CULTIVATING CLINICAL JUDGMENT IN PHARMACOLOGICAL DECISION MAKING THROUGH REFLECTION ON PRACTICE

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ABSTRACT

Registered nurses practicing across diverse clinical settings all spend significant time providing and making judgments about pharmacological therapies. However, traditional methods of teaching pharmacology have rarely focused toward clinical application of content. This study investigated whether the inclusion of reflective debriefing after pharmacology activities impacted clinical judgment of nursing students during provision of pharmacological therapies in the clinical learning environment. A sample of 168 senior, prelicensure, Bachelor of Science in nursing student participants were assigned to either the intervention or control groups. Three measurements of clinical judgment were obtained for each participant by faculty data collectors over a twelve-week critical care rotation using Lasater's (2007) Clinical Judgment Rubric. Students in the intervention group participated in two hour-long sessions of reflective debriefing about their pharmacology decisions, one between each measurement. Statistically significant changes in clinical judgment were observed between the first and second and first and third measurements for the full cohort. However, while measurements for the intervention group were observed to increase more over the semester than measurements for the control groups, changes were not found to be statistically significant. This study addresses the recommendation for nursing education research to make conclusions based on measurement of learning, rather than relying on student perception. Findings are congruent with prior studies that measured statistically significant changes in clinical judgment after one semester of learning, and support

Tanner's (2006) theory that multiple opportunities for reflection are necessary to foster clinical judgment.

DEDICATION

To my husband Brian, my family, and my friends. Thank you for the many ways you encouraged and supported me along this journey. I love and appreciate all of you.

LIST OF ABBREVIATIONS AND SYMBOLS

α	Cronbach's index of internal consistency
ANCOVA	Analysis of covariance
ANOVA	Analysis of variance
BSN	Bachelor of Science in nursing
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CITI	Collaborative Institutional Training Initiative
df	Degrees of freedom
F	F statistic for ratio of variances
IRB	Institutional Review Board
LCJR	Lasater's Clinical Judgment Rubric
LMS	Learning Management System
LTRC	Learning and Technologies Resource Center
n	Number in the sample
NCSBN	National Council of State Boards of Nursing
NCLEX-RN	National Council Licensure Examination for Registered Nurses
OSCE	Objective Structured Clinical Examination
η^2	Partial eta squared
p	Probability
PI	Principal investigator

RM-ANOVA	Repeated measure ANOVA
SD	Standard deviation
SPSS	Statistical Package for Social Sciences
SW	Shapiro-Wilks test to check normality of distribution
TCJM	Tanner's Clinical Judgment Model
>	Greater than
<	Less than
=	Equal to

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CHAPTER I – INTRODUCTION

Introduction

Pharmacology in undergraduate nursing education has traditionally been taught through classroom-based methods with little to no concurrent opportunities for clinical application. Many pharmacology courses center on learning common drug classes and prototypes while emphasizing the nurse's role in safe medication administration. However, successful completion of pharmacology courses does not necessarily translate to safe pharmacological decision-making in clinical practice. A foundational knowledge base of pharmacology may equip the nurse with information necessary to make decisions about medications but does not guarantee a nurse will be able to make the highly contextual pharmacological judgments required in practice (Dilles, Vander Stichele, Van Bortel, & Elseviers; 2011). Classroom knowledge does not automatically confer clinical competence; learning experiences must also be structured to provide opportunities for clinical decision making (Benner, Leonard, Sutphen & Day, 2010, p.29).

Registered nurses in over 90% of practice settings report spending an average of 39% of their work hours providing pharmacological and parenteral therapies (National Council of State Boards of Nursing [NCSBN], 2018, p.20, p. 26-27). Some of the more frequently performed tasks include titration of drug doses, implementation of drug protocols, medication reconciliation, client education regarding drug therapies, and assessing the appropriateness of medication therapy (NCSBN, 2018, p.29-30). Successful implementation of these practices requires analyzing client data and synthesizing it with the nurse's understanding of

pharmacology. Traditional classroom-based pharmacology provides students with the necessary knowledge base, but not the opportunities to cultivate these skills in clinical practice. Ideally, classroom pharmacology content will continue to be reinforced throughout subsequent clinical learning experiences. However, little is known about the teaching of pharmacology concepts in the clinical environment beyond anecdotal accounts and no published data were found which measure the impact of reinforcing pharmacology content in clinical learning.

Problem Statement

Pharmacological competence is an area in which many nurses could benefit from additional clinical application with continued reinforcement of learning. Older studies suggest novice nurses experience a theory-practice gap between pharmacology knowledge obtained through coursework and subsequent application in practice; however, no literature has been found in this area within the last five years (Dilles et al., 2010; Grandell-Niemi, Hupli, Leino-Kilpi, & Puukka, 2005). Moreover, registered nurses have been found to possess limited pharmacology knowledge, even of frequently prescribed drugs (Ndosi & Newell, 2008). Without a sufficient knowledge base, applying pharmacology when making decisions about patients' medications becomes challenging.

Purpose of the Study

This quantitative, descriptive, repeated-measures study examined how reflection on pharmacological activities during post-conference impacted students' clinical judgment abilities during successive medication administration activities in clinical. Clinical judgment scores of students who participated in post-clinical debriefing targeted towards reflection on pharmacological activities were compared to scores of students who participated in standard post-conference activities. This study aimed to appraise changes in students' clinical judgment

scores related to pharmacological clinical activities during three time periods within one fifteen-week semester.

Significance of the Study

Registered nurses across diverse practice settings must analyze and integrate patient data with pharmacology knowledge to provide safe medication therapy that addresses the unique needs of each client. (National Council of State Boards of Nursing [NCSBN], 2015, pp 29-30). However, undergraduate pharmacology courses often lack clinical application opportunities, as they are taught primarily through classroom-based learning. Moreover, advanced beginner nurses are often rule-based thinkers who have difficulty with discretionary judgment and contextual decision making (Benner, 1982). Additional studies are needed to identify and promote learning activities that effectively develop graduates' competency in providing safe, individualized medication therapy. This study examined the impact of reflection on practice regarding pharmacological decisions on measures of clinical judgment. Activities that help learners effectively integrate classroom pharmacology knowledge into clinical pharmacological decisions must be identified to foster student clinical judgment in this area.

Theoretical Framework

The framework for this study was Tanner's Clinical Judgment Model, which describes the cultivation of clinical judgment through reflection in and on practice (Tanner, 2006). This model proposes that clinical judgment is developed as nurses, including students, reflect on clinical practice experiences (Tanner, 2006). Reflection occurs both during the clinical learning experience as the student learns to "read the patient" and after as the student contemplates how decisions affected patient outcomes (Tanner, 2006). The nurse then carries forward the lessons learned into subsequent clinical situations, strengthening future clinical decision making (Tanner,

2006). Clinical activities that require students to recognize clinical manifestations of textbook knowledge and distinguish qualitatively among possible manifestations should help students more quickly gain nuanced clinical understanding (Tanner, 2006). The reflective pharmacological debriefings provided as the intervention in this study allowed opportunities for students to reflect on action as described by Tanner's model. Tanner's (2006) theory supports the idea that repeated opportunities for clinical decision making should result in an increase in student competence in clinical judgment over time.

Research Questions

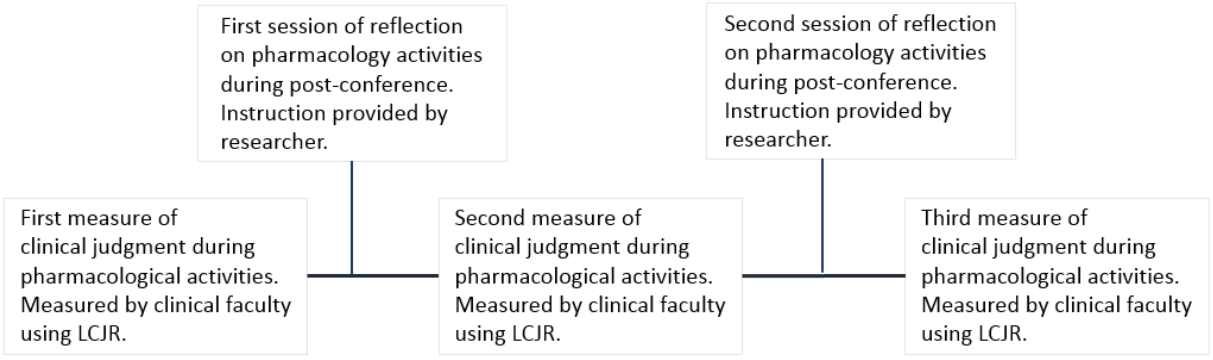
This repeated-measures study evaluated how reflective debriefing on clinical pharmacology situations impacted clinical judgment measurements during medication administration over one fifteen-week semester. This study proposed the following questions:

1. Do students enrolled in a critical care course achieve statistically significant increases in clinical judgment measurements as measured by Lasater's Clinical Judgment Rubric (LCJR) during pharmacological decisions at mid- and late-semester irrespective of their method of post-clinical debriefing?

2. Do students enrolled in a critical care course who participate in post-clinical debriefings requiring reflection on pharmacological decision making achieve greater increases in measurements on LCJR at mid- and late-semester compared to students who do not participate in these debriefings?

Methods

Lasater's (2007) Clinical Judgment Rubric (LCJR) was used to assess nursing students' clinical judgment regarding clinical medication administration activities during three timeframes throughout one twelve-week clinical rotation. Initial measurements were made during the first two weeks of clinical learning. Two additional measurements were collected during the middle two weeks of clinical learning and the final two weeks of clinical learning. Lasater's (2007) rubric was created to provide formative assessment of clinical judgment during nursing care and was developed using Tanner's (2006) model as a framework. The researcher facilitated two post-clinical reflection debriefings with each intervention group and included questions from Nielsen's (2006) Guide for Reflection which was constructed based on Tanner's model. These sessions replaced approximately one hour of the learners' standard clinical post-conference discussion time during the weeks where the study intervention was delivered. Students were asked to reflect specifically on their pharmacological activities from recent clinical experiences. The first debriefing was conducted between the first and second assessments of clinical judgment, while the second was conducted between the second and third assessments of clinical judgment. The control group in this study participated in standard clinical post-conferences without post-clinical debriefings targeted specifically to pharmacology in clinical. However, the control group was offered online resources through the course's learning management system at the conclusion of data collection to ensure they have access to similar strategies for enhancing pharmacology decisions in nursing practice. A diagram illustrating the timeline for the three measurements of clinical judgment and the two interventions of reflective debriefing on pharmacological clinical activities is provided below in Figure 1:



This figure illustrates sequencing of clinical judgment measures with reflective debriefing sessions.

Figure 1. Diagram Depicting the Timeline of the Study

A repeated-measures analysis of variance (ANOVA) was employed to answer research question one. This analysis looked for statistically significant differences in clinical judgment measurements obtained at each of the three intervals during the semester. The researcher hypothesized students in both the intervention and control groups would achieve higher measures of clinical judgment on LCJR as they progressed through their clinical learning experiences during the semester. A repeated measures between groups analysis of covariance (ANCOVA) was employed to answer research question two. This analysis looked for statistically significant differences in mean measurement increases between the intervention and control groups at mid and late semester. The researcher hypothesized that students who participated in the reflective pharmacology debriefings would achieve greater increases in clinical judgment measurements at midterm and late semester compared to students who participated in standard clinical post-conference activities.

Assumptions of the Study

Assumptions made by the researcher related to student participation in the study and cooperation of the faculty members who served as raters. The study made the following assumptions. First it assumed that all students actively reflected during the post-conference debriefing sessions and would transfer clinical judgment skills cultivated during the debriefings to future pharmacological decision-making. Because clinical time is mandatory, all students were present at the reflective debriefing sessions. The researcher attempted to engage all students in reflection by asking each about their experiences; however, there was no way to ensure transfer of learning occurred. Second, the researcher assumed that faculty members consistently scored students as established during interrater training. To address this assumption, a mid-study refresher session on use and scoring of the instrument was scheduled during the three-week period between the two semesters of data collection. The final assumption made by the researcher was that intervention and control groups would include approximately the same number of participants and that students participating were a homogenous group in regard to clinical abilities. The decision to analyze research question two using ANCOVA mitigated this concern somewhat by assigning the first clinical judgment measurement as a covariate during data analysis. However, study statistical power and accuracy assumed both student engagement in learning and cooperation of clinical faculty data collectors as established during rater training.

Moreover, this study assumed that semester four of five in a traditional Bachelor of Science in nursing (BSN) program was an appropriate time to help students cultivate pharmacological clinical judgment skills. All participants had completed a prior pharmacology course and participated in a minimum of 450 hours of previous clinical experiences. The researcher assumed students had retained enough of a foundational knowledge base of

pharmacology and had participated in an adequate quantity and quality of clinical experiences to possess sufficient context for the instructional intervention in this study.

Operational Definitions of Terms

The following terms are defined below for the purposes of this study.

Advanced beginner nurse. An advanced beginner nurse has experienced enough clinical situations to begin to recognize their meaningful aspects (Benner, 1982). However, a nurse at this stage of expertise requires cueing and guidance from more experienced nurses to connect these aspects and make clinical judgments (Benner, 1982). Nursing students are assumed to be at this stage once they have progressed through their initial clinical experiences (Benner, 1982). In this study, advanced beginner nurse was operationalized as a nursing student in semester four of five in a traditional Bachelor of Science in nursing (BSN) program.

Clinical. Clinical in nursing education refers to the practicum hours of a nursing curriculum. Clinical learning environments include healthcare facilities, simulation labs, and skills practice labs. In this study, clinical referred to hospital-based patient care experiences. Each clinical section consisted of one faculty member and no more than eight students at the study site, as mandated by the state board of nursing. In this study, clinical was operationalized as the learning that took place at acute care facilities, where students provided nursing care to clients in small groups under the instruction of clinical faculty members.

Clinical judgment. Clinical judgment is an interpretation of a patient's needs with subsequent decisions of whether to take action, when to modify existing actions, or choose to improvise new actions. These choices are then deemed appropriate or not through evaluation of the patient's response. Reflection on current clinical judgment, regardless of patient outcome, cultivates

future clinical judgment competency (Tanner, 2006). In this study clinical judgment was operationalized as Tanner's (2006) definition and referred to the students' decisions, actions, and reflections during nursing care.

Competency. Competency in nursing develops when the nurse is able to foresee the potential long-term effects of current nursing actions. The nurse can then plan care which ideally results in desired patient outcomes. Full competency as defined by Benner (1982) is typically achieved once a nurse has practiced for several years. However, the role of a clinical faculty member is to actively guide advanced beginner nurses towards the development of competency (Benner, 1982). In this study, competency was operationalized as the ability to identify and analyze the long-term effects of nursing decisions and actions.

Medication administration activities. In nursing education, medication administration typically refers to the tasks of providing medications to patients. The emphasis is often on required psychomotor skills and essential safety measures such as identifying the patient and providing the correct medications. In this study, medication administration activity was operationalized as the psychomotor tasks and standardized safety policies, such as patient identification, involved in delivering medications. It excluded the cognitive, decision-making aspects of medication delivery.

Pharmacological activities. In addition to the psychomotor skills of providing medications, nurses must assess the appropriateness of pharmacological therapies for patients, account for any specific considerations for administration, and evaluate medication effects. Pharmacological skills encompass the cognitive aspects of medication administration. In this study, pharmacological activity was operationalized as the higher-level thinking associated with medication administration. This included assessing the appropriateness of therapies, considering

individual patient data such as lab values and physical assessment findings, evaluating medication effects, and adjusting therapies based on patient response.

Post conference. In nursing education, post conference takes place at the end of each clinical learning experience. During this time, students discuss their patients and nursing care for the day. The clinical faculty interjects with questions to help students build connections between didactic knowledge and new insights gained through participation in clinical learning. In this study, post-conference was operationalized as the final hour of the clinical day during which students discussed patients and nursing care provided, with a goal of linking clinical experiences to prior didactic knowledge.

Post-clinical reflective debriefing. Reflective debriefing is a common learning strategy in clinical and simulation learning environments in nursing education (Benner, Hughes, & Sutphen, 1996; Dreifurst, 2012). During this time, instructors ask students to consider actions taken during the learning experience and examine their impact on patients. In this study, post-clinical reflective debriefing was operationalized as the intervention provided by the researcher during the students' post conference time. This intervention included questions directed towards the students' pharmacological activities with an intent to stimulate reflection on practice and foster clinical judgment. This intervention is described in further detail in the Methods section of this study.

Summary

Pharmacological therapies performed by nurses involve complex, contextual decisions that challenge new graduate nurses as they have not yet reached competence in nursing practice. Traditional undergraduate pharmacology courses often succeed in helping students build a solid foundation of medication knowledge but typically do not provide concurrent opportunities for

pharmacology application. Competence in any area of nursing practice, including pharmacology, is cultivated through repeated exposure to clinical situations that challenge the nurse's thinking and stimulate reflection on practice (Benner, 1982; Tanner, 2006). Additional opportunities to practice and reflect on medication-related decisions should assist students in more rapidly acquiring the ability to provide medication therapy that is not only safe, but optimal for each patient.

CHAPTER II - REVIEW OF LITERATURE

Introduction

The literature was reviewed to provide context and support for the investigation of this problem. Searches through CINAHL and ProQuest included the following key terms: nursing education, pharmacology, medication administration, medication competency, active learning, clinical judgment, Tanner's Clinical Judgment Model, Lasater's Clinical Judgment rubric, reflection-on-action, and clinical reflection. Peer reviewed articles published between 2006 and the present were evaluated for inclusion in this literature review. A small number of older studies were included to demonstrate changes to pharmacology learning in pre-licensure nursing education have been recommended for many years. Anecdotal educational innovation type articles were excluded from this search in favor of studies utilizing true quantitative and qualitative research designs. Quantitative studies only measuring student or faculty perceptions of learning activities and those with limited statistical power due to smaller sample size were also excluded in favor of studies with more compelling findings.

This literature review first investigated the pharmacological abilities of nurses and the influence of current nursing pharmacology educational practices on competency in clinical decision making. Studies that evaluated active learning strategies in pharmacology were examined to consider the impact of active learning on the cultivation of students' clinical judgment regarding medication administration. Literature supporting the effectiveness of reflection on practice in developing clinical judgment was then explored to corroborate the

proposed methods of this study. Literature supporting Lasater's Clinical Judgment Rubric (LCJR) was included to support validity and reliability of the tool and elaborate on its application in previous studies measuring clinical judgment. Discussion regarding the Guide for Reflection Using Tanner's (2006) Clinical Judgment Model was also included as this instructional tool was used to facilitate the instructional intervention in this study.

Pharmacological Practice in Nursing

Medication administration involves pharmacology-based cognitive skills in addition to the psychomotor and procedural competencies frequently associated with clinical nursing education. Nurses must apply pharmacological understanding to each patient's unique situation, anticipate potential risks of therapy, safely administer medications, and then evaluate medication effects (Sulosaari, Suhonen, & Leino-Kilpi, 2010). An extensive integrative literature review by Sulosaari et al. (2010) found decision-making competence to be an integral part of medication administration competence in many research studies. In a study that examined medication administration practices of nurses, Eisenhauer, Hurley, and Dolan (2007) asked forty nurses to verbalize their thinking throughout all phases of administering medications. The nurses' narratives illustrated that clinical decision-making, critical thinking, and flexibility to extend beyond rules when necessary were recurrent themes during medication administration (Eisenhauer et al, 2007). Keohane et al. (2008) used time-motion technology to measure the amounts of time nurses spent on different nursing activities. During medication administration, nurses frequently performed tasks requiring clinical judgment, such as verifying prescriptions, consulting with pharmacists, and assessing patients and laboratory values prior to giving medications (Keohane et al., 2008).

Pharmacological Competence of Novices

Pharmacology tasks require contextual decision-making not easily executed by registered nurses until they have practiced for several years (Benner, 1982). Student and new graduate nurses frequently practice at an advanced beginner level of competency, therefore requiring cueing from more experienced nurses to think beyond black-and-white rules, including those related to pharmacology (Benner, 1982). Few studies examined nursing student competence specifically, which was confirmed by one published review of the literature (Suulosaari, Kajandar, Hupli, Huupponen, and Leino-Kilpi, 2012). However, it can be inferred that nursing students and new graduates likely experience similar difficulties when making pharmacological decisions.

Pharmacological decision-making competence of inexperienced nurses was found to be insufficient for optimally safe medication administration by several studies (Dilles et al., 2010; Grandell-Niemi et al., 2005; Ndosi & Newell, 2008). Graduating senior nursing students in a multi-site study of 29 schools obtained a mean score of 55% on one instrument measuring pharmacology application ability (Dilles et al., 2010). A different instrument was administered to 292 pre-licensure students in one program to assess pharmacological competence and participants earned a mean score of 67.9% (Grandell-Niemi et al., 2005). Graduation and licensure did not automatically confer competence in pharmacological therapies as evidenced by 364 registered nurses in the same study obtaining an average score of 77.5% when tested with the same instrument (Grandell-Niemi et al., 2005). This finding was not unforeseen considering that the National Council Licensure Examination for Registered Nurses (NCLEX-RN) was developed to grant licensure in exchange for minimally safe levels of knowledge, skills, and abilities in testing candidates (The National Council of State Boards of Nursing [NCSBN],

2014). Nurses who have attained licensure have demonstrated the capacity to provide safe, effective care at the entry level (NCSBN, 2014).

Nursing students were also more likely to make medication errors due to knowledge deficits regarding pharmacology (Simonsen, Daehlin, Johansson, & Fraup, 2014). A study that compared the medication knowledge and risk for errors of graduating Bachelor of Science in nursing (BSN) students (n=243) to that of registered nurses (n=203) found both groups to have insufficient knowledge of medications (Simonsen et al., 2014). However, the drug management limitations identified in the students were associated with a greater risk of medication errors (Simonsen et al., 2014). Moreover, the incidence of medication errors among nursing students was also found to be quite high (Asensi-Vicente, Jimenez-Ruiz, & Vizcaya-Moreno, 2018). A systematic review of nineteen studies found that students' medication errors were most likely to have occurred during drug administration, but their frequency was decreased substantially when students received guidance from nurse educators (Asensi-Vicente et al, 2018).

Qualitative research investigating nursing pharmacologic competence primarily explored students' reflections and assessments of their medication administration abilities. A common theme verbalized by participants in one recent study was the difficulty transferring didactic pharmacology learning to clinical practice (Preston, Leone-Sheehan, & Keys, 2019). Several prior studies substantiated this finding; all discovered students were frequently metacognitive of their deficits when applying pharmacology knowledge to clinical practice (Honey & Lim, 2008; Reid-Searl, Moxham, Walker, & Happell, 2010). One study suggested this could stem from limited opportunities to practice pharmacology application, especially when educators lacked proficiency in integrating classroom knowledge into clinical learning experiences (Honey & Lim, 2008). Another study found students actively sought supervision from licensed nurses

when providing pharmacological therapies because they were overwhelmingly concerned with their abilities to do so safely (Reid-Searl et al., 2010).

Clinically Centered Learning for Pharmacological Competence

Students in practice disciplines, including nursing, require regular opportunities to rehearse thinking through a variety of clinical scenarios (Benner et al., 2010, p. 29). Learning environments where students are passive recipients of content do not prepare students to solve clinical problems (Benner et al., p. 69). Reflecting on actual or hypothetical clinical situations prepares students for future practice environments where potential outcomes are ill-defined, and decisions highly contextual (Benner et al, 2010, p. 30). This portion of the literature review describes the impact of application and practice-based learning activities on the development of clinical judgment and decision making.

Competence in pharmacology-related decisions was evaluated through comparison of learning activities in three studies (Jarvill et al., 2018; Meechan, Jones, & Valler-Jones, 2011; Sanko & McKay, 2017). A study by Jarvill et al (2018) used a performance checklist to evaluate medication safety competence after students participated in either an individual simulation with a faculty member or a group practice session in the lab. Students who participated in the simulation activities achieved significantly higher scores in pharmacological competency than those who participated in group lab sessions (Jarvill et al., 2018). Meechan et al. (2011) introduced a simulation-based, medications management objective structured clinical examination (OSCE) early in the nursing coursework of one cohort of students. Students who participated in the OSCE early in their studies performed significantly better in medication management and pharmacology knowledge during simulations in later coursework compared to students who did not participate in the OSCE (Meechan et al., 2011). In a third study, Sanko and

McKay (2017) compared the medication administration practices of a cohort (n=60 students) who participated in pharmacology simulations to a second cohort (n=60 students) who attended didactic instructional sessions. The cohort who participated in the simulations obtained significantly higher scores on a tool assessing medication administration practices than the control group (Sanko & McKay, 2017). However, one limitation for all three studies was the evaluation of clinical performance in simulation environments, not during practice in healthcare facilities.

Students whose pharmacology coursework included clinical application of content also achieved significantly higher scores on written assessments of pharmacological and medication administration competence than students whose learning did not include an application component. (Dubovi, Levy, & Dagan, 2017; Geist, Larimore, Rawiszer, & Al Sager, 2015; Harris, Pittiglio, Newton, & Moore, 2014; Meechan, Mason, & Catling, 2010). Geist et al. (2015) achieved this through flipped instructional delivery structured around active, student-centered learning. Dubovi et al (2017) incorporated a virtual reality simulation program that resulted in significant gains in conceptual and procedural learning of medication administration responsibilities. Meechan et al. (2010) integrated medications management activities throughout a previously didactic-only pharmacology course and found students in the blended course were better able to apply pharmacology to patient vignettes. Higher written pharmacology assessment scores were obtained with a one-time intervention of adding simulation content to a review of medication administration competencies (Harris et al., 2014) and when pharmacology was taught through case-based rather than lecture-based instruction (Kantar & Sailian, 2018). A recent systematic review of the literature recommended active strategies such as interactive online modules, simulation, and integration of pharmacology into clinical courses as these have been

found to result in better pharmacology knowledge acquisition (Gill et al., 2019). The only published study which found no significant difference in written assessment scores for simulation-based versus lecture-based instruction was one where the authors acknowledged results may have been influenced by a small sample size (n=23) (Tinnon & Newton, 2017).

Remaining literature reviewed in this area focused solely on the students' perceptions of the benefits of the activity for their learning (Aggar & Dawson, 2014; Ferguson, Delaney, & Hardy, 2014; Sharpnack & Madigan, 2012). Students who participated in active pharmacological learning overwhelmingly reported increased confidence (Ferguson et al., 2014), positive impacts on learning (Sharpnack & Madigan, 2012), and better preparation for future clinical practice (Aggar & Dawson, 2014). However, a limitation of these types of studies is the tendency for students to overestimate both their abilities and learning gains after instructional activities (Dunning, Heath, & Suls, 2004).

Reflection on Practice to Cultivate Clinical Judgment

Reflection on practice as a strategy to build clinical competency has an extensive evidence base in nursing education literature. Recent studies supported structured, instructor facilitated, reflective debriefing on clinical experiences as a method to improve students' clinical judgment during subsequent events (Dreifurst, 2012; Forneris et al., 2015; Hines & Wood, 2016; Lavoie, Pepin, & Boyer, 2013; Mariani, Cantrell, Meakim, Prieto, & Dreifurst, 2013; Page-Cutrara & Turk, 2017; Razieh, Somayah, & Fariba, 2018). Three prior studies utilized Lasater's Clinical Judgment Rubric as the instrument to measure the effects of reflective debriefing after simulation on clinical judgment (Hines & Wood, 2016, Lavoie et al., 2019; Mariani et al., 2013). One study measured clinical judgment at two intervals over one semester and found that students who participated in reflective debriefing achieved higher clinical judgment scores during

simulation although the results were not statistically significant (Mariani et al, 2013). The researchers acknowledged statistical limitations that may have impacted their results and recommended replicating this study with a larger group and a longitudinal design (Mariani et al, 2013). A second study found that providing students with a clinical judgment script helped foster reflective thinking and led to improved clinical judgment scores on LCJR that were statistically significant (Hines &Wood, 2016). The most recent study found students who participated in reflective debriefing following simulation showed greater improvement in recognizing abnormalities during future patient assessments than students who debriefed through self-assessment (Lavoie et al., 2019).

Additional studies reported statistically significant increases in clinical judgment scores following reflective learning activities (Dreifurst, 2012; Fornaris et al., 2015; Page-Cutrara & Turk, 2017). However, these studies used alternative instruments that did not assess and measure clinical judgment through observation of clinical performance, unlike those which utilized Lasater's (2007) rubric. Finally, one qualitative study explored reflective debriefing to build clinical judgment with a pilot group of five students and suggested the strategy was a safe, effective way for students to build clinical decision-making skills (Lavoie, Pepin, & Boyer, 2013).

Lasater's Clinical Judgment Rubric

Lasater's Clinical Judgment Rubric (2007) was designed as a communication tool between students and instructors to provide evaluative feedback on a student's development of clinical judgment (Lasater 2007a; Lasater, 2011). Lasater (2011) selected a rubric as the framework for this tool because rubrics encourage clear communication about the level of performance by providing a common language for educators and students to use when discussing

competence in clinical judgment. This rubric provides opportunities to describe students' performance in each of Tanner's (2006) four phases of clinical judgment, i.e. noticing, interpreting, responding and reflecting, with each phase including several sub-dimensions (Lasater 2007a; Lasater, 2011).

Lasater developed and pilot tested the rubric over seven weeks in an exploratory study in the simulation laboratory. Initial creation of the instrument took place over the first three weeks through observations of student performance. The four phases of the instrument were created first, followed by the eleven dimensions that further elaborated on aspects of the four phases. The four stages of clinical judgment development - beginning, developing, accomplished, and exemplary – were also defined at this time. The instrument was pilot-tested and revised based on an additional four weeks of observing and measuring students using the newly created rubric (Lasater, 2007).

Lasater's initial study to develop and pilot test the rubric found a mean measurement of 22.98 points (n=26) out of a potential maximum measurement of 44 points in third semester baccalaureate students with a measurement range from 5-33 points (Lasater, 2007). The potential exists for students to achieve higher levels for some criteria by the conclusion of the semester, e.g. a student with beginning clinical judgment may progress to developing or possibly accomplished depending on educational opportunities to develop clinical judgment. Students are expected to be at the accomplished level for all criteria (measurement of 33) by completion of their undergraduate studies. Some students may achieve a measurement of exemplary for certain criteria, particularly if they transfer competencies from prior professional experiences (Lasater, 2007). One example provided by Lasater would be the area of clear communication (Lasater, 2011). Although the rubric is often used to track growth in clinical judgment over an entire

program of study, small to moderate increases in clinical judgment have been observed during prior studies conducted over shorter periods of time; the primary example being the initial study when LCJR was developed, which took place over seven weeks (Lasater, 2007; Lasater 2011).

Lasater's Clinical Judgment Rubric (LCJR) has been employed in a diversity of prior research studies to assess and measure nursing students' clinical judgment abilities. The majority of these studies have evaluated clinical judgment during simulation-based learning experiences (Adamson & Kardong-Edgren, 2012; Blum et al., 2010; Bussard, 2018; Dillard et al., 2009; Fenske, Harris, Aebersold, & Hartman, 2013; Jensen, 2013; Lasater, 2007b; Shinnick & Cabrera-Mino, 2020; Strickland, Cheshire, & March, 2017). One study used LCJR to assess whether clinical judgment ability in simulation correlated with classroom performance (Hallin et al., 2016) while another assessed whether clinical judgment measured during simulation correlated with performing the expected nursing responses during simulation (Fedko & Dreifurst, 2017).

It was more difficult to source studies that evaluated students' clinical judgment during healthcare facility-based clinical learning. However, one multi-site study employed LCJR across a diversity of clinical learning environments to evaluate and compare clinical judgment abilities of junior and senior medical-surgical nursing students (Manetti, 2018). Another multi-site study employed LCJR to compare clinical reasoning abilities between students in different types of nursing preparation programs (Jensen, 2013). An additional multi-site mixed methods study utilized LCJR as a framework to guide participants' reflective observations of their own clinical judgment abilities (Moneagle, Lasater, Stoyles, & Dieckmann, 2018).

Single site studies have used this rubric to validate simulation learning and evaluation tools (Adamson & Kardong-Edgren, 2012), to compare student self-assessment of clinical

judgment to actual skill (Fenske et al.,2013), to identify predictors of clinical judgment (Shinnick & Cabrera-Mino, 2020), to compare case-based to lecture-based learning (Kantar & Sailian, 2018), and to assess faculty's ability to facilitate transfer of learning between the simulation to clinical learning environments (Dillard et al., 2009). Lasater and Nielsen (2009) used this rubric to measure the impact of concept-based learning activities on clinical judgment scores. One recommended area for further research using LCJR is exploring the impact of reflection on clinical judgment development (Lasater, 2011). This study was designed to address this gap in the literature identified by Lasater.

Two studies found LCJR to be one of only a few tools that meet criteria for evaluating learning in more than just the cognitive domain. A study by Kardong-Edgren, Adamson, and Fitzgerald (2010) reviewed 22 simulation evaluation tools and found LCJR to be only one of three instruments that simultaneously addresses learning in all three domains: cognitive, affective, and psychomotor. Davis and Kimble (2011) evaluated six simulation rubrics in another study and found LCJR to be one of two that addressed all three learning domains.

Additional studies have determined this tool has good reliability and interrater reliability provided measures are taken to ensure consistency among raters prior to the evaluation of students (Adamson & Kardong-Edgren, 2012; Adamson, Gubrud, Sideras, & Lasater, 2012; Blum, Borglund, & Parcells, 2010). Interrater reliability is frequently a concern when multiple educators evaluate student clinical performance due to differences in rater interpretation of behaviors. Therefore, Adamson et al. (2012) recommended best practices for using Lasater's rubric to assess clinical judgment behaviors based on their analysis of three studies related to psychometric implications of this tool.

Nielsen et al.'s Guide for Reflection

A Guide for Reflection based on Tanner's Model and LCJR was created by Nielsen, Stragnell, and Jester (2007) that provides prompts educators may use to elicit verbal or written student reflection on clinical judgment. This tool was intentionally created to be employed across diverse clinical learning environments and at various academic levels in nursing to promote reflective thinking and the development of clinical judgment using the student's own experiences to frame the reflective activity (Nielsen et al., 2007) The guide's questions are open-ended enough to be asked about any clinical event where a student must access prior knowledge, integrate it with new information gained during the experience, and consider what additional understanding must be acquired (Nielsen et al., 2007). Although the entire guide provides a reflective learning experience, the final questions require students to reflect on their own thoughts and reflections about the experience, promoting metacognition and deeper learning (Nielsen et al., 2007).

The Guide for Reflection was originally created to be a written reflective activity; however, the authors intended it to stimulate conversation between educators and students with each instance of feedback prompting additional dialogue and feedback (Nielsen et al., 2007). This structure supported adopting the guide as a conversational debriefing activity in which student responses will assist the facilitator of the activity to cue students towards deeper understanding of specific events. A later initiative by Lasater and Nielsen (2009) found the guide valuable in making students' clinical thinking evident to educators, allowing them to discover misunderstandings and guide students towards the development of greater clinical judgment.

Summary of Literature

The literature confirmed many nurses graduate with deficits in pharmacology knowledge, clinical judgment, and application (Dilles et al., 2010; Grandell-Niemi et al., 2005; Ndosi & Newell, 2008; Sulosaari et al., 2012; Sulosaari et al., 2015). Older evidence indicated nurse educators have been aware of the challenges of linking classroom pharmacology content to clinical application for some time (Banning, 2003; King, 2004; Latter et al, 2001). Practice disciplines, such as nursing, should include frequent opportunities for students to apply discipline-specific knowledge towards solving problems they will encounter in practice (Benner et al., 2010). Significant improvements in pharmacology knowledge and application have been measured through student observation and evaluation of written work following the integration of active learning into pharmacology (Dubovi et al., 2017; Geist et al., 2015; Harris et al., 2014; Jarvill et al., 2018; Meechan et al., 2011; Meechan et al., 2010; Sanko & McKay, 2017). Diverse active learning strategies that build competency in clinical judgment continue to be recommended to prepare pre-licensure nurses for eventual clinical practice (Institute of Medicine [IOM], 2011; NLN, 2003). However, nursing education must increase the quality and quantity of research substantiating these recommendations (Morton, 2017). Additionally, it has been recommended that nursing education increase the number of studies that evaluate learning outcomes through observation and measurement as opposed to through learner or educator perception (Baxter & Norman, 2011; Ironside & Spurlock, 2014, NLN, 2013; Spurlock, 2017). At this time, studies comparing active to traditional methods, particularly through measurement of clinical performance, appear to be limited. As nursing education will likely continue to advocate for active, student-centered instruction, additional high-quality studies that assess its effectiveness on student clinical judgement are essential.

Problem Statement

Registered nurses across a diversity of practice settings must be able to integrate foundational pharmacology knowledge with current patient data to provide medication therapy that is not only safe but addresses the unique needs of each patient. (National Council of State Boards of Nursing [NCSBN], 2015, pp 29-30). Clinical judgment about medication therapies is often highly situational, as nurses must consider prescribed medications within the context of each patient's clinical status. However, undergraduate pharmacology courses often lack clinical application opportunities, as they are taught primarily through classroom-based learning. Moreover, advanced beginner nurses are often rule-based thinkers who have difficulty with discretionary judgment and contextual decision making (Benner, 1982). Clinical judgment requires abstract thinking abilities that often are not sufficiently established until several years into the nurse's practice (Benner, 1982). Abstract thinking enables a practitioner to "think beyond the rules" regarding pharmacological nursing interventions and make judgments that lead to optimal patient outcomes (Keohane et al., 2008).

Competence in clinical judgment, including the ability to make nuanced decisions about pharmacological therapies, is cultivated through repeated opportunities to practice and reflect on clinical decisions (Tanner, 2006). Reflection after clinical experiences helps foster a nurse's overall clinical judgment abilities, including those involving provision of pharmacological therapies (Tanner, 2006). Nurse educators must identify and promote learning activities that most effectively develop graduates' competency in providing safe, individualized medication therapy. Providing opportunities for reflection on pharmacology experiences during and immediately after clinical provides opportunities for nursing students to cultivate their clinical judgment abilities (Tanner, 2006).

Theoretical Framework

Tanner's Clinical Judgment Model (TCJM) delineates the progressive acquisition of clinical judgment capabilities in nurses and was selected as the theoretical framework to guide this study (Tanner, 2006). Tanner created the model after an initial review of the literature in 1998 that covered 120 articles and a follow-up review in 2006 that explored another 71 articles. Search terms for the reviews of literature included clinical judgment and clinical decision making (Tanner, 2006). Studies were primarily descriptive and addressed questions about nurses' reasoning in clinical settings, the role of the nurses' experience in their reasoning, and the factors affecting nurses' clinical reasoning (Tanner, 2006). When developing this model, Tanner drew five primary conclusions from the body of literature on clinical judgment in nursing:

> (1) Clinical judgments are more influenced by what nurses bring to the situation than the objective situation at hand; (2) Sound clinical judgment rests to some degree on knowing the patient and his or her typical pattern of responses, as well as engagement with the patient and his or her concerns; (3) Clinical judgments are influenced by the context in which the situation occurs and the culture of the nursing unit; (4) Nurses use a variety of reasoning patterns alone or in combination; (5) Reflection on practice is often triggered by a breakdown in clinical judgment and is critical for the development of clinical knowledge and improvement in clinical reasoning (Tanner, 2006, p.204).

Nurse educators should choose to design learning experiences that encourage diverse patterns of clinical reasoning, stimulate reflection, and impact what students bring to clinical situations, even when there is little control over clinical environments, nursing unit culture, and familiarity with patients.

Tanner's Clinical Judgment Model describes four interrelated, cyclical aspects of clinical judgment in nursing practice: noticing, interpreting, responding, and reflecting (Tanner, 2006). Noticing is the nurse's initial grasp of a patient's situation, where the nurse contrasts overt patient findings with expectations based on previous experiences (Tanner, 2006). Interpreting is characterized by analytic and intuitive reasoning, where the nurse attempts to make meaning of the situation, often influenced by narratives of previous and hypothetical patients (Tanner, 2006). Responding occurs as the nurse intervenes in the situation, which includes determining which additional assessments are needed (Tanner, 2006). Tanner (2006) maintained reflecting is a significant component of the entire model and includes both reflection-in-action and reflection-on-action. Reflection in-action occurs during interaction with the patient as the nurse "reads" the situation and adjusts care (Tanner, 2006). Reflection-on-action creates conceptual knowledge nurses retrieve during subsequent patient situations, thereby advancing clinical judgment competency regardless of the outcome of the situation (Tanner, 2006). Tanner acknowledged studies linking reflection and clinical judgment are fewer in number. However, Tanner referenced Benner's (1991) research on how nurses construct narratives based on clinical experiences to learn from prior mistakes or knowledge deficits. Tanner also cited a number of studies linking reflection to development of clinical knowledge, improved judgment during complex situations, and construction of clinical reasoning (Tanner, 2006).

In nursing education, reflection occurs both during clinical learning experiences where students learn to "read patients" and after, as students contemplate how decisions affected patient outcomes (Tanner, 2006). The student begins to construct narratives of potential outcomes for various patient events and carries lessons learned through reflection into each successive clinical situation, gradually constructing clinical decision-making skills (Tanner, 2006). Learning

activities where students consider qualitative differences between patient and textbook data before making clinical decisions should result in gains in clinical judgment and understanding (Tanner, 2006). Clinically focused active learning strategies such as case studies, simulations, and clinical experiences where students made decisions about medication therapies have all been shown to promote pharmacological clinical judgment abilities (Dubovi et al., 2017; Geist et al., 2015; Harris et al., 2014; Jarvill et al., 2018; Meechan et al., 2011; Meechan et al., 2010; Sanko & McKay, 2017). However, specifically guiding students to reflect on and analyze outcomes related to administering pharmacological therapies should fulfill criteria deemed necessary by Tanner (2006) to foster stronger clinical judgment.

This study aimed to address this by answering the following research questions:

1. Do students enrolled in a critical care course achieve statistically significant increases in clinical judgment measurements as measured by Lasater's Clinical Judgment Rubric (LCJR) during pharmacological decisions at mid- and late-semester irrespective of their method of post-clinical debriefing?
2. Do students enrolled in a critical care course who participate in post-clinical debriefings requiring reflection on pharmacological decision making achieve greater increases in measurements on LCJR at mid- and late-semester compared to students who do not participate in these debriefings?

CHAPTER III - METHODS

Introduction

This study investigated the impact of reflection about pharmacological situations in clinical on student clinical judgment measurements collected over one 12-week clinical course. This chapter will describe the methods implemented by the researcher to answer the research questions proposed by this study. The following elements are addressed in this section: a) study design, b) study methods, c) participants and setting, d) ethical considerations, e) instrumentation, f) instructional intervention, g) establishment of interrater reliability, h) data collection, i) data analysis, and j) study limitations.

Study Design

This study investigated the research questions using a comparative, descriptive, repeated measures design. For research question one, time functioned as the independent variable while clinical judgment measurement functioned as the dependent variable. For research question two, time and method of post-clinical debriefing functioned as the two independent variables, clinical judgment measurement functioned as the dependent variable, and early semester clinical judgment score functioned as the covariate. The study was repeated for two semesters to recruit an adequate number of participants (n = 128) to determine statistical significance for research question two.

During each semester's twelve weeks of clinical instruction, students in the intervention group participated in two sessions of reflective debriefing about pharmacological activities in

clinical for one hour of their regular clinical post-conference time. Questions from Nielsen et al.'s (2007) Guide for Reflection were used to initiate conversation during the debriefings and to keep the conversation focused towards reflection on recent clinical activities; however, the researcher asked follow-up questions based on the students' individual experiences. See Appendix B (Guide for Reflection). Clinical faculty occasionally prompted students to discuss specific experiences. Students in the control group participated only in regular post-clinical learning activities. Clinical judgment measurements were collected during three time periods for both the intervention and control groups using Lasater's Clinical Judgment Rubric (LCJR). See Appendices A (LCJR) and C (Lesson Plan for Reflective Debriefing Sessions).

Study Methods

The researcher obtained permission from the teaching team of the fourth semester critical care course team both to implement the study within the clinical component of their course and to ask clinical faculty to serve as raters / data collectors for the study. Interrater training was included as part of the course team's pre-semester planning day as all clinical faculty agreed to serve as raters. Half of the course's clinical sections were selected to receive the intervention of reflective debriefing. Intervention groups were selected based on the researcher's availability to visit post-conferences; thus, the participants were not randomized. The researcher also intentionally assigned clinical groups taught by each of the eight clinical faculty to both the intervention and control groups to ensure each faculty was evaluating students in both groups. Although interrater reliability was established prior to data collection, this distributed the participants taught by each of the eight clinical faculty close to evenly between the intervention and control groups. The researcher created a schedule for the reflective debriefing sessions which was shared with all clinical faculty prior to the beginning of each semester of the study.

Plans were established to obtain written, informed consent from participants on the day of class immediately prior to the beginning of clinical rotations each semester.

Clinical judgment measurements were obtained for all students at the beginning, middle, and end of the semester by clinical faculty raters using LCJR. The three time periods for data collection were the initial two weeks in the clinical setting, the middle 2 weeks of clinical, and the final two weeks in the clinical setting. Over twelve weeks of clinical, students in the intervention clinical groups participated in two sessions of reflective post-conference debriefing targeted towards the students' pharmacological activities during clinical, while students in the control clinical groups participated in standard post-clinical learning activities. The first reflective debriefing sessions took place between the first and second measurements and the second sessions took place between the second and final measurements. A detailed timeline for the study is depicted below in figure 2.

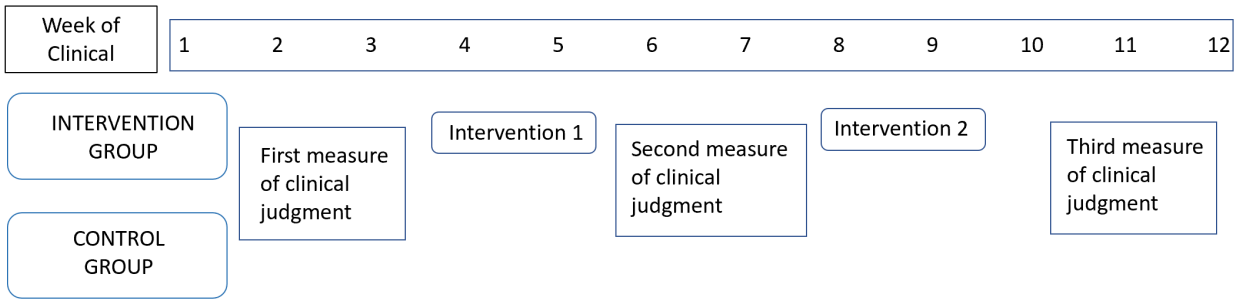


Figure 2. Diagram Depicting Placement of Clinical Judgment Measurements and Debriefing Sessions within Clinical Schedule

Mean mid- and late-semester clinical judgment measurements of students who participated in reflective debriefing on medication administration experiences in clinical post-conference were compared to measurements of students who participated in standard clinical

post-conferences. Rubrics from students who elected not to participate in the study were destroyed; their measurements were not included in the data analysis. Forty students' measurements were excluded from data analysis due to study design or due to issues arising during data collection. Specific reasons for study exclusion will be discussed in more detail with study results in Chapter IV. This study attempted to determine: 1) If clinical judgment measurements related to pharmacological clinical activities increased significantly over one semester regardless of method of post-clinical instruction, and 2) If students who participated in reflective debriefings on pharmacological clinical activities achieved statistically significant changes in clinical judgment measurements over one semester compared to students who participated in standard clinical post-conference activities.

Participants and Setting

An a priori power analysis conducted using G-Power 3.1.9.4 determined a sample size of 128 participants was required to answer research question two using a repeated measures, between-groups ANCOVA with an alpha of 0.05, a power level of 0.8, and a medium effect size (0.25) for two participant groups and three measurements. A power level of 0.8 was selected to ensure the sample size would be adequate to determine statistically significant changes in clinical judgment scores resulting from the intervention while also considering a realistic number for study participation (Cohen, 1992; Lomax & Hahs-Vaughn, 2012). Based on enrollment numbers, 170 students met eligibility criteria for inclusion in this study. Because small to moderate changes in measurements on LCJR indicate meaningful changes in clinical judgment, a medium effect size of 0.25 was selected for this study (Lasater, 2007a). The a priori power analysis for the repeated measures within-groups ANOVA required to answer research question one required a smaller sample size of 28 when the same input parameters were applied.

A public university in the southeastern United States with an average annual enrollment of 9700 students was the setting for this study. Participants were recruited from the prelicensure, Bachelor of Science in nursing (BSN) program during the first two weeks of their critical care nursing course, a fourth semester course in the program's upper-division nursing coursework. The upper-division curriculum in this program includes five semesters in total. The fourth semester was selected as an opportune time to develop clinical judgment relating to pharmacological therapies. As these students progress to more independent clinical experiences in semester five, including hospital preceptorships and community-based practice, building clinical judgment skills in pharmacology will be beneficial for future clinical learning. Moreover, when approached about the possibility of this study taking place in their course, the critical care teaching team enthusiastically welcomed the opportunity to include their students in activities with a potential to develop clinical judgment.

Ethical Considerations

Before recruitment of participants, Institutional Review Board (IRB) approval for this study was obtained from both the university where the study took place and the university where the researcher was pursuing doctoral studies (See Appendices G and H). Because the researcher teaches courses in the second and third semesters of this program, a study recruiting fourth semester students presented fewer ethical concerns than if participants were currently taught by the researcher or would be taught by the researcher in subsequent semesters. Students were informed of the potential benefits and risks of participating in the study and were made aware of their rights as participants through a recruitment script and were encouraged to ask questions during the researcher's visit to their class (See Appendix D). The researcher emphasized

declining to participate would not impact grades or clinical performance evaluations in this or subsequent courses in the curriculum.

All students in the fourth semester of their program of study during the time of the research study were given the opportunity to participate in the study. The researcher decided students repeating the course would be allowed to participate in the intervention, but their clinical judgment measurements would be excluded from data analysis as they may bias results. One student repeated the course during the two semesters the study took place. Written consent was obtained from each participant before any activities related to the study took place. See Appendix E for a sample of the consent form, including the invitation to participate in the study.

Finally, after both semesters of data collection were complete, a self-study module was offered through the learning management system (LMS) for both cohorts of students. This module provided copies of the reflective questions asked during the pharmacology debriefings and a screencast that guided students through applying these questions to hypothetical clinical scenarios involving medication therapies. This allowed students in the control group to access a learning activity similar to the one used in post-conferences with the experimental group.

Clinical faculty who served as data collectors for the study all completed Collaborative Institutional Training Initiative (CITI) Human Subjects Training and Certification prior to collecting student data. CITI certificates for all data collectors were submitted as part of the IRB application for this study. All faculty data collectors were approved by both IRBs to handle participant data. An additional faculty member without CITI certification was hired midway through the study. Participants taught by this faculty member were excluded from data collection.

Instrumentation

Lasater's Clinical Judgment Rubric (LCJR) was employed to score the clinical judgment level of fourth semester senior nursing students as they provided pharmacological therapies in the clinical learning environments at three points over the semester (See Appendix A). Permission was obtained from Dr. Kathie Lasater, EdD, RN to use her rubric for this study (See Appendix F). This instrument evaluates clinical judgment across eleven dimensions distributed among the four phases of Tanner's (2006) Clinical Judgment Model: noticing, interpreting, responding, and reflecting. Participants were evaluated at one of four levels for each dimension: beginning, developing, accomplished, and exemplary. The expectation is that nursing students will attain the accomplished level by the end of their prelicensure studies as previously established by Lasater (2011). For the purposes of this study, numerical scores of 1-4 were assigned to each respective level of the rubric, as the developer of the instrument also calculated measurements through this method in the original study (Lasater, 2007a).

Construct and content validity of LCJR have been established by multiple prior studies (Kardong-Edgren et al., 2010; Ashcraft & Opton, 2009; Davis & Kimble, 2011; Victor-Chmil & Larew, 2013). The rubric exhibited internal consistency with a Cronbach alpha of 0.95 (Jensen, 2010) and possessed good to very good construct validity with z scores for its eleven individual dimensions ranging from 0.66-0.96 (Gubrud-Howe & Sideras, 2011). When considering content validity, the rubric has been determined to be effective for evaluating learning across both the cognitive and affective domains (Davis & Kimble, 2011; Kardong et al., 2010). Interrater reliability has been measured both through intraclass correlation with a result of 0.889 and through percent agreement strategies with results of 92-96% for one study and 57-100% for another (Adamson, Gubrud, Sideras & Lasater, 2012).

Instructional Intervention

The educational intervention in this study included two sessions of reflective debriefing on recent pharmacology activities during twelve weeks of clinical in one semester. Reflective debriefing was selected as the educational intervention for this study based on its capacity to help students construct new knowledge following reflection on clinical learning events (Cantrell, 2008; Dreifurst, 2009; Dreifurst, 2012). All students, regardless of whether they consented to data collection, received the reflective debriefings as part of their clinical post-conference if their clinical group was included in the intervention group for the study. The first sessions took place between the first and second measures of clinical judgment at weeks four and five while the second sessions were conducted between the second and third measures of clinical judgment at weeks eight and nine. A figure depicting the timing of the reflective debriefing sessions and measures of clinical judgment for intervention clinical groups is depicted below in Figure 3:

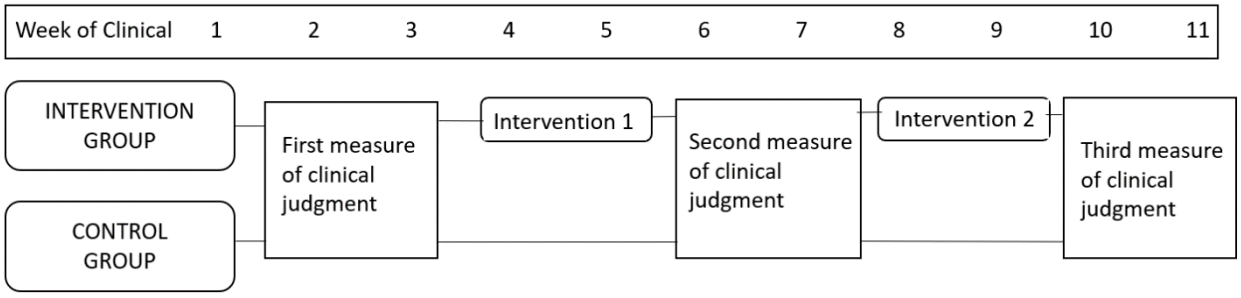


Figure 3. Diagram Depicting Placement of Debriefing Sessions Between Clinical Judgment Measurements for the Intervention Group

Each debriefing session lasted 45 minutes to one hour during participating clinical groups' post-conferences, providing an opportunity for immediate reflection on the clinical day's events. During each session, the researcher asked questions from Nielsen et al.'s (2007) Guide for Reflection which was developed using Tanner's Clinical Judgment Model as a framework (see Appendix B). Nielsen et al. (2007) intended their guide to be valuable in situations where

the facilitator of the reflective discussion has not directly observed students, which was the case for this study. Questions were selected based on the experiences the students volunteered to share, and the researcher intentionally included questions that addressed all four domains of clinical judgment. All sessions began with the researcher asking the initial question on the guide with that question targeted towards pharmacology, i.e. "Describe a clinical situation you encountered in the past week related to pharmacology." (Nielsen et al., 2007). A sample lesson plan is included as Appendix C in this document.

In order to include all students in the reflective activity, the researcher requested each student volunteer an experience from clinical that day or the week prior that involved decision making about pharmacological therapies. The researcher facilitated the session to ensure the discussion stayed directed towards pharmacology and incorporated Nielsen et al.'s (2007) questions; however, input from each group's clinical faculty member was occasionally solicited to prompt students about potential experiences for discussion. The small number of students in each clinical group (n=5-6 students) resulted in active participation by all students. The researcher also deliberately interacted with each student multiple times to prompt reflection on related clinical events. For example, if one student discussed a situation about an adverse reaction to a medication, the researcher asked other students to compare this to patients they had cared for who responded favorably to the medication or to other patients who had adverse reactions to medications. Ideally, this encouraged all students in the clinical group to reflect on similar scenarios previously encountered, how they managed similar patient situations, or consider what actions they might take in future situations.

Establishment of Interrater Reliability

Prior to the semester when the study began, the researcher provided interrater training to the clinical teaching team for the critical care course using the methods recommended by Dr. Lasater (See Appendix F). Training occurred one week before the semester's clinical learning experiences, allowing faculty to become familiar with the rubric within weeks of using it to collect data. A refresher course was also provided during the three-week time period between the two semesters of data collection. These scheduled times also ensured faculty were present on campus to attend the training session together. Eight clinical faculty taught in the critical care course during both semesters of the study and agreed to collect data. Four were masters or doctorally prepared full-time faculty. Two adjunct faculty were masters prepared (one in a doctoral program) and two were graduate teaching assistants. All had prior experience evaluating student learning as faculty or as preceptors in critical care settings. All had earned CITI certification for protection of human research subjects. A ninth adjunct faculty member was added to the course shortly before the second semester of data collection but was excluded as a data collector because she had not participated in interrater training and did not have CITI certification. Omitting this faculty member excluded eight students as participants in the study.

The objectives of the training were to familiarize clinical faculty with LCJR and its recommendations for use, to provide an opportunity to practice evaluating students using the instrument, and to establish interrater reliability. After defining the criteria and competency levels of the rubric, the researcher emphasized the protocol for the study was to consider multiple events of clinical judgment at each measurement interval (Lasater, 2007; Lasater, 2011). Expected performance by senior nursing students was also emphasized during this training. The researcher made faculty aware that fourth-semester students may begin the semester at the

beginning to developing level for all or most criteria on the rubric but could potentially progress to developing to accomplished by the end of the semester (Lasater, 2011).

Faculty practiced scoring with LCJR by viewing videos of nursing students making clinical decisions. Videos were provided by the Learning and Technology Resource Center (LTRC) at the university where the study would take place. Permission to use the videos for training was obtained from the executive director of the LTRC. Moreover, all students in the nursing program who were recorded during simulation had signed consents for their videos to be viewed for educational and research purposes. The researcher selected videos that illustrated varying levels of clinical performance by nursing students, allowing raters to discriminate between the levels of beginning, developing, accomplished, and exemplary. Clinical faculty then practiced scoring the students in the videos with the rubric. In between each video, the instructor debriefed the teaching team, asking them about the scores they provided and their rationales. This was done to help build consensus among raters about what scores they felt best described the performance of the clinicians in the video.

The researcher replicated methods for establishing interrater reliability discussed in two previously published studies that were similar in both number of raters and expected variation in clinical events and rater evaluation (Adamson et al, 2012). In both studies, raters viewed videos of selected clinical scenarios and scored them using LCJR until greater than 90 percent consistency was achieved between individual raters (Adamson et al., 2012). This was also the method recommended by Dr. Lasater when approached by the researcher about the study (See Appendix E). One study established 92 percent rater agreement for the entire group after training while the other achieved varying levels of rater agreement from 57-100 percent for pairs of raters (Adamson et al, 2012). One limitation of the study with widely varying levels of interrater

reliability was it relied on independent web-based training instead of face-to-face group training (Adamson et al., 2012). The researcher deliberately trained all raters simultaneously with group discussion of scores in an effort to achieve greater interrater reliability. Greater than 90% consensus was achieved after viewing and discussing seven videos.

Data Collection

Clinical judgment data were collected by clinical faculty raters using LCJR three times in twelve weeks during each semester. Student clinical judgment regarding pharmacological therapies was evaluated and measured by course faculty during the first two weeks, middle two weeks, and final two weeks of the clinical experience. Multiple observations of student pharmacological clinical activities and discussions about medications with students were considered at each data collection point as recommended by the developer of the instrument (See Appendix E). All students taught by the eight participating faculty members were evaluated and scored using LCJR; faculty did not know which students had or had not consented to participate in the research.

The researcher provided each faculty member with enough copies of Lasater's Clinical Judgment Rubric to score each student three times over the semester. Additional copies of the rubric were provided to faculty to use as needed. The researcher collected the completed rubrics from each faculty member immediately after each measurement and destroyed the rubrics of students who did not consent to participate in the study. Names from the rubrics belonging to participants were replaced by codes that specified whether the rubric belonged to a participant in an intervention clinical group or the control clinical group. The coded rubrics were stored in a locked file cabinet to maintain confidentiality. All rubrics of participants will be destroyed after six years, per IRB policy.

Statistical Analyses

Data collected from this study were entered into SPSS v26.0 (IBM, 2019). Statistical analyses consisted of repeated-measures analysis of variance (ANOVA) and repeated-measure analysis of covariance (ANCOVA) calculations to determine within and between groups variance in mean clinical judgment scores. Data were collected after observation of students in early, mid, and late semester.

The purposes of this study were to: a) assess for changes in clinical judgment measurements in the area of pharmacological decision making for students in a critical care course over one semester and b) determine whether participation in reflective debriefing on clinical pharmacological activities led to statistically significant differences in changes in measurements when compared to participation in standard post-conference activities. It was hypothesized that student clinical judgment scores during medication administration activities would increase for participants in both the experimental and control groups over the semester due to participation in typical clinical learning experiences. Moreover, the researcher hypothesized that clinical judgment scores for students who participated in post-clinical activities that incorporated reflection on pharmacological activities would increase at a rate that was significantly different at mid and late semester compared to students in the control group who participated in standard clinical post-conferences.

The study proposed the following two questions:

1. Do students enrolled in a critical care course achieve statistically significant increases in clinical judgment measurements as measured by Lasater's Clinical Judgment Rubric (LCJR) during pharmacological decisions at mid and late semester irrespective of their method of post-clinical debriefing?

2. Do students enrolled in a critical care course who participate in post-clinical debriefings requiring reflection on pharmacological decision making achieve greater increases in measurements on LCJR at mid and late semester compared to students who do not participate in these debriefings?

Research question one was analyzed through a repeated measures, within-groups ANOVA for the entire group of participants to assess for changes in clinical judgment for the entire study cohort at mid- or late-semester compared to early-semester. Data collection time point was the independent variable and clinical judgment measurement was the dependent variable for this calculation. Research question two was analyzed through a between-groups analysis of co-variance (ANCOVA) with the early semester score as the covariate. Method of post-conference learning, i.e. reflective debriefing versus traditional, was the independent variable for this calculation while clinical judgment measurement was the dependent variable. Mid-semester and late-semester measurements were examined separately for significant differences in the two groups at each time point. Because participants were selected to receive the intervention based on clinical group assignment, they were not randomized to the intervention and control groups. This element of study design factored into the decision to use a repeated measures ANCOVA to answer research question two. Because an ANCOVA controls for any differences in early semester scores between the two groups (Lomax & Hahs-Vaughn, 2012), the researcher did not need to assess for differences in clinical judgment scores between the intervention and control groups at the beginning of the study.

Assumptions and Limitations of Data Analysis

Repeated measures analyses make several statistical assumptions that will be analyzed and discussed in detail in Chapter IV. These assumptions relate to normality of data distribution

and whether the analysis recognizes and accounts for assumptions that are violated (Lomax & Hahs-Vaughn, 2012). In addition, because repeated measures studies are longitudinal, there was a risk some participants would not complete the study due to withdrawal from the course prior to completion of the semester. For this study, few students (3 of 168) withdrew prior to conclusion of data collection. Nevertheless, if a large percentage of students with lower performance had dropped out of the study due to course withdrawal, bias would have been a concern, due to greater participation by high-performing students.

Summary

This chapter described the methodology employed in this study and included discussion of research design, description of the sample and setting, and psychometric properties of the research instrument. Procedures to establish interrater reliability were carefully considered and the study's educational intervention was described in detail. Rationales were provided for the statistical analyses selected to answer each research question and included measures taken during power analysis to ensure statistically powerful results. A convenience sample of 168 students consented to participate in this study and 128 met criteria for inclusion in the data analysis. Statistical analyses of data required to answer the two research questions in this study will be discussed in the following chapter.

CHAPTER IV - RESULTS

Introduction

The purpose of this repeated-measures study was to determine the impact of a post-clinical pharmacological debriefing activity on clinical judgment measurements for students in a critical care course. Course clinical faculty measured clinical judgment for all participants using Lasater's Clinical Judgment Rubric (2007) during three time periods over the 15-week semester; one during the first two weeks in the clinical setting, the second at midterm, and the third during the final two weeks in the clinical setting. Assessment was based on observations and conversations with students before, during, and following pharmacological decisions and interventions in clinical. Students assigned to clinical groups that received the intervention participated in two post-clinical pharmacological debriefings facilitated by the PI in place of two clinical post-conferences; the first debriefing occurred between measures one and two while the second occurred between measures two and three. Students assigned to control clinical groups participated in standard clinical post-conferences each week. The study was repeated for two semesters, fall 2019 and spring 2020, to meet conditions for sample size (N=128) determined through a priori power analysis.

The PI entered clinical judgment data recorded by the faculty data collectors into Statistical Package for the Social Sciences (SPSS) version 26 (2019). Descriptive statistics were first generated for both research questions. The researcher next analyzed whether clinical judgment measurements for the entire group changed at a statistically significant rate from

measures one to two, two to three, and one to three using a repeated measures analysis of variance (RM-ANOVA) Finally, changes in clinical judgment measurements of students who participated in two sessions of the pharmacology debriefing activity were compared to changes in measurements of students who did not receive this intervention using a repeated measures analysis of covariance (RM-ANCOVA), fixed effects, main effects and interactions. The researcher selected this analysis to control for any differences between the two group's first, pre-treatment measurements by treating them as covariates in the analysis. This chapter will first describe demographics of participants and then elaborate on the statistical analyses related to the two research questions.

Demographic Data of Participants

Nearly all (168 of 170) eligible students in their fourth semester of a prelicensure, Bachelor of Science in Nursing (BSN) program consented to participate in this study. However, this number was reduced to 128 due to several exclusion criteria and circumstances during the study. Eight students were excluded because a part-time instructor hired halfway through the study provided their clinical education. This clinical faculty member lacked CITI certification and had not participated in interrater training with the rest of the clinical teaching team. Three students dropped the critical care course mid-semester and therefore left the study, while one other student was excluded because she had previously taken the course. The final 26 students were excluded for missing data. The majority of these students (n= 20) were unable to complete hospital-based clinical learning and be observed for their final LCJR measurement after hospitals dismissed nursing students due to the COVID-19 outbreak. The other six students had missing data due to absences from clinical during weeks that included the reflective debriefing sessions.

Half of the clinical groups for the course had been pre-assigned by the researcher to receive the reflective debriefing intervention. These assignments were determined to arrange the debriefings so they would not conflict with the researcher's own teaching responsibilities. Additionally, the researcher ensured that each of the eight clinical faculty would be assigned an equal number of intervention and control clinical groups. Although, interrater reliability had been established prior to the study, the researcher selected this strategy to address any remaining differences between raters. Participants were therefore assigned to either the intervention or control group based on clinical group assignment.

Participants ranged in age from 20 - 51 years of age, with a mean age of 24. The researcher was interested in age of participants because transfer of competence from previous degrees or occupational experiences correlated with higher clinical judgment measurements in Lasater's original studies (Lasater 2007; Lasater 2011). Twenty-one percent of participants (n= 27) were 25 years of age or older, while seventy-nine percent (n= 101) fell into the traditional undergraduate age range of 18-24 years old. A greater number of participants were female (n= 111) than male (n= 17). Twenty-one percent of the sample population identified as part of a racial or ethnic group other than white, non-Hispanic (n=27). Table 1 presents the demographic data of participants.

Table 1: Demographic Characteristics of Participants

Descriptor	N	Percentage
Age		
Age 18-25	101	79
Age Older than 25	27	21
Gender		
Female	111	87
Male	17	13
Race / Ethnicity		
White, Non-Hispanic	101	79
Black, Non-Hispanic	12	9
Hispanic, Any Race	5	4
Asian / Pacific Islander	6	5
Native American	2	1.5
More than One Race	2	1.5

Changes in Clinical Judgment Measurement over One Semester's Clinical Instruction

Research question one asked, "Do students enrolled in a critical care course achieve statistically significant increases in clinical judgment measurements as measured by Lasater's Clinical Judgment Rubric (LCJR) during pharmacological decisions at mid- and late-semester irrespective of their method of post-clinical debriefing?" To answer this question, clinical faculty data collectors assessed the clinical judgment of all participants at three intervals during the clinical component of a critical care course using Lasater's (2007) Clinical Judgment Rubric

(LCJR). This instrument has a potential total measurement range from 11-44 when all criteria are addressed. Measurement ranges for each of the four sub-domains are noticing 3-12, interpreting 2-8, responding 4-16, and reflecting 1-8 (Lasater, 2007).

Descriptive Statistics

The mean total clinical judgment measurement (n= 128) of the group at early semester was 26.06 (SD = 7.253). Mid-semester (n= 128) and late semester (n= 128) data collection yielded increased measurements of 29.58 (SD = 5.924) and 30.58 (SD = 6.615) respectively. Table 2 details the descriptive statistics for these three measurements.

Table 2: Descriptive Statistics for Mean Clinical Judgment Measurements at Each Time Interval

Total Clinical Judgment Measurement: Full Cohort	N	Mean	Std. Deviation
Early-Semester	128	26.06	7.253
Mid-Semester	128	29.58	5.924
Late-Semester	128	30.58	6.615

Likewise, mean measures were calculated for each of the four sub-domains of clinical judgment at early-, mid-, and late-semester. Mean measures for all four sub-domains of noticing, interpreting, responding, and reflecting increased for both the mid-semester (second) and the late-semester (third) measurements. Descriptive statistics, including mean measures, for each of the four sub-domains at each measurement interval are presented in Table 3.

Table 3: Mean Measurements for Each Sub-Domain of LCJR at Each Measurement Interval

Sub-Domain of LCJR	N	Early Semester Mean	Mid Semester Mean	Late Semester Mean
Noticing	128	7.22	7.91	8.16
Interpreting	128	4.51	5.02	5.41
Responding	128	9.56	11.09	11.22
Reflecting	128	4.77	5.55	5.72

Repeated Measures Analysis of Variance

A within-factors repeated measures ANOVA was performed at $\alpha = .05$ (95% confidence interval) to determine if the increases in total clinical judgment measurements between different time intervals during the semester were statistically significant. Mean measures for each of the sub-domains were also analyzed at $\alpha = 0.05$ to identify any statistically significant differences in measurement increases. Tests to check that all assumptions for a repeated measures ANOVA had been met were addressed before interpreting the statistical analyses.

Assumptions: Repeated Measures ANOVA

Repeated measures ANOVA assumes sphericity; however, repeated measures tests are highly susceptible to violations of assumptions of sphericity (Lomax & Hahs-Vaughn, 2012). Therefore, Mauchly's Test of Sphericity was performed as part of this analysis. For each of the ANOVAs performed, the assumption of sphericity was violated because the Mauchly's W was significant ($p = < 0.01$). Because the value of Mauchly's W was greater than 0.75 in all analyses, the Huynh-Feldt Correction was applied when interpreting each repeated measure ANOVA to account for violations to the assumption of sphericity and reduce the risk of a Type I error (Lomax & Hahs-Vaughn, 2012). Table 4 shows the results of Mauchly's Test of Sphericity for each of the within-factors repeated measures ANOVAs.

Table 4: Results of Mauchly's Test of Sphericity for Each Repeated Measurements ANOVA

Within Subjects Effect	Mauchly's W	Significance
Total Clinical Judgment Measurement	0.790	<0.01
Noticing Measurement	0.818	<0.01
Interpreting Measurement	0.803	<0.01
Responding Measurement	0.811	<0.01
Reflecting Measurement	0.862	<0.01

Repeated measures ANOVA also assumes normality in distribution of data. Histograms depicting measurements for each of the three data collection intervals were generated using SPSS version 26 to check for normality. Measurements approximately followed a normal distribution although measure one demonstrated negative skewness and measures two and three demonstrated positive skewness. Skewness of the distributions is consistent with study findings. The histograms to check for normal distribution are depicted below in Figures 4, 5, and 6.

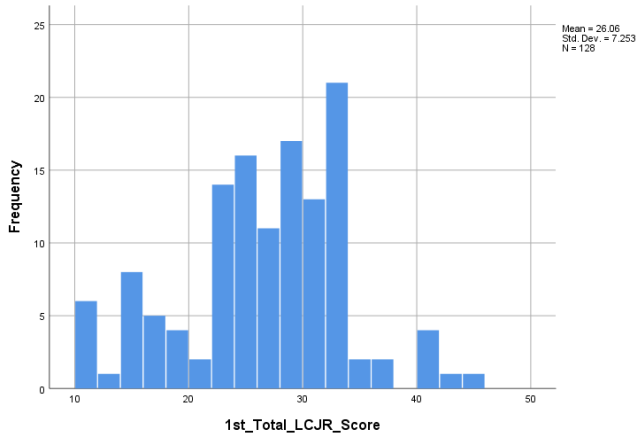


Figure 4. Histogram Demonstrating Normal Distribution of First Clinical Judgment Measurements

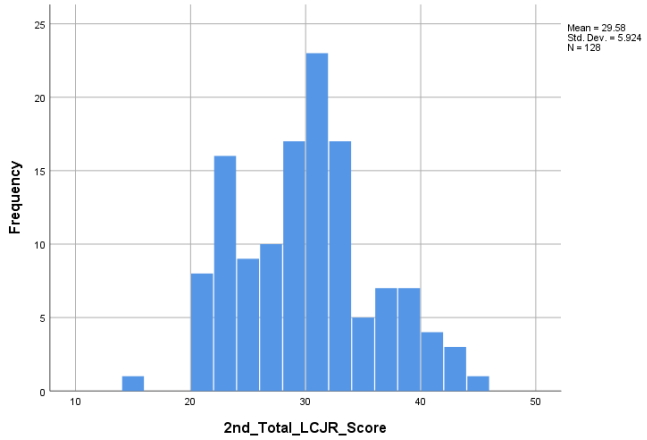


Figure 5. Histogram Demonstrating Normal Distribution of Second Clinical Judgment Measurements

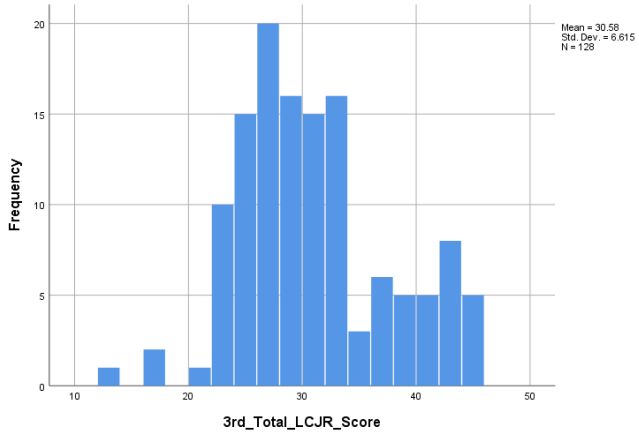


Figure 6. Histogram Demonstrating Normal Distribution of Third Clinical Judgment Measurements

Results: Repeated Measures Analysis of Variance

The PI used a repeated measures ANOVA to analyze the mean total measurements and mean measurements for the four sub-domains for the entire group of participants at each of the three time points to determine statistically significant changes in mean measurements between time intervals. A significant within-groups effect for time was detected at the $p = < 0.01$ level for both the total clinical judgment measurement [$F(1.6, 212.405) = 18.886$, $p = <0.01$] and each of the four sub-domain measurements of noticing [$F(1.713, 217.547) = 9.002$, $p = <0.01$],

interpreting [$F(1.690, 214.621) = 15.155$, $p = <0.01$], responding [$F(1.702, 216.173) = 17.747$, $p = <0.01$] and reflecting [$F(1.780, 226.071) = 20.978$, $p = <0.01$]. The observed power for each of these calculations, after applying the Huynh-Feldt correction equaled 1.000, meaning the probability of rejecting the null hypothesis was 1.00 (Lomax & Hahs-Vaughn, 2012).

Effect size calculations, using partial eta squared (η^2), were included during each repeated measures ANOVA calculation to determine the strength of any statistically significant results. A medium effect size in ANOVA is defined as η^2 greater than or equal to 0.06 but less than 0.14, while a large effect is defined as η^2 greater than or equal to 0.14 (Cohen, 1988). Medium effect sizes were observed for both the total LCJR measurement increase (η^2=0.129) and for the increases in the sub-measurements of noticing (η^2=0.066), interpreting (η^2=0.107), and responding (η^2=0.123). A large effect size was noted for the increase in the sub-measurement of reflection (η^2=0.142). Results for each within-factors repeated measures ANOVA are detailed in table 5.

Table 5: Within-Subjects Effects for Total and Sub-Domain Measurements

Within-Subjects Effect (Huynh-Feldt correction applied)	F	Time df	Error df	Sig.	Effect Size: Partial Eta Squared (Huynh-Feldt correction applied)	Observed Power
Total LCJR Measurement	18.886	1.6	212.405	<0.01	0.129	> 0.999
Noticing Measurement	9.002	1.713	217.547	<0.01	0.066	> 0.999
Interpreting Measurement	15.155	1.690	214.621	<0.01	0.107	> 0.999
Responding Measurement	17.747	1.702	216.173	<0.01	0.123	> 0.999
Reflecting Measurement	20.978	1.780	226.071	<0.01	0.142	> 0.999

Because the within-factor results for all repeated measures ANOVA analyses were found to be significant, pairwise comparisons were calculated to determine which specific sets of measurements differed significantly from each other. Pairwise comparison data were obtained for both the total LCJR measurements and LCJR sub-measurements of the group of participants. For total LCJR measurements, significant differences in measurements were observed between the early and middle semester measurements ($p=<0.01$) and again between the early and late semester measurements ($p=0.01$). However, no significant changes in measurements were observed between the middle semester measurements and late semester measurements ($p= 0.709$). Table 6 presents pairwise comparison data for research question number one.

Table 6: Pairwise Comparisons for Total LCJR Measurements

Pairwise Comparison	Significance
Early and Middle Semester Measurements	<0.01
Early and Late Semester Measurements	<0.01
Middle and Late Semester Measurements	0.709

Pairwise comparison data were also analyzed for each LCJR sub-domain to determine which sets of time intervals produced measurement increases that were statistically significant. For all four sub-domains, significant increases were also observed between the early and middle semester and early and late semester measurements. Table 7 presents results of the pairwise comparisons for each LCJR sub-domain analysis.

Table 7: Pairwise Comparisons for LCJR Sub-Domain Measurements

Pairwise Comparison	Significance
Noticing	
Early and Middle Semester Measurements	<0.01
Early and Late Semester Measurements	<0.01
Middle and Late Semester Measurements	0.996
Interpreting	
Early and Middle Semester Measurements	<0.01
Early and Late Semester Measurements	<0.01
Middle and Late Semester Measurements	0.096
Responding	
Early and Middle Semester Measurements	<0.01
Early and Late Semester Measurements	<0.01
Middle and Late Semester Measurements	1.000
Reflecting	
Early and Middle Semester Measurements	<0.01
Early and Late Semester Measurements	<0.01
Middle and Late Semester Measurements	0.854

Differences in Clinical Judgment Based on Method of Post-Conference Instruction

Research question two asked, "Do students enrolled in a critical care course who participate in post-clinical debriefings requiring reflection on pharmacological decision making achieve greater increases in measurements on LCJR at mid- and late-semester compared to

students who do not participate in these debriefings?" This question was answered using the clinical judgment measures collected by clinical faculty raters at early-, mid-, and late-semester using Lasater's Clinical Judgment Rubric. A repeated measures ANCOVA was performed to assess for statistically significant differences in LCJR total and sub-domain measurements for students who had participated in two sessions of pharmacology-focused post-clinical debriefing as compared to students who had participated in traditional clinical post-conferences.

Descriptive Statistics

Complete data were returned for 128 students who participated in the study. The mean total LCJR measurements for the intervention group (n= 62) were 25.66 (SD = 7.362) at early-semester, 28.53 (SD = 5.676) at mid-semester, and 31.26 (SD = 6.596) at late-semester. The mean total LCJR measurements for the control group (n=66) were 26.44 (SD = 7.186) at early-semester, 30.56 (SD = 6.026) at mid-semester, and 29.94 (SD = 6.619) at late-semester. Table 8 depicts the mean total LCJR measurements for the two groups at each measurement interval during the semester.

Table 8: Descriptive Statistics for Total LCJR Measurements of Intervention and Control Groups

Measurement Interval	Assigned Group	Mean	Std. Deviation	N
Early	Intervention	25.66	7.362	62
	Control	26.44	7.186	66
Mid	Intervention	28.53	5.676	62
	Control	30.56	6.026	66
Late	Intervention	31.26	6.596	62
	Control	29.94	6.619	66

Mean measurements for each of the four sub-domains of LCJR were calculated for both intervention and control groups at early-, mid- and late-semester. The intervention group

demonstrated an increase in mean measures in all four LCJR sub-domains over the semester. Mean measurements for the control group were less consistent. Tables 9-12 depict the mean LCJR sub-domain measurements for the two groups at each time interval during the semester.

Table 9: Descriptive Statistics for Noticing Measurements of Intervention and Control Groups

Time Interval	Assigned Group	Mean	Std. Deviation	N
Early Semester	Intervention	7.03	2.040	62
	Control	7.39	1.880	66
Mid Semester	Intervention	7.61	1.633	62
	Control	8.20	1.939	66
Late Semester	Intervention	8.45	1.799	62
	Control	7.89	2.009	66

Table 10: Descriptive Statistics for Interpreting Measurements of Intervention and Control Groups

Measurement Interval	Assigned Group	Mean	Std. Deviation	N
Early	Intervention	4.53	1.445	62
	Control	4.48	1.438	66
Mid	Intervention	4.81	1.239	62
	Control	5.21	1.271	66
Late	Intervention	5.58	1.448	62
	Control	5.24	1.337	66

Table 11: Descriptive Statistics for Responding Measurements of Intervention and Control Groups

Measurement Interval	Assigned Group	Mean	Std. Deviation	N
Early	Intervention	9.29	2.742	62
	Control	9.82	2.855	66
Mid	Intervention	10.69	2.316	62
	Control	11.47	2.609	66
Late	Intervention	11.24	3.061	62
	Control	11.20	2.531	66

Table 12: Descriptive Statistics for Reflecting Measurements of Intervention and Control Groups

Measurement Interval	Assigned Group	Mean	Std. Deviation	N
Early	Intervention	4.81	1.608	62
	Control	4.73	1.641	66
Mid	Intervention	5.44	1.081	62
	Control	5.65	1.196	66
Late	Intervention	5.81	1.401	62
	Control	5.64	1.355	66

Repeated Measures Analysis of Covariance

To determine if there were statistically significant differences in total or sub-domain clinical judgment measurements between the intervention and control groups at mid- or late-semester, repeated-measures ANCOVA calculations were performed at $\alpha = .05$ (95% confidence interval) for both the total LCJR measurements and LCJR sub-domain measurements. Repeated

measures ANCOVA was selected to assess for significant differences in clinical judgment measurements between the intervention and control group at mid- and late-semester while controlling for initial early-semester measurements. The researcher determined this test was preferential to a between-groups repeated measure ANOVA because ANCOVA accounts for any differences in initial, early-semester measurements for the intervention and control groups by treating these measurements as covariates (Lomax & Hahs-Vaughn, 2012). One delimitation of the study design was the choice not to randomize participants to the intervention versus control groups; ANCOVA was seen as one potential means to account for this decision statistically. Tests to check that all assumptions for a repeated measures ANCOVA had been met were examined before interpreting the statistical analyses.

Assumptions: Repeated Measures ANCOVA

ANCOVA analyses must meet multiple assumptions before results can be interpreted. According to Levene's test, the homogeneity of variance assumption was met for both mid-semester [F (1, 126) = 0.566, p = 0.453] and late semester measurements [F (1, 126) = 0.359, p = 0.550] as the p values for these analyses were non-significant. Shapiro-Wilks tests were employed to test the assumption of normality of distribution for the study population. Data were found to be normally distributed for the mid-semester measurement distributions for both the intervention (SW = 0.962, df = 62, p = 0.050) and control groups (SW = 0.975, df = 62, p = 0.213). However, the assumption of normality was not met for either the intervention (SW = 0.0955, df = 62, p = 0.024) or control groups (SW = 0.937, df = 62, p = 0.002) at the late-semester measurements. Due to the robustness of F tests, non-normality is only an issue if data are severely outside of a normal distribution (Lomax & Hahs-Vaughn, 2012). One way this decision can be made is by examining visual representations of study data to check for outliers

(Lomax & Hahs-Vaughn). Boxplots, shown below in Figure 7 illustrate no outliers in either of these groups.

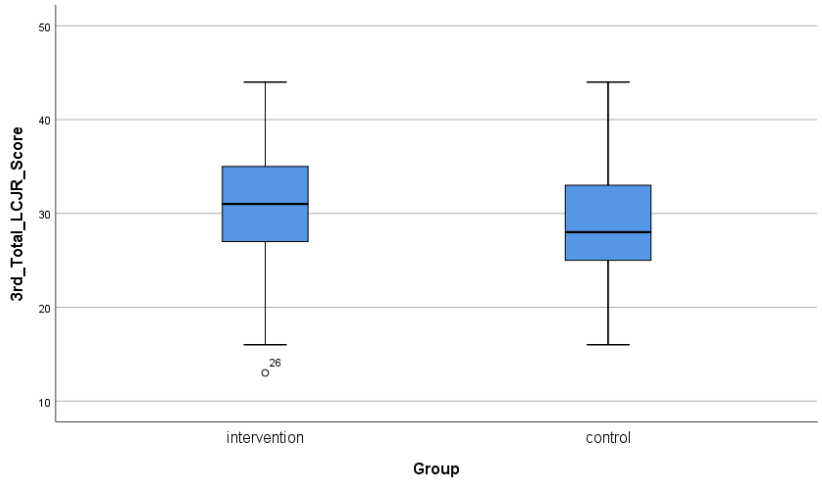


Figure 7. Boxplot of Late-Semester LCJR Measurements of the Intervention and Control Groups

The assumption of linearity for the covariate with the dependent variables was examined by group of the independent variable and was evaluated for each level of the dependent variable. This assumption was tested by running a scatterplot which showed a linear relationship between these variables, meaning the assumption was met. These scatter plots are provided below as Figures 8 and 9.

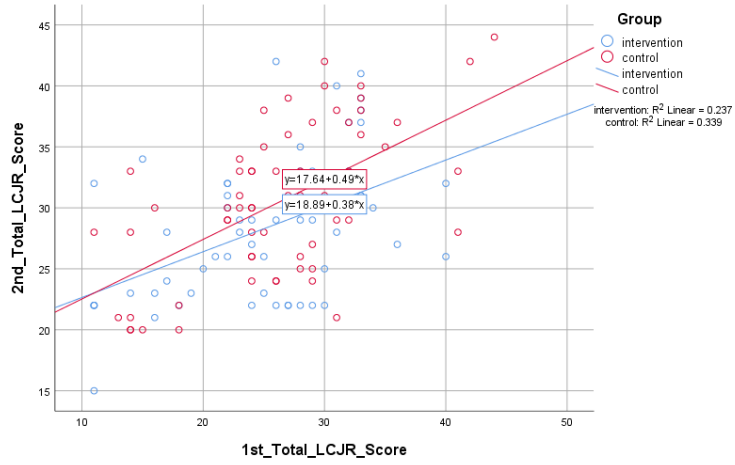


Figure 8. Scatterplot Demonstrating Linear Relationships Between the First and Second Clinical Judgment Measurements

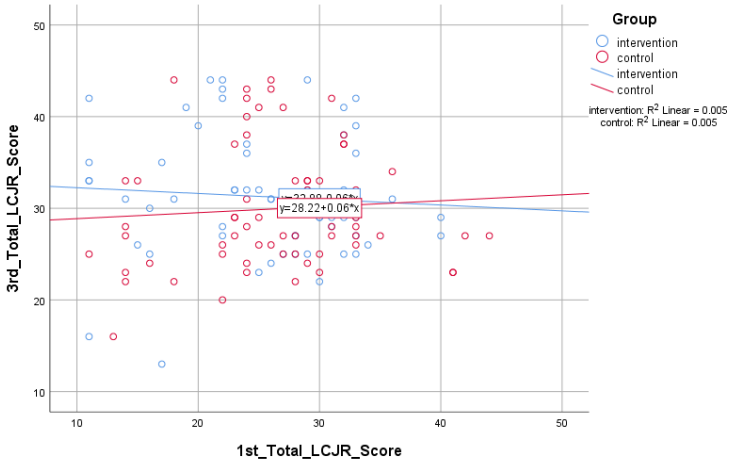


Figure 9. Scatterplot Demonstrating Linear Relationships Between the First and Third Clinical Judgment Measurements

To test the assumption of homogeneity of regression slopes, between-subjects effects data were examined for a significant interaction between the covariate and the independent variable. A non-significant result ($p = 0.199$) confirmed this assumption had also been met. There was no need to test for sphericity in this study since this test is only needed for ANOVA and ANCOVA when three or more dependent variables are present.

Results: Repeated Measures Analysis of Covariance

Repeated measures ANCOVA calculations were performed to evaluate for statistically significant differences between the intervention and control groups for mean total LCJR measurements and mean LCJR sub-domain measurements at both mid and late semester. Early semester measurements were assigned as a covariate in all analyses to account for a non-randomized study design. Changes in all LCJR measurements from early to mid-semester and early to late semester were analyzed using SPSS version 26.

Analysis of covariance found a statistically significant effect of the covariate, early semester LCJR on the dependent variables, mid and late semester LCJR measurements ($F_{\text{early semester measurement}} = 21.601$; $df = 1,124$; $p = < 0.01$) for individual participants. Moreover, the

analysis did not find a statistically significant effect from the interaction between the covariate and the assigned group on the dependent variables ($F_{\text{group*early semester measurement}} = 1.670$; $df = 1,124$; $p = 0.199$) or a significant difference between the early semester measurements of the intervention group and control group ($F_{\text{group}} = 1.372$; $df = 1,124$; $p = 0.244$). These conditions must be met before the rest of the ANCOVA may be interpreted (Lomax & Hahs-Vaughn, 2012).

For total LCJR measurements, no significant differences were found between the intervention and control groups at either mid [F (1, 125) = 3.704, $p = 0.570$] or late semester [F (1, 125) = 1.261, $p = 0.264$]. A statistically significant change in measurements was observed at mid-semester in the LCJR sub-domain of interpreting [F (1, 125) = 4.825, $p = 0.030$]. However, group assignment only accounted for 3.7 percent of the variance in mid-semester interpreting measurements (η^2=0.037, observed power = 0.587).

Additional repeated measures ANCOVAs determined there were no other statistically significant differences in measurements between groups at either time interval in any of the other four sub-domains of LCJR or in the late semester sub-domain measurement for interpreting. ANCOVA results for LCJR sub-domain measurements are presented in table 13 below along with LCJR total measurements. Table 14 provides details of the significant finding for interpreting at the mid-semester measurement.

Table 13: Between-Subjects Effects on LCJR Total and Sub-Domain Measurements

Between-Subjects Effect	Time	F	df	Error df	Significance
Total LCJR Measurement	Mid-semester	3.704	1	125	0.057
	Late semester	1.261	1	125	0.264
Noticing Measurement	Mid-semester	2.310	1	125	0.131
	Late semester	2.467	1	125	0.117
Interpreting Measurement	Mid-semester	4.825	1	125	0.030
	Late semester	3.695	1	125	0.177
Responding Measurement	Mid-semester	2.027	1	125	0.157
	Late semester	0.007	1	125	0.933
Reflecting Measurement	Mid-semester	1.944	1	125	0.166
	Late semester	0.453	1	125	0.502

Table 14: Significant Between-Subjects Effects for Mid-Semester Interpreting Measurements

Between-Subjects Effect	F	df	Error df	Significance	Partial Eta Squared	Observed Power
Mid-semester Interpreting	3.704	1	125	0.057	0.037	0.587

Summary

This chapter presented demographic data for the study population along with statistical analyses of data necessary to answer the two research questions proposed by this study. The repeated measures ANOVA calculated to answer research question one suggested there was a statistically significant difference in all clinical judgment measures by mid-semester that persisted through late semester. No significant changes in measurements occurred between mid- and late-semester. For research question two, the repeated measures ANCOVA found one small

significant difference in measurements in the area of interpreting at mid-semester, but otherwise indicated no statistically significant differences between any other clinical judgment measurements of the intervention and control groups at either mid- or late-semester. The significance of these findings will be discussed in the following chapter along with assumptions and limitations of the study. Implications for nursing education and recommendations for further research will also be shared in chapter five.

CHAPTER V - DISCUSSION

Introduction

Strong clinical judgment regarding pharmacological treatments is essential to patient safety and decreasing medication errors. Transfer of pharmacology competence from traditional learning environments to clinical practice has been identified as a rarely explored area of nursing education research (Suulosaari et al., 2012). Additionally, nurses are known to graduate with deficits in both foundational pharmacology knowledge and decision-making regarding pharmacological therapies (Dilles et al., 2010; Grandell-Niemi et al., 2005; Ndosi & Newell, 2008). Nursing students, in particular, are prone to making medication errors due to knowledge deficits combined with lesser developed clinical judgment (Asensi-Vicente et al, 2018; Simonsen et al., 2014). Moreover, research designs incorporating objective assessments are needed in nursing education, as prior studies have traditionally made conclusions based on student or faculty perception of learning rather than on observable, measurable outcomes (Ironside & Spurlock, 2014; Morton, 2017; NLN, 2013). Nursing education studies based on direct observational data of learners provide stronger evidence than those that examine data self-reported by students (Baxter & Norman, 2011; Spurlock, 2017).

This study was designed to evaluate the impact of reflective debriefings on prelicensure students' clinical judgment regarding pharmacology decisions made during clinical learning. Faculty raters measured clinical judgment of students during pharmacology interventions in clinical using Lasater's (2007) Clinical Judgment Rubric. For the intervention group, reflective

debriefings took place twice during clinical post-conferences, once during the first six weeks of the twelve-week clinical rotation and once during the second six weeks. The first clinical judgment measurement was collected before any reflective debriefings took place, the second after one debriefing, and the third after two debriefings.

During the reflective debriefings, each student shared his or her own clinical experiences and reflected on judgments made related to pharmacological interventions as a group. Debriefings were structured around the four domains of clinical judgment as defined by Tanner (2006). The PI asked students to describe: 1) what they noticed while providing pharmacological therapies, 2) interpretations of medication and patient data, 3) their responses including medication administration and communication, and 4) their reflections both during and after providing pharmacological therapies. Clinical judgment data were analyzed to assess for statistically significant changes in clinical judgment between the intervention and control groups and within the full research cohort over the twelve-week period of research.

A repeated measures ANCOVA found no significant differences in clinical judgment measures between the group of students participating in the intervention and those who participated in standard clinical post-conferences. However, repeated measures ANOVA found a statistically significant increase in pharmacological clinical judgment for the full cohort of students by the mid-point of clinical instruction which persisted to the late semester measurement. A slight, but non-statistically significant increase occurred between the mid and late semester measurements. Findings from this study along with observations by the researcher and participating clinical faculty provide meaningful implications for nursing education and for further research in this area.

Significant Findings

Research Question One

Research question one asked, "Do students enrolled in a critical care course achieve statistically significant increases in clinical judgment measurements as measured by Lasater's Clinical Judgment Rubric (LCJR) during pharmacological decisions at mid- and late-semester irrespective of their method of post-clinical debriefing?" The dependent variable, clinical judgment, was measured by faculty raters using Lasater's Clinical Judgment Rubric as they observed and discussed students' pharmacological interventions during clinical learning. Statistically significant increases in total and sub-domain clinical judgment measurements were observed at both the mid and late semester measurements when compared to initial early semester measurements. Moreover, a large effect size was noted for the increase in subdomain measures of reflecting while medium effect sizes were noted for the increases in total clinical judgment measures and in subdomain measures of noticing, interpreting, and responding. An observed power greater than 0.999 for both total LCJR measurements and all four subdomain measurements strongly supported rejecting the null hypothesis that clinical judgment measures would not change over the semester for this cohort of participants.

This study obtained observational, numerical data which validated the increase in pharmacological clinical judgment traditionally noted only anecdotally by nurse educators. Multiple interactions with students provided rich contextual data of their pharmacological interventions, allowing clinical faculty to evaluate specific objectives across four distinct subdomains of clinical judgment. Use of a clinical judgment rubric allowed for numerical evaluation of each student's specific strengths and areas for improvement, while providing consistency in assessment among eight faculty teaching in a diversity of critical care learning

environments. This evaluation method differed substantially from the pass-fail or satisfactory-unsatisfactory methods of clinical evaluation frequently utilized in prelicensure programs. With calls for competency-based learning from the AACN (American Association of Colleges of Nursing [AACN], 2019) and anticipated changes in NCLEX-RN testing related to clinical judgment (NCSBN, 2019), observation-based, quantitative measures of clinical competence are particularly valuable.

Research Question Two

Research question two asked, "Do students enrolled in a critical care course who participate in post-clinical debriefings requiring reflection on pharmacological decision making achieve greater increases in measurements on LCJR at mid- and late-semester compared to students who do not participate in these debriefings?" To answer this question, clinical judgment measurements obtained by clinical faculty raters once again served as the dependent variable, while method of post-clinical instruction served as the independent variable.

Reflective debriefings included questions from Nielsen et al.'s (2007) Guide for Reflection as initial discussion prompts to ensure reflection encompassed all four components of clinical judgment. Learners reflected on and described recent pharmacological activities, questioned each other, and clinically reasoned through pharmacological events as a group. Throughout the debriefing, the PI and clinical faculty interjected periodically with questions to facilitate clinical judgment but allowed students to independently reason through their experiences verbally. Reflective debriefings took the place of standard post conferences twice for learners in the intervention group, once during each half of the twelve-week clinical rotation. Learners in the control group participated only in standard clinical post-conferences. Although learners in the intervention group had greater increases in mean total and subdomain clinical

judgment scores, statistical analyses using ANCOVA indicated no significant differences in score changes between groups.

The reflective debriefings provided in place of two clinical post-conferences failed to produce greater changes in clinical judgment about pharmacological therapies than those achieved during standard clinical learning activities. It is essential that nurses possess solid clinical judgment for safe practice, particularly when providing pharmacological therapies as medication errors frequently result in poor patient outcomes. Reflection on action is known to foster growth in nurses' clinical judgment that impacts future clinical decisions (Tanner, 2006). Moreover, instructor-facilitated reflection as means to cultivate competency in clinical judgment has a strong foundation of prior evidence (Dreifurst, 2012; Forneris et al., 2015; Hines & Wood, 2016; Lavoie et al., 2013; Mariani et al., 2013; Page-Cutrara & Turk, 2017; Razieh et al., 2018). Lack of statistically significant findings for this research question provide a strong case that opportunities for reflection on practice may need to be more frequent or more numerous, particularly in regard to pharmacological therapies.

Discussion

This study contributed findings about clinical judgment of prelicensure nursing students in the area of pharmacology. Specifically, it examined: 1) whether clinical judgment regarding provision of pharmacological therapies could significantly increase during one semester's clinical learning experiences, and 2) whether participation in additional pharmacology-based post-clinical debriefings significantly increased measurements of clinical judgment development in this area. Medication-related decisions comprise approximately 40 percent of a nurse's role regardless of practice environment (NCSBN, 2018, p.29-30). It is essential to identify through research whether learners are developing competence in this area and to create learning

interventions that promote transfer of pharmacology knowledge to clinical competence. Furthermore, study designs which generate evidence through observation and measurement of student clinical performance using validated instruments fulfills a petition called for in nursing education research (Ironside & Spurlock, 2014; Morton, 2017; NLN, 2013).

The clinical learning environment was selected as the setting for the learning intervention in this study because, while students initially learn pharmacology in the classroom, they ultimately apply it in clinical practice, beginning during the hundreds of supervised clinical learning hours required by prelicensure nursing programs. Although prior studies have found novel pharmacology learning activities superior to traditional passive learning for developing competency in medication administration and pharmacology application, all were evaluated in non-clinical settings (Dubovi et al., 2017; Geist et al., 2015; Harris et al., 2014; Jarvill et al., 2018; Meechan et al., 2010; Meechan et al., 2011; Sanko & McKay, 2017). Research studies conducted in contained learning environments may control for variations in data collection encountered due to the diversity of situations in clinical learning environments; however, they sacrifice the opportunity to examine transfer of knowledge from the learning intervention to highly contextual clinical situations.

To account for the variation across clinical learning environments, this study was intentionally implemented in a senior level, critical care course that included rotations to both the emergency department and intensive care units for all students. These environments provided diverse opportunities for learners to manage medications and provide pharmacological interventions, allowing ample opportunities for faculty raters to observe learners' thinking and judgment in this area. The repeated measures design, with three periods for data collection, allowed for each clinical judgment measurement to be based on multiple evaluations of student

clinical practice. In addition, by semester four of five the learning objective during medication administration would be to achieve greater competence in making pharmacological decisions, not to practice procedural skill.

The theoretical foundation of this study, Tanner's Clinical Judgment Model (2006), supported the study's design and may lend an explanation for the research findings. According to this model, development of clinical judgment is gradual and is not expected to occur through singular learning events. Reflection on a diversity of prior clinical events and decisions progressively fosters clinical judgment that nurses apply to both similar and unfamiliar future clinical events (Tanner, 2006). By collecting clinical data over a twelve-week period of weekly clinical experiences, participants learned through and were evaluated during multiple clinical learning events. Prior studies using Lasater's (2007) Clinical Judgment Rubric also support longer periods of learning interventions to achieve significant, lasting increases in clinical judgment (Blum et al., 2010; Jensen, 2013; Lasater, 2007; Lasater, 2011). The length of time allowed for data collection may have contributed to a statistically significant increase in pharmacological clinical judgment was measured for the full cohort of participants in this study. Reflective debriefings for the intervention group also provided spaced learning opportunities; sessions were scheduled once during the first six weeks and once for the second for each clinical group receiving the additional intervention. However, while learners receiving the intervention had higher mean clinical judgment measurements by the end of the study, it is likely that a greater number and frequency of opportunities for reflection may be necessary to produce statistically significant increases in scores between groups.

Clinical judgment measurements observed in this research cohort were congruent with those expected of students in the middle to end of their program of study. Mid-program students

in prior studies have also achieved total LCJR measurements in the mid-20s to low-30s (Jensen, 2013; Lasater, 2007; Lasater & Nielsen, 2009; Manetti, 2018). At the beginning of their fourth semester of five, participants in this study had a mean total clinical judgment measurement of 26.06, placing them slightly above the level of developing (measurement = 22 points) on Lasater's (2007) rubric. At the midpoint of the clinical rotation, the mean total LCJR measurement had increased to 29.58. By the conclusion of the clinical rotation, before entering their final capstone clinical experience, the cohort's mean total LCJR measurement had increased to 30.58. Prelicensure students are expected to have reached the level of accomplished by graduation, evidenced by a measurement of approximately 33 points (Lasater, 2007; Lasater, 2011). This places the cohort of students in this study at an expected level of clinical judgment for senior nursing students entering their final semester.

Implications

Conclusions from the findings of this study offer several meaningful considerations for nursing education practice. Results also inform clinical nursing practice, particularly for healthcare facilities employing significant numbers of newly licensed or less experienced nursing staff. Considerations for clinical evaluation methods and designing clinical learning experiences may be garnered from this research.

Improvement in clinical judgment, whether examining pharmacology-specific judgment or general clinical judgment, can be objectively measured through direct observation of learners using rubrics or other detailed evaluation instruments. These provide richer clinical performance data than typical evaluation methods in prelicensure nursing education. In many programs, clinical learning is graded as pass-fail rather than numerically. Most clinical evaluation tools simply assess broad performance measures as satisfactory or unsatisfactory, often with a needs-

improvement category added during mid-course evaluation. This may make it difficult for clinical faculty, particularly those lacking a foundation in educational evaluation methods, to identify and describe specific strengths and areas of improvement for the student.

Rubrics, on the other hand, assign numerical measurements to different degrees of competency and are subdivided into domains consisting of specific, discrete objectives. Lasater (2007) created the Clinical Judgment Rubric to provide a vehicle for instructors to provide rich, specific feedback to students about their clinical judgment abilities. Instructors in this study provided anecdotal feedback to the PI that using the rubric encouraged them to observe and evaluate students more carefully and thoughtfully than usual to ensure accurate data were reported. This attention to detail helped numerically illustrate the pattern of clinical judgment development in the area of pharmacology for the study cohort. Rubrics and other detailed evaluation measures may also benefit clinical nursing practice. Supervisors and preceptors could more clearly communicate feedback on performance to nursing staff. Specific, detailed feedback would be particularly helpful to early career nurses, as it would help them identify areas to strengthen in their nursing practices.

Repeated practice of learning activities, particularly those that aim to foster higher level cognitive skills such as clinical judgment is another recommendation informed by the findings of this study. Repeated practice has previously been recommended to help nursing students progress from performing procedural skills step-by-step to performing more automatically (Oermann, Muckler, & Morgan, 2016). This study offers evidence that cognitive skills may also require repeated practice to make clinical judgment more automatic. Advanced beginner nurses require frequent cuing and guidance from expert nurses to identify salient aspects of clinical situations and to make clinical judgments (Benner, 1982). Reflection during and after clinical

situations continually cultivates the clinical judgment ability of nurses at all levels (Tanner, 2006). Two sessions of reflective debriefing during the study timeline may not have provided sufficient opportunity to accelerate the development of clinical judgment beyond what is already achieved in one semester. Lack of significant findings related to this intervention suggest more frequent reflective debriefing over clinical activities may have been necessary to increase clinical judgment about medications beyond what is already being achieved through typical clinical learning. Moreover, additional learning interventions could be created that assist students in becoming more attentive to their thinking during provision of pharmacological therapies. This might help nurses to become more thoughtful and careful practitioners during pharmacological interventions, rather than seeing medication administration merely as another task to complete. Nursing expertise, whether in provision of pharmacological therapies or other clinical responsibilities, develops over time and requires multiple, repeated patient encounters to build contextual understanding and competency (Benner, 1982).

Strengths

A primary strength of this study was its rigorous design. Data were generated using a psychometrically tested rubric and based on observation of participants by clinical faculty raters rather than students' own perceptions of learning. Prior to data collection, all raters were trained on the instrument by the PI, and interrater reliability was established using methods recommended by the developer of the instrument. An adequate sample of participants was included in data analysis to achieve a statistical power level of 0.8. To account for non-randomization of participants to the intervention and control groups, a repeated measures ANCOVA was used to answer the research question comparing groups. The twelve-week time

period of the study provided multiple data collection opportunities and allowed time for the reflective debriefings to potentially impact clinical practice.

Further strengths of this study are its contributions to the body of evidence in nursing education research. This study attempted to contribute to several gaps in the nursing education literature. First, it examined the development of clinical judgment specifically in the area of pharmacological decisions. Second, it evaluated the impact of a pharmacology learning activity implemented and evaluated in the clinical setting, examining whether post-clinical reflection-based learning transferred to clinical competence. Finally, findings from this study add to multiple prior studies describing the development of clinical judgment in prelicensure nursing students. This study provides additional evidence that development of clinical judgment in prelicensure nursing students is rarely impacted by single learning events, such as the two reflective debriefings in this study, but can occur progressively over a semester's time, as was observed in the full cohort of participants.

Limitations

Limitations affecting the generalizability and validity of results from this study must also be considered. First, this study was conducted at a single site in the southeastern United States. Although the sample was diverse in a number of ways and of an adequate size to achieve statistical power, clinical judgment changes observed in this student population should not be generalized to other student populations. Secondly, participants were not randomized to the intervention versus control groups as clinical group assignment in nursing education is often deliberate and takes into consideration various student and faculty factors. This was mitigated partially by selecting a repeated measures ANCOVA to analyze the data for research question two, assigning the early semester score as a covariate in the analysis. However, a truly

randomized design would have prevented this limitation from potentially influencing results. Methods for establishing interrater reliability also present a limitation. The ninety percent agreement method was utilized based on recommendations by the creator of the instrument; however, ten percent variability in rating by individual faculty may have impacted scoring enough to influence statistical results.

Implementation of the study intervention created additional limitations. Two reflective debriefing interventions were not sufficient to impact clinical judgment abilities in the intervention group. While the length of the repeated measures design allowed ample time for clinical judgment development and data collection, additional or more frequent debriefing interventions may be needed to result in statistically significant differences between groups of learners. Finally, this study was conducted in the clinical learning environment. Despite the advantages of being able to observe and measure transfer of learning, it also introduces the potential for variability in student experience and faculty evaluation, regardless of measures taken to strengthen interrater reliability. Participants received similar, but not identical, learning and evaluation experiences.

Recommendations for Further Research

Based on the findings of this study, the following areas for additional research are recommended:

- Implement a study with a similar design where pharmacological reflective debriefing is implemented more frequently or one where additional pharmacology review activities are included.

- Implement a similar study with a more rigorous design, such as one where learners are randomized to intervention and control groups.
- Explore ways to better establish interrater reliability for studies where data are collected through clinical observation. Ten percent variance when rating clinical performance may have an impact on how this type of data is interpreted.
- Design a qualitative study exploring the experiences of nursing faculty using Lasater's (2007) Clinical Judgment Rubric to evaluate clinical learning.
- Develop additional studies where the impact of learning activities created to foster clinical judgment is measured objectively during student clinical practice. These studies may address pharmacology or other competencies frequently practiced by nurses.
- Design additional studies that examine transfer of learning from educational activities to clinical practice. Researchers in nursing education could partner with doctorally prepared clinical partners to then examine the impact on patient outcomes. Editors of nursing education publications have called for more research linking educational methodologies to improved patient outcomes (Patterson et al., 2018).

Conclusion

Strengthening clinical judgment about pharmacological therapies in the prelicensure nursing student is essential. Providing these therapies comprises a significant portion of a nurse's daily practice activities and includes multiple clinical judgments where errors may occur. Medication errors have serious repercussions for both the patient and the nurse. This study aimed to present evidence for implementing pharmacology focused reflective discussion into clinical learning with an intent to strengthen student clinical judgment during the provision of pharmacological therapies. Methods for this study were driven by Tanner's (2006) Clinical

Judgment Model and included a study intervention of instructor facilitated reflective debriefing that incorporated all four domains of clinical judgment: noticing, interpreting, responding, and reflecting.

This study contributed evidence that statistically significant changes in clinical judgment regarding pharmacological therapies may be observed in senior, prelicensure students during their critical care course. While the reflective debriefings resulted in higher clinical judgment scores for the intervention group, differences in mean scores for the two groups were not found to be statistically significant. The mixed findings of this study present an opportunity to further investigate this area through additional research, whether by repeating the study with more frequent reflective debriefings or through exploring the experiences of faculty data collectors. Moreover, this study contributed meaningful implications for nursing education, particularly when making decisions regarding learning activities and clinical evaluation.

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APPENDIX A – LASATER'S CLINICAL JUDGMENT RUBRIC

TABLE 2

Lasater Clinical Judgment Rubric

Dimension	Exemplary	Accomplished	Developing	Beginning
Effective noticing involves:				
Focused observation	Focuses observation appropriately; regularly observes and monitors a wide variety of objective and subjective data to uncover any useful information	Regularly observes and monitors a variety of data, including both subjective and objective; most useful information is noticed; may miss the most subtle signs	Attempts to monitor a variety of subjective and objective data but is overwhelmed by the array of data; focuses on the most obvious data, missing some important information	Confused by the clinical situation and the amount and kind of data; observation is not organized and important data are missed, and/or assessment errors are made
Recognizing deviations from expected patterns	Recognizes subtle patterns and deviations from expected patterns in data and uses these to guide the assessment	Recognizes most obvious patterns and deviations in data and uses these to continually assess	Identifies obvious patterns and deviations, missing some important information; unsure how to continue the assessment	Focuses on one thing at a time and misses most patterns and deviations from expectations; misses opportunities to refine the assessment
Information seeking	Assertively seeks information to plan intervention: carefully collects useful subjective data from observing and interacting with the patient and family	Actively seeks subjective information about the patient's situation from the patient and family to support planning interventions; occasionally does not pursue important leads	Makes limited efforts to seek additional information from the patient and family; often seems not to know what information to seek and/or pursues unrelated information	Is ineffective in seeking information; relies mostly on objective data; has difficulty interacting with the patient and family and fails to collect important subjective data
Effective interpreting involves:				
Prioritizing data	Focuses on the most relevant and important data useful for explaining the patient's condition	Generally focuses on the most important data and seeks further relevant information but also may try to attend to less pertinent data	Makes an effort to prioritize data and focus on the most important, but also attends to less relevant or useful data	Has difficulty focusing and appears not to know which data are most important to the diagnosis; attempts to attend to all available data
Making sense of data	Even when facing complex, conflicting, or confusing data, is able to (a) note and make sense of patterns in the patient's data, (b) compare these with known patterns (from the nursing knowledge base, research, personal experience, and intuition), and (c) develop plans for interventions that can be justified in terms of their likelihood of success	In most situations, interprets the patient's data patterns and compares with known patterns to develop an intervention plan and accompanying rationale; the exceptions are rare or in complicated cases where it is appropriate to seek the guidance of a specialist or a more experienced nurse	In simple, common, or familiar situations, is able to compare the patient's data patterns with those known and to develop or explain intervention plans; has difficulty, however, with even moderately difficult data or situations that are within the expectations of students; inappropriately requires advice or assistance	Even in simple, common, or familiar situations, has difficulty interpreting or making sense of data; has trouble distinguishing among competing explanations and appropriate interventions, requiring assistance both in diagnosing the problem and developing an intervention
Effective responding involves:				
Calm, confident manner	Assumes responsibility; delegates team assignments; assesses patients and reassures them and their families	Generally displays leadership and confidence and is able to control or calm most situations; may show stress in particularly difficult or complex situations	Is tentative in the leader role; reassures patients and families in routine and relatively simple situations, but becomes stressed and disorganized easily	Except in simple and routine situations, is stressed and disorganized, lacks control, makes patients and families anxious or less able to cooperate

TABLE 2 (Continued)

Lasater Clinical Judgment Rubric

Dimension	Exemplary	Accomplished	Developing	Beginning
Clear communication	Communicates effectively; explains interventions; calms and reassures patients and families; directs and involves team members, explaining and giving directions; checks for understanding	Generally communicates well; explains carefully to patients; gives clear directions to team; could be more effective in establishing rapport	Shows some communication ability (e.g., giving directions); communication with patients, families, and team members is only partly successful; displays caring but not competence	Has difficulty communicating; explanations are confusing; directions are unclear or contradictory; patients and families are made confused or anxious and are not reassured
Well-planned intervention/flexibility	Interventions are tailored for the individual patient; monitors patient progress closely and is able to adjust treatment as indicated by patient response	Develops interventions on the basis of relevant patient data; monitors progress regularly but does not expect to have to change treatments	Develops interventions on the basis of the most obvious data; monitors progress but is unable to make adjustments as indicated by the patient's response	Focuses on developing a single intervention, addressing a likely solution, but it may be vague, confusing, and/or incomplete; some monitoring may occur
Being skillful	Shows mastery of necessary nursing skills	Displays proficiency in the use of most nursing skills; could improve speed or accuracy	Is hesitant or ineffective in using nursing skills	Is unable to select and/or perform nursing skills
Effective reflecting involves:				
Evaluation/self-analysis	Independently evaluates and analyzes personal clinical performance, noting decision points, elaborating alternatives, and accurately evaluating choices against alternatives	Evaluates and analyzes personal clinical performance with minimal prompting, primarily about major events or decisions; key decision points are identified, and alternatives are considered	Even when prompted, briefly verbalizes the most obvious evaluations; has difficulty imagining alternative choices; is self-protective in evaluating personal choices	Even prompted evaluations are brief, cursory, and not used to improve performance; justifies personal decisions and choices without evaluating them
Commitment to improvement	Demonstrates commitment to ongoing improvement; reflects on and critically evaluates nursing experiences; accurately identifies strengths and weaknesses and develops specific plans to eliminate weaknesses	Demonstrates a desire to improve nursing performance; reflects on and evaluates experiences; identifies strengths and weaknesses; could be more systematic in evaluating weaknesses	Demonstrates awareness of the need for ongoing improvement and makes some effort to learn from experience and improve performance but tends to state the obvious and needs external evaluation	Appears uninterested in improving performance or is unable to do so; rarely reflects; is uncritical of himself or herself or overly critical (given level of development); is unable to see flaws or need for improvement

Lasater's Clinical Judgment Rubric. Reprinted from Lasater, K. (2007). Clinical judgment development: Using simulation to create an assessment rubric. *Journal of Nursing Education, 46*(11), 496-503. Retrieved from: http://www.oclbcp.org/documents/simulation%20articles/lassiter.pdf

APPENDIX B – NIELSEN ET AL.'S GUIDE FOR REFLECTION

TABLE

Guide for Reflection Using Tanner's (2006) Clinical Judgment Model

Instructions
This Guide for Reflection is intended to help you think about a given clinical situation you have encountered during the past week and your nursing response to that situation. The situation can be a specific physiological patient problem, such as an elevation in temperature, respiratory difficulty, or electrolyte imbalance. You may choose to describe a situation involving a patient's family. The situation can be a description of your role in interdisciplinary problem solving. The reflection situation may describe an ethical issue you encountered in practice. Use the guide for reflection as a way to help you tell the story of the situation you encountered.
The guide provides you with a way of thinking about care that supports the development of your clinical judgment. Although there are many ways of organizing your thinking about patient care and professional nursing practice, Tanner's (2006) Clinical Judgment Model provides the framework for the questions in this study guide. Your professional development is further supported with feedback from faculty. Feedback about your reflections will be provided using the Lasater (2007) Clinical Judgment Rubric.
Introduction
Describe a nursing situation you encountered this week. (See the instructions above.)
Background
• Describe your relationship to the patient at the time you noticed the situation (e.g., previous contact with patient and/or family, the quality of your relationship).
• Consider experiences you have had that helped you provide nursing care in this situation. Describe your formal knowledge (e.g., physiology, psychology, communication skills), previous nursing experience with a similar problem, and/or personal experiences that helped guide you as you worked with the patient.
• Describe your beliefs about your role as the nurse in working on the situation.
• Describe any emotions you had about the situation.
Noticing
• What did you notice about the situation initially?
• Describe what you noticed as you spent more time with the patient and/or family.
Interpreting
• Describe what you thought about the situation (e.g., its cause, potential resolutions, patterns you noticed).
• Describe any similar situations you have encountered in practice before. Describe any similarities and differences you observed when compared with the current situation.
• What other information (e.g., assessment data, evidence) did you decide you needed as you considered the situation? How did you obtain this information? What help with problem solving did you get from your preceptor?
Your conclusion: What did your observations and data interpretation lead you to believe? How did they support your response to the situation? Include pertinent pathophysiology and/or psychopathology.
Responding
• After considering the situation, what was your goal for the patient, family, and/or staff? What was your nursing response, or what interventions did you do? List all actions that you took.
• Describe stresses you experienced as you responded to the patient or others involved in the situation.
Reflection-in-Action
• What happened? How did the patient, family, and/or staff respond? What did you do next?
Reflection-on-Action and Clinical Learning
• Describe three ways your nursing care skills expanded during this experience.
• Name three things you might do differently if you encounter this kind of situation again.
• What additional knowledge, information, and skills do you need when encountering this kind of situation or a similar situation in the future?
• Describe any changes in your values or feelings as a result of this experience.

Guide for Reflection Using Tanner's (2006) Clinical Judgment Model. Reprinted from Nielsen, A., Stragnell, S., and Jester, P. (2007). Guide for reflection using the clinical judgment model. *Journal of Nursing Education, 46,* 513-516. Retrieved from: https://www.healio.com/nursing/journals/jne

APPENDIX C – LESSON PLAN FOR REFLECTIVE DEBRIEFING SESSIONS

Introduction

The post-clinical reflective debriefing on pharmacology activities will require students to use metacognitive skills to examine their thoughts and actions while performing pharmacological interventions during the clinical day in their critical care learning experiences. Students will consider the patient's response to therapies and consider how they will modify their nursing actions in future clinical situations.

Learning Goal

Students will cultivate clinical judgment skills through reflection on practice that can be applied to future clinical situations involving pharmacological therapies.

Learning Objectives

Review activities from the clinical day that involved pharmacological therapies.

Reflect on observations made of patient data and subsequent actions taken during the clinical day's pharmacological activities.

Analyze patient responses to pharmacological therapies.

Describe potential nursing management of pharmacological therapies in similar future situations.

Associated Course Objectives

2. Analyze subjective and objective data to plan care for clients in the critical care setting.

3. Employ clinical judgement in the nursing care of clients with critical illness.

Teaching Materials

Nielsen's (2007) Guide for Reflection

Students' clinical concept mapping paperwork from clinical experiences.

Procedure for Instruction

1. The post-clinical debriefing will take place during the clinical post-conference of each group receiving the intervention.
2. The researcher will ask students to volunteer events from that day's clinical learning experience that involved pharmacological therapies.
3. The researcher will ask questions from Nielsen's (2007) Guide for Reflection directed towards the student(s) involved in the events being discussed. Thoughts from additional students will be solicited for questions asking to compare the event to prior or potential events.

APPENDIX D – RECRUITMENT SCRIPT

Hello, my name is Rebecca Davis. I am a doctoral student in nursing education at The University of Alabama. I am conducting research for my dissertation on reflective learning activities and their role in the development of clinical judgment. This learning activity will be a part of clinical post-conference discussions in NUR 401 this semester. I'm inviting you to participate because you are enrolled in a NUR 401 clinical section during one of these two semesters.

As part of your clinical learning this semester, your clinical instructor will use a rubric to evaluate your clinical judgment about pharmacology decisions three times – at early, mid, and late semester. I will be providing a learning activity twice a semester for half of the clinical groups in between these measurements. This activity will be a debriefing, guided by me, about the pharmacology activities you participated in that week. The objective is to stimulate clinical judgment about your pharmacology-related nursing care to help you make clinical decisions in the future. These groups will be my intervention group for the study. The groups I do not visit for the activity will still participate in regular post-conference activities, some of which will include discussion about medications. These groups will be the control groups for the study. After the final measurement of clinical judgment, I will post a screencast in the NUR 401 Canvas course that walks you through a patient pharmacology case and includes reflective questions similar to the ones I will ask during the post-conference activity.

Participation in this research includes allowing me to use the clinical judgment scores your instructor collects to analyze the effectiveness of the learning activity. This will not require any additional time from you. The evaluations of your clinical judgment and the post-conference activity, if your group receives it, will occur during your regular clinical hours.

Your choice whether or not to participate will not have an impact on either your course grade or your clinical evaluation. Your clinical instructors will be doing evaluations of clinical judgment of all students, so they will not know who is or is not a participant. When your instructors turn the rubrics in to me, I will immediately shred yours if you have decided not to participate. If you have decided to participate, I will immediately remove your name from the rubric. I will then code it as belonging to a participant in either the intervention or control group. I will not be measuring or comparing the results of individual students, just using the numbers to determine the effect of the new learning activity for the entire group.

Do any of you have any questions about the research or the activity?

I will hand out consent forms now. If you would like to participate in the study, please sign the consent form and place it in the box at the back of the room. If you do not want to participate, please place the blank consent form in the same box at the back of the room. If you have any more questions, you may come by my office, rm 335, email me at rdavis89@crimson.ua.edu or call my cell number, 256-457-8222. Thank you.

APPENDIX E – CONSENT FORM WITH INVITATION TO PARTICIPATE IN RESEARCH

Invitation to Participate in Research

Hello, my name is Rebecca Davis. I am a doctoral student in nursing education at The University of Alabama. I am conducting research for my dissertation about how reflection helps nurses develop clinical judgment.

Reflection about your medication decisions will be a part of clinical post-conference discussions in NUR 401 this semester. I'm inviting you to participate because you are enrolled in a NUR 401 clinical section this semester. Your consent form provides details about how the clinical learning activity will be used in this study.

- Your consent will allow me to use the clinical judgment scores your instructor collects to evaluate the new learning activity. This will not require any additional time from you; both the evaluations and post-conference activities will occur during regular clinical hours.

- Your choice whether to participate will not impact your course grade or your clinical evaluation. Your clinical instructors will be doing evaluations of clinical judgment on all students, so they will not know who is participating in the study.

- If you choose not to participate, I will shred your rubrics as soon as your instructors return them to me. Your scores will not be used to evaluate the new activity.

- If you choose to participate, I will immediately remove your name from your rubrics after your instructor returns them to me. I will then label them as belonging to a member of either the intervention or control group.

- Your rubrics will not be used to measure or compare the results of individual students or clinical groups. I will only use your scores to calculate effects of the learning activity for the entire group.

Do any of you have any questions about the research or participation?

If you have any more questions, you may come by my office, rm 335, email me at rdavis89@crimson.ua.edu or call my cell number, 256-457-8222.

I will hand out consent forms in class tomorrow. If you would like to participate in the study, please sign the consent form and place it in the box at the back of the room. If you do not want to participate, please place the blank consent form in the same box at the back of the room.

Thank you!

Consent Form:

Clinical Judgment in Pharmacology Decision Making through Reflection on Practice

I am inviting you to participate in a research study. This study will look at nurses' decisions about medications. It is designed to see if reflection helps nursing students learn to make decisions about medications.

Participation is completely voluntary. The primary investigator is Rebecca Davis. I am a doctoral student at The University of Alabama.

Summary of this Study:

This study:

- Will take place during your clinical and post-conference.
- Focuses on medication activities.
- Has no expected risks to you.

Procedure for the study:

Twice this semester, some clinical groups will discuss their medication activities during post-conference. Other groups will have typical post-conferences.

Three times this semester, your instructor will assess your decisions about medications. You will be scored with a rubric. This will not be part of your clinical grade.

Your written consent allows me to use your scores to evaluate the new learning activity. If you choose not to participate, I will not use your scores.

Possible risks:
There are no expected risks to you. If you do not participate, it will not affect your clinical grade.
These activities will take place during normal clinical time. No extra time is required.

Some clinical groups will not participate in the new activity. At the end of the semester, I will provide a video in Canvas. It will present a case and questions similar to the post-conference activity.

Expected benefits:

Results from this study may benefit nursing education. We may learn if reflection affects nurses' decision-making about medications.

You also may benefit from this activity. It may help you make decisions about medications.

Your participation will help me complete my doctoral research.

Confidentiality:

I will remove your name from your rubric as soon as your instructor gives it to me.

I will code your rubric to tell me if you are in a group that participated in the new activity. I will use this code only to record your score. No one outside the study will see your rubrics.

I will store your consent forms and rubrics in a locked cabinet. I will shred your consent form after 3 years and your rubrics in 6 years, per IRB policy.

Freedom to withdraw:

You may withdraw from the study at any time. There is no penalty if you withdraw.

Contact information:
Please ask any questions now.
If you have questions later, please contact Rebecca Davis at 256-457-8222 or rdavis89@crimson.ua.edu

My supervisor is Dr. Felecia Wood. You may contact her at 205-469-8207 or at fwood@ua.edu.

If you have questions about your rights as a participant, or concerns or complaints about the research, you may contact the UAH Office of the IRB at 256.824.6992. You may also email the UAH IRB chair Dr. Ann Bianchi at irb@uah.edu

If you have questions, concerns, or complaints about your rights as a person in a research study, call Ms. Tanta Myles, the Research Compliance Officer of The University of Alabama, at 205-348-8461 or toll-free at 1-877-820-3066.

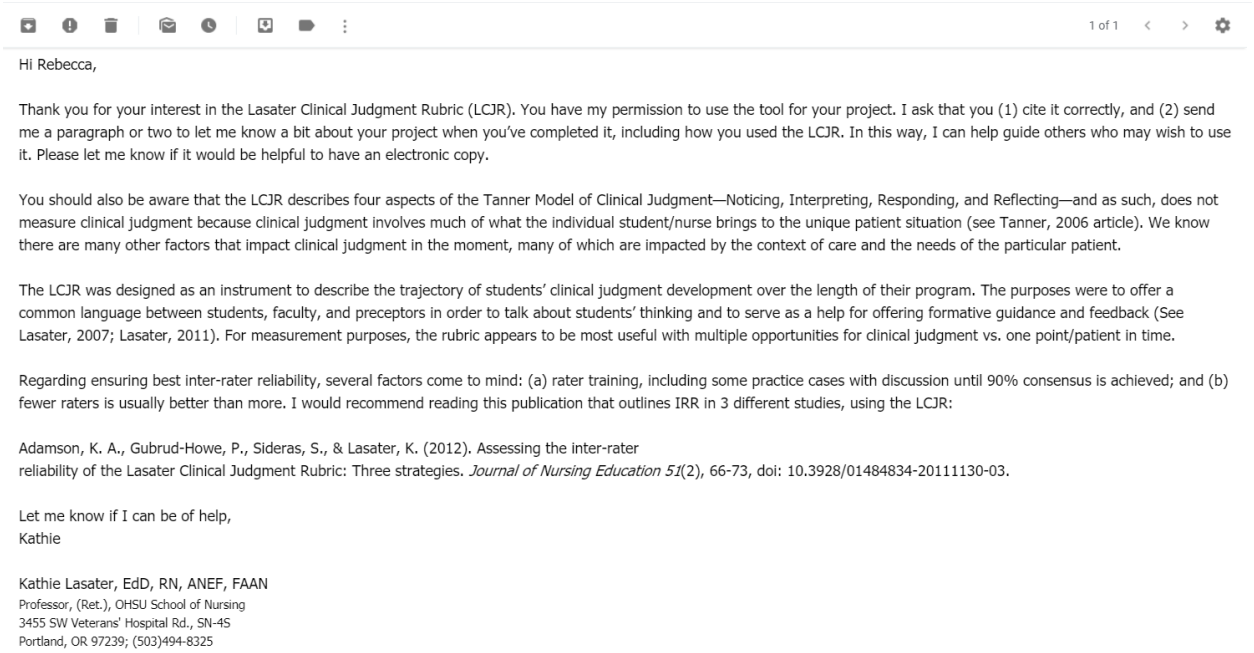
You may also ask questions, make suggestions, or file complaints and concerns through the IRB Outreach Website at http://ovpred.ua.edu/research-compliance/prco/ . You may email the Office for Research Compliance at rscompliance@research.ua.edu.

If you agree to participate in my research, please sign and date below. I am more than 18 years old.

This study was approved by the Institutional Review Board at UAH and The University of Alabama. It will expire in one year from August 7, 2019.

Name (Please Print) Signature Date

APPENDIX F – IMAGE OF EMAIL FROM K. LASATER GRANTING PERMISSION TO USE LCJR



1 of 1

Hi Rebecca,

Thank you for your interest in the Lasater Clinical Judgment Rubric (LCJR). You have my permission to use the tool for your project. I ask that you (1) cite it correctly, and (2) send me a paragraph or two to let me know a bit about your project when you've completed it, including how you used the LCJR. In this way, I can help guide others who may wish to use it. Please let me know if it would be helpful to have an electronic copy.

You should also be aware that the LCJR describes four aspects of the Tanner Model of Clinical Judgment—Noticing, Interpreting, Responding, and Reflecting—and as such, does not measure clinical judgment because clinical judgment involves much of what the individual student/nurse brings to the unique patient situation (see Tanner, 2006 article). We know there are many other factors that impact clinical judgment in the moment, many of which are impacted by the context of care and the needs of the particular patient.

The LCJR was designed as an instrument to describe the trajectory of students' clinical judgment development over the length of their program. The purposes were to offer a common language between students, faculty, and preceptors in order to talk about students' thinking and to serve as a help for offering formative guidance and feedback (See Lasater, 2007; Lasater, 2011). For measurement purposes, the rubric appears to be most useful with multiple opportunities for clinical judgment vs. one point/patient in time.

Regarding ensuring best inter-rater reliability, several factors come to mind: (a) rater training, including some practice cases with discussion until 90% consensus is achieved; and (b) fewer raters is usually better than more. I would recommend reading this publication that outlines IRR in 3 different studies, using the LCJR:

Adamson, K. A., Gubrud-Howe, P., Sideras, S., & Lasater, K. (2012). Assessing the inter-rater reliability of the Lasater Clinical Judgment Rubric: Three strategies. *Journal of Nursing Education 51*(2), 66-73, doi: 10.3928/01484834-20111130-03.

Let me know if I can be of help,
Kathie

Kathie Lasater, EdD, RN, ANEF, FAAN
Professor, (Ret.), OHSU School of Nursing
3455 SW Veterans' Hospital Rd., SN-4S
Portland, OR 97239; (503)494-8325

APPENDIX G - INSTITUTIONAL REVIEW BOARD APPROVAL UNIVERSITY OF ALABAMA HUNTSVILLE

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

_X_ Expedited (see pg 2)
__ Exempted (see pg 3)
__ Full Review
__ Extension of Approval

Date: 7 August 2019

PI: Rebecca Davis
PI Department: University of Alabama-College of Education
The University of Alabama in Huntsville

Dear Rebecca,

The UAH Institutional Review Board of Human Subjects Committee has reviewed your proposal titled: *Cultivating Clinical Judgment in Pharmacological Decision Making through Reflection on Practice* and found it meets the necessary criteria for approval. Your proposal seems to be in compliance with these institutions Federal Wide Assurance (FWA) 00019998 and the DHHS Regulations for the Protection of Human Subjects (45 CFR 46).
Please note that this approval is good for one year from the date on this letter. If data collection continues past this period, you are responsible for processing a renewal application a minimum of 60 days prior to the expiration date.

No changes are to be made to the approved protocol without prior review and approval from the UAH IRB. All changes (e.g. a change in procedure, number of subjects, personnel, study locations, new recruitment materials, study instruments, etc) must be prospectively reviewed and approved by the IRB before they are implemented. You should report any unanticipated problems involving risks to the participants or others to the IRB Chair.

If you have any questions regarding the IRB's decision, please contact me.

Sincerely,

[redacted]

Ann L. Bianchi
IRB Chair
Associate Professor, College of Nursing

APPENDIX H - LETTER OF COMPLIANCE AGREEMENT: INSTITUTIONAL REVIEW BOARDS OF THE UNIVERSITIES OF ALABAMA AND THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

The University of Alabama Institutional Review Board (IRB)

IRB Authorization Agreement (IAA)

A. Institution Providing IRB Review (Institution A): The University of Alabama in Huntsville
IRB Registration #: IORG0004109 Federalwide Assurance #: FWA00019998

B. Institution Relying on the Designated IRB (Institution B): The University of Alabama
Federalwide Assurance #: FWA00004939

C. The Officials signing below agree that The University of Alabama may rely on the Designated IRB for review and continuing oversight of the human subjects research described below:

☐ This agreement applies to all human subjects research covered by Institution B's FWA.

☒ This agreement is limited to the following specific protocol(s):

Name of Research Project: *Cultivating Clinical Judgment in Pharmacological Decision Making through Reflection on Practice*

Principal Investigator: Rebecca Davis

Collaborating Investigator (Institution B): N/A

Sponsor or Funding Agency: N/A Award Number, if any: N/A

D. The review performed by the Designated IRB will meet the human subjects protection requirements of Institution B's OHRP-approved Federalwide Assurance (FWA). The IRB at Institution A will follow written procedures for reporting its findings and actions to appropriate officials at Institution B. Relevant minutes of IRB meetings will be made available to Institution B upon request. Institution B remains responsible for ensuring compliance with the IRB's determinations and with the terms of its OHRP-approved FWA. This document must be kept on file by both parties and provided to OHRP upon request.

E. Signature of Signatory Official (Institution A):

[redacted] Date: 21 August 2019

Print Full Name: Gloria W. Greene, MA, CRA
Institutional Title: Director, Office of Sponsored Programs

F. Signature of Signatory Official (Institution B):

[redacted] Date: 8/22/19

Print Full Name: John C. Higginbotham, PhD, MPH
Institutional Title: Senior Associate Vice President for Research and Economic Development