al., 2020; Madireddy & Rufa, 2023). When learners feel psychologically safe, they are more willing to take risks, voice uncertainties, and engage critically with feedback. In this PhD study, focus group participants repeatedly stressed that psychological

safety enabled them to participate openly in reflective dialogue, reinforcing findings from other research that learners are more likely to acknowledge mistakes, explore alternative strategies, and reflect deeply when protected from fear of judgement (Ko & Choi, 2020).

To foster psychological safety, the RLC model embedded pre-briefing practices such as clarifying learning objectives, reinforcing confidentiality, establishing ground rules, and defining participant roles. The literature highlights that these elements reduce uncertainty and anxiety, enhance learner comfort, and provide a clear sense of direction (Jones & Alinier, 2015; Decker et al., 2021). In this study, the use of SMART objectives was particularly valuable, as they provided focus and motivation while ensuring that debriefing discussions remained purposeful (Nascimento et al., 2021). Nevertheless, the benefits of pre-briefing and enhanced psychological safety are not automatic. If confidentiality is not perceived as genuine, or if objectives and roles are unclear, learners may disengage or feel exposed (Ko & Choi, 2020; Kolbe et al., 2020). Likewise, reassurance without sufficient rigour risks diluting the depth of reflection.

Despite the potential strengths of the RLC model in enhancing clinical reasoning skills, the assumption that a multiphasic design—incorporating pre-briefing, multimodal strategies, and incremental debriefing facilitation—universally benefits learners is not without limitations. Their effectiveness depends heavily on group composition and facilitator competence and adaptation. Cheng et al. (2020) argued that too little information risks disengagement, while excessive information may cause overload, anxiety, and stress. In groups with varied

competence and seniority, incremental design may fail to simultaneously challenge advanced learners and support novices, potentially reinforcing disparities rather than bridging them. These risks highlight that multiphasic and pre-briefing structures are not guarantees of improved outcomes but frameworks whose success depends on facilitator skill in calibrating information, tone, and pacing to learner needs.

This tension is further complicated in multicultural learning environments, where cultural norms strongly influence how participants communicate, contribute, and express emotion. Rana et al. (2023) demonstrated that learners from cultures emphasising hierarchy, privacy, or indirect communication may hesitate to contribute openly, particularly in mixed groups. Pearson and Smith (2013) similarly noted that unacknowledged cultural needs can undermine trust and cohesion. Focus group participants on this PhD study echoed these concerns, describing how inclusive and culturally responsive facilitation enhanced trust and improved group communication. Cultural differences also shape emotional expression: while some learners may verbalise emotions, others may consider it inappropriate. Palaganas et al. (2021) stressed that facilitators must not misinterpret restraint as disengagement but instead apply culturally attuned strategies to ensure inclusivity.

Furthermore, the questioning strategies embedded in the RLC, such as open-ended prompts and Appreciative Inquiry, may not resonate across all cultures. As Chung et al. (2013) observed, some learners perceive such questioning as vague or intrusive, while others view it as challenging authority. In this study, some participants reported discomfort when

questioning styles conflicted with their cultural expectations. Similarly, differences in tone, body language, or assertiveness may create misunderstandings, where enthusiasm in one culture is perceived as disrespect in another (Rana et al., 2023; Palaganas et al., 2021). Left unaddressed, such mismatches risk fragmenting dialogue and undermining clinical reasoning development. These findings highlight that debriefers' cultural competence is not peripheral but central to the success of structured debriefing, requiring facilitators to adapt communication style, tone, and strategies while maintaining rigour.

The importance of debriefer competence is well established in the literature. Systematic reviews by Sabei & Lasater (2016) and Cheng et al. (2015) identified skilled debriefing facilitation as a critical determinant of clinical reasoning and judgement, highlighting the role of constructive feedback, psychological safety, and encouragement of multiple perspectives. Forstrønen et al. (2020) further showed that effective facilitators promote meaningful engagement even among learners with varying baseline competence. These findings resonate with this PhD study, where participants linked their clinical reasoning improvements not only to the RLC structure but also to the way facilitators guided discussions. Yet competence is not without limits: experienced debriefers may rely on habitual routines, while novice facilitators may lack the ability to adapt the model effectively. Moreover, cultural and hierarchical dynamics may still inhibit contributions from less confident learners despite skilled facilitation. These considerations suggest that facilitator expertise enhances but does not guarantee equitable outcomes.

Taken together, the multiphasic, multimodal, and psychologically supportive design of the RLC model appears to have contributed meaningfully to the enhanced clinical reasoning observed in the experimental group. However, its impact is context-dependent, shaped by facilitator competence, cultural dynamics, and learner variability. Future research should therefore examine the interaction between structured models such as the RLC and facilitator expertise, comparing outcomes when the model is applied by novice versus experienced educators. Studies should also explore how cultural competence influences interactions with the RLC model strategies. Such work would help disentangle whether it is the model itself, the facilitator's expertise, the learners' characteristics, or the synergy among these factors that most effectively drives the development of clinical reasoning.

8.3 Group Dynamics

In this study, the simulation groups comprised nurses with differing levels of seniority, experience, and competence (Chapter 5, Section 5.3.1). While not directly examined, the influence of group composition on learning dynamics is well documented in the literature. Hermann (2015), in a systematic review, suggested that mixed-skill groups can foster dynamic learning environments by leveraging participants' varied strengths and encouraging knowledge exchange. Similarly, Emani et al. (2018), in a prospective observational study of crisis resource management training, reported that diverse learner backgrounds enhanced group learning through shared expertise and the power of groupthink. Verkuyl et al. (2020) and DiPierro et al. (2022) further highlighted the benefits of heterogeneous group composition for clinical reasoning development, while Fernandez et al. (2020), in a

randomised controlled trial, demonstrated that mixed-experience groups in resuscitation-focused SBE promoted peer learning, energised group discussions, and fostered balanced group dynamics and leadership skills. Collectively, these studies indicate that varied experience, competence, and seniority can enrich debriefing discussions by generating broader and more relevant perspectives that optimise clinical reasoning.

However, qualitative findings from this PhD study revealed that some participants perceived variations in competence, experience, and seniority as undermining to their clinical reasoning development (Chapter 6, Section 6.2.1.2). A key challenge appeared to be the misalignment of learning needs within mixed groups. Novice learners often concentrated on mastering foundational skills, while more experienced participants sought advanced challenges (O'Rourke et al., 2023). When scenarios or debriefing discussions were not appropriately matched to these differing needs, advanced learners perceived the sessions as insufficiently complex, whereas novices felt overwhelmed (O'Rourke et al., 2023; Asegid & Assefa, 2021). Such misalignment risks frustration, disengagement, and uneven contributions. Yet these perceptions did not align with the inferential findings, which showed statistically significant improvements in clinical reasoning for the experimental group compared with the control group, with gains sustained across repeated measures (Chapter 5, Section 5.3.5). This divergence underscores the complexity of interpreting how group composition influences outcomes and highlights the need for further research to explore correlations between competence, experience, and learning needs.

Power dynamics presented another limitation of mixed-experience groups. Focus group participants of this PhD study reported that less experienced learners sometimes felt hesitant to contribute when working alongside senior colleagues, which negatively affected collaboration and information exchange. This aligns with Nestel et al. (2011), who found that experienced learners often dominated during SBEs, limiting opportunities for others to participate. Floridis (2023) similarly argued that hierarchical dynamics fragment discussions, frustrating novices (who feel silenced) and experienced participants (who find the pace too slow). Dieckmann et al. (2023) added that senior dominance can reduce discussions to directive instruction rather than collaborative reflection, constraining deeper learning. These findings resonate with this PhD study's qualitative results, where some participants described how seniority differences disrupted group balance and hindered their ability to develop clinical reasoning.

However, again, these qualitative findings diverged from the inferential results, which indicated that despite challenges associated with competence and seniority variation, the experimental group achieved significantly higher clinical reasoning outcomes than the control group. This suggests that while individual learners may experience barriers, the structured framework of the RLC model may still enable collective gains. This tension highlights a critical area for future research: examining how power imbalances and group composition interact with structured debriefing models to shape both individual and group-level learning outcomes.

8.4 Professional Seniority and Previous Experience

Professional seniority and variations in clinical experience among participants may have contributed to the clinical reasoning outcomes observed in both the experimental and control groups. Such variation can enrich learning through peer knowledge sharing, collaborative reasoning, and experiential insight (DiPierro et al., 2022; Tutticci, & Huss, 2025). As illustrated in Table 12, participants had diverse clinical backgrounds, with 45.5% (n=50) having 3 to 5 years of experience and 54.5% (n=60) having 6 to 16 years. Additionally, 56.4% (n=62) perceived themselves as competent, while 34.7% (n=48) identified as proficient or expert.

This disparity in seniority is noteworthy. More experienced professionals are likely to possess well-developed clinical reasoning schemas, deeper reflective practices, and greater adaptive expertise (DiPierro et al., 2022; Tutticci, & Huss, 2025; O'Rourke et al., 2023). Their engagement in leadership roles may also support their capacity to participate meaningfully in reflective learning and decision-making processes, potentially making them more receptive to the structured nature of the RLC model (Tutticci, & Huss, 2025; O'Rourke et al., 2023).

Conversely, less experienced participants may initially lack the cognitive frameworks to independently sustain reflective practice or construct complex reasoning. Without a gradual and constructive debriefing structure, these learners may struggle to fully benefit from SBE learning experiences (Almomani et al., 2021). These factors do not diminish the effectiveness

of the RLC model but instead highlight its relevance in supporting participants across the professional development continuum. In particular, structured debriefing models such as the RLC model may be especially valuable for less experienced staff, offering scaffolded opportunities to build reflective capacity and cognitive complexity over time.

Moreover, there were also variations in learners' previous exposure to the SBE topic, as discussed in Chapter 5 (Section 5.3.1). This variation likely reflects differences in learners' baseline knowledge and skills. Lodge and Kennedy (2015), in a pre-/post-test study, demonstrated that learners with prior topic familiarity were better able to engage with and integrate new knowledge. Prior exposure enabled participants to link new concepts with existing knowledge, increased cognitive flexibility, and supported the adaptation of clinical reasoning skills to new scenarios. Their findings also indicated that a solid foundation encouraged active engagement and generated more relevant and impactful learning experiences.

Although studies employing higher levels of evidence are limited, other research lends support to this view. Hughes et al. (2014), using focus groups and questionnaires in obstetric SBE, explored how prior knowledge shaped learning. Similarly, Boet et al. (2012), in a pre-/post-test study of knowledge retention, and Legoux et al. (2021), in a systematic review, found that prior exposure facilitated effective recall, solution generation, and collaboration in clinical decision-making. These studies also reported that pre-existing knowledge promoted long-term skill retention, improved contextual understanding, and enabled confident

application of theoretical knowledge in practice, particularly among non-surgical physicians (Legoux et al., 2021). Boet et al. (2012) further observed that participants with prior exposure were better able to contribute to debriefing discussions, enhancing self-awareness and enabling deeper reflection. These findings were reflected in this PhD study: as reported in Chapter 6 (Section 6.2.1.1), focus group participants with prior knowledge expressed greater confidence in handling complex scenarios, actively engaged in debriefing, and demonstrated enhanced clinical reasoning. This suggests that previous exposure can meaningfully enhance learners' engagement and cognitive performance during SBE and RLC debriefing.

However, the influence of prior knowledge is not universally beneficial. Several scholars have warned that overreliance on pre-existing knowledge may unintentionally reinforce inequities between learners with differing educational backgrounds or levels of exposure. Norman (2009), for instance, argued that strong prior knowledge may lead to cognitive anchoring or confirmation bias, whereby learners rely too heavily on familiar patterns and fail to re-evaluate new clinical information. This may limit adaptive expertise and inhibit openness to alternative clinical approaches during debriefing. Similarly, Van Merriënboer and Sweller (2010), through the lens of cognitive load theory, suggested that learners with substantial prior knowledge may find structured simulation debriefing redundant or disengaging, leading to superficial processing and reduced motivation.

Furthermore, evidence from Sawyer et al. (2016) suggests that learners with limited prior exposure may, paradoxically, demonstrate greater post-simulation gains due to the novelty

and cognitive challenge of the experience. These learners may benefit disproportionately from the experiential learning cycle, particularly when structured to promote gradual skill development (Sawyer et al., 2016). This challenges the assumption that prior exposure is uniformly advantageous and instead points to the compensatory potential of well-designed SBE for less experienced learners. It also raises questions about equity and engagement: learners with greater prior knowledge may dominate debriefing discussions, potentially limiting contributions from others and skewing the reflective process. In interprofessional or hierarchically mixed groups, such imbalances can undermine collaborative learning and erode the inclusivity required for meaningful participation.

Therefore, while pre-existing knowledge can enhance learning for some, it also presents pedagogical and practical challenges. Facilitators must be adept at managing group dynamics, balancing participation, and tailoring questioning strategies to accommodate varied knowledge levels. These considerations underscore the importance of skilled debriefing, particularly when using structured models like the RLC model, which must be applied flexibly to ensure inclusive, equitable, and effective learning experiences. The model's success, therefore, is closely tied to facilitator competence in managing differences in seniority, experience, and prior knowledge**.**

Future research is needed to examine these dynamics more closely. Longitudinal studies could track how prior exposure and professional seniority interact with structured debriefing models to influence both immediate and long-term clinical reasoning development.

Comparative studies could explore whether novices, intermediates, and experts benefit differently from the RLC model, and whether tailoring the pacing or questioning strategies to specific competence levels optimises outcomes. There is also a need to investigate how power dynamics arising from seniority influence participation in mixed groups, and whether deliberate facilitation strategies can mitigate these effects. Finally, experimental research comparing novice versus experienced facilitators applying the RLC may help disentangle whether improvements in clinical reasoning are primarily attributable to learners' prior knowledge, the design of the model, or the expertise of the facilitator.

8.5 Clinical Reasoning Process

In this study, for optimal development of clinical reasoning skills during the RLC, the model was co-designed in line with the clinical reasoning cycle of Levett-Jones et al. (2010), which includes collecting cues, processing information, coming to an understanding of a patient problem or situation, planning and implementing interventions, evaluating outcomes, and reflecting on and learning from the process. For effective reasoning development, it is vital to collect the right cues and take the right action for the right patient at the right time and for the right reason (Levett-Jones et al., 2010). One potential contributing factor to the study's findings of the RLC's positive impact on participants' ability to collect patient data, identify problems, prioritise interventions, and evaluate outcomes lies in discussing both technical and human factor–related skills during RLC. In terms of technical skills, facilitators were required to expand participants' understanding reflectively and incrementally, encouraging them to

elaborate on data collection, problem identification, prioritised interventions, and outcome evaluation as part of the RLC structure and framework.

Many studies emphasise the critical role of collecting the most important patient data and assessment findings in developing effective clinical reasoning. A narrative review by Corrao & Argano (2022) identified comprehensive data gathering as fundamental for accurate diagnosis, highlighting that failure to prioritise relevant cues risks misdiagnosis and poor clinical decisions. Ryder et al. (2023) further stressed that collecting essential patient information is central to minimising adverse events and enhancing safety, while also enabling holistic, person-centred care that incorporates psychosocial, cultural, and environmental dimensions. Giuffrida et al. (2023), in a scoping review, added that reasoning is not a static event but a process requiring continuous reassessment and data collection to monitor patient progress and adapt interventions. However, in critical care contexts, this process is complicated by case complexity, high volumes of data, and constant shifts in patient status. Learners must distinguish critical cues from background noise, a skill that is particularly difficult for novices. Time pressure adds further challenge, as noted by Corrao & Argano (2022) and Giuffrida et al. (2023), demanding rapid yet accurate prioritisation under conditions of uncertainty. This suggests that while immersive scenarios can replicate real-world pressures to sharpen reasoning, they can also overwhelm learners and risk reinforcing superficial cue recognition rather than deep analytical engagement. The positive impact observed in this study on participants' data collection and problem identification may

therefore reflect not only the RLC's structured design but also the necessity of grappling with information overload within complex critical care scenarios.

Similarly, prioritising interventions within immersive scenarios and debriefings using the RLC was found to strengthen clinical reasoning by directing attention to the most urgent aspects of patient care. This process required participants to analyse and synthesise information, make judgments on severity, and predict potential outcomes. Prioritisation also promoted efficient use of limited time and resources. Yet, as Ryder et al. (2023) emphasised, prioritisation in critical care is rarely straightforward: patients often present with multiple comorbidities and complex conditions, making the "right" priority ambiguous and context dependent. Patient preferences and values, which play an important role in defining appropriate interventions, may be difficult to elicit in critical care contexts, particularly with sedated patients or where cultural and linguistic differences exist. This reinforces the challenge of designing SBE that meaningfully incorporates patient-centred care while still fostering clinical reasoning under pressure. In this study, immersive scenarios presented participants with both relevant and irrelevant information across simple and complex cases, encouraging them to discern priorities amid competing demands. While focus group findings indicated that this design enhanced their clinical reasoning, such complexity also risks cognitive overload and frustration for less experienced learners. This tension illustrates that while prioritisation tasks are pedagogically valuable, their effectiveness depends on how well scenario complexity is matched to learner competence and experience.

Outcome evaluation also emerged as a key factor in developing clinical reasoning during immersive scenarios and RLC debriefings. Reflectively discussing outcomes encouraged learners to assess the appropriateness of their interventions, consider the consequences of their decisions, and refine their reasoning strategies. Mamede & Schmidt (2023) argued that outcome evaluation reinforces evidence-based practice by helping learners integrate empirical evidence into clinical reasoning. Focus group participants in this study echoed this, reporting that the RLC helped them analyse treatment plans, evaluate results, and reflect on their own decision-making processes. Ryder et al. (2023) highlighted that analysing outcomes also builds pattern-recognition skills, which are essential for reasoning in complex clinical contexts. Corrao & Argano (2022) added that outcome evaluation supports data-driven decision-making while identifying unintended consequences and risks, thereby fostering more comprehensive clinical reasoning. However, as with data collection and prioritisation, outcome evaluation is not without challenges. Positive outcomes may reinforce reasoning accuracy, but they can also mask errors if results occur by chance rather than through sound reasoning. Conversely, negative outcomes may discourage learners without necessarily indicating flawed reasoning. This complexity underscores the need for structured facilitation, such as that embedded in the RLC, to guide learners in distinguishing between outcome and process, ensuring reflection does not reduce to self-blame or superficial validation.

Overall, the potential positive impact of the RLC on data collection, problem identification, intervention prioritisation, and outcome evaluation suggests the value of reflectively and incrementally addressing these elements during SBE and RLC debriefings. Yet the evidence

also indicates that each element carries inherent tensions: data collection can be distorted by information overload; prioritisation may overwhelm novices or frustrate experts; outcome evaluation risks conflating success with sound reasoning. The study's findings therefore highlight not only the RLC's potential but also the importance of facilitator skill in navigating these tensions to achieve equitable, meaningful, and advanced clinical reasoning development.

Future research should therefore investigate how structured debriefing models such as the RLC can balance these tensions across learners with varying competence levels, clinical experience, and cultural backgrounds. Specifically, studies are needed to examine how facilitators calibrate scenario complexity, prioritisation tasks, and outcome evaluation discussions to avoid overwhelming novices while maintaining challenge for more advanced participants.

8.6 Generalisability and Transferability

As discussed in (chapter 1, section 1.5.3), the study data were collected in a single simulation Centre from the critical care nurses (research participants) of nine tertiary hospitals. The nurses who attended the SBE activities of this study were from different cultural backgrounds and different countries with a mix of seniority, competence, experience, and previous exposures to the learning topic in each SBE learning group. The learning SBE design of this study was immersive scenarios using high-fidelity mannequins and task trainers incorporating

deliberate practice. The case complexity ranged from simple with single organ failure to complex with multiple organ failure and comorbidities The simulation Centre (research site) of this study is accredited by the Society of Simulation in Healthcare (SSH) and all the SBE activities met the international simulation standards of SSH.

All the above suggest this study's findings are generalisable in terms of the used simulation standards, and variations in learners' cultural, experience, and seniority backgrounds, However, it may be argued that additional sites with participants from other cultural backgrounds and other healthcare professions other than nursing would have increased generalisability at global level and for interprofessional SBE.

8.7 Contribution to Knowledge and Implications for Practice

Contributions to knowledge from this study can be categorised as supporting and reinforcing what is already known and evaluated; developing and demonstrating what was previously known and investigated; and introducing new data and findings.

Regarding the new findings that were not previously known and investigated, the RLC model was co-designed and evaluated to enhance and optimise the clinical reasoning skills of the critical care nurses attending group-based immersive SBE with high complexity scenarios in a multicultural learning environment, in considerations to nurses' competence, seniority, experience. The model was deemed valid to enhance and optimise clinical reasoning skills in

consideration of these contributing and influencing factors. That was not previously known and investigated. Moreover, the RLC model was co-designed to be multiphasic and multimodal incorporating Appreciative Inquiry, Bloom's taxonomy, and the Plus/Delta models with a central focus on the clinical reasoning process of Levette (2010). The concurrent integration of these approaches in addition to the multiphasic design of the model positively contributed to enhancing and optimising participants' clinical reasoning skills. This was not previously investigated, and little data were available about this.

Regarding the development and demonstration of what is previously known, this study has built on previous evidence about the positive impact of enhanced psychological safety on clinical reasoning development and enhancement. The co-design phase of the RLC model considered including elements to enhance participants' psychological safety. Those included but were not limited to emotional reflection and detailed pre-briefing. The pre-briefing phase emphasised the learning objectives, confidentiality assurance, basic assumption statement, ground rules, roles and responsibilities, expectations from the learners and debriefers, and timelines, those were developed and demonstrated in the model by integrating them in a multimodal and multiphasic design. Moreover, this study has built on previous evidence about the negative impact of cognitive overload on clinical reasoning development associated with scenario complexity and the amount and volume of information to be delivered and discussed. For that, the RLC model was co-designed to be learner-centred, multiphasic, multimodal, reflective, gradual, and incremental.

Regarding supporting and reinforcing what is already known and evaluated, reflective, open-ended, Socratic, and incremental questioning and discussions during SBE debriefing have been previously identified as positive contributing factors to learner-centredness and self-awareness. This study has demonstrated and reinforced in the RLC model the use of reflective and incremental facilitation approaches to encourage self-awareness, learner-centredness, and enhanced clinical reasoning skills development. That was demonstrated by putting information into meaningful chunks and segments with a balanced and systematic presentation of information to help participants focus on key learning aspects, understand the context, and make connections to their experiences during the SBE, leading to the construction of enhanced clinical reasoning skills.

This PhD work has been presented at local and international levels and published in high-impact factor and reputable journals (Appendices 12-18):

- A research paper published in BMC Medical Education.
- A systematic scoping review published in Dimensions of Critical Care Nursing (DCCN).
- Research abstracts published in the International Journal of Healthcare Simulation (IJoHS), (2023 and 2024).
- Research paper published in the Journal of Emergency Medicine Trauma & Acute Care (JEMTAC), 2023.
- Chapter book proceeding for the International Nursing Management Conference (INMC), 2024/ Turkey.

- Oral presentation at the Association for Simulated Practice in Healthcare (ASPiH) conference/ UK (2022, 2023, and 2024).
- Oral presentation at 11th International Conference on Interprofessional Education and Collaborative Practice (IPECP), All Together Better Health (ATBH)/ Qatar-Doha, 2024.
- Oral presentation at Qatar Health Annual Conference (2022, 2023, and 2024).
- Oral presentation at the Middle East Forum on Quality and Safety in Healthcare 2024
- Poster presentation at the fifth annual Qatar Simulation Symposium, AI in Health Care Simulation Education: Innovation and Integration/ University of Doha for Science &Technology.

Many recommendations that apply to local, national, and global practices can be made based on the study's findings:

- The cultural variations and SBE case complexity can negatively impact psychological safety associated with cognitive overload and non-enhanced clinical reasoning skills development, especially, with variations in learners' competence, seniority, and experiences within the SBE learning group. To overcome that, it is recommended to:
    - ✓ use Socratic, incremental, and open-ended reflective questions during debriefing using RLC.
    - ✓ Allow learners to reflect on their emotions and explore the underlying causes.
    - ✓ Pre-brief.

- Multiphasic and multimodal debriefing using RLC incorporating Plus/Delta, Appreciative Inquiry, and Bloom Taxonomy methods can reduce and mitigate the potential risk of cognitive overload associated with case complexity, competence, seniority, and experience variations. Hence, achieving enhanced clinical reasoning skills development.
- Debriefing using RLC with a central focus on technical and human factors-related aspects is important to achieve enhanced clinical reasoning skills development.
- Imbalanced power and group dynamics can occur during debriefing learning groups with cultural variations and different competence, seniority, and experience levels. Debriefing using RLC can potentially achieve balanced group power and dynamics.
- The debriefer's cultural competence and conflict management skills are important to effectively facilitate SBE debriefing in the presence of cultural variations and different learners' competence, seniority, and experience levels.

8.8 Limitations and Recommendations for Future Research

- The RLC model was co-designed and tested in a critical care immersive SBE modality with expanded debriefing time (30-45 Minutes). This highlights an applicability limitation about the use of the model for non-immersive SBE designs with limited debriefing time. This suggests future research to evaluate the model for different SBE modalities with limited debriefing time and for non-critical care SBE.

- The RLC model was tested using level two and three patient severity critical care scenarios. Highlighting an applicability limitation for using the model for simple simulation scenarios or scenarios without complexity variations. Suggesting evaluating the model against unified levels of case complexity.
- The RLC model was tested within the context of the Gulf region. Highlighting an applicability limitation to other contexts at a global level. This suggests future multisite research at a global level to enhance the model's generalisability on a bigger scale.
- The RLC model was tested to be used for face-to-face simulation debriefing. Highlighting an applicability limitation about the use of the model in consideration of Artificial Intelligence and advanced technology such as Augmented Reality (AR) and Virtual Reality (VR) SBEs.
- The RLC model was tested for a single profession (nursing). Highlighting applicability limitations to other healthcare professions and interprofessional education. This suggests future research to test the model for multi-professional and interprofessional SBE.
- Although Braun and Clarke's (2006) reflexive thematic analysis informed the process, the resulting themes were presented in a more topic-oriented manner, resembling content analysis. This descriptive emphasis may have limited deeper interpretive insights, which future studies could address by applying a more reflexive thematic approach.

The limitation of RLC concerning the single-profession validity has been addressed. The model was globally recognised and approved by the European Resuscitation Council (ERC)/UK to be validated for interprofessional SBE in the ERC advanced life support courses. This can potentially give a chance for the model to be globally disseminated and used for interprofessional education in addition to nursing education. The ERC education leads are interested and keen to know the outcome of the model validity for interprofessional education (Appendix 19).

8.9 Conclusion

This study has contributed to understanding the influencing and contributing factors that enhance and optimise clinical reasoning skills during RLC in group-based immersive SBE. The study focused on clinical reasoning development in the context of varying scenario complexities, alongside differences in participants' cultural backgrounds, competence, seniority, and experience levels.

The validation of the RLC model revealed that previous exposure to the learning topic before attending SBE positively enhanced participants' clinical reasoning skills during RLC and SBE activities. However, differences in seniority, competence, experience, and cultural background were potentially associated with negative effects on group dynamics and power balance.

Cultural variation—particularly in relation to personal beliefs, communication skills, language barriers, perceptions of emotional expression, and openness to discussion—was also identified as a potential challenge that could hinder participants' development and enhancement of clinical reasoning skills during SBE.

Overall, the RLC was shown to enhance participants' clinical reasoning by supporting their ability to collect the most relevant data and assessment findings, accurately identify patient problems, prioritise interventions, and evaluate outcomes

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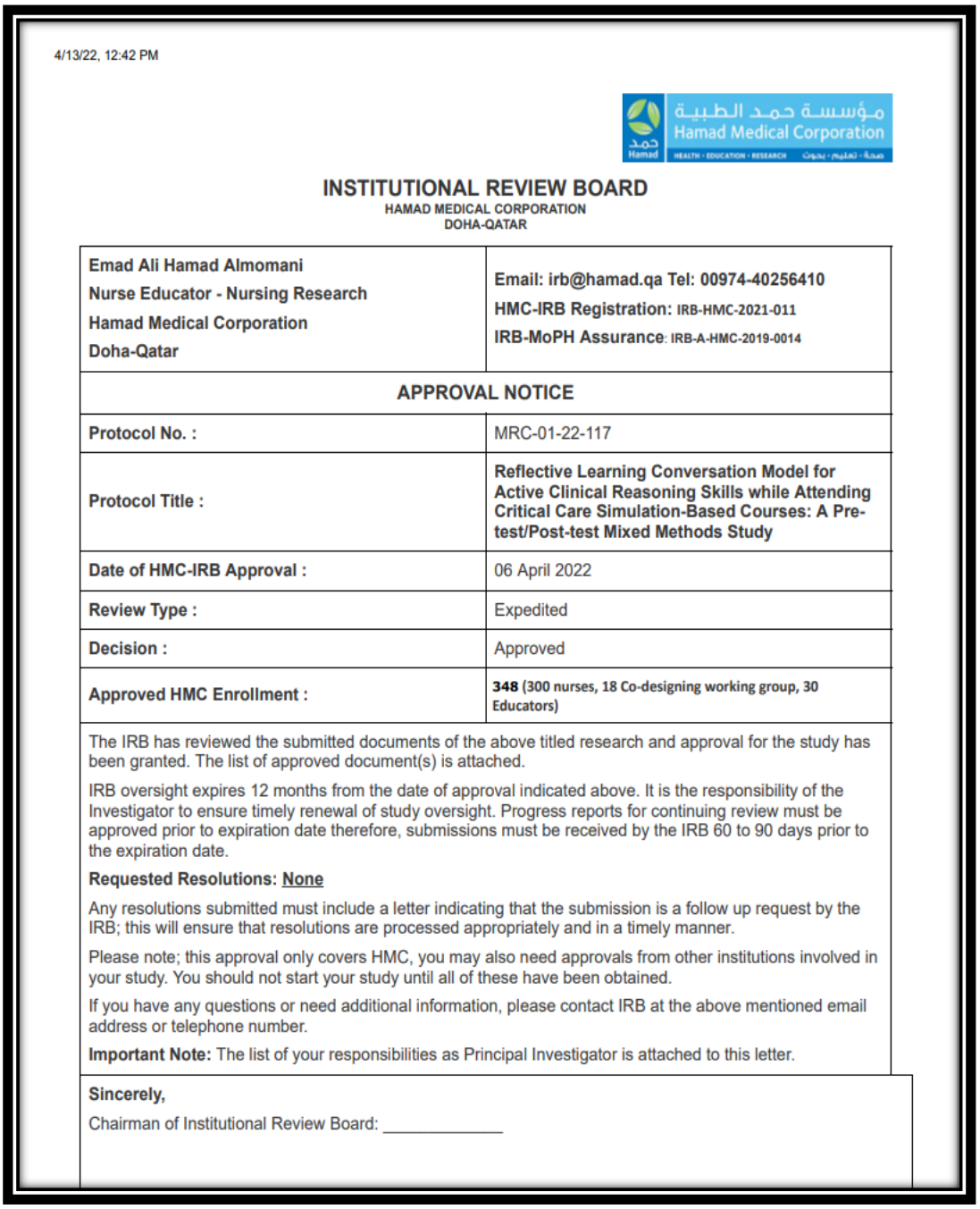
Appendices

9.1.1 Appendix 1: Institutional Research Board (IRB) study site approval



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مؤسسة حمد الطبية
Hamad Medical Corporation
HEALTH · EDUCATION · RESEARCH

INSTITUTIONAL REVIEW BOARD
HAMAD MEDICAL CORPORATION
DOHA-QATAR

Emad Ali Hamad Almomani **Nurse Educator - Nursing Research** **Hamad Medical Corporation** **Doha-Qatar**	**Email: irb@hamad.qa Tel: 00974-40256410** **HMC-IRB Registration:** IRB-HMC-2021-011 **IRB-MoPH Assurance**: IRB-A-HMC-2019-0014
APPROVAL NOTICE	
Protocol No. :	MRC-01-22-117
Protocol Title :	**Reflective Learning Conversation Model for Active Clinical Reasoning Skills while Attending Critical Care Simulation-Based Courses: A Pre-test/Post-test Mixed Methods Study**
Date of HMC-IRB Approval :	06 April 2022
Review Type :	Expedited
Decision :	Approved
Approved HMC Enrollment :	**348** (300 nurses, 18 Co-designing working group, 30 Educators)

The IRB has reviewed the submitted documents of the above titled research and approval for the study has been granted. The list of approved document(s) is attached.

IRB oversight expires 12 months from the date of approval indicated above. It is the responsibility of the Investigator to ensure timely renewal of study oversight. Progress reports for continuing review must be approved prior to expiration date therefore, submissions must be received by the IRB 60 to 90 days prior to the expiration date.

Requested Resolutions: None

Any resolutions submitted must include a letter indicating that the submission is a follow up request by the IRB; this will ensure that resolutions are processed appropriately and in a timely manner.

Please note; this approval only covers HMC, you may also need approvals from other institutions involved in your study. You should not start your study until all of these have been obtained.

If you have any questions or need additional information, please contact IRB at the above mentioned email address or telephone number.

Important Note: The list of your responsibilities as Principal Investigator is attached to this letter.

Sincerely,

Chairman of Institutional Review Board: _____

9.1.2 Appendix 2: University of Hertfordshire (UH) ethical approval

University of Hertfordshire UH

HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO	Emad Ali Almomani
CC	Guillaume Alinier
FROM	Dr Rosemary Godbold, Health, Science, Engineering & Technology ECDA Vice Chair
DATE	01/03/2022

Protocol number: **HSK/PGR/UH/04728**

Title of study: Reflective Learning Conversation Model for Active Clinical Reasoning Skills while Attending Critical Care Simulation-Based Courses: A Pre-test/Post-test Mixed Methods Study.

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

Prof. Natalie Pattison, UH School of Health and Social Work

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

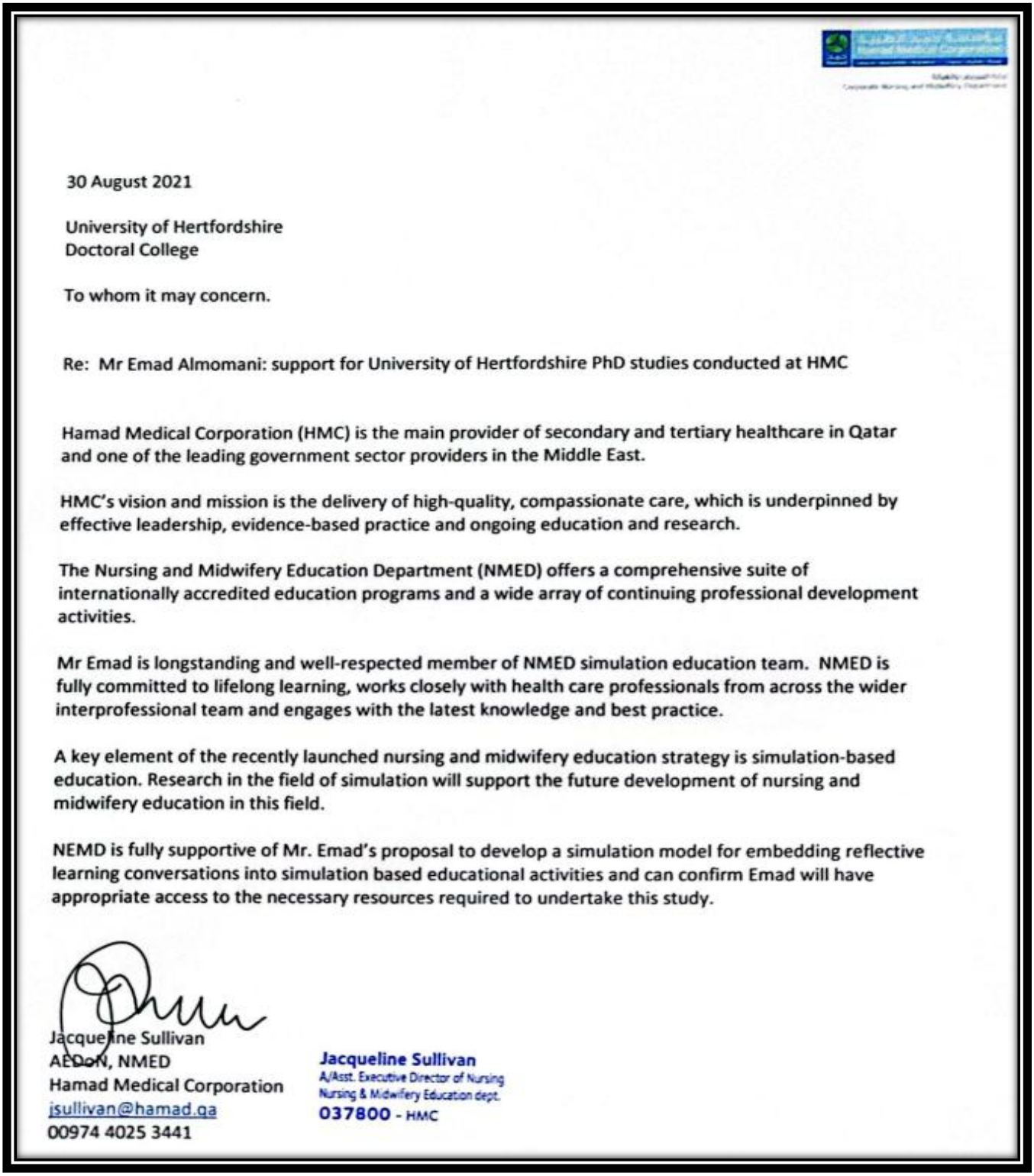
Validity:

This approval is valid:

From: 01/03/2022

To: 31/12/2022

9.1.3 Appendix 3: Support letter from the Executive Director of Nursing Education for the PhD study



30 August 2021

University of Hertfordshire
Doctoral College

To whom it may concern.

Re: Mr Emad Almomani: support for University of Hertfordshire PhD studies conducted at HMC

Hamad Medical Corporation (HMC) is the main provider of secondary and tertiary healthcare in Qatar and one of the leading government sector providers in the Middle East.

HMC's vision and mission is the delivery of high-quality, compassionate care, which is underpinned by effective leadership, evidence-based practice and ongoing education and research.

The Nursing and Midwifery Education Department (NMED) offers a comprehensive suite of internationally accredited education programs and a wide array of continuing professional development activities.

Mr Emad is longstanding and well-respected member of NMED simulation education team. NMED is fully committed to lifelong learning, works closely with health care professionals from across the wider interprofessional team and engages with the latest knowledge and best practice.

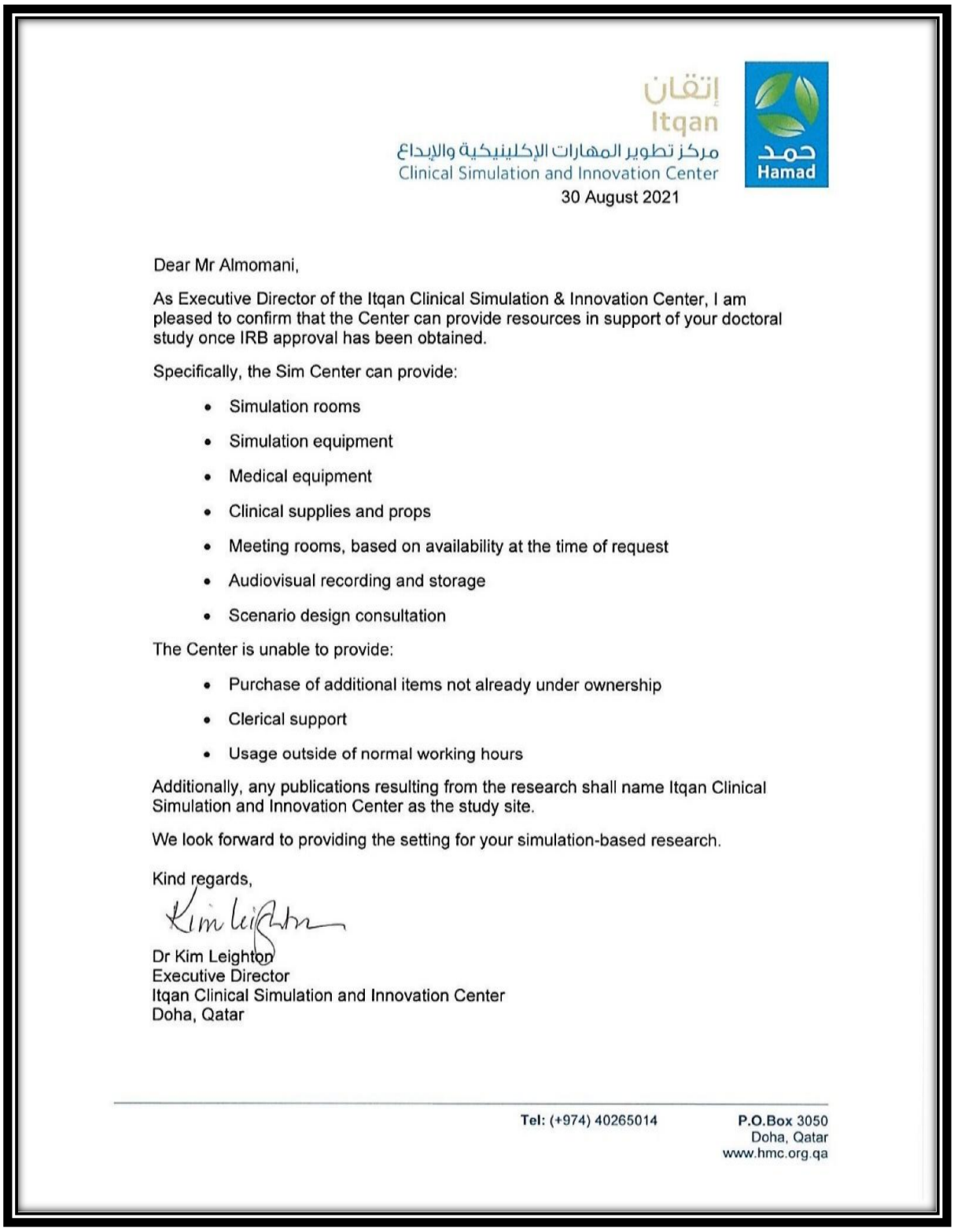
A key element of the recently launched nursing and midwifery education strategy is simulation-based education. Research in the field of simulation will support the future development of nursing and midwifery education in this field.

NEMD is fully supportive of Mr. Emad's proposal to develop a simulation model for embedding reflective learning conversations into simulation based educational activities and can confirm Emad will have appropriate access to the necessary resources required to undertake this study.

Jacqueline Sullivan
AEDoN, NMED
Hamad Medical Corporation
jsullivan@hamad.qa
00974 4025 3441

Jacqueline Sullivan
A/Asst. Executive Director of Nursing
Nursing & Midwifery Education dept.
037800 - HMC

9.1.4 Appendix 4: Support letter of the study by the Executive Director of HMC's Clinical Simulation Centre



إتقان
Itqan
مركز تطوير المهارات الإكلينيكية والإبداع
Clinical Simulation and Innovation Center

حمد
Hamad

30 August 2021

Dear Mr Almomani,

As Executive Director of the Itqan Clinical Simulation & Innovation Center, I am pleased to confirm that the Center can provide resources in support of your doctoral study once IRB approval has been obtained.

Specifically, the Sim Center can provide:

- Simulation rooms
- Simulation equipment
- Medical equipment
- Clinical supplies and props
- Meeting rooms, based on availability at the time of request
- Audiovisual recording and storage
- Scenario design consultation

The Center is unable to provide:

- Purchase of additional items not already under ownership
- Clerical support
- Usage outside of normal working hours

Additionally, any publications resulting from the research shall name Itqan Clinical Simulation and Innovation Center as the study site.

We look forward to providing the setting for your simulation-based research.

Kind regards,

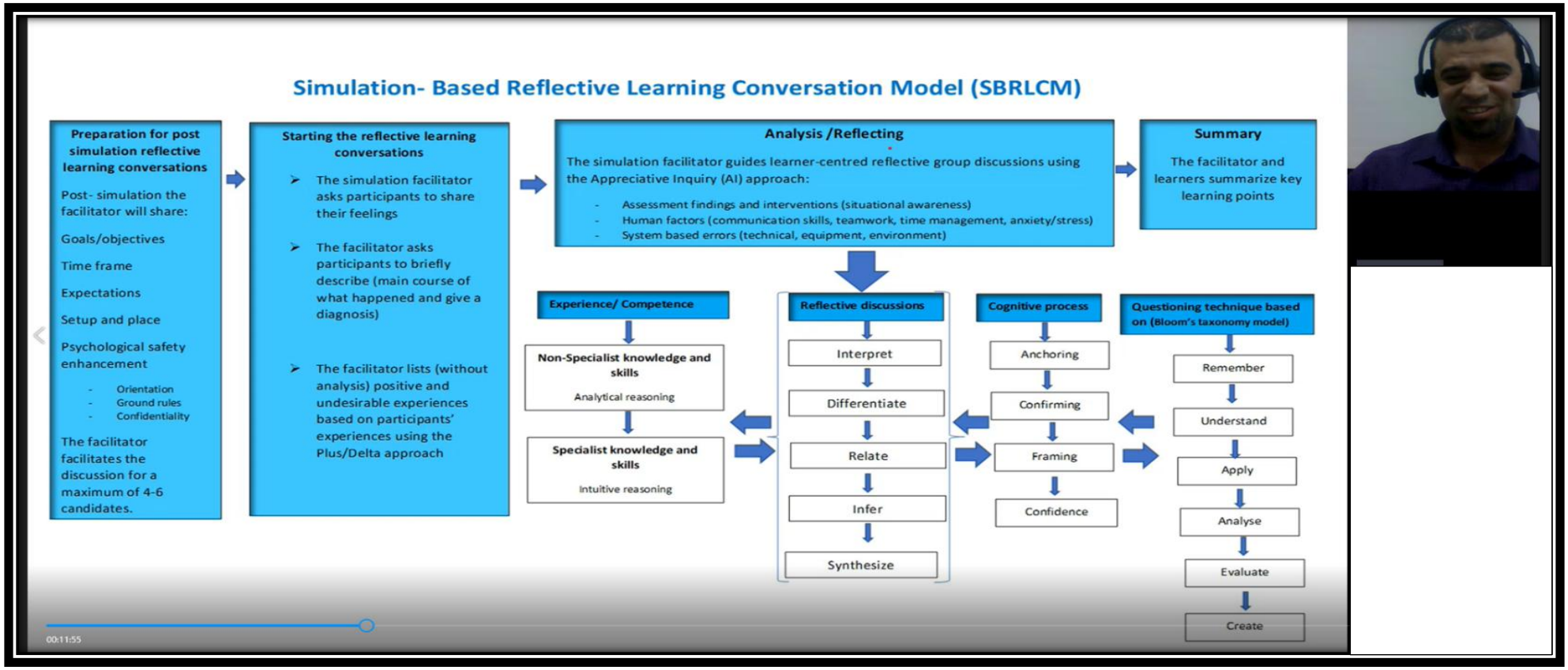
Kim Leighton

Dr Kim Leighton
Executive Director
Itqan Clinical Simulation and Innovation Center
Doha, Qatar

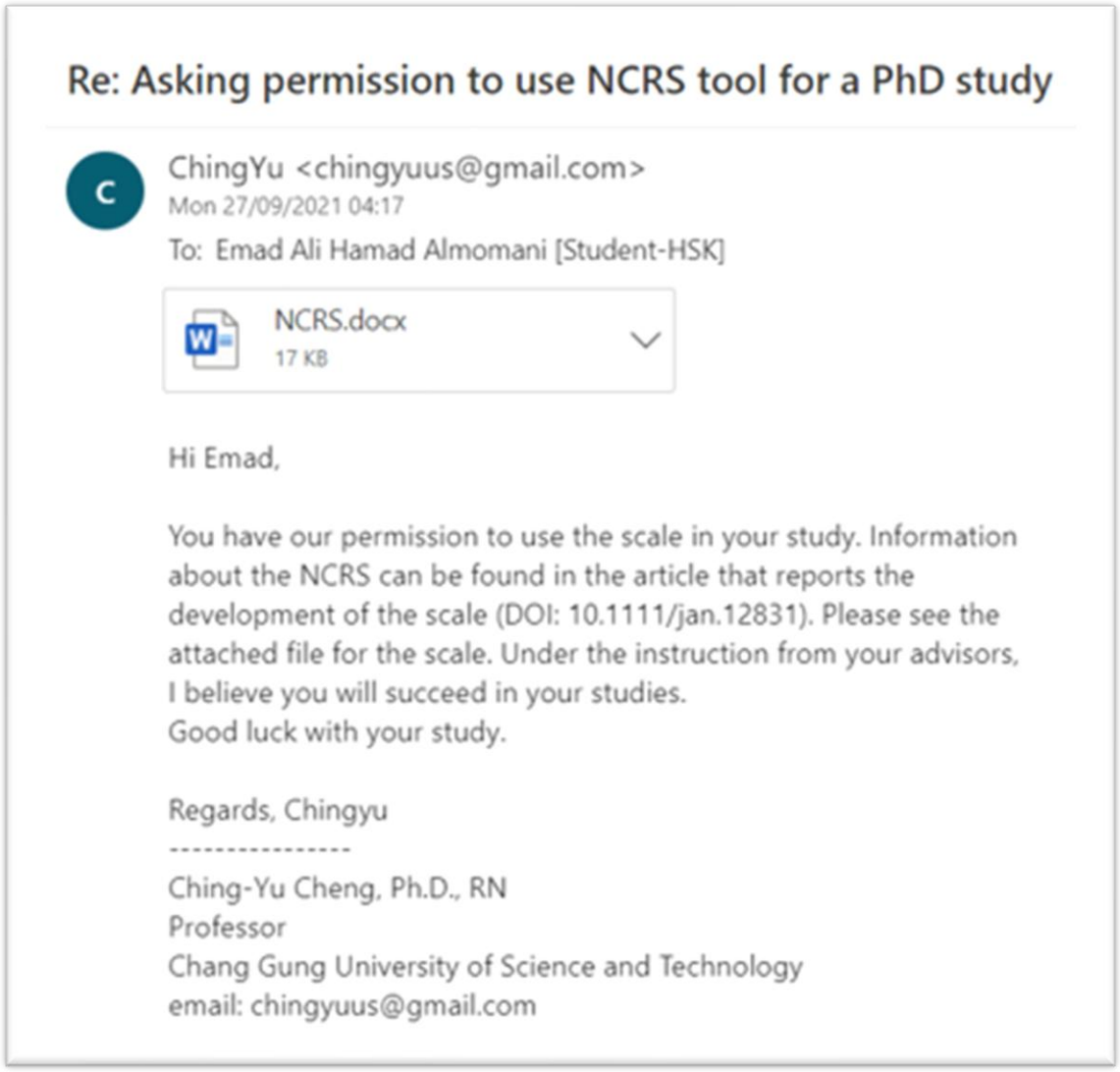
Tel: (+974) 40265014

P.O.Box 3050
Doha, Qatar
www.hmc.org.qa

9.1.5 Appendix 5: The co-designed post-simulation reflective learning conversation model working group



9.1.6 Appendix 6. Permission to use the NCRS questionnaire



Re: Asking permission to use NCRS tool for a PhD study

C

ChingYu <chingyuus@gmail.com>
Mon 27/09/2021 04:17
To: Emad Ali Hamad Almomani [Student-HSK]

NCRS.docx
17 KB

Hi Emad,

You have our permission to use the scale in your study. Information about the NCRS can be found in the article that reports the development of the scale (DOI: 10.1111/jan.12831). Please see the attached file for the scale. Under the instruction from your advisors, I believe you will succeed in your studies.
Good luck with your study.

Regards, Chingyu

Ching-Yu Cheng, Ph.D., RN
Professor
Chang Gung University of Science and Technology
email: chingyuus@gmail.com

9.1.7 Appendix 7. Expert review form for the Post-simulation Reflective Learning Conversation Model

Content Validation for Post-Simulation Reflective Learning Conversation Debriefing Model

To validate the model, we need to calculate the percentage of agreement using (Content Validation Ratio CVR & Content Validation Index CVI).
Kindly highlight in yellow your assessment for each section

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Preparation for post simulation reflective learning conversations

Post- simulation the facilitator will share:

Goals/objectives

Time frame

Expectations

Setup and place

Psychological safety enhancement

- Orientation
- Ground rules
- Confidentiality

The facilitator facilitates the discussion for a maximum of 4-6 candidates.

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Starting the reflective learning conversations

- The simulation facilitator asks participants to share their feelings
- The facilitator asks participants to briefly describe (main course of what happened and give a diagnosis)
- The facilitator lists (without analysis) positive and undesirable experiences based on participants' experiences using the Plus/Delta approach

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Analysis /Reflecting

The simulation facilitator guides learner-centred reflective group discussions using the Appreciative Inquiry (AI) approach:

- Assessment findings and interventions (situational awareness)
- Human factors (communication skills, teamwork, time management, anxiety/stress)
- System based errors (technical, equipment, environment)

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Clinical experience *and* exposure to simulation topic

- **No previous experience in the clinical specialty**
- **No previous exposure to simulation topic**

(Analytical reasoning)

- **Experience, knowledge and skills in the clinical specialty**
- **No previous exposure to the simulation topic**

(A mix of analytical reasoning and Intuitive reasoning)

- **Experience, knowledge, and skills in the clinical speciality**
- **Previous exposure to simulation topic**

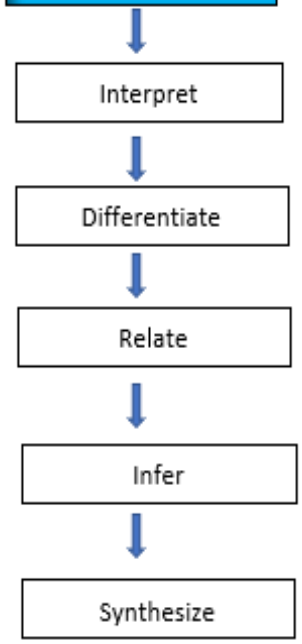
(Intuitive reasoning)

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

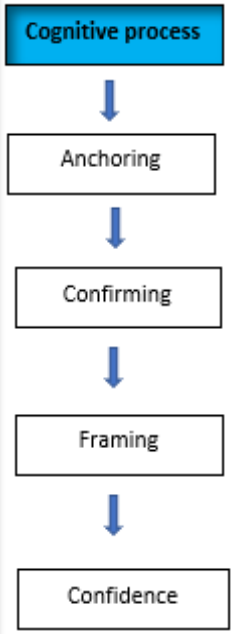
Reflective discussions



Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

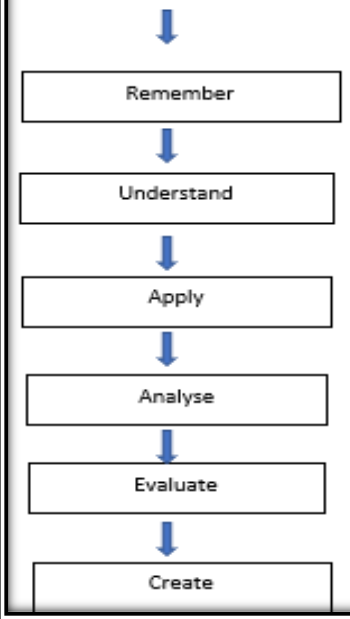


Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Questioning technique based on (Bloom's taxonomy model)



Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Starting the reflective learning conversations

The facilitator and/or co-facilitator begin the reflective learning conversations process as follows:

Firstly, before we move on to the details of your experience, we would like you all think about and describe what you felt during the simulation and explain what you think caused this.

We would like each of you to briefly describe the case and give an overview of what happened during your simulation experience.

Now, we would like to ask each of you to share what you think went well and what you need to further improve based on your individual and your team- experience.

Whilst you do this, the co-facilitator will write a summary of what is said. He/she will categorize what you say as either a good experience, undesirable experiences and/or potential for improvement.

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Preparation for post simulation reflective learning conversations

The facilitator and co-facilitator prepare the setting and introduce the ground rules:

Thank you for attending this simulation activity. We recognise that all of you are knowledgeable, capable, and will aim to do your best to improve and develop.

We are going undertake reflective conversations which will focus on your simulation activity experience and ways in which you can develop and improve. The purpose of the reflective conversation is to learn from your experiences, improve and consolidate. It is a blame-free, safe learning environment where you are free to share your feelings, thoughts, and experiences.

We (myself and the co-facilitator) will facilitate the conversations. However, as learners, you will primarily be leading the discussion, with our support. We may at some point contribute, if needed.

We will ask purposeful reflective questions and all of you are expected to contribute to the conversations. As facilitators, we will ensure you all have an equal opportunity to participate.

The conversations usually take around 45-60 minutes. However, we may extend the session by few minutes if it is required.

Everything discussed is confidential and will remain within this place, and we expect the same commitment from you.

At some point myself or the co-facilitator will summarize in writing what went well and what is needed for further improvement based on your experiences. We will also add our observations as facilitators as this will guide us and ensure our reflective conversations are organized and objective.

Once we finish the conversation, we will move on to the next simulation activity based on your schedule.

Before we start our conversation, do you have any concerns or questions? Are you clear about the process? Are you comfortable with the setting and the environment? Are there any distracting factors?

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Analysis /Reflection

We will now go through the good experiences, the undesirable experiences, and the potential areas for improvement.

and have detailed reflective conversations around each of these categories.

It was mentioned that (there was a delay in managing tachycardia). Let's explore why this happened and how it could be avoided next time:

1) Would each of you (define tachycardia and list the causes of tachycardia). (knowledge focus).
2) I observed that during the simulation your patient was tachycardiac. Tachycardia can be caused by many pathologies, but I wonder how you interpreted the cause of tachycardia in this instance? - (understanding focus).
3) During the simulation it was observed that there was a delay in solving/treating the tachycardia, and that may provoke dysrhythmia. Can you describe what was in your mind at the time with regards to how to manage or treat the tachycardia? (applying focus).
4) It was observed that you treated the tachycardia thinking it was caused by sepsis, and we know that sepsis has a special treatment protocol. I wonder why you related tachycardia to sepsis and not to any other cause? Can you elaborate more on this and explain what was in your mind? (analysing-synthesis focus).
5) You all agreed to relate the tachycardia to sepsis and decided to give IV fluids and oxygen which as we know falls within the sepsis management strategy. I wonder how you inferred and evaluated that what you did was an appropriate intervention and management strategy? Can you elaborate more on this? (evaluation focus).
6) Moving forward, even though you were able to intervene and make treatment decisions, there was a delay in managing the tachycardia and the patient deteriorated rapidly. We know time is critical in this case, so I wonder how you developed the treatment plan? Can you elaborate more on what was in your mind at that time? (creation and metacognition focus).

Based on our analysis and reflective conversations around sepsis related tachycardia, how do you think early recognition of sepsis-related tachycardia can be managed effectively within a timely manner?

Additional notes:

Content Validation Ratio CVR	Essential	Useful but not essential	Not essential

Content Validation Index CVI	1= irrelevant	2= relatively relevant	3= relevant	4= highly relevant

Summary

Thank you for your input, contributions, and active engagement throughout the reflective learning conversations

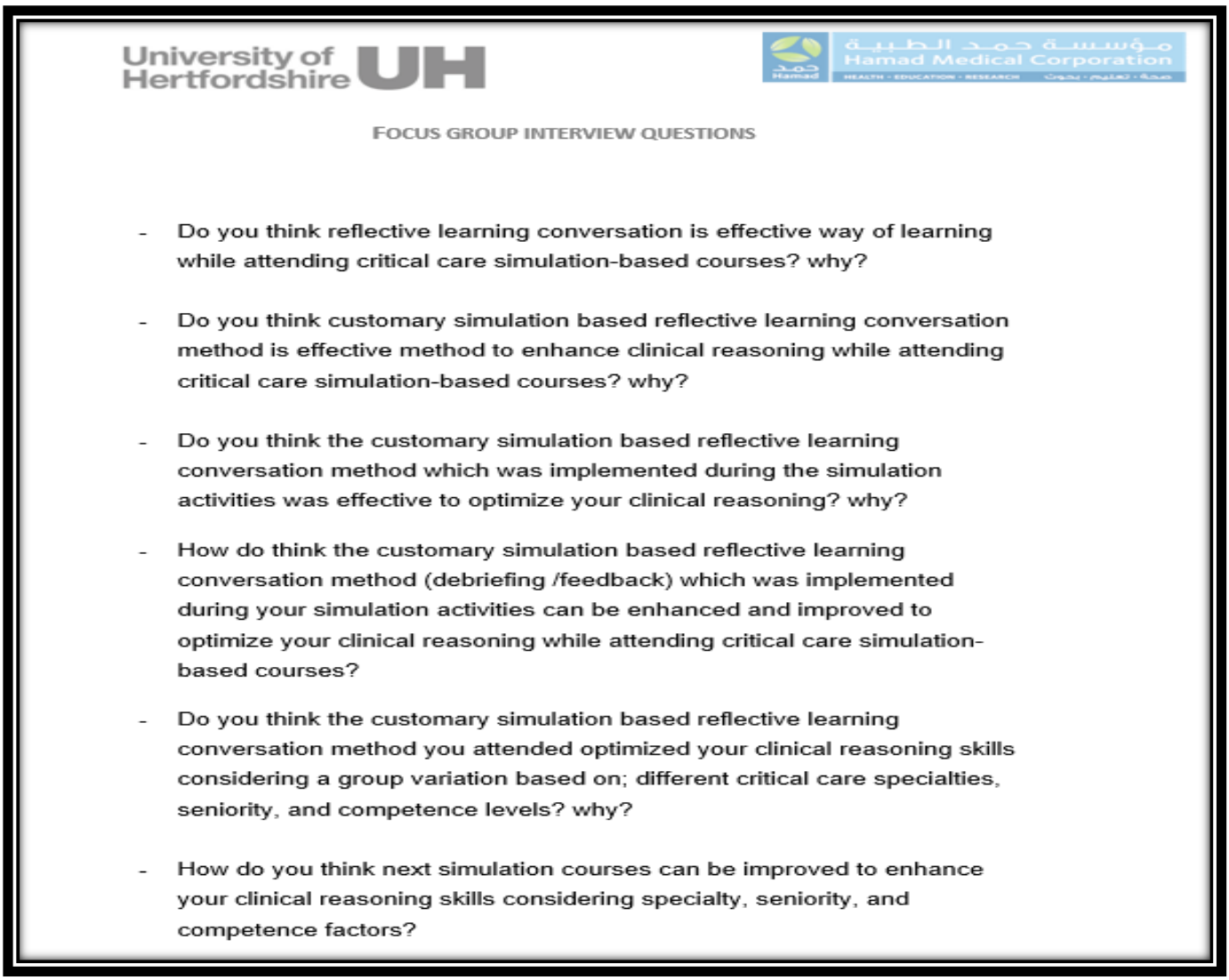
We ask each of you to summarize and conclude the learning points arising from this reflective learning conversation.

We as facilitators would like to add that .....

Do you have any questions? Would you like to add anything before we move to the next simulation activity?

Additional notes:

9.1.8 Appendix 8. Focus group questions used for the experimental group.



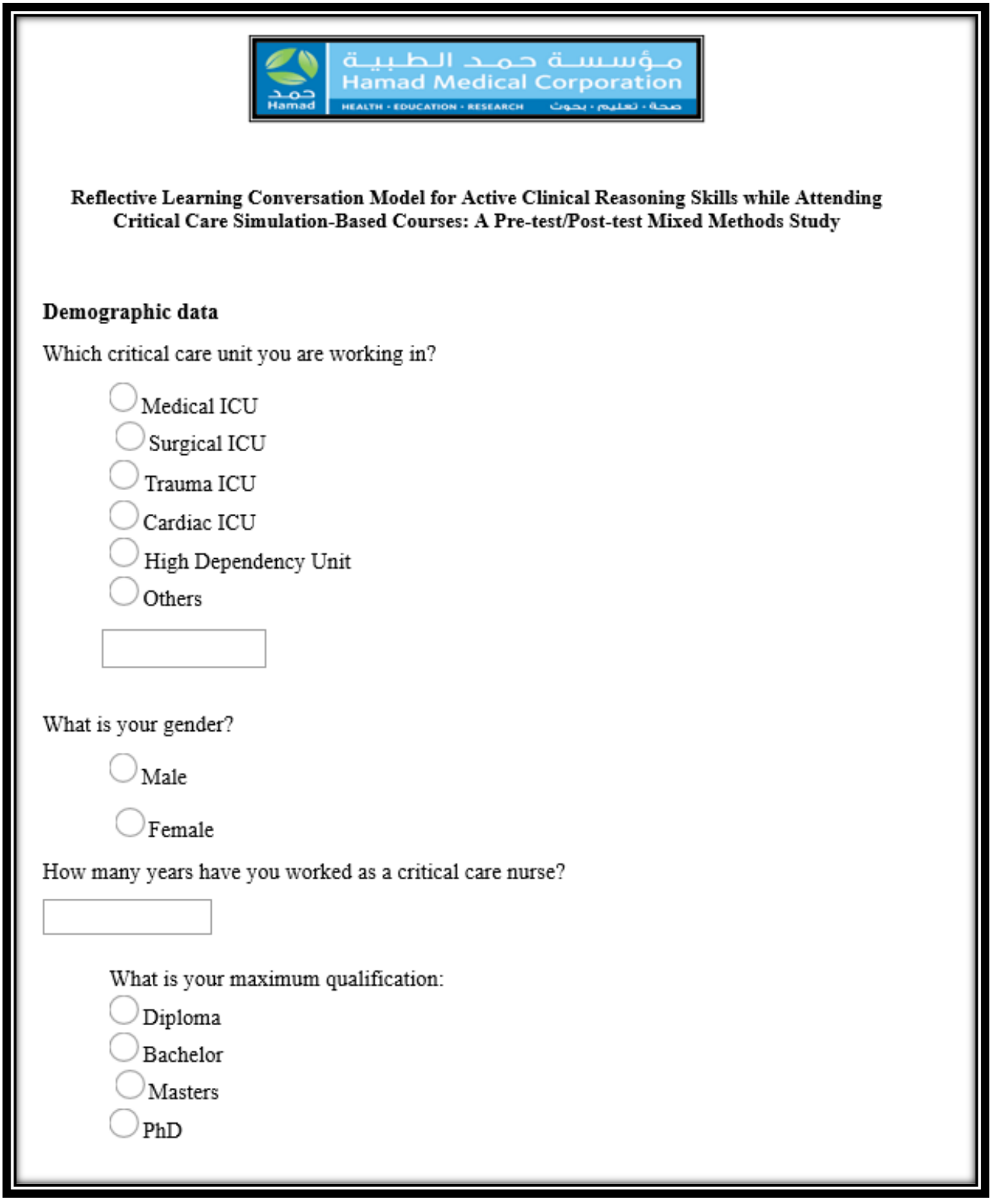
University of Hertfordshire UH

Hamad Medical Corporation

FOCUS GROUP INTERVIEW QUESTIONS

- Do you think reflective learning conversation is effective way of learning while attending critical care simulation-based courses? why?
- Do you think customary simulation based reflective learning conversation method is effective method to enhance clinical reasoning while attending critical care simulation-based courses? why?
- Do you think the customary simulation based reflective learning conversation method which was implemented during the simulation activities was effective to optimize your clinical reasoning? why?
- How do think the customary simulation based reflective learning conversation method (debriefing /feedback) which was implemented during your simulation activities can be enhanced and improved to optimize your clinical reasoning while attending critical care simulation-based courses?
- Do you think the customary simulation based reflective learning conversation method you attended optimized your clinical reasoning skills considering a group variation based on; different critical care specialties, seniority, and competence levels? why?
- How do you think next simulation courses can be improved to enhance your clinical reasoning skills considering specialty, seniority, and competence factors?

9.1.9 Appendix 9. The study's questionnaire



مؤسسة حمد الطبية
Hamad Medical Corporation
HEALTH · EDUCATION · RESEARCH صحة · تعليم · بحوث
حمد Hamad

Reflective Learning Conversation Model for Active Clinical Reasoning Skills while Attending Critical Care Simulation-Based Courses: A Pre-test/Post-test Mixed Methods Study

Demographic data

Which critical care unit you are working in?

- ○ Medical ICU
- ○ Surgical ICU
- ○ Trauma ICU
- ○ Cardiac ICU
- ○ High Dependency Unit
- ○ Others

[ ]

What is your gender?

- ○ Male
- ○ Female

How many years have you worked as a critical care nurse?

[ ]

What is your maximum qualification:

- ○ Diploma
- ○ Bachelor
- ○ Masters
- ○ PhD

What is your current position?

What was the rating of your last annual appraisal?

- ○ Beginner/Novice
- ○ Advance Beginner
- ○ Competent
- ○ Proficient
- ○ Expert

My overall competence level when caring for critically ill patients is:

- ○ Beginner/Novice
- ○ Advanced Beginner
- ○ Competent
- ○ Proficient
- ○ Expert

How many patients hospitalized in Critical Care have you cared for over the last 12 months?

How many mechanically ventilated patients with multi-organ failure have you cared for over the last 12 months?

How many mechanically ventilated patients with single organ failure have you cared for over the last 12 months?

How many patients with O2 therapy demand but without organ failure have you cared for over the last 12 months?

The following is a valid and reliable Nurses Clinical Reasoning Scale NCRS which measures self-perceived nursing clinical reasoning ability. Please read each item and click the number that best describes your current performance.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1. I know how to collect an admitted patient's health informationquickly.	5	4	3	2	1
2. I can apply proper assessment skills to collect a patient's currenthealth information.	5	4	3	2	1
3. I can identify abnormalities from the collected patient information.	5	4	3	2	1
4. I can identify a patient's health problems from the abnormalinformation collected.	5	4	3	2	1
5. I can recognize possible early signs or symptoms when apatient's health deteriorates.	5	4	3	2	1
6. I can explain the mechanism and development associated withthe early signs or symptoms when a patient's health deteriorates.	5	4	3	2	1
7. I can accurately prioritize and manage any identifiable patientproblems.	5	4	3	2	1
8. I can correctly explain the mechanism behind a patient'sproblems.	5	4	3	2	1
9. I can set nursing goals properly for the identified patientproblems.	5	4	3	2	1
10. I can provide appropriate nursing intervention for the identifiedpatient problems.	5	4	3	2	1
11. I am knowledgeable of each nursing intervention provided.	5	4	3	2	1
12. I can identify and communicate vital information clearly to thedoctors based on the patient's current condition.	5	4	3	2	1
13. I can anticipate the prescription ordered by the doctor according to the patient information provided.	5	4	3	2	1
14. I can accurately evaluate and identify whether a patient'scondition is improved.	5	4	3	2	1
15. I know the follow-up steps to take if the patient's conditiondoes not improve.	5	4	3	2	1

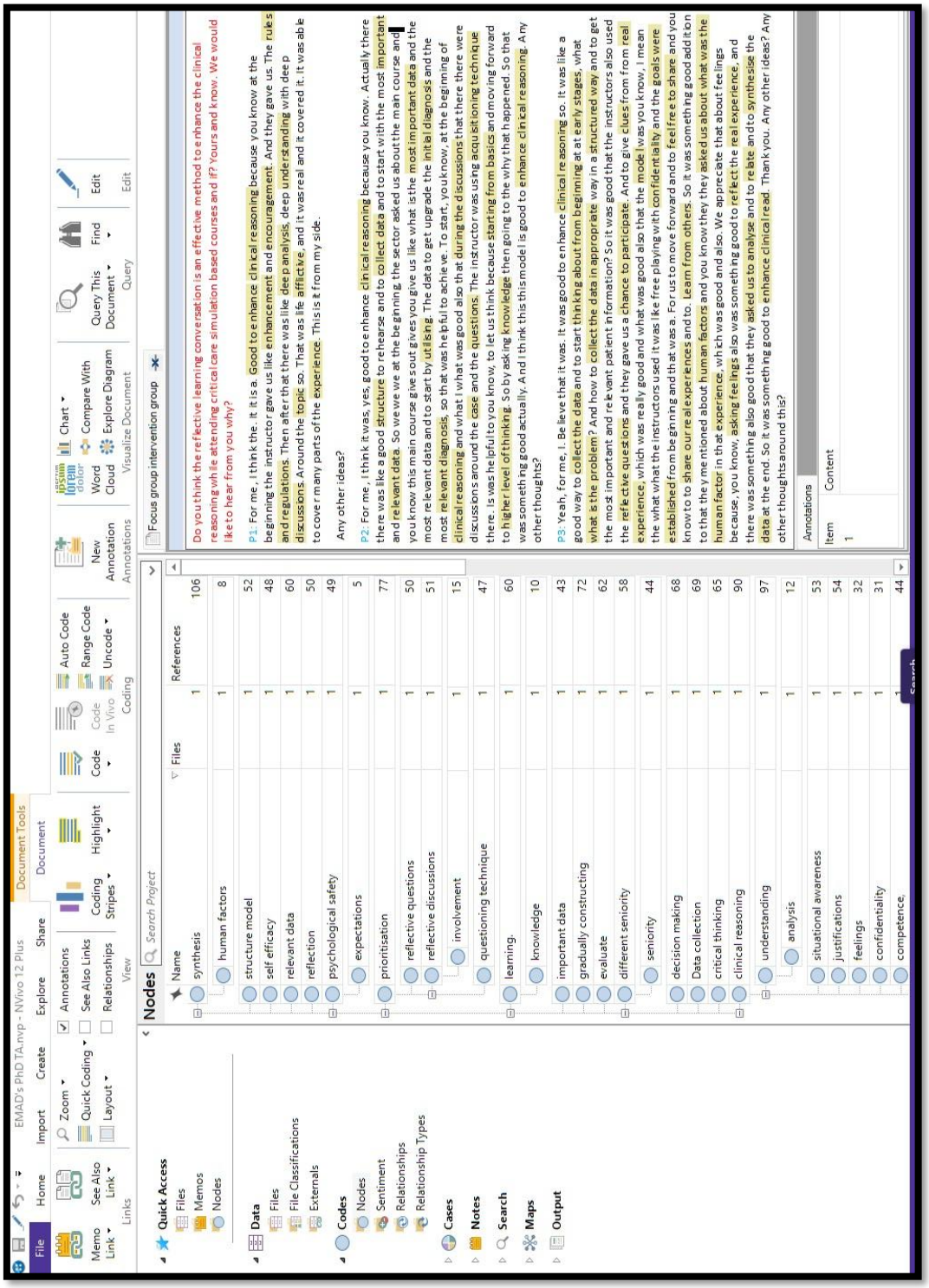
Nurses Clinical Reasoning Scale used with permission of authors Liou, S., Liu, H., Tsai, H., Tsai, Y., Lin, Y., Chang, C., & Cheng, C. (2015). The development and psychometric testing of a theory-based instrument to evaluate nurses' perception of clinical reasoning competence. Journal of Advanced Nursing. 72(3), 707 – 717, doi:10.1111/jan.12831.

The following is a valid and reliable General Self-Efficacy Scale (GSE). Please read each item and click the number that best describes your current performance

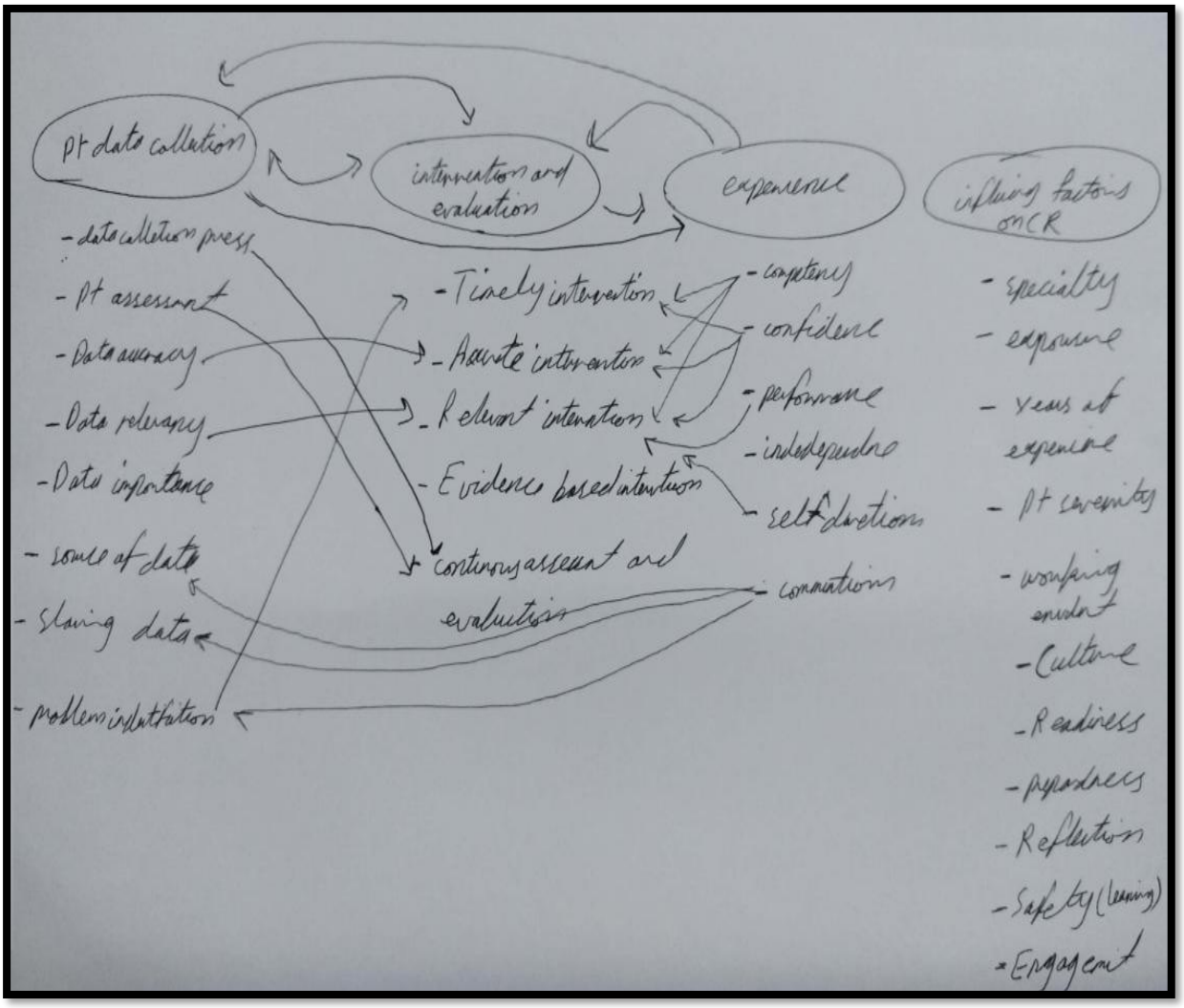
	Not at all true	Hardly true	Moderately true	Exactly true
1. I can always manage to solve difficult problems if I try hard enough	1	2	3	4
2. If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4
3. It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4
4. I am confident that I could deal efficiently with unexpected events.	1	2	3	4
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4
6. I can solve most problems if I invest the necessary effort.	1	2	3	4
7. I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4
8. When I am confronted with a problem, I can usually find several solutions.	1	2	3	4
9. If I am in trouble, I can usually think of a solution	1	2	3	4
10. I can usually handle whatever comes my way.	1	2	3	4

General Self-Efficacy Scale (GSE) used with permission of Schwarzer, R., & Jerusalem, M. (1995). Generalized Self-Efficacy Scale. In J. Weinman, S. Wright, & M. Johnston, *Measures in health psychology: A user's portfolio. Causal and control beliefs* (pp. 35-37). Windsor, UK: NFER-NELSON

9.1.10 Appendix 10. NVIVO 12 Line-by-line coding and nodes



9.1.11 Appendix 11. Initial thematic map



9.1.12 Appendix 12. Scoping review paper

Educational
DIMENSION

Assessment of Clinical Reasoning While Attending Critical Care Postsimulation Reflective Learning Conversation

A Scoping Review

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Background: The critical care environment is characterized with a high level of workload, complexity, and risk of committing practice mistakes. To avoid clinical errors, health care professionals should be competent with effective clinical reasoning skills. To develop effective clinical reasoning skills, health care professionals should get the chance to practice and be exposed to different patient experiences. To minimize safety risks to patients and health care professionals, clinical reasoning with a focus on reflective learning conversation opportunities can be practiced in simulated settings.

Objectives: To explore the most valid and reliable tools to assess clinical reasoning while attending adult critical care–related simulation-based courses in which reflective learning conversations are used.

Methods: A scoping review was conducted following Joanna Briggs Institute and Preferred Reporting Items for Systematic Reviews Extension for Scoping Reviews. Eight electronic databases were searched, and full-text review was completed for 26 articles.

Results: The search resulted in no studies conducted to measure clinical reasoning while attending adult critical care–related, simulation-based courses in which the reflective learning conversation method was embedded.

Discussion: This highlights the need to evaluate current available clinical reasoning tools or develop new tools within the context of adult critical care simulation where reflective learning forms a key part of the simulation procedures.

Keywords: Clinical reasoning, Critical care education, Simulation-based education, Simulation reflective learning conversation

[Dimens Crit Care Nurs. 2023;42(2):63-82]

DOI: 10.1097/DCC.0000000000000567

Clinical reasoning is described as those thinking and decision-making processes that are used in clinical practice[1] and is defined as "a complex cognitive process that uses formal and informal thinking strategies to gather and analyze patient information, evaluate the significance of this information, and determine the value of alternative actions."[1(p1155)] It is a process that enables one to collect data, solve problems, and make decisions and judgments to provide high quality of care in the workplace.[1] Effective and efficient clinical reasoning requires knowledge, skills, and abilities grounded in reflection supported by an individual's capacity for self-regulation and lead to the development of expertise.[2] Clinical reasoning is a process by which health care practitioners collect cues, process the information, come to an understanding of a patient's problem or situation, plan and implement interventions, evaluate outcomes, and reflect on and learn from the process.[3] Effective clinical reasoning depends on the health care practitioner's ability to collect the right cues and to take the right action for the right patient at the right time and for the right reason.[3] Clinical reasoning is interconnected with clinical decision-making,[4] and decision-making is a critical element in health care practice to ensure patient safety and to enhance patient outcomes.[5] It is associated with clinical judgment, which is also important to establish; clinical decision-making; critical thinking; problem solving; reflective practice; clinical competence; and evidence-based practices.[5-7]

Reflective practice is an integral element in health care to maintain patient safety.[8] Clinical reasoning is a reflective process in which health care practitioners perform the most appropriate intervention based on the clinical situation.[9] Through reflection, we make sense of experiences.[6] Reflective practice enhances active learning and helps learners to avoid being passive receivers of new knowledge and skills.[10] Critical thinking is a crucial element in reflective practice in which health care practitioners make sense of experiences through facing and feeling actual experiences.[11,12] Constructivist learning theory ascertains that learners play an active role in learning and construct their own understanding and knowledge through experiencing and reflecting on those experiences to gain new learning.[13] Learning involves an active process in which learners construct meaning by linking new ideas with their existing knowledge.[14] The constructivist learning theory can be actively and effectively applied in critical care simulation-based education[15,16] to develop reflective health care practitioners.[17,18] This reflective process is a core element for experiential learning through self-reflection and subsequent analysis that learners build knowledge and improve their practice.[19]

Simulation is defined by the Society of Healthcare Simulation as a "technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions."[20(p44)] Simulation reflective learning conversation in health care is a method in which a group of skilled mix health care practitioners meet to reflectively discuss experiences to improve patient care.[6,21,22] To standardize the simulation practices, the International Nurses Association for Clinical Simulation and Learning published standards for best practice in nursing simulation that provide research-based guidelines in developing and implementing simulation experiences.[22] The International Nurses Association for Clinical Simulation and Learning recommends that all simulation activities must have a planned debriefing process.[22] The debriefing process refers to 3 essential strategies: feedback, debriefing, and postsimulation guided reflective learning conversations. The postsimulation reflective learning conversations develop learners' critical thinking[22] and clinical reasoning skills[6,21] and enhance learners' ability to think reflectively and constructively learn from previous experiences, [23-28] It incorporates empathic, active, and reflective discussions shared between participants in a small group, facilitated by a trained facilitator.[10,22,26-30] Given the importance of patient safety and to avoid risk of exposure in real-life critical care clinical settings, simulation is used to explore clinical reasoning in a controlled, low-risk, and safe environment.[28-31] Simulation immerses learners in scenarios that mimic clinical situations, simultaneously mitigating safety risks and increasing standardization in health care education.[32] Simulation participation leads to increased efficiency in student learning, decreased student clinical time and placements needed, and practice mistakes.[33,34] Through simulation, learners get the chance to practice clinical reasoning with focused learning opportunities.[35] Moreover, simulation-based education helps health care professionals to overcome the emotional strain of the situation and enhance clinical reasoning and confidence.[33,34,36,37]

Building clinical reasoning skills is a continuous process throughout a career.[38] Benner and Tanner[39] categorize 5 levels of competence as novice, beginner, competent, effective, and expert. All health care providers are faced with making complex decisions in situations with a high degree of uncertainty.[40] Expert health care practitioners use an effective clinical reasoning approach to find workable solutions, but even senior practitioners can face new skill complexities, which can lead to errors.[40] On the other hand, junior critical care practitioners need time to build up their experience and apply and consolidate their clinical reasoning skills in various clinical situations.[41] Experts relate more cues together than novices and have a better ability to proactively predict what may happen to a patient compared with novice practitioners who are mostly reactive, [3]

In comparison to other health care specialties, critical care is a stressful environment with high work intensity and patient severity.[40] In critical care, multiprofessional

health care teams look after patients having or at risk of developing acute and life-threatening organ dysfunction.[42] High levels of critical care workload and complexity can put health care providers at risk of committing mistakes and practice errors[43]; therefore, effective clinical reasoning is essential to maintain patient safety. Given the importance of patient safety and to avoid risk of exposure in real-life critical care clinical settings, simulation can be alternatively used to practice and consolidate clinical reasoning in a controlled, low-risk, and safe environment.[31] However, because of the multidimensional nature of clinical reasoning[44,45] and the difficulty in evaluating clinical reasoning,[44] health care educators may find challenges to objectively evaluate different clinical reasoning levels; therefore, they need to evaluate using best available valid and reliable clinical reasoning assessment tools that consider variations in seniority, competence, case complexity, and specialty.

Scoping review design represents a methodology that allows assessment of emerging evidence as a first step in research development, provides indications for where further research may be required and inform the development of new research projects, helps to summarize and disseminate research findings, gives clear indication of the volume of literature and studies available with its focus, identifies research gaps, and makes recommendations for future research.[46] Considering limited research around critical care simulation-related reflective learning conversations and the focus of current simulation research on academic practices, a scoping review was conducted to explore the topic and its associated factors within the clinical and academic contexts.

OBJECTIVES

In this scoping review, we aimed to explore the best available tools used to assess clinical reasoning for (nurses, physicians, physiotherapists, pharmacists, and respiratory therapists) while attending adult critical care simulation-based education in which different forms of debriefing process incorporating reflective learning conversations were applied.

METHODS

A scoping review was chosen as the framework for this study with the goal of synthesizing a comprehensive body of research literature using the rigorous methods set out by the Joanna Briggs Institute[46] and Preferred Reporting Items for Systematic Reviews Extension for Scoping Reviews guidelines.[47] The review aimed to answer the question: "Are there valid and reliable clinical reasoning assessment tools for reflective learning conversations that are used in adult critical care simulation?" The review team included 5 reviewers: 2 senior nurse educators, 1 clinical nurse specialist for critical care, and 2 senior academics with expertise in health care critical care and simulation-based education. The search was supported by an academic health sciences librarian to conduct searches of 8 databases: MEDLINE, Scopus, PubMed, Cochrane Library, CINAHL, and ERIC, to identify relevant primary research conducted on this topic, and Google Scholar and OpenGrey to include the gray literature. The review was retrospectively registered in Open Science Framework OSF platform with registration DOI (10.17605/OSF.IO/BDGWZ). The searches were conducted between June 10 and 30, 2021.

The search strategy was informed by existing reviews and other literature and included MeSH topics of "Reflective Practice," "Reflective Conversation," "Reflective Learning Conversation," "Clinical Reasoning," Clinical Reasoning Models," "Clinical Reasoning tools," "Reflective Practice Assessment Tools," "Reflective practice tools," "Critical care simulation," "Critical care simulation-based education," "Debriefing," "After Action Review," and "Video Reflexive Ethnography." The inclusion criteria were academic or clinical quantitative and qualitative primary studies, which described the use of tools measuring clinical reasoning for nurses, physicians, physiotherapists, pharmacists, and respiratory therapists while attending adult critical care simulation-based courses in which different forms of debriefing process incorporating reflective learning conversations were used. The studies of non–critical care–related simulation, undergraduate students, and pediatric and neonatal simulations were excluded. The list of search terms was developed based on examination of reviews of clinical reasoning and simulation-related reflective learning conversations. The search included primary studies published from 2000 onward. The search was conducted using these search terms with Boolean operators, and 47 search terms (Table 1) were identified.

Initial search results were screened for inclusion criteria of research reports written in English language. The PRISMA flow diagram (Figure) shows that 1831 records reduced to 203 when duplicates were removed. The primary author and 2 of the research team members reviewed all abstracts. Disagreements over inclusion for full text review were resolved through discussion, full text review, and further review for team consensus as needed. Twenty-six full-text articles were assessed for eligibility. Each study information was independently extracted by 3 reviewers based on the title, year of publication, study objective, description, debriefing process method, study sample, study findings, and whether the simulation was related to critical care education. The reviewers recorded key information from included articles in a Microsoft Word data extraction form. The number of studies identified and selected at each stage of the scoping review and the reasons for exclusion are presented in separate tables within this article, in addition to

TABLE 1 Searching Terms of the Scoping Review

Alternative Words (Synonyms)			
"reflective conversation*"	AND	AND	AND
reflect*N3 conversation	"clinical reasoning"	"critical care"	"simulation"
"learning conversation"	"clinical reason*"	"intensive care"	"simulation based"
learn*N3 conversation	"clinical judgment"	"ICU"	"simulation training"
"reflective learn*"	"clinical judge*"	"critically ill"	Simulat*N3 training
Learn*N3 reflective	"decision making"		"simulation courses"
"reflective dialogue"	"clinical decision"		"simulation program"
"reflect*N3 dialogue	"clinical sense"		"simulation upskilling"
"reflective feedback"			"simulation assessment"
"reflect*N3 feedback"			Simulat*N3 assessment
"reflective debriefing"			"simulation development"
"Reflective debrief*"			simulat*N3 development
"reflect*N3 debriefing"			"simulation feedback"
"Reflective discussions"			Simulat*N3 feedback
Reflect*N3 discussions			"simulation debriefing"
			simulat*N3 debriefing
			"simulation debrief*"
			"debriefing"
			"After Action Review"
			"AAR"
			"Video Reflexive Ethnography"
			"VRE"

the narrative description to address the research questions (Table 1).

RESULTS

After careful consideration to the inclusion criteria, 26 studies were reviewed in full, and 4 of them were retained in the final analysis (Figure) as they were the only studies that related to critical care simulation and measured the clinical reasoning using assessment tools (Table 2). Data were extracted based on the title, year of publication, study objective, description/methodology, debriefing process method, study sample, study findings, and whether the simulation was related to critical care education. The review process yielded an "empty" review[54] (where no eligible studies are identified), and none of the studies achieved the inclusion criteria (Figure). However, the authors thought there was useful information to share about these 4 studies, in addition to the 22 studies for which full-text review was conducted (Table 3).

DISCUSSION

The review aimed to explore the adult critical care simulation courses (postregistration); therefore, the non–critical care–related simulation, undergraduate students, and pediatric and neonatal simulations were excluded. Of 26 studies that were fully reviewed, 4 studies were very close to the inclusion criteria as all of them used the Lasater Clinical Judgment Rubric[51] to measure clinical reasoning while attending critical care simulation-based courses. However, considering the exclusion criteria, 3 studies pertained to critical care simulation for nursing students,[48,52,53] and 1 study was conducted for neonatal critical care simulation.[50] Furthermore, the 4 studies[48,50,52,53] measured the clinical reasoning without considering case complexity, seniority levels, and competence variations (Table 2).

Within those 4 studies,[48,50,52,53] the forms of debriefing process were different; the first study[48] used the prebriefing and debriefing conversations with nursing students, and the second study[50] discussed in general the effect of simulation-based education on neonatal simulation outcome using traditional debriefing. The third study[52] discussed using flipped learning and traditional debriefing to develop presimulation curriculum prior to nursing simulation-based exercise. Finally, the fourth study[53] pertained to adult critical care simulation but did not use any form of reflective learning conversation during the simulation-based course. Therefore, these 4 studies were excluded. The explanations for the exclusion reasons are presented in Table 2. The other 22 studies, which were reviewed in full, were excluded because they were non–critical care related, although they used some forms of debriefing process during the simulation activities (Table 3).

Having what is deemed as an empty review still adds value to science especially by searching very specific domains and objectives to find out literature gaps. Recognizing the

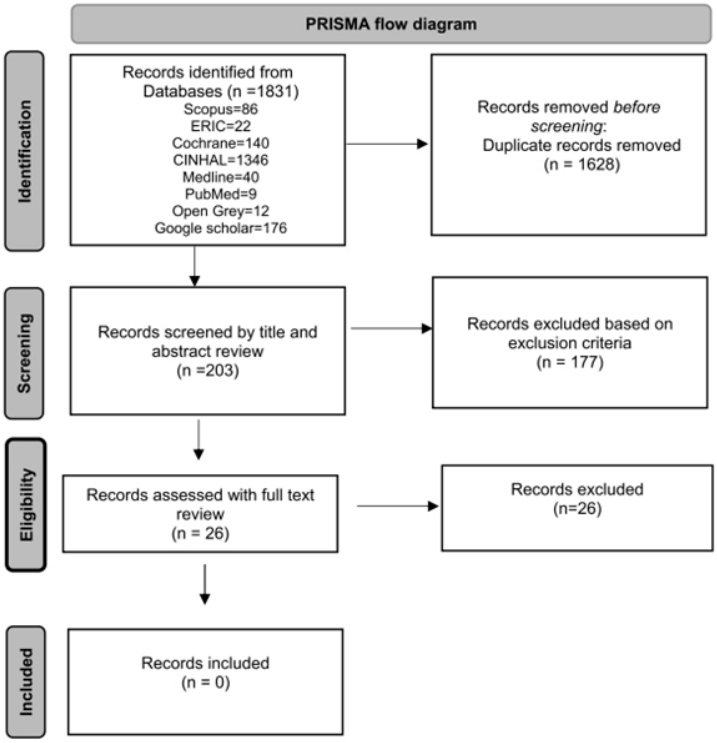

Figure. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) flow diagram.

limitation of an empty review, which may confuse readers and may be disregarded as irrelevant,[54] is important. To avoid such shortcomings, a standardized reporting structure should be followed for empty reviews,[54] and in this review, Joanna Briggs Institute[46] and Preferred Reporting Items for Systematic Reviews Extension for Scoping Reviews guidelines were used. The results of this empty review identify that no studies are published that measured clinical reasoning while attending reflective learning conversations of adult critical care–related, simulation-based courses. In addition, factors regarding the importance of exploring seniority, clinical competence, case complexity, and specialty as contributing issues are also not accounted for in the literature. This highlights the need to evaluate current clinical reasoning tools or develop new tools within the context of adult critical care simulation where reflective learning forms a key part of the simulation procedures.

Importantly, although the review has a narrow focus of adult critical care, similar findings are evident in the broader simulation literature; formalized and validated tools that center on reflective learning in simulation are lacking. Tavares et al[26] and Coggins et al[73] outline the value of these approaches, but there is a limited evidence base to support this. This lack of empirical research in the wider field of medical simulation, along with this review, further emphasizes the need for robust evidence focusing on the impact and value of reflective learning conversations in simulation.

CONCLUSION

The multidimensional nature of clinical reasoning highlights the need to use valid and reliable tools to assess clinical reasoning during reflective learning conversations in the context of medical simulation. This review reveals the availability of valid and reliable tools to assess clinical reasoning while attending non–critical care and neonatal critical care simulation-based education in which different forms of debriefing process incorporating reflective learning conversations are implemented, but there is no reported evidence on tools to assess clinical reasoning while attending adult critical care simulation-based education in which reflective learning conversations are used. Much of the simulation research is focused on academic settings, and not on critical or acute care, but some of these methods can cross over to critical care education in academics and in the hospital-based orientation, and ongoing critical care education

TABLE 2 Studies That Were Closely Considered Before Exclusion

Study	Tool	Objective	Description	Debriefing Process Method	Sample	Critical Care Simulation Yes/No	Findings	Reason for Exclusion
Shinnick and Woo[48]	LCJR	To investigate whether a standard debriefing script, based on Tanner's[49] Clinical Judgment Model, could foster clinical judgment.	Data were gathered and analyzed from 3 sources: independent raters observing students in simulation, participating students, and the students' clinical instructors. During the simulation course, students had 6 clinical learning experiences in area hospitals and 2 simulated learning experiences. At the conclusion of each experience, the clinical instructor led a 30- to 45-min debriefing guided by the standardized debriefing script to promote reflective discussion Following the debriefing, on the second and fifth clinical days and after both simulated experiences, students rated perceptions of their individual clinical judgment skills using the LCJR and clinical instructors rated each student's reflective skills using only the reflective level of the LCJR	Debriefing	Senior baccalaureate nursing students enrolled in an 8-wk synthesis course focused on providing complex, critical care at a large public university in the southeast United States	Yes	Students identified the script as an effective debriefing tool, and significant improvements were observed in clinical judgment scores from all data sources. The standardized debriefing script helped students focus on the learning process, resulting in student improvement in all areas of clinical judgment: noticing, interpreting, responding, and reflecting.	The clinical reasoning was assessed for baccalaureate nursing students. Note: the inclusion criterion was registered health care critical care practitioners.

(continues)

TABLE 2 Studies That Were Closely Considered Before Exclusion, Continued

Study	Tool	Objective	Description	Debriefing Process Method	Sample	Critical Care Simulation Yes/No	Findings	Reason for Exclusion
Letcher et al[50]	LCJR	To determine if simulation-based education has an effect on nurse knowledge and clinical judgment for NICU nurses, ultimately improving patient outcomes.	Quasi-experimental pretest-posttest design included n = 130. Participants received 3 sessions of simulated scenarios and structured debriefing. Using a high-fidelity manikin, the intervention consisted of 3 simulation-based sessions, each 3 h in length. Data were collected preintervention-postintervention. Both self- and observer ratings were measured using LCJR for each nurse participant who was randomly assigned as lead nurse for a particular scenario within each session.	Debriefing	New graduates' nurses, 6 mo after hire, and nurses with 30 plus years in NICU.	Yes	Trended patterns demonstrated improvement over time for clinical judgment (year 2) for both self- and evaluator ratings using the LCJR.[51] Simulation-based learning can be effective in advancing knowledge and clinical judgment for NICU nurses as evidenced in pre/post assessment scores/ratings. Clinical outcomes have been favorably impacted in areas influenced by nursing knowledge and clinical judgment.	NICUs Note: the inclusion criterion was adult critical care simulation
Yang[52]	LCJR	To examine the effects of neonatal simulation-based practice by applying flipped learning based on Tanner's[49] Clinical Judgment Model to the presimulation briefing for nursing students	A quasi-experimental nonequivalent control group preintervention and postintervention design. Using Tanner's[49] Clinical Judgment Model, flipped learning was developed and applied to the pre-simulation briefing curriculum prior to the neonatal nursing simulation exercise. Flipped learning was compared with a general presimulation briefing with 65 South Korean students. Clinical judgment was evaluated by LCJR.[51]	Debriefing	Senior nursing students	Yes	The experimental group's critical thinking, self-confidence and clinical judgment ability increased, but knowledge, satisfaction and anxiety did not differ from that of the control group. Applying flipped learning based on Tanner's[49] Clinical Judgment Model to presimulation briefing increased critical thinking, self-confidence and clinical judgment ability.	NICUs Note: the inclusion criterion was adult critical care simulation

(continues)

TABLE 2 Studies That Were Closely Considered Before Exclusion, Continued

Study	Tool	Objective	Description	Debriefing Process Method	Sample	Critical Care Simulation Yes/No	Findings	Reason for Exclusion
Hines and Wood[53]	LCJR	Assessment of clinical competence, Time to Task (ability to perform specific, critical nursing care activities within 5 min), and compared it to 2 subjective measures; LCJR[51] and common "pass/fail" assessment	A prospective, "known groups" of novice and expert nurses participated individually in a manikin-based simulation of patient in decompensated heart failure. Time to Task included key nursing task elements to be completed in the first 5 min of entering the patient/manikin room Fourteen nursing instructors or preceptors, blinded to group assignment, reviewed 28 simulation performance (15 expert and 13 novice) and scored them using the LCJR with pass/fail assessments.	Non	15 Expert and 13 Novice nurses Expert nurses (ICU or emergency department nurses with >5 y of clinical experience) Novice nurses (senior prelicensure nursing students nearing graduation)	Yes	The LCJR total score was significantly different between experts and Novices ($P < .01$) and revealed adequate sensitivity (ability to correctly identify "Expert" nurses; (0.72) but had a low specificity ability to correctly identify "novice" nurses; (0.40) Commonly used subjective measures of dinical nursing competence have difficulties with achieving acceptable specificity. However, an objective measure, Time to Task, had good sensitivity and specificity in differentiating between groups	There was no any form of debriefing process as part of the simulation-based activity

Abbreviations: LCJR, Lasater Clinical Judgment Rubric; NICU, neonatal intensive care unit.

The inclusion criteria are academic or clinical primary studies that described the use of tools measuring clinical reasoning while attending adult critical care simulation-based courses in which different forms of debriefing process incorporating reflective learning conversations were used. Research question: Are there valid and reliable clinical reasoning assessment tools for reflective learning conversations that are used in adult critical care simulation?

TABLE 3 Studies That Were Considered for Full Text Review

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Liaw et al[44]	CREST	To develop a valid and reliable tool to measure the effectiveness of simulation in developing clinical reasoning skills for recognizing and responding to clinical deterioration.	A scale development with psychometric testing and mixed-methods study. A 3-phase prospective study was conducted. Phase 1 involved the development and content validation of the CREST. Phase 2 included the psychometric testing of the tool with 15 second-year and 15 third-year nursing students who undertook the simulation-based assessment. Phase 3 involved the usability testing of the tool with nine academic staff through a survey questionnaire and focus group discussion The development was based on ➢ Levett-Jones model,[3] which described the clinical reasoning processes, and existing instruments ➢ Lasater[51] dinical reasoning assessment tool ➢ The RAPIDS-tool, which was developed to measure nurses' simulation performance in assessing and managing a deteriorating patient[55]	Years 2 and 3 undergraduate nursing students	No	The internal consistency was high with a Cronbach α of .92. A high interrater reliability was demonstrated with an intraclass correlation coefficient of 0.88. The usability of the tool was rated positively by the nurse educators but the need to ease the scoring process was highlighted. CREST is valid and reliable to measure the effectiveness of simulation in developing clinical reasoning skills for recognizing and responding to clinical deterioration.

(continues)

TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Lasater[51]	LCJR	To assess students' responses to simulated scenarios, within the framework of Tanner's[49] (2006) Clinical Judgment Model. To develop a rubric that describes levels of performance in clinical judgment. Pilot test the rubric in scoring students' performance. To develop a rubric providing a measure of clinical judgment to explore the effects of simulation on student aptitude, experience, confidence, and skill in clinical judgment.	A qualitative-quantitative-qualitative design of exploratory research. The description-observation-revision-review cycle was repeated weekly for 3 wk of simulation activities until the rubric was developed enough to pilot. Each group of 12 students engaged in the simulation activity for 2½ h, for a total of 48 students. At the end of each week's observations, the researcher wrote and refined the descriptors, then submitted them for review by the rubric and clinical judgment experts. Descriptive analysis and ANOVA measures were used to analyze the data and examine 5 independent variables for any significant influence. A focus group of 8 observed student volunteers was convened for 90 min to test the concepts of clinical judgment embedded in the rubric.	Third term nursing students in an adult medical-surgical clinical course.	No	LCJR is proven as valid and reliable rubric to measure clinical judgment. The LCJR offers performance expectations, as well as language for feedback and assessment of students' clinical judgment development. The rubric has relevance for all clinical contexts, including acute care, long-term care, and community health. LCJR offers a means by which the concept of clinical judgment can be described for students, preceptors, and faculty. It serves as a guide for students' development of clinical judgment.

(continues)

TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Hallin et al[56]	LCJR	The aim of the study was to identify prelicensure nursing students' ability to make clinical judgments in terms of how they perceive, interpret, and act in complex care situations measured in team achievements. A further aim was to investigate possible correlations between team achievements and theoretical performance, personal characteristics, and circumstances of the simulation scenarios.	Quasi-experimental project. The data collection included videotaped simulation scenarios, a questionnaire about the students' personal characteristics and grades of theoretical courses, total grading points for 10 theory courses in the nursing program. HFS was used. The matrix LCJR was used to analyze and score the students' clinical judgments	Prelicensure nursing students who attended 3 main courses (anatomy/physiology, medicine/surgery, leadership/organization).	No	The student teams in their first meeting with HFS in a complex care situation achieved low clinical judgment points; most teams were in the stages of beginning and developing. For attaining high team achievements, the majority of the students in the team should theoretically be "high performance." Being observers and having HFS experience before nursing education was significant too. However, age, health care experience, and assistant nurse degrees were of secondary importance. Further research at universities regionally, nationally, and internationally is needed.
Nunes et al[57]	LCJR	To determine the degree of association between clinical judgment and diagnostic reasoning of nursing students in clinical simulation.	This is a correlational research design using a quantitative approach. The sample consisted of 41 nursing students who assisted a patient with vaso-occlusive crisis in a high-fidelity clinical simulation setting. The simulation, including debriefing of all participants which was recorded on video. After debriefing, the videos with records of the simulation-based experience and the debriefing were analyzed by 3 independent observers who assessed the students' performance using LCJR.	Students completing the penultimate and last term (seniors and juniors, respectively) of 2 undergraduate nursing courses participated in the research. Juniors who have attended and passed the class on care for hospitalized adults and elderly people, and seniors who have completed the class on urgent and emergency care were included in the study (n = 41).	No	Clinical judgment was associated with diagnostic reasoning ($r = 0.313$; $P = .046$), as well as the "noticing" aspect of clinical judgment with diagnostic reasoning ($r = 0.312$; $P = .047$).

TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Jensen[58]	LCJR	To evaluate nursing students' clinical reasoning skills during patient simulation using the LCJR. To compare students' self-assessed and faculty assessed ratings of clinical reasoning skills.	The descriptive study involved faculty evaluation and student self-report of clinical reasoning skills during a patient care simulation over 2 semesters. The LCJR evaluated student performance during a simulated emergent patient situation. After the simulation, laboratory personnel accompanied the students to a separate room where they rated themselves using the LCJR. Faculty discussed students' actions and completed the LCJR scoring. Scores were compared between nursing students and faculty and between programs, associate and baccalaureate of science.	Nursing senior students of associate (AS) and baccalaureate degree (BS) programs, (n = 88).	No	Students' scores differed statistically based on program, BS means greater than AS, but student and faculty ratings were rarely significantly different. Additional research across multiple programs for a larger sample size and additional testing of the clinical reasoning tool are needed.
Dubula[59]	LCJR	To assess the effect of debriefing on the development of clinical judgment in second and fourth-year nursing students.	A quantitative, one group quasi-experimental pretest/posttest design. The data collected through self-administered questionnaire and LCJR.	Second and fourth-year nursing students (n = 56).	No	There was a significant improvement in the level of clinical judgment after debriefing. The results have also shown that debriefing improved clinical judgment among the fourth more than the second year.
Yang[52]	C-LCJR	To compare a simulation-teaching model with a traditional teaching method in enhancing the clinical judgment ability of nursing undergraduate students and to validate the C-LCJR.	Comparative study in which 4 classes of nursing students were randomly assigned to 2 control and 2 experimental classes. The experimental classes were taught using simulation teaching with standardized patients, whereas the control classes were taught using traditional teaching methods. At the end of the experiment, students in both kinds of classes evaluated their clinical judgment using the C-LCJR. Teachers also rated the students but without knowing who had received the simulation teaching	Undergraduate nursing students (n = 157).	No	Compared with the control classes, students in the experimental classes performed better in all subdomains of C-LCJR. The simulation teaching model is more effective than the traditional (non–simulation-based) teaching method in improving clinical judgment of Chinese nursing students.

(continues)

TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Kim et al[60]	SET-dehydration	To develop a simulation evaluation tool (SET-dehydration) to assess students' clinical judgment in caring for children with dehydration based on the LCJR, and to examine its reliability and validity.	Quantitative research conducted over 2 phases. Developing (SET-dehydration) based on LCJR, and then test validity, reliability of the developed tool. Nursing students' clinical judgment was evaluated. Descriptive statistics, Cronbach α, Cohen κ coefficient, and CFA were used to analyze the data.	Undergraduate nursing students (n = 120).	No	The SET-dehydration provides a means to evaluate clinical judgment in simulation education. Its reliability and validity should be examined further.
Georg et al[61]	vpLCJR	To develop an assessment rubric guided by the LCJR to assess nursing students' clinical reasoning processes when encountering virtual patient simulation. To test the new assessment rubric's abilities to capture the nursing students' clinical reasoning processes as they encounter virtual patient simulation.	Deductive and abductive analyses with 2-phase design. In phase 1, the LCJR was adapted to assess nursing students' clinical reasoning skills in encounters with semilinear virtual patients. In phase 2 the newly developed rubric was tested for validity, reliability, and usability to capture nursing students' clinical reasoning processes during virtual patient simulations.	A convenience sample of second-year nursing students (n = 130).	No	vpLCJR is reliable and valid to assess students' clinical reasoning skills and provide feedback to students. vpLCJR should be incorporated in more formative assessment of nursing students' clinical reasoning process when encountering virtual patients as a means to promote higher order learning with a focus on clarifying expectations and providing feedback for learning.
Hayden et al[62]	C-CEI	To evaluate not only students' ability to perform a technical skill while attending simulation but also their ability to judgment.	Five nursing programs assisted with reliability and validity testing of the C-CEI. Using a standardized validation questionnaire, faculty rated the C-CEI on its ability to accurately measure student performance and clinical competency. Videos scripted at 3 levels of performance were used to test reliability.	Nursing faculty members (n = 35) participated in rating content validity, and (n = 31) viewed videos of simulation scenarios at 3 levels of proficiency and rated each of the scenarios using the C-CEI.	No	The C-CEI is valid and reliable tool for evaluating both the simulation and traditional clinical environments. Content validity ranged from 3.78 to 3.89 on a 4-point Likert-like scale. Cronbach α was >.90 when used to score 3 different levels of simulation performance.

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TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Seo and Eom[63]	C-CEI	To assess the effect of a simulation nursing education program in terms of clinical reasoning, problem-solving process, self-efficacy, and clinical competency using the OPT model in nursing students.[18]	Nonequivalent control group pretest-posttest design recruiting experimental and control groups. Clinical reasoning was evaluated by C-CEI tool.	Senior undergraduate nursing students (n = 45) including the experimental group (n = 25), and control group (n = 20).	No	There was a significant improvement in clinical reasoning. The simulation nursing education program using the OPT model for undergraduate students is very effective in promoting clinical reasoning, problem-solving processes, self-efficacy, and clinical competency.
Eubank[64]	C-CEI	To evaluate the effectiveness of using HFS for novice nurses to increase knowledge, competency, and confidence when a patient status deteriorates.	A pretest and posttest design. The C-CEI was used to evaluate performance of participants in patient care simulations including the clinical reasoning.	Novice registered nurses and licensed practical nurses assigned to adult and pediatric medical surgical patients (n = 24).	No	There was significant improvement in confidence of the novice nurses in assessment, communication, clinical judgment, and patient safety in failure to rescue simulations.
Fürstenberg et al[65]	CRI-HT-S	To empirically develop a CRI-HT-S and to assess the clinical reasoning ability of advanced medical students during a simulation involving history taking.	A 360-degree competence assessment in the role of beginning residents. CRI-HT-S was developed to evaluate clinical reasoning of advanced medical students. Scale was tested using factor analysis and ANOVA tests.	Fifth- and sixth-year medical students (n = 65).	No	The empirically constructed CRI-HT-S could be applied with consistent performance and acceptable internal consistency to assess clinical reasoning indicators during history taking.
Macauley[66]	CDM tool	To assess the effect of simulation on CDM in doctor of physical therapy students in a physical therapy program.	Pretest-posttest quasi-experimental design study. The students' CDM was measured prior to and after completing the simulation.	First- and second-year doctor of physical therapy students in a physical therapy program (n = 122) including experimental group (n = 71), and control group (n = 51).	No	Students demonstrated statistically significant changes in CDM after participating in one simulation experience. Further research is required to replicate these results and determine the optimal dosage of simulation experiences for long-term learning.

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TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Furze et al[45]	Clinical Reasoning Grading Rubric	To describe the development and revision of a tool to assess physical therapy student clinical reasoning skills across the curriculum.	A Clinical Reasoning Grading Rubric was created using the following a multistep process: (1) Initial pilot research exploring the clinical reasoning process, (2) use of theoretical constructs from cognitive learning theory and learner skill acquisition, (3) content expert review, and (4) feedback from key stakeholder groups (clinicians, faculty, and students). Questionnaire survey and focus groups were conducted.	Ten physical therapy education faculty members, and 4 key stakeholder groups.	No	The Clinical Reasoning Grading Rubric can be used to evaluate the clinical reasoning of students at multiple points in time across the curriculum. This instrument has applicability for assessment of clinical reasoning skill development from clinical to residency education. The rubric also provides insight into the teaching and learning environment and may be helpful in informing pedagogical strategies and curriculum change.
Kim and Kim[67]	Rubric for Evaluating the Clinical Reasoning Skill Categories	To assess the effects of the addition of a 1-time simulation experience to the didactic curriculum on nursing students' knowledge acquisition, clinical reasoning skill, and self-confidence.	A quasi-experimental crossover design consisted of intervention and waitlist control groups. Participants were nonrandomly assigned. Clinical reasoning skill was measured using a rubric developed through literature review and faculty consensus. The tool validity and reliability were tested.	Junior nursing students enrolled in the medical surgical nursing course (n = 94) including intervention group (group A, n = 48) and control group (group B, n = 46).	No	Students in the simulation group scored significantly higher on clinical reasoning skill and related knowledge than those in the didactic lecture group. Findings suggest that undergraduate nursing education requires a simulation-based curriculum for clinical reasoning development and knowledge acquisition.
Dreifuerst[68]	HSRT	To discover the effect of the use of a simulaton teaching strategy, DML, on the development of clinical reasoning in nursing students.	Exploratory, quasi-experimental, pretest-posttest study. Participants were assigned to either the experimental or control group where the DML was compared with customary debriefing. To measure the clinical reasoning, HSRT was conducted before and after the debriefing experience. DASH-SV was conducted with 4 supplemental questions about the DML (DMLSQ) process, during the postdebriefing assessment.	Undergraduate nursing students taking an adult health-medical surgical courses (N = 238) including experiment group (n = 122) and control group (n = 116).	No	There was statistical significance in the change in clinical reasoning scores between pretest and posttest for those who used the DML as compared with the control.

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TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Forneris et al[25]	HSRT	To replicate Dreifuerst's[68] findings of enhanced clinical reasoning scores using a structured debriefing: DML.	A quasi-experimental, pretest-posttest, repeated measure research design was used to evaluate nursing students' clinical reasoning using the HSRT.	Nursing students (n = 153) including experiment group (n = 78) and control group (n = 75).	No	The change in HSRT mean scores to measure clinical reasoning between the intervention and control groups was determined to be significant.
Plackett et al[69]	The electronic CREST (e-CREST)	To assess the feasibility, acceptability and potential effects of e-CREST—the electronic Clinical Reasoning Educational Simulation Tool.	A feasibility randomized controlled trial. Student volunteers were recruited in cohort one via email and on teaching days, and in cohort 2, e-CREST was also integrated into a relevant module in the curriculum. The intervention group received 3 patient cases and the control group received teaching as usual; allocation ratio was 1:1. Researchers were blind to allocation. Clinical reasoning skills were measured using a survey after 1 wk and a patient case after 1 mo	Final-year undergraduate students from 3 UK medical schools (n = 264).	No	e-CREST improved students' ability to gather essential information from patients over controls. Of the intervention group, most agreed e-CREST helped them to learn clinical reasoning skills.
Alexander[70]	NCRS	To explore the impact of purposeful simulation role assignment, using preferred learning styles, on prelicensure nursing students' clinical reasoning.	A double-blind randomized control trial of experimental and control groups. NCRS was used to measure the clinical reasoning.	Prelicensure nursing students (n = 204)	No	There was a statistically significant increase in clinical reasoning scores for both the experimental and control groups. There was also a statistically significant increase in clinical reasoning scores for both the direct care provider and the observers. The known-groups validity was confirmed. The Cronbach α for the entire instrument was .9. The reliability and validity of the NCRS were supported. The scale is a useful tool and can be easily administered for the self-assessment of clinical reasoning competence of clinical nurses and future baccalaureate nursing graduates.

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TABLE 3 Studies That Were Considered for Full Text Review, Continued

Study	Tool	Objective	Description	Sample	Critical Care Simulation Yes/No	Findings
Gee[71]	NSSCT	The purpose of this study was to examine the impact of HFPS on the clinical reasoning skills of nursing students.	A 2-group, randomized crossover design. Each participant took a baseline NSSCT, followed by the experimental group participating 3 simulation scenarios and the control group participating in the standard curriculum only. Then a second NSSCT was administered to each participant. Then, the control group participated in the 3 simulation scenarios, whereas the experimental group participated in the standard curriculum only. Then, a third NSSCT was administered. NSSCT mean scores were compared between and within the groups after each administration.	First-semester, prelicensure, BSN students (n = 14).	No	There were no statistical differences in mean NSSCT scores ($P = .064$) between the control group and experimental group after the second NSSCT administration, suggesting that the clinical reasoning skills were not different between students who completed the 3 simulation scenarios versus students who participated in the standard curriculum alone. The results from this study did not conclude that HFPS improved clinical reasoning in first-semester, prelicensure, BSN students.
Keiser and Turkelson[72]	SSSCL	To develop, implement, and evaluate an SP-SBLE to improve confidence and evaluate clinical performance and reasoning in AG-ACNP students.	A mixed-methods design was used to evaluate an SP-SBLE on AG-ACNP student clinical performance and reasoning. To evaluate the clinical performance and reasoning each student was asked to complete the SSSCL.	A convenience sample of 10 students in the AG-ACNP doctor of nursing practice program.	No	The use of an innovative SP-SBLE demonstrated potential as an effective methodology to improve self-confidence and enhance clinical reasoning in AG-ACNP students. The debriefing sessions and reflective writing assignment demonstrated promise in improving the confidence and clinical reasoning abilities of AG-ACNP students.

Abbreviations: AG-ACNP, adult-geriatric acute care nurse practitioner; ANOVA, analysis of variance; BSN, bachelor of science in nursing; CDM, clinical decision-making; C-CEI, Creighton Competency Evaluation Instrument; CFA, confirmatory factor analysis; CRI-HT-S, Clinical Reasoning Indicators—History Taking Scale; C-LCJR, Chinese version of LCJR; CREST, Clinical Reasoning Evaluation Simulation Tool; DASH-SV, Debriefing Assessment for Simulation in Healthcare–Student Version; DML, Debriefing for Meaningful Learning; HFPS, high-fidelity patient simulator; HFS, high-fidelity simulation; HSRT, Health Sciences Reasoning Test; LCJR, Lasater Clinical Judgment Rubric; NCRS, Nurses Clinical Reasoning Scale; NSSCT, Nursing-Specific Script Concordance Test; OPT, Outcome-Present State Test; SSSCL, Student Satisfaction and Self-confidence in Learning Scale; SET, Simulation Evaluation Tool; SBLE, simulated-based learning experiences; SP, simulated patient; vpLCJR, virtual patient LCJR.

is therefore recommended to search specific tools that can be tested and/or newly developed in critical care simulation sessions for clinical and academic settings.

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9.1.13 Appendix 13. The post-simulation reflective learning conversation debriefing model publication at BMC Medical Education

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Reflective learning conversations model for simulation debriefing: a co-design process and development innovation

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Abstract

Background Health practitioners must be equipped with effective clinical reasoning skills to make appropriate, safe dinical decisions and avoid practice errors. Under-developed clinical reasoning skills have the potential to threaten patient safety and delay care or treatment, particularly in critical and acute care settings. Simulation-based education which incorporates post-simulation reflective learning conversations as a debriefing method is used to develop dinical reasoning skills while patient safety is maintained. However, due to the multidimensional nature of clinical reasoning, the potential risk of cognitive overload, and the varying use of analytic (hypothetical-deductive) and non-analytic (intuitive) clinical reasoning processes amongst senior and junior simulation participants, it is important to consider experience, competence, flow and amount of information, and case complexity related factors to optimize dinical reasoning while attending group- based post-simulation reflective learning conversations as a debriefing method. We aim to describe the development of a post-simulation reflective learning conversations model in which a number of contributing factors to achieve clinical reasoning optimization were addressed.

Methods A Co-design working group (N = 18) of doctors, nurses, researchers, educators, and patients' representatives collaboratively worked through consecutive workshops to co-design a post-simulation reflective learning conversations model to be used for simulation debriefing. The co-design working group established the model through a theoretical and conceptual-driven process and multiphasic expert reviews. Concurrent integration of appreciative inquiry, plus/delta, and Bloom's Taxonomy methods were considered to optimize simulation participants' dinical reasoning while attending simulation activities. The face and content validity of the model were established using the Content Validity Index CVI and Content Validity Ratio CVR methods.

Results A Post-simulation reflective learning conversations model was developed and piloted. The model was supported with worked examples and scripted guidance. The face and content validity of the model were evaluated and confirmed.

Conclusions The newly co-designed model was established in consideration to different simulation participants' seniority and competence, flow and amount of information, and simulation case complexity. These factors were considered to optimize clinical reasoning while attending group-based simulation activities.

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Keywords SBE, Clinical reasoning, Reflective learning conversations model, Post-simulation debriefing

Background

Clinical reasoning is considered as a backbone of health care clinical practice [1, 2], and an essential element of clinical competence [1, 3, 4]. It is a reflective process that healthcare practitioners use to identify and perform the most appropriate intervention for each clinical situation they encounter [5, 6]. Clinical reasoning is described as a complex cognitive process that uses formal and informal thinking strategies to gather and analyze patient information, evaluate the significance of this information, and determine the value of alternative actions [7, 8]. It depends upon the ability to collect cues, process information, and understand patient problems to take the right action, for the right patient, at the right time, for the right reason [9, 10].

All healthcare providers are faced with making complex decisions in situations where there is a high degree of uncertainty [11]. In critical and acute care practice, clinical situations and emergencies arise where immediate reactions and interventions are essential to save lives and to maintain patient safety [12]. Under-developed clinical reasoning skills and a lack of competence in critical and acute care practices are associated with higher rates of clinical errors, delay of care or treatment [13], and patient safety risks [14–16]. To avoid practice errors, healthcare practitioners must be competent and well-equipped with effective clinical reasoning skills for safe and appropriate decision-making [16–18]. The non-analytic (intuitive) reasoning process is a fast-track process, which is preferred by expert health practitioners. In comparison, the analytic (hypothetical-deductive) reasoning process, which is slower and more deliberate in nature, is more commonly used by less experienced practitioners [2, 19, 20]. Taking into consideration the complexity of healthcare clinical environments and the potential risk for practice errors [14–16], Simulation-Based education (SBE) is commonly used to give a chance for healthcare practitioners to develop competence and clinical reasoning skills in a safe environment, and to be exposed to various case complexities while patient safety is maintained [21–24].

Simulation is defined by the Society for Simulation in Healthcare (SSH) as a "technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions" [23]. Well-structured simulation activities give participants a chance to be immersed in scenarios that mimic clinical situations, simultaneously mitigating safety risks [24, 25], and to practice clinical reasoning through focused learning opportunities [21, 24, 26–28]. SBE augments on-site clinical experiences by exposing learners to clinical experiences they may not have experienced in a real-life patient environment [24, 29]. It is a non-threatening, blame-free, controlled, low-risk, and safe learning environment that encourages the development of knowledge, clinical skills, competence, critical thinking, and clinical reasoning [22, 29–31], and it helps healthcare professionals overcome the emotional strain of a situation to enhance learning [22, 27, 28, 30, 32].

To support the effective development of clinical reasoning and decision-making skills through SBE, attention must be given to the design, modalities, and structure of post-simulation debriefing processes [24, 33–35]. Post-simulation reflective learning conversations (RLC) are used as a debriefing method to help participants to reflect, explain actions, and in the context of teamwork to use the peer support and power of group-think [32, 33, 36]. Using group-based RLC is associated with a potential risk of underdeveloped clinical reasoning especially with different participants' competence and seniority levels. The dual-process framework described the multidimensional nature of clinical reasoning, and the variation in the tendency to use analytic (hypothetical-deductive) reasoning processes by senior health practitioners and non-analytic (intuitive) reasoning processes by junior health practitioners [34, 37]. These dual reasoning processes are associated with a challenge of the best reasoning process to fit different situations, and it is unclear and debatable how analytical and non-analytical can be effectively used in the presence of senior and junior participants within the same simulation group, and even for groups of seniors and juniors but with different competence and experience levels attending different simulation scenario complexities [34, 37]. That multidimensional nature of clinical reasoning is associated with a potential risk of underdeveloped clinical reasoning and cognitive overload especially when practitioners attend group-based SBEs with different case complexity and seniority levels [38]. Importantly, despite the availability of many simulation debriefing models using RLC, none of these were developed with a specific focus on developing clinical reasoning skills in consideration of experience, competence, flow and amount of information, and simulation case complexity factors [38, 39]. All of that brought the need to develop a structured model, which takes account of different contributing and influencing factors to optimize clinical reasoning while attending post-simulation RLC as a debriefing method. We describe a co-design and development process of theoretically and conceptually driven post-simulation RLC. A model was developed

to optimize clinical reasoning skills while attending SBE taking into consideration a wide range of contributing and influencing factors to achieve clinical reasoning development optimization.

Methods

A post-simulation RLC model was co-designed drawing on existing models and theories of clinical reasoning, reflective learning, education, and simulation. A collaborative working group (N=18) was established to co-design the model, which consisted of 10 critical care nurses from a range of grades, experience, and gender, one critical care physician, three patient representatives who had previously been admitted to a critical care unit, 2 researchers, and 2 senior nurse educators. This co-design innovation was devised and developed as a result of an equal partnership of stakeholders who have a lived experience of healthcare, either as healthcare professionals who were involved in the development of the proposed model, or other stakeholders, such as patients [40–42]. Including patient representatives in the co-design process adds further value to the process as the ultimate aim of the initiative is to enhance patient care and safety [43].

The working group conducted six 2–4-hour workshops which focussed on developing the model structure, flow, and content. The workshops included discussions, exercises, and activities to establish the model. Elements of the model were underpinned by a range of evidence-based resources, models, theories, and frameworks. Those included: constructivist learning theory [44]; dual loop framework [37]; clinical reasoning cycle [10]; Appreciative Inquiry (AI) method [45]; and the Plus/Delta debriefing method [46]. The model was co-designed in alignment with the International Nursing Association of Clinical and Simulation Learning INACSL standards of the debriefing process [36] and established to be self-explanatory incorporating worked examples. The model was developed and categorized into four phases: preparation for post-simulation reflective learning conversations; starting the reflective learning conversations; analysis / reflecting; and summary (Fig. 1). Details of each phase are discussed below.

The *preparation phase* of the model was established to mentally prepare the participants for the next phases, and to enhance participants' active participation and engagement with secured psychological safety [36, 47]. This phase includes introducing the goals and objectives; expected duration of the RLC; expectations from both facilitators and participants during the RLC; orientation to venue and simulation setup; and enhancing and reinforcing psychological safety by exploring any concerning and distracting issues to participants and assuring confidentiality in a blame-free learning environment. The following representative responses by the co-design working group were considered to develop the RLC model preparation phase. Participant 7: "As a practicing junior nurse, if I attend a simulation activity with no previous background about the scenario in presence of seniors, I may avoid participating in the post-simulation conversations unless I feel that my psychological safety is secured, and I am protected without consequences".

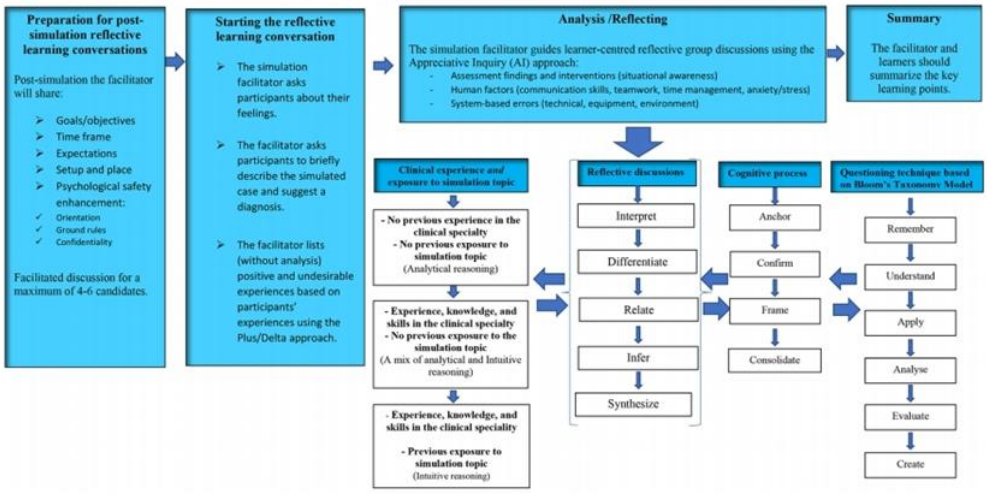

Fig. 1 Post-simulation Reflective Learning Conversations RLC Model

Participant 4: "I believe having orientation and setting up the ground rules at early stages would help the simulation learners to be actively engaged during the post-simulation reflective learning conversations".

The *starting phase of the RLC* model included exploring participants' feelings; describing scenario's main course and diagnosis; listing participants' positive and undesirable experiences but without analysis. This phase of the model is established to trigger candidates to be self- and task-oriented, and mentally prepared for advanced analyses and in-depth reflection [24, 36]. It aimed to reduce the potential risk of cognitive overload [48] especially for those who are new to the simulation topic and without previous clinical experience of the skill/topic [49]. Asking participants to briefly describe the simulated case and suggest a diagnosis will help facilitator to ensure that group learners have the basic and generic understanding about the case before proceeding to advanced analysis/reflecting phase. Moreover, asking participants at this phase to share their feelings during simulation scenarios would help them to overcome emotional strain of a situation to enhance learning [24, 36]. Addressing emotions will also help the RLC facilitators to understand how participant's' feelings affected the individual and group performances, and these can be critically discussed during the reflecting/analysis phase. The Plus/Delta method was embedded into this phase of the model as a preparatory and critically important step for reflecting/analysis phase [46]. Through using the Plus/Delta method both participants and learners can address/list their observations, feelings, and simulation experiences which then can be discussed point by point during reflecting/ analysis phase of the model [46]. That would help participants to achieve metacognition status with focused and prioritized learning opportunities toward clinical reasoning optimization [24, 48, 49]. The following representative responses by the co-design working group were considered to develop the RLC model starting phase. Participant 2:" I believe as a patient who was previously admitted in the critical care units that we should address the feeling and emotions of simulation learners, I am raising this up because during my admission period, I observed a high level of stress and anxiety among healthcare practitioners, especially, during the critical and emergency situations. The stress and emotions during the simulation experience need to be considered in this model". Participant 16: "For me as an educator, I think it is very important to incorporate the Plus/Delta method so learners will be encouraged to be actively engaged by mentioning good things they faced during the simulation scenario and areas for improvement".

Despite the critical importance of previous phases of the model, the *analysis/reflecting phase* is the most important to achieve clinical reasoning optimization. It was established to achieve advanced analysis/synthesis and deep reflection in consideration to clinical experience, competence, and exposure to simulation topics; flow and structure of RLC; amount of delivered information to avoid cognitive overload; effective use of reflective questioning technique to achieve learner-centeredness and active learning. In this phase, the clinical experience and exposure to simulation topic was categorized into three sections to match different experience and competence levels; first: no previous experience in the clinical specialty/ no previous exposure to simulation topic, second: experience, knowledge, and skills in the clinical specialty/ no previous exposure to the simulation topic, and third: experience, knowledge, and skills in the clinical speciality/ previous exposure to simulation topic. This was classified to meet demands of different experiences and competence levels within the same group, therefore balancing the tendency of less experienced practitioners to use analytical reasoning in comparison to more experienced ones who tend to use non-analytical reasoning skills [19, 20, 34, 37]. The flow of the RLC was developed in a structured way based on the clinical reasoning cycle [10], reflective simulation framework [47], and experiential learning theory [50]. That was achieved through a sequential process of; interpret, differentiate, relate, infer, and synthesize.

To avoid cognitive overload, facilitate learner-centred and reflective conversation process with adequate time, and give chances to participants to reflect, analyse, and synthesise to achieve confidence were considered. The cognitive process during the RLC was addressed based on the dual loop framework [37] and cognitive load theory [48] through a process of anchoring, confirming, framing, and consolidating. Having a structured flow of conversations and giving adequate time to reflect considering both experienced and non-experienced participants would reduce the potential risk of cognitive load especially after complex simulation scenarios with different participants' previous experience, exposure, and competence levels. The reflective questioning technique of the model was established based on Bloom's taxonomy model [51] and Appreciative Inquiry (AI) [45] method in which the simulation facilitators question in incremental, Socratic, and reflective way starting with knowledge related questions toward skills and reasoning related questions. This questioning technique would encourage participants to be actively engaged and to incrementally reflect with low risk of cognitive overload, therefore enhancing clinical reasoning optimization. The following representative responses by the co-design working group were considered to develop the RLC model analysis/reflecting phase. Participant 13: "To avoid cognitive overload, we need to consider the amount and flow of information while attending the post-simulation

learning conversations, for that, I think giving enough time for learners to reflect is crucial, and starting the conversation with basic knowledge and skills and then incrementally discussing the higher levels of knowledge and skills to achieve metacognition". Participant 9: "I do strongly believe that questioning technique using Appreciative Inquiry (AI) method and reflective questions using Bloom's Taxonomy model would encourage active learning and learner-centredness, at the same time, will reduce the potential risk of cognitive overload". The *summary phase* of the model aimed to summarize the key learning points raised during the RLC and to ensure that learning objectives are achieved. Participant 8: "It is very important that both learners and facilitators to agree on the most important take home messages, and the critical aspects that should be considered to achieve transference into practice".

Ethical approvals were obtained with protocol numbers (MRC-01-22-117) and (HSK/PGR/UH/04728). The model was piloted in three critical care simulation-based specialty courses to evaluate model usability and practicality. The model face validity was evaluated by the co-design working group (N=18), and by educational experts working as directors of education (N=6) to amend appearance, grammatical and flow related issues. Following face validity, content validity was evaluated by senior nurse educators (N=6) certified by the American Nurse Credentialing Center (ANCC) and working as educational planners, and (N=6) directors of education with more than 10 years of educational and simulation experiences. The content validity was conducted using a Content Validity Ratio (CVR) and a Content Validity Index (CVI). The CVI was assessed using Lawshe's method [52] and CVR assessed using Waltz and Bausell 's method [53]. The CVR items were essential, useful but not essential, and not essential. The CVI was scored based on a four-point scale to address relevancy, simplicity, and clarity where 1=irrelevant, 2=relatively relevant, 3=relevant and 4=highly relevant. After ensuring face and content validities, awareness and orientational sessions in addition to hands on workshops were conducted to the educators who are going to use the model.

Results

The working group was able to produce and pilot a post-simulation RLC model to optimize the clinical reasoning skills while attending critical care SBEs (Figs. 1, 2 and 3). The CVR=1.00, and the CVI=1.00, reflecting appropriate face and content validities [52, 53].

Discussions

The model was established to fit group- based SBE in which immersive and complex scenarios are used for participants with same or different experience, exposure, and seniority levels. The RLC conceptual model was developed in alignment with the INACSL simulation standards of simulation debriefing [36] and designed to be learner-centered and self-explanatory incorporating

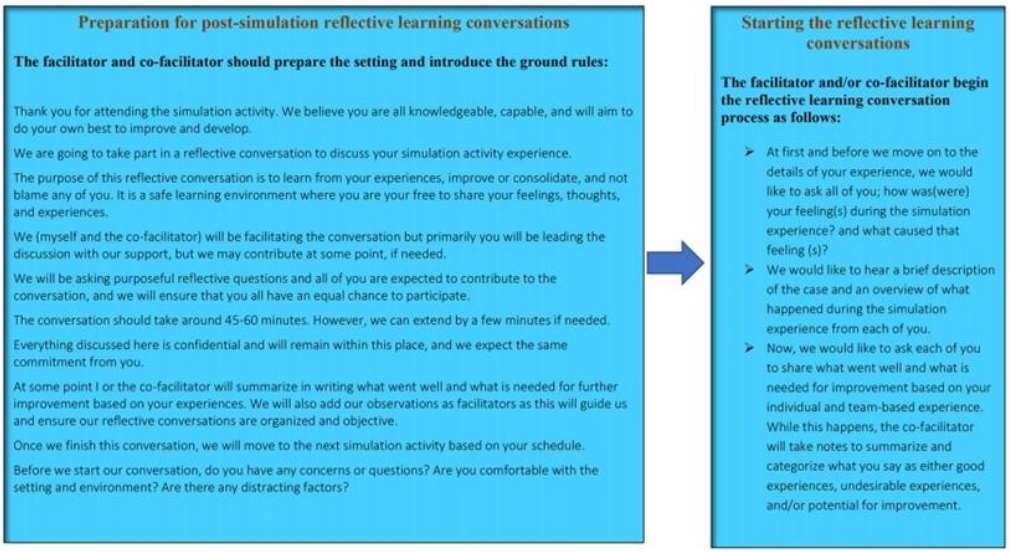

Fig. 2 Post-simulation Reflective Learning Conversations RLC Model Script/Example

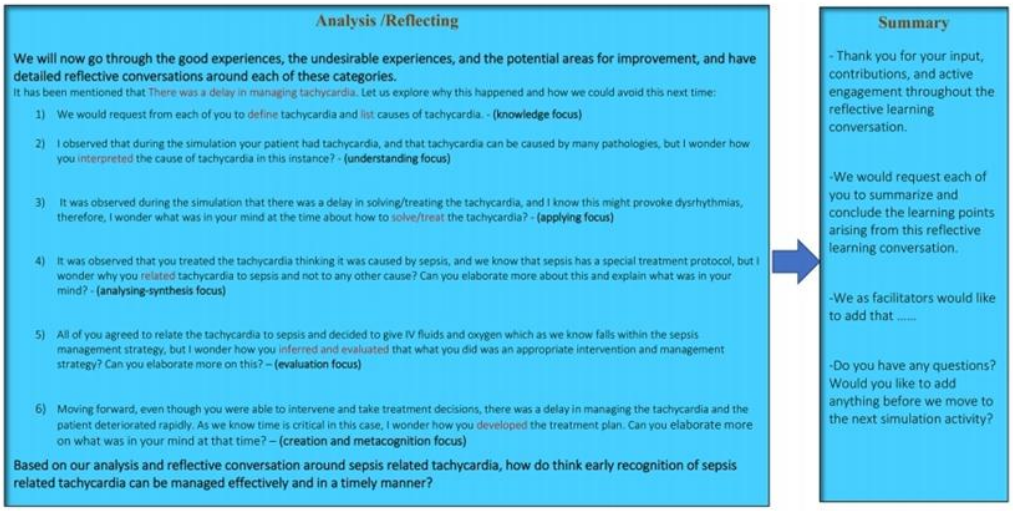

Fig. 3 Post-simulation Reflective Learning Conversations RLC Model Script/Example, cont.

worked examples (Figs. 1, 2 and 3). The model was purposefully developed and categorized into four phases to meet the simulation standards by starting with briefing followed by reflective analysis/synthesis and ended with take home messages and summary. To avoid potential risks of cognitive overload, each phase of the model was purposefully developed as a prerequisite to next phase [34].

The impact of seniority and group harmony factors while attending RLC have not previously investigated [38]. Taking in account the practical concepts of dual loop and cognitive overload theories into simulation practices [34, 37], it is important to consider that attending group- based SBEs with different participants' experience and competence levels within same simulation learning group is a challenge. Ignoring the amount of information, flow and structure of teaching delivery, and concurrent use of fast and slow cognitive reasoning processes by seniors and juniors, are associated potential risk of cognitive overload [18, 38, 46]. These factors were considered in the development of the RLC model to avoid underdeveloped and/or suboptimal clinical reasoning [18, 38]. For that, it is important to take in account that conducting RLC with different seniority and competence levels provokes domination effect by senior participants. That could happen due to tendency of senior participants to escape the basic concepts of learning which may be critical to junior participants to achieve metacognition and to move to higher level of thinking and reasoning process [38, 47]. The RLC model was designed to engage both seniors and junior nurses through the appreciative inquiry and plus delta methods [45, 46, 51]. By using these methods, the inputs of both senior and junior participants with different competence and experience levels will be all listed and reflectively discussed point by point by the debriefing facilitator and co-facilitator [45, 51]. The debriefing facilitators would add their inputs in addition to simulation participants' inputs, consequently, all collective observations would comprehensively cover each learning point, therefore, metacognition enhancement toward clinical reasoning optimization [10].

The flow of information and structure of teaching delivery using the RLC model were considered through a systematic and multiphasic processes. That design aimed to help debriefing facilitators ensuring that each participant is clear and confident at each phase before moving to next phases. The facilitator will be able to trigger reflective discussions to engage all participants, and to reach a point that participants with different seniority and competence level are agreed to best practice of each discussion point before moving to next [38]. Using that way would help experienced and competent participants to share their inputs/observations whereas the inputs/observations of less experienced and competent participants are appreciated and discussed [38]. However, achieving that would challenge the facilitator on how to balance the discussions and to give equal chances for senior and junior participants. For that, the questioning technique of the model was purposefully developed using Bloom's taxonomy model incorporating the Appreciative Inquiry and Plus/ Delta methods [45, 46, 51]. Using these methods and starting with knowledge and

understanding focus questions/ reflective discussions would encourage less experienced participants to participate and be actively engaged in the discussions, which after, the facilitator will gradually move to higher level of evaluation and synthesis questions/discussions in which both senior and junior participants should be given equal chances to participate based on their previous exposure and experiences to either clinical skill or simulation scenario. This way would help less experienced participants to be actively engaged and to benefit from shared experience by more experienced participants and the input of debriefing facilitators. On other hand, the model was not designed only to fit the SBEs with different participants competence and experience levels, but also when SBE group participants have same experience and competence levels. The model developed to enhance smooth and systematic movement transition of the group from knowledge and understanding focus to synthesis and evaluation focus to achieve the learning objectives. The model structure and flow were designed to fit simulation groups with different and same competence and experiences levels.

Moreover, despite that healthcare SBE incorporating RLC is used to develop clinical reasoning and competence for healthcare practitioners [22, 30, 38], however, the associated factors in relation to case complexity and potential risk of cognitive overload need to be considered, especially when participants attend SBE scenarios mimic critically ill patients with high complexity that need immediate interventions and critical decisions [2, 18, 37, 38, 47, 48]. For that, it is critical to consider while attending SBEs the tendency of experienced and less experienced participants' to concurrently shift between analytical and non-analytical reasoning systems, and to establish an evidence-based methods that keep both seniors and juniors actively engaged in the learning process. Therefore, the model was developed that whatever simulation case complexity is introduced, the facilitator should ensure that knowledge and basic understanding aspects are covered at first for both senior and junior participants, and then to progress incrementally and reflectively to facilitate the analysis, synthesis, and evaluation aspects. This will help junior to build up and consolidate learning, and at the same time seniors to synthesize and develop new learning. That would meet reasoning process demands of each participant with respect to previous experiences and competence, and to have a universal format that fit the tendency of seniors and juniors to concurrently shift between analytical and non- analytical reasoning systems, consequently, clinical reasoning optimization.

Moreover, simulation facilitators/debriefers may struggle to master simulation debriefing skills. Using a cognitive debriefing script is deemed effective to increasing facilitators' knowledge acquisition and behavioural skills compared with those facilitators who did not use a script [54]. Script is a cognitive aid that may promote simulation faculty development efforts and augment debriefing skills particularly in those educators who are still solidifying their debriefing expertise [55], therefore, scripted worked examples were added to the model to enhance simulation faculty development, and to achieve higher practicality and to develop a friendly user model. (Figures 2 and 3).

The concurrent integration of Plus/Delta, Appreciative Inquiry, and Bloom's Taxonomy questioning methods were not previously addressed in currently available simulation debriefing and guided reflection models. The integration of these methods highlights the innovative aspects of the RLC model in which these methods were integrated in a universal format to achieve clinical reasoning optimization and learner-centredness. Medical educators can benefit from using the RLC model for simulation debriefing of group- based SBEs to enhance and optimize participants' clinical reasoning development. The scripts of the model may help the educators to master the reflective debriefing process and to consolidate their skills in being confident and competent debriefing facilitators.

SBEs may incorporate a wide range of different modalities and methods including but not limited to mannequins based SBE, task trainers, patient simulators, standardized patients, virtual and augmented reality. Taking in account that debriefing is one of the essential simulation standards, the post- simulation RLC model can be used as a debriefing model while using these modalities. Moreover, despite that the model was developed for nursing discipline but also potential to be used for interprofessional healthcare SBEs, highlighting the need for future research initiatives to validate the RLC model for interprofessional education.

Limitations

- The post- simulation RLC model was developed and evaluated to be used for critical care nursing SBEs. Future evaluations/ validations of the model to enhance the generalizability level of the model be used for other health care disciplines and interprofessional SBEs are recommended.
- The model was developed through theoretical and conceptual driven process by a co-design working group. To enhance the validity and generalizability levels of the model, advanced reliability measures using comparative studies can be considered in the future.

Conclusions

To minimize practice errors, health care practitioners must be competent with effective clinical reasoning skills to ensure safe and appropriate clinical decision-making. SBE incorporating RLC as a debriefing method promotes the development of knowledge and practise-focused skills necessary to develop clinical reasoning. However, the multidimensional nature of clinical reasoning associated with previous experience and exposure, variations in competence, amount and flow of information, and simulation scenario complexity, highlighted the importance of developing a post- simulation RLC model whereby clinical reasoning skills are actively and effectively embedded. Ignoring these factors may lead to underdeveloped and suboptimal clinical reasoning. The RLC model was established in consideration to these contributing and influencing factors to optimize clinical reasoning while attending group-based simulation activities. To achieve that the model concurrently integrated the use of appreciative inquiry, plus/delta, and Bloom's Taxonomy methods.

List of abbreviations

CVR	Content Validity Ratio
CVI	Content Validity Index
SSH	Society for Simulation in Healthcare
SBE	Simulation based Education
INACSL	International Nursing Association of Clinical and Simulation Learning

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Authors' contributions

All authors (EA, JS,OS, EM, NP, GA) meet all the below criteria: Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work. Drafting the work or revising it critically for important intellectual content. Final approval of the version to be published. Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

The study was approved by the institutional review board (IRB) of Hamad medical corporation (MRC-01-22-117) and the University of Hertfordshire (HSK/PGR/UH/04728). All participants were informed on this study using a plain language information sheet outlining the study and signed an informed consent before the start of the study. All experiments were performed in accordance with relevant national ethical guidelines.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Publisher's Note

9.1.14 Appendix 14: The International Journal of Healthcare Simulation (IJoHS) publication (1)

Co-design: a guided reflective learning conversation model for simulation-based education

Emad Almomani, M Jacqueline Sullivan, Omar Saadeh, Emad Mustafa, Natalie Pattison, Guillaume Alinier

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Abstract

Background:

The critical care environment is stressful with complex clinical cases and high levels of workload [1]. Adequate exposure to various clinical experiences is essential to develop effective clinical reasoning skills [2]. Taking into consideration the risk of clinical practice mistakes and the importance of patient safety, simulation is an effective method to immerse learners in scenarios that mimic clinical situations with focused learning opportunities. Guided reflection through reflective learning conversations following simulation activities is recognized as an effective method to develop clinical reasoning skills [3]. We describe a co-design process to develop a simulation guided reflective learning conversation model to optimize the clinical reasoning skills for critical care nurses attending simulation-based activities.

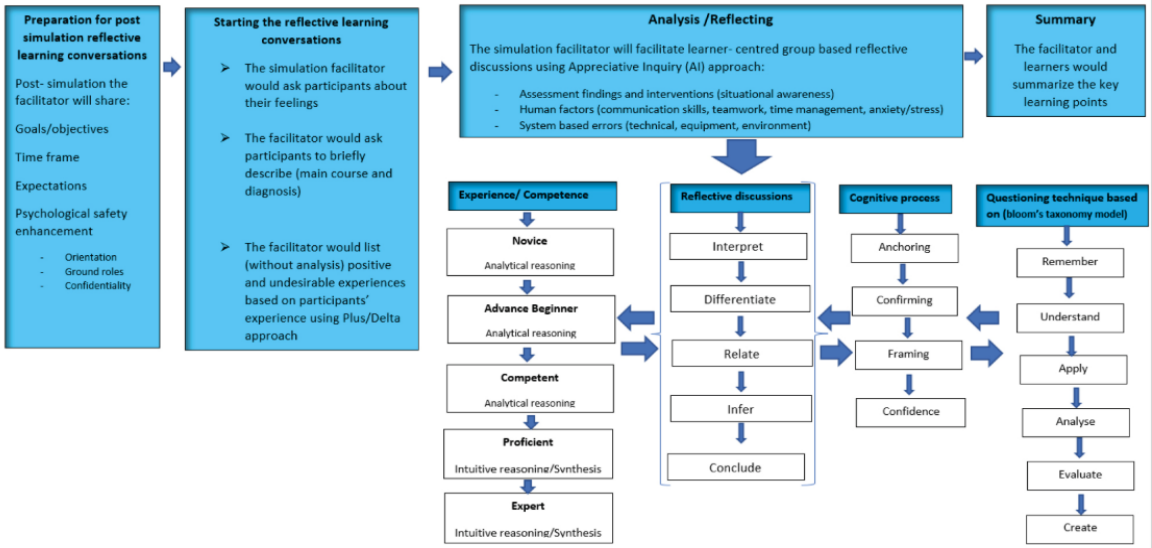
Methods:

A co-design working group of 10 critical care nurses of varying levels of seniority, experience, nationality, and gender; two critical care doctors; three patient representatives; 2 researchers, and 5–6 critical care educators are working collaboratively to co-design the guided reflective learning conversation model, in which clinical reasoning can be optimized with consideration to a wide range of case complexity, subspecialty, and competence levels. The co-design working group is meeting online for 4–6 workshops of 4 hours. The co-design process is built on valid and reliable clinical reasoning and educational theoretical frameworks and models. The inputs to the process, exercises, and activities are taking place during the workshops and the outputs of the workshops are described to establish the co-design process. The final draft of the model will be validated and tested. The study sample will be grouped into experimental and control cohorts of critical care nurses who attend critical care simulation-based courses (N=300). Data will be collected through surveys, focus groups, and simulation-based objective assessment and observations. The study has received Institutional Review Board approval from the Hamad Medical Corporation Medical Research Centre (MRC-01-22-117) and the University of Hertfordshire (HSK/PGR/UH/04728).

Results:

The first draft of the co-design model is presented in Figure 1. The final draft of the model will be released, validated, and tested in the near future using mixed methods research with comparative quasi-experimental and pre-test/post-test design.

Fig.1 Simulation- Based Reflective Learning Conversation Model (SBRLCM)



Conclusion:

Clinical reasoning is multidimensional with difficulty to structure and evaluate during debriefing. Developing a guided reflective learning conversation model in which clinical reasoning skills are actively and effectively embedded, would therefore enable critical care nurses developing clinical reasoning skills to meet the special demands of critical care.

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9.1.15 Appendix 15: Journal of Emergency Medicine Trauma & Acute Care Publication

JEMTAC
Journal of Emergency Medicine Trauma & Acute Care
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Qatar Health 2022 Conference

Approaches that promote clinical reasoning in clinical and simulation-based practice settings

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ABSTRACT

Background: Clinical reasoning is described as a reflective process that enables health care practitioners to collect data, solve problems, and make decisions and judgments to enhance patient outcomes and patient safety[1]. To avoid practice mistakes, healthcare professionals should possess or develop effective clinical reasoning skills. To develop effective clinical reasoning skills, enough exposure to various experiences is required. Practicing and developing clinical reasoning skills can be achieved in both clinical and simulated settings[2]. Using structured clinical reasoning models could enhance effective clinical reasoning development[3]. This review aims to explore the current clinical reasoning models.

Methods: A scoping review was undertaken to answer the question; what are the best available clinical reasoning models to enhance clinical reasoning in clinical and simulated settings? The following sources were searched: Medline; Scopus; Education Research Complete, and Google Scholar to identify relevant recent primary research conducted on this topic published in 2000 onwards. The search included [MeSH] topics of; "Clinical reasoning" and "Clinical Reasoning Models". The inclusion criteria were primary studies that described the use of clinical reasoning models in clinical and simulated settings. Two independent researchers agreed on the inclusion of the identified papers for full-text review. This review followed the review guidelines of the Joanne Briggs institute.

Results: There are valid clinical reasoning models to be used for clinical and simulated settings which are; TANNER, DML, clinical Reasoning Model (CRM), Outcome-Present State Test (OPT), and Self-Regulated Learning (SRL) model (Table 1). However, the validity of these models needs to be tested considering different health care specialties, the scope of practice, complexity, and seniority levels.

Conclusion: Considering the importance of clinical reasoning skills in health care practices, using structured models could enhance the clinical reasoning process, however, despite the availability of clinical reasoning models, additional validation for these models is still required.

Keywords: Clinical reasoning, Clinical reasoning models, Reflective practice, Problem-solving, Clinical judgment

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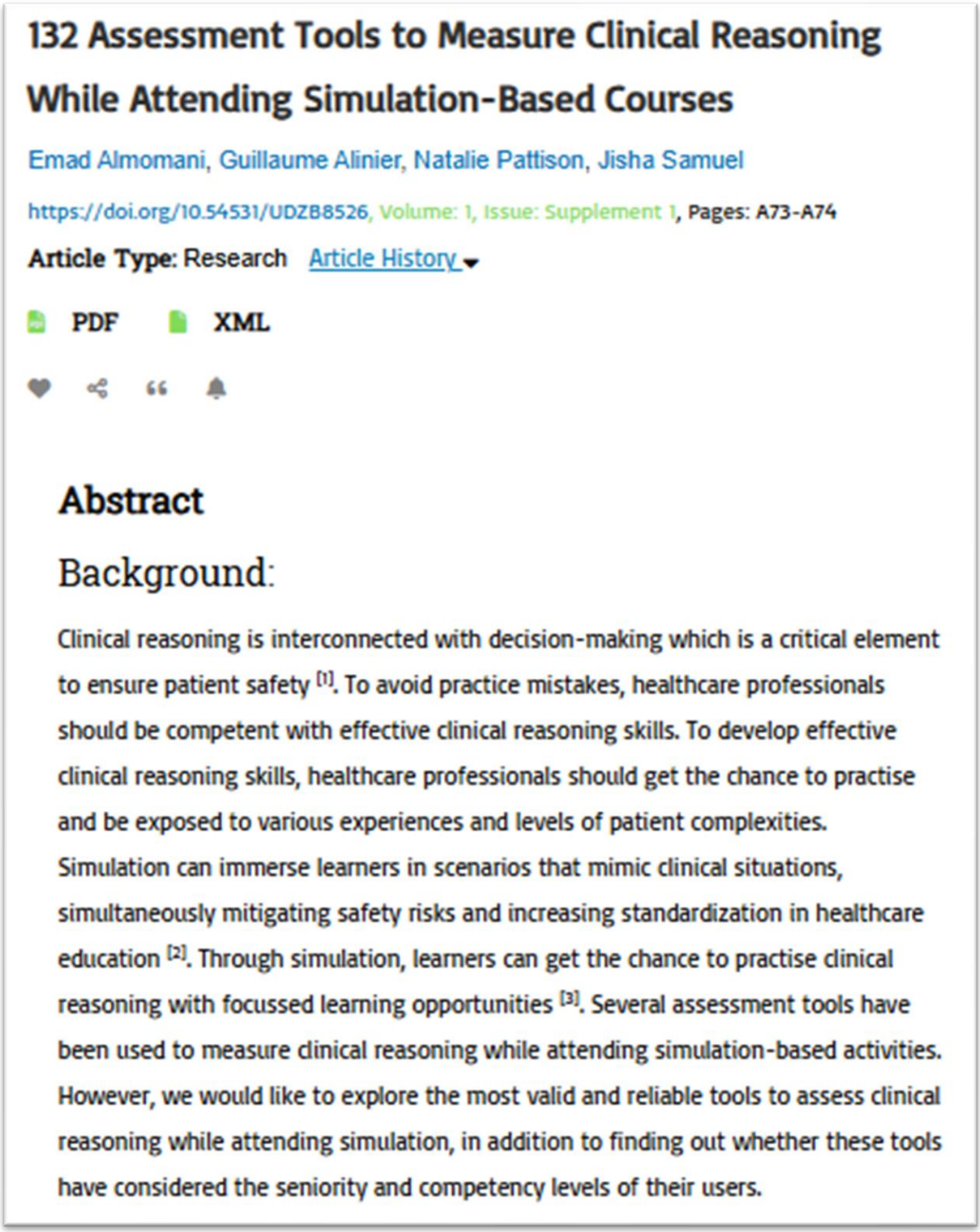
9.1.16 Appendix 16: The International Journal of Healthcare Simulation (IJoHS) publication (2)



132 Assessment Tools to Measure Clinical Reasoning While Attending Simulation-Based Courses

Emad Almomani, Guillaume Alinier, Natalie Pattison, Jisha Samuel

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Abstract

Background:

Clinical reasoning is interconnected with decision-making which is a critical element to ensure patient safety [1]. To avoid practice mistakes, healthcare professionals should be competent with effective clinical reasoning skills. To develop effective clinical reasoning skills, healthcare professionals should get the chance to practise and be exposed to various experiences and levels of patient complexities. Simulation can immerse learners in scenarios that mimic clinical situations, simultaneously mitigating safety risks and increasing standardization in healthcare education [2]. Through simulation, learners can get the chance to practise clinical reasoning with focussed learning opportunities [3]. Several assessment tools have been used to measure clinical reasoning while attending simulation-based activities. However, we would like to explore the most valid and reliable tools to assess clinical reasoning while attending simulation, in addition to finding out whether these tools have considered the seniority and competency levels of their users.

Method:

A scoping review was undertaken to answer the questions: What are the best available valid and reliable tools to evaluate clinical reasoning while attending simulation-based activities? Do we have valid and reliable clinical reasoning assessment tools for simulation that measure clinical reasoning considering different seniority and competency levels? We searched Medline, Scopus, Education Research Complete, and Google Scholar to identify relevant recent primary research conducted on this topic from 2000 onwards. The search included MeSH topics of: 'Clinical reasoning', 'Simulation-based courses' and 'Clinical Reasoning tools'. The inclusion criteria were primary studies that described the use of tools measuring clinical reasoning while attending simulation-based courses. Two independent researchers agreed on the inclusion of the identified papers for full-text review. This review followed the review guidelines of Joanne Briggs institute.

Findings:

There are valid and reliable tools to evaluate clinical reasoning while attending simulation which is Clinical Reasoning Evaluation Simulation Tool CREST [1]; Lasater Clinical Judgment Rubric LCJR [4]; Creighton Competency Evaluation Instrument Creighton C-SEI- Tool [5]. However, the validity and reliability of these tools were tested on undergraduate student nurses, and there was no consideration for different seniority and competence levels, and applicability to other healthcare professions.

Implications for practice:

There is an adequate number of tools to measure clinical reasoning while attending simulation. However, there is a significant basis to test the reliability and validity of these tools against different competence and seniority levels, and applicability to other healthcare professions.

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Google Scholar

9.1.17 Appendix 17: International Nursing Management Conference (INMC) abstract

[O-06]

Optimizing Reasoning Skills through Structured Clinical Reasoning Models

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Introduction: Clinical reasoning is described as a complex cognitive process that uses formal and informal thinking to gather and analyze patient information [(1)]. Effective clinical reasoning depends upon the nurse's ability to collect the right cues and to take the right action for the right patient at the right time, and for the right reason [(2)]. Effective clinical reasoning is essential to ensure patient safety and to enhance patient outcomes; therefore, having structured clinical reasoning models for clinical and educational purposes would be helpful to optimize the reasoning process of clinical staff [(3)]. This work describes a scoping review conducted to find out the best available clinical reasoning models.

Methods: A scoping review was undertaken to answer the questions: What are the best available clinical reasoning models? We searched Medline, Scopus, Education Research Complete, and Google Scholar to identify relevant recent primary research conducted on this topic from the year 2000 onwards. The search included MeSH topics of: "Clinical reasoning", and "Clinical Reasoning models". The inclusion criteria were primary studies that described the use of models for clinical and educational practices. This review followed the review guidelines of the Joanne Briggs Institute.

Results: Five valid and reliable models to structure the clinical reasoning process were found: Tanner's model, Debriefing for Meaningful Learning DML, Outcome-Present State-Test (OPT), Self-Regulation Model SRL, and Clinical Reasoning Model CRM.

Discussion: The current models were established to develop general nursing clinical reasoning skills, rather than being focused on specialty, seniority, competence, and case complexities which are influencing factors in the clinical reasoning process. That highlights the importance and significance need to develop new models or re validate the current models.

Conclusion: There are clinical reasoning models to structure the clinical reasoning, however, to optimize the reasoning process, it is recommended to consider all influencing factors.

Keywords: clinical reasoning, reasoning models, structured reasoning skills

9.1.18 Appendix 18: International Nursing Management Conference (INMC) chapter book

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Clinical Reasoning Optimization for Simulation- Based Education Sessions and Clinical Practice

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***Abstract*–** Effective clinical reasoning depends upon the nurse's ability to collect the right cues and to take the right action for the right patient at the right time and for the right reason. Effective clinical reasoning is essential to ensure patient safety and to enhance patient outcomes, therefore having structured clinical reasoning models for clinical and educational purposes would be helpful to optimize the reasoning process. This work describes a scoping review conducted to find out the best available clinical reasoning models. We searched Medline, Scopus, Education Research Complete, and Google Scholar to identify relevant recent primary research conducted on this topic from the year 2000 onwards. The search included MeSH topics of: "Clinical reasoning", and "Clinical Reasoning models". The inclusion criteria were primary studies that described the use of models for health care clinical and educational practices. This review followed the review guidelines of the Joanne Briggs Institute. Five valid and reliable models to structure the clinical reasoning process for clinical and simulation-based education were found. Despite the presence of many clinical reasoning models, these were established to develop general health care practitioners' clinical reasoning skills, rather than being focused on specialty, seniority, competence, and case complexities which are influencing factors in the clinical reasoning process. This highlights the importance and significance need to develop new models or revalidate the current models. There are clinical reasoning models to structure the clinical reasoning, however, to optimize the reasoning process, it is recommended to consider all influencing factors.

***Keywords*–**Clinical reasoning, reasoning models, simulation-based education.

I. INTRODUCTION

Clinical reasoning (CR) is considered as a backbone of health care clinical practice (1), and effective clinical reasoning is central to clinical competence (2). CR is a reflective process in which healthcare practitioners perform the most appropriate intervention based on the clinical situation (2). It is recognized as an important element to enhance professional development (1) and evidence-based practices (3).

All healthcare providers are faced with making complex decisions in situations with a high degree of uncertainty reasoning skills (2). CR is a complex cognitive process that involves multiple steps of thinking with possible risk of cognitive overload (4, 5), and underdeveloped CR skills potentially threaten patient safety and delay of care or treatment, especially when dealing with critically ill patients who need immediate interventions and clinical decisions (5).

CR and clinical judgement are often used interchangeably in the literature (6), but many studies described CR as a process, whereas clinical judgement is the result of the process and represents the decisions that a clinician makes (3.6.7). CR and clinical judgment are concepts specific to a given clinical situation and are interconnected with clinical decision-making (3.6). CR and decision-making are critical elements in health care practice to ensure patient safety and to enhance patient outcomes (6). CR is described as those thinking and decision-making processes that are used in clinical practice (8) and also as a complex cognitive process that uses formal and informal thinking strategies to gather and analyze patient information, evaluate the significance of this information, and determine the value of alternative actions (9). Effective and efficient CR requires knowledge, skills, and abilities grounded in reflection supported by an individual's capacity for self-regulation leading to the development of expertise (10).

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A CR Cycle was developed by (11) as systematic steps with logical consideration of CR involving; collecting cues, processing the information, coming to an understanding of a patient problem or situation, planning and implementing interventions, evaluating outcomes, and reflecting on and learning from the process. Effective CR depends upon the nurse's ability to collect the right cues and to take the right action(s) for the right patient at the right time, and for the right reason(s) (11).

All healthcare providers are faced with making complex decisions in situations with a high degree of uncertainty (12). The non-analytic (intuitive) reasoning process is a fast-track process, which is favoured by expert health practitioners. In comparison, the analytic (Hypothetical-Deductive) reasoning process, which is slower and more deliberate in nature, is more commonly used by less experienced practitioners (1,13). Underdeveloped CR skills potentially threaten patient safety and provoke delay of care or treatment (14). Taking into consideration the clinical environment's complexity and potential risk of practice mistakes, it is recommended to think about alternative methods in which healthcare practitioners get the chance to practice clinical skills, develop CR skills, and be exposed to different case complexities while maintaining patient safety (15). Simulation-based education (SBE) is considered an effective method to develop CR skills while maintaining patient safety (15).

Simulation is commonly used in healthcare as a non-threatening, safe environment that encourages developing knowledge, clinical skills, competence, critical thinking, and clinical reasoning through practicing with trial and error (15, 16). Simulation is defined by the Society for Simulation in Healthcare as a "technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions" (17, p.44).

Given the importance of patient safety, simulation is used to develop clinical reasoning in a controlled, low risk, and safe environment (18). Even though clinical experiences foster the development of clinical reasoning skills (19), some clinical situations may be rarely experienced, therefore they can be, simulated (15).

The multidimensional nature of CR and potential risk of cognitive overload, in addition to variation of healthcare professionals' tendency to use analytic (Hypothetical-Deductive) and non-analytic (intuitive) CR process (1,13), highlights the importance of CR optimization while attending simulation and clinical practice considering the wide range of contributing factors related to; previous experience to the simulation learning topic and competence level, simulation scenario case complexity, and learners' specialty and subspecialty backgrounds, therefore, we conducted a systematic scoping review to explore the best available clinical reasoning model to optimize the CR process while attending SBE sessions and during clinical practice.

The systematic reviews can be considered as pillar of evidence-based healthcare to inform the development of trustworthy clinical and educational guidelines (20). The systematic scoping review has become increasingly popular as a form of knowledge synthesis and to map evidence from a variety of sources (21).

Scoping review design represents a methodology that allows assessment of emerging evidence as a first step in research development, provides indications for where further research may be required, and inform the development of new research projects. It also helps to summarize and disseminate research findings, give clear indication of the volume of literature and studies available with this focus, identifies research gaps, and makes recommendations for future research (20.21).

Arksey and O'Malley (22) developed an original framework for conducting scoping reviews and this framework was then advanced and extended by (23, 24). Scoping review methodology was then further refined and corresponding guidance developed by a working group from Joanna Briggs Institute (JBI) and the JBI Collaboration (JBIC) (21). In the early stages of developing the scoping review guidelines, JBI labelled systematic review as "systematic scoping review" in their original guidance (21) but JBI refined the terminology to simply 'scoping reviews' in acknowledgement that all types of knowledge synthesis should be systematic in their conduct (21.24). The JBI published an updated version of the scoping review approach as a standardized format for scoping reviews, therfore, there now exists clear guidance regarding the definition of scoping reviews, how to conduct scoping reviews, and the steps involved in the scoping review process (21,24).

II. METHOD

A scoping review was undertaken to answer the questions: What are the best available clinical reasoning models? We searched Medline, Scopus, Education Research Complete, and Google Scholar to identify relevant recent primary research conducted on this topic from the year 2000 onwards. The search included MeSH topics of: "Clinical reasoning", and "Clinical Reasoning models". The inclusion criteria were primary studies that described the use of models for health care clinical and simulation-based practices. This review followed the review guidelines of the Joanne Briggs Institute (21).

III. RESULTS

- Five valid and reliable models to structure the CR process were found
- TANNER's clinical judgment model (25)

- Debriefing for Meaningful Learning (DML) model (26)
- Outcome-Present State-Test (OPT) model of clinical reasoning (27)
- Self-Regulation Model SRL model (28)
- Clinical Reasoning Model (CRM) (11)

IV. DISCUSSION

Tanner's Model (25) was developed to provide guidance for faculty members to help nursing students identifying areas for improvement. Tanner describes that nurses make clinical judgments by selecting from alternatives, weighing evidence, and using intuition. Tanner's Model was based on a conceptual framework and literature synthesis on clinical judgment, and conclusions derived from the literature. According to (25), CR involved four main aspects or phases: noticing, interpreting, responding, and reflecting, all of which occur during patient care in an iterative, nonlinear pattern. The model depicts constant change, interrelations, and feedback, beginning with the understanding that the nurse's background and the context of the situation will influence everything else. The model describes that expert nurses enter the care of patients with a fundamental sense of clinical judgment about what is good and right and a vision for what makes appropriate care. This model describes the complexity of thought involved in expert nursing, and guides student reflection and faculty questioning for meaningful reflections toward greater competence in nursing care. Tanner's model is deemed effective to enhance the clinical reasoning in a qualitative concept-based method by (29), a quasi-experimental non-equivalent control group pre- and post-intervention design by (30), and a mixed method study using Delphi survey and observation by (31). However, despite the focus of this model on clinical judgment and reasoning of practicing nurses but there is no consideration to different nurses' level of competence, seniority, specialty, case complexities, scopes of practice, and the usability by other healthcare professions. Therefore, the particular focus of this model presents limited explanatory power and generalizability level, and additional validations are recommended.

The Debriefing for Meaningful Learning model (26) was developed to discover the effect of the use of a simulation teaching strategy on the development of clinical reasoning in nursing students. Exploratory, quasi-experimental, pre-test-post-test study was conducted. Participants were assigned to either the experimental or control group where the DML was compared to customary debriefing. The Debriefing Assessment for Simulation in Healthcare–Student Version (DASH–SV) was conducted with four supplemental questions about the DML (DMLSQ) process, during the post-debriefing assessment. The study sample was undergraduate nursing students taking an adult health-medical surgical course (N=238), forming the experimental group (n=122) and control group (n=116). There was statistical significance in the change in CR scores between pre-test and post-test for those who used the DML as compared to the control group students. DML was deemed effective to enhance the clinical reasoning in pilot study by (32) exploratory, quasi-experimental, pretest–posttest study by (33), and a study of quantitative factor analysis method by (34). DML model was developed and tested for nursing undergraduate students and not for practicing nurses nor for other healthcare professionals. Therefore, the particular focus of this model on undergraduate students highlights limited generalizability level, and additional validations are recommended considering all contributing factors to the CR process.

The Outcome-Present State-Test (OPT) model is a structure or blueprint that helps students organize the thinking involved in clinical reasoning (27). It provides a framework for contrasting the relationships between problem and outcome states and provides a guide for problem solving. The OPT model helps students organize the thinking involved in clinical reasoning, and this model has been shown to assist the development of clinical reasoning related to experiences of psychiatric-mental health nursing students. The OPT model is unique in that the juxtaposition of an identified keystone nursing issue is contrasted with a specified outcome state and provides a conceptual structure for the use of standardized languages "Present states" in the nursing model. The present state is derived from an analysis and synthesis of relationships between and among nursing and client nursing care needs. The OPT model is deemed effective in enhancing the clinical reasoning of learners in a descriptive quantitative study by (10), and quasi-experimental study by (35). The OPT model was not tested and evaluated by practicing nurses considering different contributing factor to clinical reasoning The model was deemed valid for undergraduate nursing students only, therefore additional validations for practicing nurses and other health care professions are recommended.

The Self-Regulated Model (SRL) for reflective clinical reasoning describes self-regulation as a dynamic process that includes the observations of behaviors and self-regulation of reactions to make self-judgments of competence and areas for improvement for clinical reasoning (28). The environmental self-regulation of skills, activities, physical context, and relationships with preceptors, staff and patients is necessary to determine the context where clinical reasoning takes place. Metacognitive self-regulation includes metacognitive (reflective) self-correction associated with the use of knowledge and thinking strategies that are used to determine goals. These three types of self-regulation support the development and acquisition of higher order thinking skills such as interpretation, analysis, inference, explanation, and evaluation. As individuals move through the states and stages of concrete experience, reflective observation, abstract conceptualization and active experimentation learning, occurs (36). The educator's role is to guide students through the process, to correct errors

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in faulty thinking, and encourage deeper levels of reflection. The SRL model is deemed effective to enhance the clinical reasoning in a descriptive study by (10), and qualitative study by (37). However, The SRL model was validated for undergraduate nursing students and not for practicing nurses nor other healthcare professionals considering different specialties, scopes of practice, competence levels and the other contributing factors, therefore, additional validations are recommended to enhance its generalizability and usability levels.

The Clinical Reasoning model (CRM) is an educational model that has the potential to enhance nursing students' clinical reasoning skills and consequently their ability to manage 'at risk' patients (11). The CRM model uses an eight-step cyclical process: *look, collect, process, decide, plan, act, evaluate, and reflect*. Effective use of the CRM by nursing students and its application in clinical practice by novice nurses is directly linked to the five rights of clinical reasoning, that is, the ability to collect the right cues and take the right action(s) for the right patient at the right time, and for the right reason(s). The study found that both novice and expert nurses used all the thinking strategies while caring for patients in a real-world situation, but that there were some differences between the novice and expert nurses.

The CRM encourages higher order thinking processes while nurses engage in each step (38). It has applications for classroom teaching and provides a structure that links well with problem-based and enquiry-based learning. The phases and steps in the model are appropriate for self-directed learning and can be used to develop computerized learning packages and case studies. The CRM also provides an approach that can be used in simulated learning experiences using patient simulators or standardized patients. The first seven steps of the CRM are accomplished during the simulation experience and the last step occurs during the debriefing process (39). The CRM was deemed effective to enhance CR in a double-blind, randomized control trial (40). However, the CRM needs further validations considering practicing nurses and other healthcare professionals considering different competence, specialty, case complexity, and scopes of practice, and not only for the undergraduate students, therefore, additional validations are recommended considering all clinical reasoning contributing and influencing factors.

V. CONCLUSION

Despite the availability of several valid and reliable clinical reasoning models to enhance a progressive development of CR skills, there is no general agreement as to which is the best for practicing and undergraduate nurses, and the best for clinical and education-based settings. Most importantly, none of these models were developed and tested considering the potential risk of cognitive overload associated with a wide range of case complexity, seniority, competence, scope of practice, specialty, and subspecialty factors. Current models are limited in their explanatory power and generalizability level because they are based on a specific focus, and none was developed based on holistic review and consideration to all contributing and influencing factors. Therefore, there is a need to test and evaluate the current clinical reasoning models considering all contributing and influencing factors, and/or to develop a comprehensive model in which all the clinical reasoning contributing and influencing factors are evaluated with consideration to; experience, physical, psychological, functional, and environmental factors which might lead to cognitive overload and consequently affect the optimization and effectiveness of the nurses' clinical reasoning process. Moreover, the multidimensional nature of CR and the tendency of shifting between analytical and non-analytical clinical reasoning processes, especially when health care practitioners are faced with practice uncertainties, deserves a further focused exploration to optimize the effectiveness of CR process in both clinical and health care educational settings.

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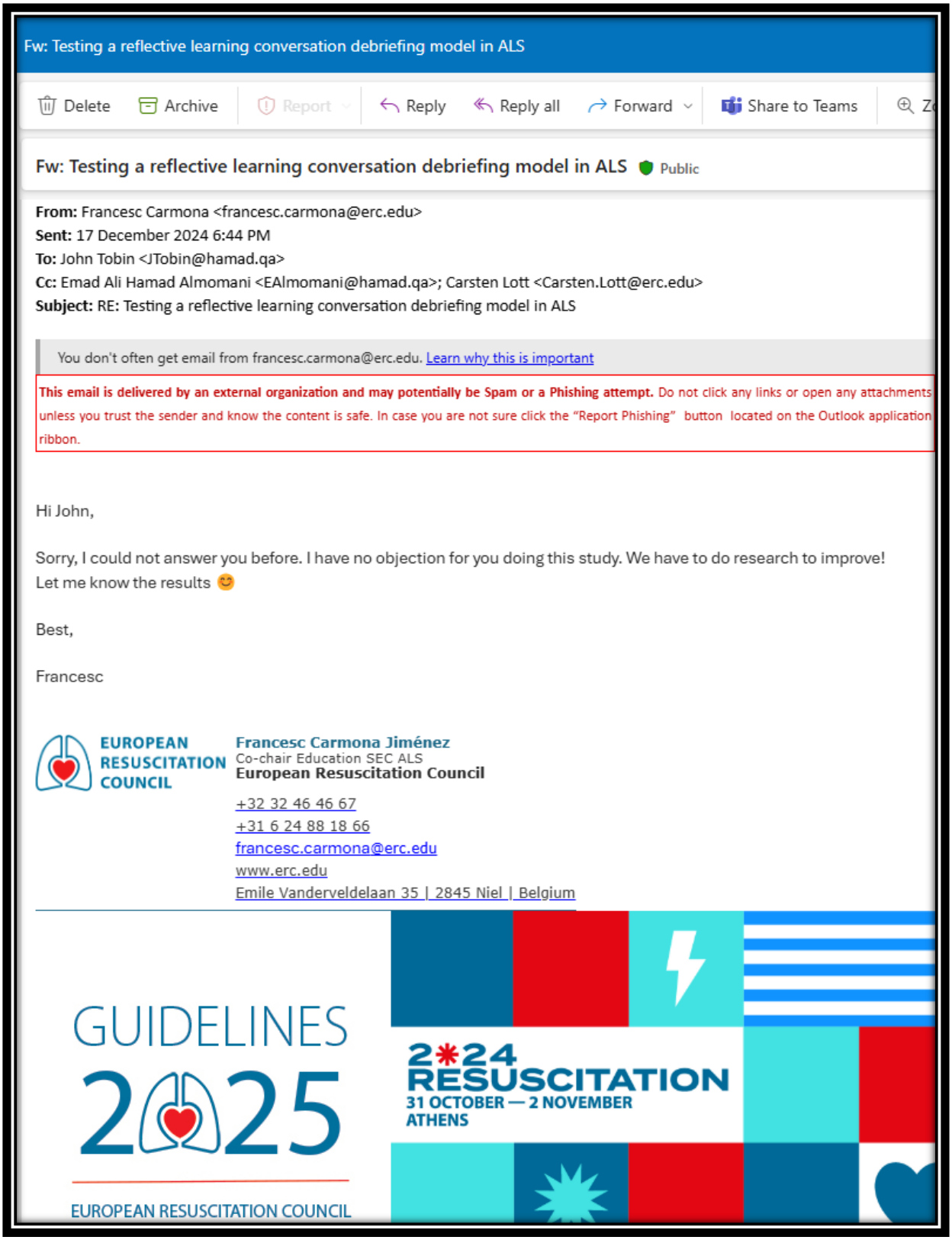
9.1.19 Appendix 19. ERC Approval to Test the Model in Interprofessional Advanced Life Support Courses



Fw: Testing a reflective learning conversation debriefing model in ALS

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Sent: 17 December 2024 6:44 PM
To: John Tobin <JTobin@hamad.qa>
Cc: Emad Ali Hamad Almomani <EAlmomani@hamad.qa>; Carsten Lott <Carsten.Lott@erc.edu>
Subject: RE: Testing a reflective learning conversation debriefing model in ALS

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Hi John,

Sorry, I could not answer you before. I have no objection for you doing this study. We have to do research to improve! Let me know the results 😊

Best,

Francesc

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