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Deliberate Practice of IV Medication Procedures by Student Nurses: Feasibility, Acceptability, and Preliminary Outcomes: A Dissertation

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University of Massachusetts Worcester

Graduate School of Nursing

*Deliberate Practice of IV Medication Procedures by Student Nurses:
Feasibility, Acceptability, and Preliminary Outcomes*

A Dissertation Presented

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ABSTRACT

Background: Medication errors continue to be one of the most prevalent problems in healthcare related to patient safety, often resulting in injury or death, with higher incidences of error occurring with intravenous medications. The purpose of this study was to explore the use of deliberate practice (DP) with second-degree nursing students in developing and maintaining fundamental intravenous medication management practices required for safe practice.

Method: This was a feasibility study using a two-arm, single-blind, randomized controlled trial design. Vygotsky's Zone of Proximal Development model was used to explore the use of a DP teaching intervention to achieve competency in skills associated with safe IV medication management. A convenience sample of first-year, first-semester nursing students enrolled in an accelerated graduate program (N = 32) were invited to participate; 19 enrolled, and 12 completed the study. Students (n = 12) received three 30-minute one-on-one practice sessions at 2-week intervals with an expert nurse (the intervention group focused on IV skills and the control group on skills unrelated to IVs). Pre- and post-intervention instruments tested participants' confidence with IV management and safety skills. The primary outcome was their ability to safely administer and monitor IV medications during a 20-minute videotaped medication administration scenario.

Results: Low recruitment (19 of 32) and high attrition (37%) were observed. Participants completing the study (5 in the intervention group and 7 in the control group) reported that the time required to attend the sessions was not burdensome (91.7%); time allotted was adequate (100%); 100% reported positive experience; 91.7% found the DP

sessions essential to learning. Change in confidence scores for IV skills were not significant ($P = 0.210$), but were higher in the intervention group ($2.97-4.14 = 1.50$ change) compared to the control group ($2.71-3.77 = 1.04$ change). Significant differences were found in overall medication administration skills between the control and intervention groups ($t [-2.302]$, $p = 0.044$) in favor of the intervention group, particularly with medication preparation skills ($p = 0.039$). Overall raw scores were low in both groups; only 16–42 (26%–70%) of the total 60 steps required for safe practice were completed. Participants scored lowest in the evaluation phase, with all participants performing less than 50% of the 14 steps.

Conclusion: Even though participant satisfaction was high, significant attrition occurred. Students reported the DP sessions to be beneficial and they felt more confident in performing skills, but three 30-minute sessions (90 minutes) were not adequate to develop, maintain, or refine all the IV-management skills associated with safe medication practices. Determining the length and duration of DP sessions as well as comparing the efficacy of DP sessions between individual and group sessions with varying doses and frequencies is needed to advance our understanding of using DP within nursing education.

DISSERTATION PROPOSAL

Deliberate Practice to Achieve
Safety Competencies

by

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Introduction

Numerous reports have brought to light the prevalence of unnecessary injuries and deaths caused by healthcare workers who lack the knowledge, skills, and attitudes (KSAs) to provide safe care (Institute of Medicine [IOM], 1999, 2006, 2010; Maxfield, Grenny, McMillan, Patterson, & Switzier, 2005). In an effort to reduce these errors, Quality and Safety for Nursing Education (QSEN) was established to educate nurses on quality and safety practices during their pre-licensure education (Robert Wood Johnson Foundation [RWJF], 2010). Initial QSEN pilot work indicated traditional teaching strategies might not be sufficient and experiential learning opportunities throughout the curriculum would be needed.

Despite several years of developing and integrating QSEN competencies into undergraduate (UG) nursing programs, recent QSEN reports indicate successful integration of content, but programs continue to lack adequate opportunities for practicing the KSAs required for safe practice (Disch, Barnsteiner, & McGuinn, 2013; Wolf, Hicks, & Serembus, 2006). Medication errors continue to be one of the most prevalent problems in healthcare related to patient safety, oftentimes resulting in injury or

death (MedMarx, 2013). A 2006 IOM report estimated medication errors harm 1.5 million patients annually with 7,000 deaths costing upwards of a billion dollars (Institute of Safe Medication Practice [ISMP], 2013). MedMarx (2013), the largest adverse drug-reporting agency in the U.S., received over 1.3 million medication error reports with 40 thousand adverse drug reaction (ADR) records from high alert medication errors for the period 2006–2008 (harm only); with most errors being caused by drugs administered via parenteral (via needle, IV, IM, SQ) route (ISMP, 2013; MedMarx, 2013). Higher incidences of error occur when high-alert medications are administered intravenously (IOM, 2006; MedMarx, 2013; Westbrook, Rob, Woods, & Parry, 2011). Medication management is primarily a nursing responsibility, with nurses spending up to one-third (17–29%) of their time performing this and associated functions (Hendrich, Chow, Skierczynski, & Lu, 2008; Keohane et al., 2008; Westbrook, Duffield, Li, & Creswick, 2011). The National Council of State Boards of Nursing (NCSBN) reported that more than 40% of new nurse graduates report making medication errors (NCSBN, 2013). Other studies have reported 65% (Cheragi, Manoocheri, Mohammadnejad, & Ehsani, 2013) and 78% (Jones & Treiber, 2010) of nurses admitting to making medication errors.

According to MedMarx reports, less than 3% of 1,305 student-made medication errors reported from 1999–2003 resulted in patient harm; the most prevalent cause of student nurse errors was students' performance deficits (MedMarx, 2013). Occurrences may be much higher for nurses as well as student nurses; as these estimates are based primarily on self-reported errors, underreporting continues to be problematic (Cheragi et al., 2013; Pagotto, Varallo, & Mastroianni, 2013; Wolf et al., 2006).

New nurses and nursing students have reported inadequate training and experience with the administration of IV medications, leaving them vulnerable to medication errors (Dilles, Vander Stichele, Van Bortel, & Elseviers, 2011; Vaismoradi, Jordan, Turunen, & Bondas, 2014; Valdez, de Guzman, & Escolar-Chua, 2013). Research is needed to identify the most effective teaching strategies that support the development and enhancement of skills required for safe medication management practices, and the feasibility of implementing planned practice opportunities to maintain competency in these skills. In the past decade, deliberate practice (DP), repetition of a skill under the supervision of an expert mentor to achieve mastery, has been used in medical education to develop and maintain competency with positive effects. Only recently has this teaching strategy been examined in nursing, and initial results have been promising. Research examining the specifics of dose and frequency of DP is needed to determine feasibility, acceptability, efficacy, and satisfaction of this teaching strategy to teach safe medication management practices pre-licensure.

The purpose of this feasibility study is to explore the use of DP in developing and maintaining fundamental IV medication skills to provide quality and safer nursing care among second-degree nursing students. The specific aims of this study are as follows: (a) to evaluate the feasibility, acceptability, and satisfaction of using DP to teach safe medication administration of intravenous medications, and (b) to measure the preliminary efficacy of a DP intervention at improving the confidence and skills of second-degree nursing students' ability to safely prepare, administer, and monitor the effects of intravenous medications.

This feasibility study will provide preliminary data to help determine whether DP of IV medication administration is a feasible, acceptable, and appropriate teaching strategy for second-degree nursing students. Examining the use of bi-monthly DP sessions to maintain and refine skills will assist in determining the feasibility (resources such as faculty, laboratory time and availability, supplies, scheduling) of implementing DP into accelerated programs.

Background and Significance

QSEN. In 1999, the IOM estimated up to 98,000 patients die each year as a result of unsafe healthcare practices, and 7,000 of these were attributed to medication errors. The 2003 IOM *Health Professions Education* report called for a radical transformation in nursing education to ensure “future nurses have the necessary knowledge, skills and attitudes (KSAs) to improve the quality and safety of the health care systems in which they work” (IOM, 2003). The RWJF (2010) funded a project initiative known as Quality and Safety Education for Nurses (QSEN) to address these concerns, launching a national initiative to ensure safety and quality competencies are met prior to licensure (Cronenwett, Sherwood, & Gelmon, 2009). Six core competencies for safe nursing care were identified: patient-centered care, teamwork and collaboration, evidence-based practice (EBP), quality improvement (QI), safety, and informatics. To ensure QSEN initiatives were met, the American Association of Colleges of Nursing (AACN) adopted and incorporated in 2011 the QSEN competencies into their Baccalaureate Essentials, requiring all accredited schools to integrate these competencies into their programs (AACN, 2016).

QSEN-related pilot project work was conducted to identify the KSAs needed to achieve QSEN core competencies (Cronenwett et al., 2007); the teaching strategies being utilized and the effectiveness of these strategies (Smith, Cronenwett, & Sherwood, 2007); and how and when to incorporate these competencies into curriculums (Barton, Armstrong, Preheim, Gelmon, & Andrus, 2009). The findings from initial QSEN pilot work (Cronenwett, et al., 2007; Smith, et al., 2007) as well as recent studies on educating nurses (Benner, P., Sutphen, M., Leonard, V., & Day, L., 2010) indicate reliance on traditional teaching strategies such as lecture and reading and writing assignments to integrate these competencies may not be effective. Innovative, planned participatory student learning experiences in controlled environments are likely needed to ensure that QSEN competencies are achieved by all students.

In light of these findings, educators have been examining new strategies to integrate and teach QSEN competencies (QSEN, 2013). The majority of studies relate to the use of simulation (Shearer, 2013) to provide the experiential learning component to teach skills but do not incorporate opportunities to develop and maintain skills beyond the initial training session or course, relying on clinical experiences to further develop skills. Sufficient evidence exists demonstrating the inadequacies and wide variability of clinical experiences (within and between programs) due to facility policies (i.e., restricting medication administration), acuity (no intravenous lines/medications), low census, student-teacher ratios (generally one faculty to eight–ten students) limiting time spent one-on-one to learn skills, as well as competition for appropriate clinical sites (Handwerker, 2012; Houghton, Casey, Shaw, & Murphy, 2013; Killam & Heerschap, 2013; Pauly-O'Neill, Prion, & Nguyen, 2013).

Accelerated nursing programs. The U.S. Department of Labor estimated the need for more than one million registered nurses by the year 2018 (AACN, 2016). In an attempt to meet this demand, accelerated degree programs for non-nursing graduates have proliferated (AACN, 2016). Even though accelerated programs may provide an adequate pool of nurses in a short period of time, and these students are generally considered exceptional with highly competitive admission requirements, research has found their clinical performance similar (Oermann, Alvarez, O'Sullivan, & Foster, 2010) or slightly lower (Rafferty & Lindell, 2011) than their traditional baccalaureate counterparts during the first year of practice. Perceived challenges for students of accelerated programs is the lack of time for students to gain essential clinical skills. Even though clinical hours are equivalent to traditional programs, there may not be enough time to process the experiences (Oermann, Poole-Dawkins, Alvarez, Foster, & O'Sullivan, 2009). Although graduates of accelerated programs report overall satisfaction with their education, they recommend curricular changes including more time on pharmacology, and increasing simulation, and clinical time to develop skills (Nugent & LaRocco, 2014). According to NCSBN, their 2013 annual survey results (N = 1,750) indicated that for the past 3 years nurse educators and employers reported an increase in the number of newly licensed nurses who are not clinically competent to practice as entry-level nurses. And orientation periods continue to be insufficient to prepare new graduates for practice no matter what educational program they completed (Duclos-Miller, 2011; Oermann et al., 2009; Parker, Giles, Lantry, & McMillan, 2014; Teoh, Pua, & Chan, 2013). Therefore, I am targeting students in an accelerated program as it has been reported that these programs will increase, and, due to the accelerated pace, students while knowledgeable may not have

time to develop and refine the psychomotor skills needed for safe practice (Nugent & LaRocco, 2014; Oermann et al., 2009; Oermann et al., 2010).

Deliberate practice. Medical school programs face the same or similar issues related to developing and maintaining skills, and in the past decade have studied the use of deliberate practice to ensure skills are maintained and refined throughout the program (Ahya et al., 2012; Barsuk, McGaghie, Cohen, O'Leary, & Wayne, 2009; Bender, Kennally, Shields, & Overly, 2014; Castellvi et al., 2009; Crochet et al., 2011; De Win, Van Bruwaene, De Ridder, & Miserez, 2013; Duvivier et al., 2011; Gelfman et al., 2014; Heiman et al., 2012; McGaghie, Issenberg, Cohen, Barsuk, & Wayne, 2011a; McGaghie, Issenberg, Petrusa, & Scalese, 2010; Nesbitt et al., 2013; Wayne, Barsuk, O'Leary, Fudala, & McGaghie, 2008). Numerous studies in medicine have found the use of deliberate practice, especially when combined with simulation, to be superior to standard clinical/laboratory learning techniques in developing and maintaining competency among physicians (McGaghie et al., 2011a; McGaghie et al., 2010). Currently, medicine is exploring frequency and duration of DP needed for specific skill acquisition, maintenance, and refinement toward expertise (De Win et al., 2013).

Only three studies in nursing have explored deliberate practice in developing and maintaining competency, each with favorable results (Hauber, Cormier, & Whyte, 2010; Liou, Chang, Tsai, & Cheng, 2013; Oermann et al., 2011). Sufficient evidence exists to support the use of deliberate practice to maintain, develop, and refine skills (Ahya et al., 2012; Barsuk, Ahya, Cohen, McGaghie, & Wayne, 2009; Barsuk, Cohen, Feinglass, McGaghie, & Wayne, 2009; Barsuk, Cohen, McGaghie, & Wayne, 2010; Castellvi et al., 2009; Crochet et al., 2011; De Win et al., 2013; Duvivier et al., 2011; Gelfman et al.,

2014; Hauber et al., 2010; Heiman et al., 2012; Issenberg & McGaghie, 2002; Liou et al., 2013; Malik et al., 2013; Marcus, Vakharia, Kirkman, Murphy, & Nandi, 2013; McGaghie, 2008; McGaghie et al., 2011a; McGaghie, Issenberg, Cohen, Barsuk, & Wayne, 2011b; McGaghie, Issenberg, Petrusa, & Scalese, 2006; Mitchell, 2002; Moulaert, Verwijnen, Rikers, & Scherpbier, 2004; Nesbitt et al., 2013; Oermann et al., 2011; Pachman, Sweller, & Kalyuga, 2013; Palter & Grantcharov, 2014; Pusic, Pecaric, & Boutis, 2011; Pusic et al., 2012; Rackow et al., 2012; Reid, Dodds, & McColl, 2013; Sawatsky, Mikhael, Punatar, Nassar, & Agrwal, 2013; Sawyer et al., 2011; van de Wiel, Van den Bossche, Janssen, & Jossberger, 2011; Watson, 2012; Wayne et al., 2008; Wayne et al., 2006), but how much time and how frequently skills need to be practiced remains unclear. More evidence is needed to determine the dose (time) and frequency needed to maintain and refine skills associated with safety, such as medication management practices. Given the fast-paced nature and tightly woven curricula of accelerated programs, determining the time and resources required to implement DP sessions is essential.

Medication management and errors. Medication management is a complex process involving several stages, each with numerous steps. The five stages include the following: (a) ordering/prescribing, (b) transcribing and verifying, (c) dispensing and delivering, (d) administering, and (e) monitoring and reporting—this last stage is a newly identified stage with little research (Hughes & Blegen, 2008). Complexity of medication management increases with intravenous drug therapy and includes the following: obtaining drug for administration, obtaining diluent, reconstituting the drug, taking the drug to patient's bedside, checking for patient allergies, checking route of drug

administration, checking drug dose, checking patency of cannula, expelling air from syringe, administering drug, flushing cannula, and signing off administration of the drug (McDowell, Mt-Isa, Ashby, & Ferner, 2010).

Despite QSEN initiatives, adverse events continue to occur in hospitals. Since nurses provide the majority of care in hospital settings, they have been identified as attributing to the majority of adverse events—many of which are related to medication administration errors (D'Amour, Dubois, Tchouaket, Clarke, & Blais, 2014). Since the IOM's seminal report "To Err is Human" brought to light the number of preventable errors (IOM, 1999), national initiatives by the Institute for Healthcare Improvement (IHI, 2014); the National Coordinating Council for Medication Error Reporting and Prevention (NCCMERP, 2014); the National Quality Forum (NQF, 2014); Hughes & Blegen, 2008; and the Joint Commission (2014) have been launched in an attempt to reduce these by identifying causes and implementing measures to reduce their occurrence. Unfortunately over a decade later, preventable errors continue to occur.

The IOM (2006) defined an error "as the failure of a planned action to be completed as intended (i.e., error of execution) or the use of a wrong plan to achieve an aim (i.e., error of planning)" (IOM, 2006). The NCCMERP defines medication errors as "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional." (NCCMERP, 2014).

In the hospital setting, nurses are predominantly responsible for the administration of medications (Hughes & Blegen, 2008; IOM, 2006). Nurses spend up to one-third of their time preparing, administering, and monitoring effects of medications (Westbrook,

Duffield, et al., 2011). D'Amour et al. (2014) found 76.8% of 411 adverse events occurring in 11 hospitals in Quebec, Canada were attributed to nurses; 98.8% of those errors were medication adverse events (MAEs) (D'Amour et al., 2014). Johnson and Young (2012) had similar findings with nurses being directly involved in 67% of 259 medication errors, and 14% (n = 55) being involved in some point in the incident. A secondary data analysis of student medication errors (n = 1,305) conducted by Wolf et al. (2006) found that errors were attributed to students' performance deficits due to inexperience and distractions.

Numerous causes have been attributed to medication errors. Human factors include experience and knowledge, including slips, memory lapses, with the lack of knowledge of drugs being attributed to the majority of errors (Hughes & Blegen, 2008; IOM, 2006; Keers, Williams, Cooke, & Ashcroft, 2013a). The most common errors continue to be the wrong time, omissions, and wrong dose (IOM, 2006; Keers et al., 2013a; Keers, Williams, Cooke, & Ashcroft, 2013b; Tzeng, Yin, & Schneider, 2013; Weiss & Elixhauser, 2013). Although errors can occur at any stage of the medication management process, they most often occur at the administration stage (21% median, range: 5.5%–40.1%; Krahenbuhl-Melcher et al., 2007). The incidence and severity of an error occurring increases when injectable drugs are involved—most involve incorrect diluent/solvent, rate of bolus or infusion rate (Cousins, Sabatier, Begue, Schmitt, & Hoppe-Tichy, 2005; IOM, 2006; Keers, et al., 2013a, 2013b; Taxis & Barber, 2003a).

Medication errors are more likely to occur in pediatric (Gonzales, 2010) and geriatric populations, with patients with chronic conditions multiple medications (Hughes & Blegen, 2008; IOM, 2006; Weiss & Elixhauser, 2013) There is an increased risk of

error if administered via intravenous route. Parenteral, particularly intravenous, route of medication and high alert medications with multiple concentrations such as heparin and insulin have been associated with higher rates of error (ISMP, 2013; Lu et al., 2013). According to HCUP 2013 report (Hughes & Blegen, 2008), the most common drugs associated with ADE in 2011 were steroids, antibiotics, opiates, narcotics, and anticoagulants. A number of studies (Gonzales, 2010; Krahenbuhl-Melcher et al., 2007; Taxis & Barber, 2003a, 2003b, 2004; Tzeng et al., 2013; Weiss & Elixhauser, 2013) and reports (ISMP, 2013) have been conducted related to high-alert medications, recommending further education with these specific medications. Numerous studies have shown that medications given parenterally, by needle via subcutaneous, intramuscular, or intravenous route, are more frequently involved in medication errors in general, and cause more harm (Abbasinazari, Talasaz, Mousavi, & Zare-Toranphoshti, 2011; Anselmi, Peduzzi, & Dos Santos, 2007; Beckett, Sheehan, & Reddan, 2012; Deters, Prasa, Henschel, & Schaper, 2009; Ferner, 2001; Ferner et al., 2001; Hicks & Becker, 2006; Husch et al., 2005; Jones & Treiber, 2010; Keers et al., 2013a; Nguyen et al., 2014; Rooker & Gorard, 2007; Seki & Yamazaki, 2006). These studies demonstrated that the lack of experience and knowledge with intravenous medication preparation and administration is the causal factor of these medication errors and are not limited to high risk medications.

A systematic review conducted by Keers et al. (2013a) analyzed 54 studies to appraise evidence relating to the causes of MAEs in hospital settings. Fifteen (27.8%) of the studies focused on intravenous route of administration (Keers et al., 2013a). The majority of the studies investigated errors directly involving nurses (n = 35, 59.3%),

student nurses (n = 1) or both nurses and students (n = 1). They found slips and lapses (misidentification of either medication or patient) were the most commonly reported unsafe acts, followed by knowledge-based mistakes (staff did not know enough about the medication they were administering [n = 11] or the infusion pump they were using [n = 7], medication calculations [n = 10] and deliberate violations including fast bolus intravenous administration [n=2]). Staff inexperience with medication, environment, procedures, or equipment as well as being new attributed to medication errors (n = 8). Insufficient training and experience has strong links with knowledge and rule-based mistakes (n = 8). Similar findings were noted by Abbasinazari et. al (2011), where they found rapid administration of bolus infusion rates to be the most common type of error associated with intravenous medication administration (20.6%, n = 357).

McDowell et al. (2010) conducted a systematic review and found that the probability of making an error during intravenous therapy was 0.73 (95% credible interval CrI, 0.54 to 0.90). This rate was reduced to 0.22 (95% CrI 0.1 to 0.31) if error-checking was introduced at each stage of the medication administration process. Error occurred most frequently in the reconstitution step.

Hicks and Becker (2006) reviewed 73,769 IV-related medication errors reported to MEDMARX, a national medication error-reporting program, occurring over a 5-year period (2000–2004; MedMarx, 2013). Content analysis revealed three themes: product shortage, calculation errors, and tubing interconnectivity predisposed patients to harm. When product shortages occur, less familiar medications are used in the interim that may lead to error. Interconnectivity of tubing has resulted in peripheral, enteral, and epidural lines being inadvertently switched, administration of oral medications drawn up in

syringes administered intravenously—these errors were described in 300 records (Hicks & Becker, 2006). Errors in calculations, especially in the pediatric population (Gonzales, 2010) where medications are weight-based, drugs supplied in different concentrations and confusion between weight and volume (mg vs. mL) were commonly associated with errors. The three most commonly reported types of IV-related medication errors were omission error (28.5%), improper dose/quantity (22.9%), and prescribing error (16.2%). Improper preparation of the drug and wrong administration technique accounted for 6.8% and 3.4%, respectively.

Infusion pump issues were examined by Rooker and Gorard (2007) and Husch et al. (2005). Rooker and Gorard, (2007) found that out of a total of 207 bags of intravenous crystalloid fluids, only 53 (26%) were correctly administered at the prescribed rate—138 (67%) bags infused too slowly and 16 bags (8%) too rapidly. 39% of the bags infused accurately when a metered pump was used, compared to 21% when a pump was not used ($p < 0.01$). Husch and colleagues (2005) compared 426 medications infused through a pump. A total of 389 errors were documented. Of these, 285 (66.9%) had two or more errors related to administration. A total of 37 of these errors were rate related.

Two studies examined medications errors (ME) and nurse experience and found a significant proportion of errors suggest skill and knowledge deficiencies, especially with intravenous medications (Doherty & McDonnell, 2012; Westbrook, Rob, et al., 2011). Findings suggest that the number of errors and their severity reduced as clinical experience increased. Westbrook, Rob, et al. (2011) observed 107 nurses from six wards at two teaching hospitals administer 568 intravenous medications. Of the 568 intravenous administration, 69.7% ($n = 396$; 95% CI 65.9–73.5) had at least one clinical error, and

25.5% (95% CI 21.2–29.8) of these were serious. Four error types (wrong intravenous rate, mixture, volume, and drug incompatibility) accounted for 91.7% of the errors. Wrong rate was the most frequent and accounted for 95 of 101 serious errors. Error rates and severity decreased with clinical experience. Each year of experience, up to 6 years, reduced the risk of error by 19.9% and serious error by 18.5%. Administration by bolus was associated with a 312% increased risk of error. Patient identification was only checked in 47.9% of administrations but was associated with 56% reduction in intravenous error risk (Westbrook, Rob, et al., 2011). Doherty and McDonnell (2012) examined 6,643,252 medication-related safety reports of tenfold MEs occurring over a 5-year period at a Canadian pediatric hospital serving patients under 18. Prescribing and administration phases of drug administration were most commonly associated with tenfold errors (n = 109, 43.3% and n = 87, 34.5%, respectively). Incorrect programming of drug delivery equipment (infusion pumps) was the most frequent error source (n = 52). The omission (n = 46)/addition of zeroes (n = 19), simultaneous programming of multiple infusion rates (n = 19), and inter-swapping of infusion rates (n = 9) were the most frequently identified error mechanisms. Intravenous formulation of medication was the most significant tenfold medication error enabler (n = 113; Doherty & Mc Donnell, 2012).

Nurses' perspectives of medication errors were examined in two studies. In Cheragi et al., (2013), nearly 65% (64.55%, n = 237) of nurses admitted to making medication errors. The most common types of errors reported were wrong dosage and infusion rate. The most common causes were using abbreviations instead of full names of drugs and similar names of drugs (lack of pharmacological knowledge). Most medication

errors (60.78%) involved intravenous injections of drugs (Cheragi et al., 2013). Similar findings were noted in an integrative literature review (n = 9) conducted by Hewitt (2010), including confusion between drugs with similar names or similar packaging, confusion regarding infusion devices and miscalculations as common contributors to medication errors.

Research related to medication competence in nursing has and continues to focus primarily on numeracy skills (Fleming, Brady, & Malone, 2014; Hunter Revell & McCurry, 2013; Ramjan et al., 2014; Sulosaari, Kajander, Hupli, Huupponen, & Leino-Kilpi, 2012; Sulosaari, Suhonen, & Leino-Kilpi, 2011; Wright, 2010). However, two integrative reviews related to general competency of medication administration of student nurses (Sulosaari et al., 2012; Sulosaari et al., 2011) and registered nurses (Sulosaari et al., 2011) were located. In the Sulosaari et al. (2012) integrative review (n = 19), three main categories were identified that included factors associated with individual nurse students, clinical learning environment, and educational institution. Individual nurse student factors included age, educational background, stage of the nursing education, success in studies, learning strategy, attitude, previous experiences in mathematics, and self-confidence. Too few learning opportunities and lack of supervision were the primary factors related to clinical learning environment. Factors associated with learning institution included lack of comprehensive medication education and clinical practice, and lack of congruence between coverage of pharmacology content and clinical practice. Sulosaari and colleagues (2011) found three major categories that facilitate the integration of medication competency: decision-making competence, theoretical competence, and practical competence. These are interrelated within decision-making

competence encompassing both theoretical competence (knowledge) and practical competency (ability to apply that knowledge).

More effective teaching methods are needed to promote medication safety and ensure that students achieve and maintain medication competence.

Theoretical/Conceptual Framework

Vygotsky's Zone of Proximal Development (ZPD) will serve as the framework to guide this study. The ZPD is a well-established educational framework frequently used in primary (Siyepu, 2013; Tharp & Gallimore, 1988; Vygotsky, 1978 [1935]) and secondary education (De Leon, 2012; Diez-Palomar, Menendez, & Civil, 2011; Huong, 2007; Poehner, 2012; Tasker, Johnson, & Davis, 2010; Wass, Harland, & Mercer, 2011) as well as psychology (Asmolov, 2010; Bozhovich, 2010; Dowdy et al., 2013; Kravtsova, 2009; Zaretskii, 2009). Theoretical and conceptual frameworks are important to guide and support research, define and operationalize concepts, as well as describe their relationships (Dulock & Holzemer, 1991). The theory of the ZPD is an appropriate framework to use since the focus of this study is to examine the association of deliberate practice (dose and frequency) to competency and skill decay. The ZPD explains how competency of a new skill is developed, how deliberate practice of the skill is required to maintain competency and prevent skill decay (Figure 1; Tharp & Gallimore, 1988).

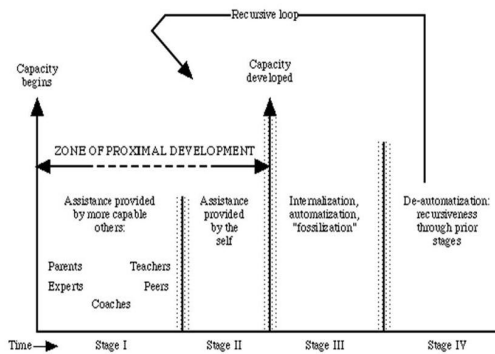
The ZPD and Assisted Performance is a borrowed theory from psychology, early childhood development and special education. The theory was developed by a Russian educational psychologist, Lev Semenovich Vygotsky (1896–1934). Vygotsky specialized in abnormal psychology and special education of children. Several recent research studies (Berragan, 2011; Duers & Brown, 2009; Mangena & Chabeli, 2005; McAllister, Searl, &

Davis, 2013; Mikkelsen, Reime, & Harris, 2008; Phillips et al., 2013; Priharjo & Hoy, 2011) and theoretical papers (Chen, Feng, & Chiou, 2009; Daley, Menke, Kirkpatrick, & Sheets, 2008; Rhodes, Schutt, Langham, & Bilotta, 2012; Rolloff, 2010; Sanders & Welk, 2005; Spouse, 1998) in nursing and medical education journals (Dunphy, 2003; Gelinas-Phaneuf & Del Maestro, 2013; Kneebone, 2005; Kneebone, Scott, Darzi, & Horrocks, 2004; Lefroy, Brosnan, & Creavin, 2011; Miskovic, Wyles, Ni, Darzi, & Hanna, 2010) have suggested the use of ZPD as a framework to guide education practices in these disciplines, but no research studies were located explicitly stating the use of the ZPD as a framework.

According to Vygotsky's ZPD and Assisted Performance theory, learning can be achieved with the assistance of a more knowledgeable other (MKO) such as a teacher or a peer (Tharp & Gallimore, 1988; Vygotsky, 1978 [1935]; Westbrook & Li, 2013). The ZPD theory consists of four stages: The first two stages comprise the "Zone of Proximal Development" where the learner is challenged to learn a new skill or solve new problems. The MKO assists the student throughout the ZPD by providing responsive assistance in the form of feedback, modeling, linguistic means of assistance (instructing, questioning, and cognitive structuring) and contingency management (positive and negative feedback by way of patient response to interventions). In Stage I, a learner relies on the assistance of the MKO to perform a skill. In Stage II, the learner is able to carry out a skill by themselves; however, this does not mean the skill is fully developed. In Stage III, performance of the skill is developed and "automatized" or "internalized;" therefore, assistance from the MKO is no longer needed. Stage IV, de-automatization of performance of a skill may occur as a result of not performing the skill frequently,

leading to recursion back through the ZPD; thus, without continued deliberate practice, some skills are lost (Tharp & Gallimore, 1988; Vygotsky, 1978 [1935]). How much time and how frequently skills need to be practiced, however, remains unclear.

Key components of the ZPD include the following: the more knowledgeable other (MKO); language as central to learning (internal speech); education leads to development (in direct contrast to Piaget who believed development must precede education); the ZPD a hypothetical, dynamic region where learning and development occur; and social engagement and collaboration (joint problem-solving and inter-subjectivity) as a source of cognitive development. Later, other educational theorists described these concepts as “scaffolding,” as they provide a temporary structure to support learning (Tharp & Gallimore, 1988; Vygotsky, 1978 [1935]; Westbrook & Li, 2013).



Stages I & II:

MKO (i.e., a teacher or peer) can facilitate learning in the ZPD

Stage III: Skill must be deliberately practiced (DP) in order to achieve competency (internalization/automatization)

Stage IV: If skill not DP, then skill/competency will be lost (de-automatization)

Figure 1. Zone of Proximal Development.

From *Rousing Minds to Life: Teaching, Learning, and Schooling in Social Context*, by R. Tharp and T. Gallimore, 1988, p. 250. Copyright Cambridge University Press (1988) Reprinted with permission.

Vygotsky's ZPD has been used in a few studies in nursing. Dowdy et al., (2013) found the use of scaffolding by peers and adults to increase knowledge and skills of nutrition and exercise in middle school students (N = 58) was effective in this population.

Fotheringham, (2013) examined the usefulness of feedback and peer support to develop skill and judgment of nurse practitioners (N = 95) and found learning by doing, repetition of a demonstrated skill, with judicious feedback, to be the most important aspects of developing new skills. Phillips et al. (2013) explored the use of a virtual learning tool and determined that repeated observation of skills reinforced midwifery student nurses' (N = 140) learning (Phillips et al., 2013). Duers and Brown (2009) found the use of encouragement, feedback on performance facilitated student nurses' (N = 96) higher level of learning and improved their experience with formative assessment.

Deliberate practice refers to Ericsson's (2008) theory of skill acquisition where mastery is achieved by repetition and frequency of the skill under the supervision and guidance of an expert (Ericsson, 2008). Deliberate practice has been referenced frequently in medical education since the 1990s as a means of skill acquisition (Ahya et al., 2012; Barsuk, Ahya, et al., 2009; Barsuk, McGaghie, Cohen, Balachandran, & Wayne, 2009; Bender et al., 2014; Castellvi et al., 2009; Crochet et al., 2011; De Win et al., 2013; Duvivier et al., 2011; Gelfman et al., 2014; Heiman et al., 2012; McGaghie, 2008; McGaghie et al., 2011a, 2011b; Nesbitt et al., 2013; Wayne et al., 2008). In recent years, it has also appeared in several nursing studies demonstrating positive learning outcomes (Hauber et al., 2010; Liou et al., 2013; Oermann et al., 2011); however, the frequency and dose required to maintain skill sets has not yet been researched in nursing.

Unsafe practices related to the preparation and administration of intravenous medications has been identified as a cause of ADEs leading to patient harm, including death (ISMP, 2013; MedMarx, 2013). This study seeks to understand the time and frequency of practice required to develop and maintain the fundamental safety skills associated with the preparation, administration, and monitoring of intravenous medications. Nursing has traditionally relied on experiential knowledge attained by clinical placements and years on the job—as described by Benner’s theory of novice to expert (Benner, 1982). However, according to Ericsson, experience alone is not sufficient to attain expertise in a skill; the number of years of experience in a domain is typically a poor predictor of attained performance (Ericsson, 2008). In order to improve performance, skills need to be deliberately practiced repetitively with immediate feedback and time for reflection and problem solving (Ericsson, 2008; McGaghie et al., 2011a, 2011b; McGaghie et al., 2010).

In light of the risk for patient safety, a theoretical framework that supports acquisition of basic skills, critical thinking, and expertise in higher-level skills—such as the preparation, administration, and monitoring of intravenous medications, is needed to ensure safety. The ZPD along with Ericsson’s concept of DP provides such a framework. Implementation of this framework would require threading DP training of safety competencies throughout nursing programs as planned participatory experiences. Determining the dose and frequency of DP required is essential in order to establish feasibility (time and resources) of utilizing this framework to teach safe nursing practices.

Methods

Design. This is a feasibility study that will use a randomized controlled trial (RCT) design to examine a deliberate practice teaching intervention to teach skills associated with safe IV medication administration. This study will provide data on feasibility including achievable recruitment; acceptability of randomization, participants' completion of assessments, retaining an active intervention group using deliberate practice; adherence to learning protocol for deliberate practice, optimal outcome measures and preliminary data for a robust sample-size calculation for a future powered study for efficacy. In addition, this study will identify if the lab setting and necessary equipment and materials can be made available and easily accessed throughout the study period.

Feasibility studies are conducted prior to large-scale studies to enhance the likelihood of success of a future powered study. They are used to assess the process (i.e., recruitment/retention rates, eligibility requirements, data collection tools), resources (time, laboratory and supply availability), management (potential human and data management) problems and estimate parameters. The results of this study will inform the development and implementation of a future larger-scale powered RCT.

Sample. A convenience sample of first-year nursing students enrolled in an accelerated Graduate Entry Pathway (GEP) program (N = 33) at the University of Massachusetts Worcester will be invited to participate in this study during the first semester after their annual scheduled IV training is completed. Instruction related to safe administration of IV medications is scheduled for August 25th & 26th with a return demonstration scheduled for September 2, 2014 (A. Carroll, personal communication

7.9.14). The GEP program admits students with a baccalaureate degree in a field other than nursing. There are 33 GEP students anticipated to begin their coursework Fall 2014. They are predominantly female (85%, n = 28), white (82%; = 27), with an average age of 28 (range 21–46; D. Brescia, personal communication, 2014). Recruitment for the study will begin after IRB approval is granted.

Students will be eligible for this study if they are (a) enrolled in their first semester of the UMass GSN GEP program; (b) agree to attend three 30-minute bi-monthly individual (one-on-one) audiotaped teaching sessions throughout the semester; (c) have transportation to and from these sessions; and (d) agree to participate in a 20-minute post-intervention videotaped skills scenario at the end of the semester. Students who have received special training in IV medication administration prior to entering the GEP program, or previously held or presently hold a position where IV skills were/are used will be excluded.

Setting. The study will be conducted at the University of Massachusetts Worcester. The deliberate practice and control sessions will take place in the nursing simulation laboratory housed in the Albert Sherman Center.

Measures. Nine instruments will be used in this feasibility study: Demographic Data Form (Appendix A); IV Pump Self-Confidence Survey (IVPSCS; Appendix B); Safety Skills Self-Confidence Survey (SSSCS; Appendix C); Skills Inventory Checklist (SIC; Appendix D); Simulation Design Scale (SDS; Appendix E); Feasibility/Resource Tracking Form (Appendix F); Participant Progression Form (Appendix G); a Medication Administration Checklist (Appendix H); and a Post-Intervention Survey (Appendix I).

The Demographic Data Form will ask for age, gender, ethnicity, race, education

(first degree major/minor), and prior healthcare experience.

The IV Pump Self-Confidence Survey (IVPSCS) will be administered to participants pre- and post-intervention. The IVPSCS is a 10-item questionnaire, using a 5-point Likert-type scale (1 = strongly disagree; 5 = strongly agree). Good internal consistency (Cronbach's alpha = 0.83) and validity have been reported in a study of 43 third-year baccalaureate nursing students at a Canadian University (Luctkar-Flude, Pulling, & Larocque, 2012). Scores are calculated by adding each item score (lowest score 10, highest score 50).

The Safety Skills Self-Confidence Survey (SSSCS) will be administered to participants pre- and post-intervention. The SSSCS is a 10-item questionnaire, using a 5-point Likert-type scale (1 = strongly disagree; 5 = strongly agree). Scores are calculated by adding each item score (lowest score 10, highest score 50). This survey was developed to complement the IVPSCS to assess student perspective on all skills reviewed and not only the IV skills. As it is a newly developed instrument, reliability will be determined in this study.

The Skills Inventory Checklist (SIC) will be administered pre-intervention as an individual tool and post-intervention (integrated into the post-intervention survey). The SIC is a checklist to determine the number of times participants have performed 15 fundamental nursing skills (0, 1-2 times, 3-5 times, 6-10 times or >10 times) prior to entering the study and post-study.

The Simulation Design Scale (SDS; Jeffries & Rizzolo, 2006; National League of Nursing, 2014) is a 20-item instrument using a 5-point Likert-scale. The SDS is designed to evaluate the five design features of instructor-developed simulations. The five design

features include (a) objectives/information; (b) support; (c) problem solving; (d) feedback; and (e) fidelity. The instrument measures the presence of specific features in the simulation, and the importance of those features to the learner. Ten content experts were used to establish content validity, but CVI was not calculated (A. McGuire, personal communication, 2014). Cronbach's alpha was 0.92 for the presence of features, and 0.96 for the importance of features (Jeffries & Rizzolo, 2006). Scores are calculated by adding each item score (lowest score 20, highest score 100).

A Feasibility/Resource Tracking Form will be completed by the principal investigator (PI) each session. The form addresses the time required to set up laboratory, track availability, and usage of supplies, and scheduling laboratory time for each session, as well as any problems encountered during the session. The form contains the date, time, number of participants seen and the scenario, supplies used as well as five dichotomous (yes or no) questions related to difficulty: reserving lab space, preparing the lab (time required to do so), using the lab, obtaining supplies, completion of scenarios. If difficulties were encountered, space for a brief explanation is provided.

A Participant Progression Form will be used each session to track participant progression through the ZPD. Participants will be ranked according to the number of prompts they require to complete the scenario. Each stage is scaled by the number of prompts each participant requires in order to complete the scenario: Stage I = requires assistance to perform skill, participant required 6 or greater prompts; Stage II = required little assistance, required 3–6 prompts; Stage III = competent, required 2 or less prompts. A total of three Participant Progression Forms will be completed for each participant to

determine if progression through the ZPD was achieved based on the number of prompts required each session.

A Medication Administration Competency Checklist will be used at the post-intervention videotaped skills scenario to measure participants' ability to prepare and administer intravenous medications safely (i.e., determine appropriateness of the medication order, choose correct drug, accurately calculate medication dosage, prepare and administer via the correct route, rate, and effectiveness of the medication. Content validity was established through peer review by four content experts with a CVI of 1.00. Several items were deemed relevant but required slight revision; i.e., verbalizes action in addition to performing, these changes were made. The Checklist is organized into three sections evaluating the participant's ability to prepare, administer and evaluate the effectiveness of intravenous medications via the following: continuous infusion; secondary medication piggyback (IVPB) infusion; and intravenous push medication (IVP). Two raters will review the videos and note whether the participants met the standards for each of the technical skills by checking off whether or not each step was completed. (The Preparation Phase involves 17 steps; Administration Phase, 29; and Evaluation/Monitoring Phase, 14 steps). Participants score one point for each checklist item that is completed. Inter-rater score sheets will be compared for degree of agreement of participant performance. Any discrepancy (of more than 10 points) between the rater's results will prompt an additional review of the video to resolve the difference in interpretation. To ensure intra-rater reliability, the same raters will review a randomly selected sample of three videos and rescore participant performance using the same

checklist 2 weeks after first viewing and rating; responses to the first and second rating will be compared.

A Post-Intervention Survey will be administered to all participants upon completion of the study. The survey contains five open-ended questions to assess expectancies and intervention preferences and a 20-item Likert scale related to receipt of intervention content, practice session experience, previous and concurrent IV medication experience, and any sharing of information related to participation in practice sessions with other GEP students. This survey uses a 7-point scale for student response options “0 = no opinion; 1 = strongly disagree; 2 = somewhat disagree; 3 = disagree; 4 = agree; 5 = somewhat agree; 6 = strongly agree, 7 = not applicable. An additional survey item asks participants to report how much information they shared with other GEP students regarding the practice sessions (0 = none, 1 = very little, 2 = some, 3 = a lot, 4 = most but not all, 5 = all). Face validity of the survey was established via review by three nursing faculty of a small university in New Hampshire not involved in the study, who have knowledge of QSEN and fundamental skills.

Procedures. Once Institutional Review Board approval is obtained from the University of Massachusetts Worcester, the PI will schedule a time in the Fall, 2014 semester to meet with the potential participants during, right before, or right after one of their classes to explain the study purposes, including the risks, benefits and their right to withdraw from the study without penalty, including student grades. Students will not be explicitly informed that the focus of the intervention is on IV medication administration but rather on the knowledge and skills associated with QSEN safety competencies. Of note, their performance during the intervention will not be graded. Any questions will be

answered at that time, and consent will be obtained from those students agreeing to participate. Consented students will complete the pre-intervention instruments: IV Pump Self-Confidence Survey (IVPSCS; 2 minutes), Safety Skills Self-Confidence Survey (SSSCS; 2 minutes); the Skills Inventory Checklist (SIC; 2.5 minutes) and the Demographic Form (3 minutes). Once completed, the participants will place these into an envelope, seal it and once randomized into their group and given a participant number, they will place the number on the envelope and deposit it into a locked box which will be kept in a research member's office at UMass Worcester GSN. Participants will complete a separate form indicating their name and preferred mode of contact to receive reminders of their practice sessions. Participants will be randomized into intervention and control groups upon completion and collection of the baseline data, pre-intervention instruments. Once randomized, the participants will sign-up for three 30-minute sessions during October and November, 2014 and a 20-minute videotaped skills scenario session and completion of post-intervention instruments (10 minutes) after January 1, 2015.

To reduce bias, participants will be asked to not share their experiences in the sessions with other students. The study intervention sessions and control sessions will take place in a room away from members of the research team who will be conducting the outcome assessment. The research team members who will review the outcome video recordings will be blinded to group assignment. The intervention and the control sessions will be delivered individually by the same person (the PI) according to the study protocol to maximize consistency.

Randomization. After completion of the pre-intervention forms, students will be randomized into either the intervention or the control group. A member of the research

team who will not be involved in opening the envelopes, will place intervention (Group 2) and control (Group 1) assignments in sealed, opaque, numbered envelopes. The PI will distribute the unopened numbered envelopes to the participants who will open them and learn their group assignment number. The PI will record the name of the participant, their ID number, and their group assignment number on a Participant ID Log Sheet. The Participant ID Log will be stored in a sealed envelope in a locked cabinet in a member of the research team's office at UMass GSN in Worcester that is accessible only to the PI.

Both groups will receive the standard instruction related to safe administration of IV medications given in their educational program prior to the start of the bi-monthly DP or control sessions. Reminders via the participants preference (i.e., e-mail, text, or telephone) will be sent out 1 week before their scheduled date, time of a scheduled skill session, and again 2 days before said session. The reminder will merely state "this is a reminder that you are scheduled for a skill session on [date] and [time] at the Albert Sherman Center."

Intervention group. The intervention group will participate in three 30-minute individual DP sessions at the Albert Sherman Center during the months of October and November. A written scenario of a patient requiring intravenous medications will be presented to the participants. All scenarios will include algorithms with scripts based on QSEN teaching focus points. Each patient scenario will require participants to determine the appropriateness of the medication order based on the assessment and background information provided in the scenario, perform a medication calculation of an intravenous medication (bolus and continuous drips), select the appropriate solution and supplies, prepare and administer medications, state how they would assess, evaluate the response,

and intervene if required. During the DP session the PI will provide responsive assistance to the participants in the form of feedback, modeling, linguistic means of assistance (instructing, questioning, and cognitive structuring) and contingency management (positive and negative feedback reflected in patient's response to the participants' interventions). Participants will have 20 minutes to complete the scenario (practice the skills), during which time the PI will complete the Participant Progression Form (tally of how many prompts the student required to complete the scenario), and the remaining 10 minutes will be used for debriefing, reviewing key concepts, and participants completing the Simulation Design Scale (SDS), and the PI will complete the Feasibility/Resource Tracking Form. Completed SDS forms will be deposited by the participants into a locked box, which will be stored in a research team member's office at the UMass GSN Worcester campus.

Control group. In order to allow for comparison between the two groups and to control for attention, the control group will be used to minimize the potential effects of interacting with a skilled nurse (the PI) regarding medication administration. Participants in the control group will meet with an the PI for the same amount of time as the intervention group, three 30-minute individual sessions during October and November, 2014 in the Albert Sherman Center. Immediately after randomization, the PI will provide blocks of time for participants randomized to the control group to sign up for a 30-minute session with the PI. The PI, however, will not specifically lead the participant through the process of safe IV medication administration. Instead, the PI will present the student with a written scenario of a patient requiring nursing care. The scenarios will include algorithms with scripts with QSEN teaching focus points unrelated to IV medication

administration (insertion and care of a patient with a urinary catheter, wound care, and initiating and managing a nasogastric tube feeding). Each scenario will require participants to determine the appropriateness of the nursing care based on the assessment and background information provided in the scenario and to state how they would assess, evaluate the response, and intervene if required. The PI will provide feedback in a supportive, empathetic manner. Participants will have 20 minutes to complete the scenario. The remaining 10 minutes will be used for debriefing and reviewing key concepts and completing the Simulation Design Scale (a 20-item, 5-point Likert scale that takes approximately 3 minutes to complete). The PI will tally the number of prompts required during the scenario on the Participant Progression Form and record any noteworthy comments/situations that may have arisen during the session on the Feasibility/Resource Tracking Form. Completed SDS forms will be deposited by the participants into a locked box and will be managed the same as the DP sessions forms noted above.

All practice sessions will be completed by December. All participants will participate in a 20-minute individually videotaped scenario beginning the first week of January, 2015 to test their ability to safely administer IV medications (calculate, prepare, and administer medications appropriately, assess, evaluate, and intervene). Four 4-hour blocks of time will be made available throughout the week with availability for morning, afternoon, and evening sessions. Additional times to complete the simulation scenario will be reserved the second week of January for those participants who were unable to attend the first week. Any outstanding participants will arrange a time as soon as possible to complete the videotaped scenario. Post-intervention instruments including the IVPSCS

(2 minutes), SSSCS (2 minutes), and Post-Intervention Survey (5 minutes) will be completed immediately following the videotaped scenario and deposited into a locked box by participant. The videotapes and the locked box will be kept in a research member's office at UMass Worcester GSN. The videotaped scenarios will be reviewed within 10 days and rated individually by two members of the research team other than the PI (blinded to which group the participant was in) using the Medication Administration Skills Checklist (i.e., as the raters review the video, they check off whether or not a skill/step on the Medication Administration checklist was completed or missed by the participant, the number of steps completed will then be tallied, the check-lists will be compared for inter-rater and intra-rater reliability (see response #12 "Data Analysis"). The videotapes will be destroyed three (3) years after completion of the study.

Intervention fidelity. To assess the fidelity of the support provided during each DP and control session, each session will be audiotaped for random periodic review. One audiotaped session will be randomly selected from each group each week and reviewed by a member of the research team for adherence to protocol, and identification of any drift or errors in the delivery of material (i.e., annotations of drifts from protocol identified on the tape) will be made by a member of the research team. Any problems with conducting the sessions and drift from protocol will be brought to the attention of the PI. To evaluate potential contamination between groups, each Participant will be asked to respond to a question on the Post-Intervention Survey about the degree to which they shared information about the study contents with other GEP students (1 = not at all to 5 = shared all of it). These audiotapes will be destroyed three (3) years after completion of the study.

Data analysis. Descriptive and distributional analyses will be performed to describe the sample. Pre- and post-comparison of mean values and related effect sizes (standardized and unstandardized) will be used to evaluate outcomes. Data will be double-entered into SPSS 22.0 and analyzed.

Descriptive statistics will be reported for sociodemographic as well as pre/post scores of the IVPSCS and the SSSCS responses to SDS and use/availability of resources. Pre/post comparison of mean values and related effect sizes (standardized and unstandardized) will be used to evaluate outcomes. The magnitude of the pre/post change in outcomes between the intervention and control groups will be compared; standard deviations will be useful for planning of future studies. Multivariate analysis will be used to examine differences between groups (GPA, age, gender, ethnicity, race, previous healthcare experience, and outcomes). Pearson coefficients will be used to compare correlations between GPA, age, ethnicity, gender, previous healthcare experience, and outcomes. Paired sample t-tests will be used to evaluate confidence using IV pumps and confidence in safety skills. Spearman rho will be used to assess inter-rater reliability scores of the Medication Administration Checklist. Excel spreadsheets will be utilized to capture the open-ended data from the Post-Intervention Survey, and responses will be analyzed using content analysis (Bryman, 2008). We will conduct quantitative content analysis of the open-ended questions on the Post-Intervention Survey. The first three open-ended responses and question # 6 on the survey will be independently coded by the PI and one member of the dissertation committee on the basis of primarily positive or negative feedback regarding the DP sessions and suggestions for improvement. We will count the occurrence and frequency of specific comments. Written comments that are

illegible will be excluded. Additional comments that do not appropriately fit into either the positive or negative feedback categories will be grouped together and reviewed for common themes/responses. Cohen's kappa for assessing inter-rater reliability will be calculated for both positive and negative responses. We will tally the responses to questions #4 and #5 to quantify how frequently practiced skills were used outside of the DP session and how often the students shared information regarding the practice sessions with other GEP students. Any differences in evaluation will be resolved by discussion between the raters, and, if necessary, a third member of the dissertation committee will participate to resolve any discrepancies.

Feasibility studies are not powered to detect statistically significant differences. However a $p \leq .1$ will be considered important for future planning purposes (Melynk & Fineout-Overholt, 2005). For assessment of pre/post changes in self-confidence, I will compare scores using a t test for paired samples, with a significance level set at $P \leq .1$ (2-tailed test), with Cohen d calculated as a standardized measure of effect size (controlling for dependency in paired values).

Limitations. Findings from this study will be limited to geographic location, program type, and population. Participants' experiences outside the study such as work or clinical experiences where some students may have more opportunity to use/practice IV medication administration skills may impact results. To mitigate this issue, we will collect data on IV experience. Contamination by way of communication between group participants may also occur although participants will be asked not to share their experiences with others. An effort to identify and control for outside participant

experiences and potential contamination between participants will be made via the Post-Intervention Survey responses.

Human subjects considerations. Since students are considered a “vulnerable” population, additional ethical issues may arise such as coercion, privacy, and perceived benefit; careful consideration on how to protect students who participate in educational research is needed. Coercion can occur when students are recruited by faculty they rely on for education and/or compensation for participation as in the form of course credits, a grade, or a perceived educational benefit. The PI and research team members involved in the recruitment and delivery of DP sessions are not faculty for the population being recruited. Results of the individual student performance will not be shared with faculty in the GEP program of the GSN. Participation of the students will be completely voluntary; there will be no penalty for non-participation or withdrawing from the study including grades. Participants will be completely informed of the study requirements, risks and realistic benefits. IRB approved consent forms will be reviewed and signed prior to participation. All data will de-identified, coded, and stored in a locked file cabinet in the PI or research team member’s office at the university. The ID codes will be known only to the PI. The PI and faculty will ensure a supportive environment to alleviate any stress participants may have related to participation in the study, and participants will always have the option of withdrawing from the study at any time without repercussions.

Conclusion

This study will provide preliminary data to help determine whether DP of IV medication administration is a feasible, acceptable, and appropriate teaching strategy for student nurses.

QSEN has mandated that nurses have the knowledge, skills, and attitudes to safely enter into practice; this has been endorsed by the AACN pre-licensure. Several national agencies, including the Joint Commission and the National League of Nursing, have identified medication administration as an area in need of improvement in safety practices. Research has shown that medications administered intravenously are frequently involved in medication errors, especially with new nurses, due to lack of experience with intravenous medications and programming pumps (Cheragi et al., 2013; Jones & Treiber, 2010; Keers et al., 2013a, 2013b; NQF, 2014; Sulosaari et al., 2012; Sulosaari et al., 2011; Westbrook, Rob, et al., 2011). As such, determining if three bi-monthly 30-minute DP sessions are adequate to develop, maintain, and refine skills associated with safe medication practices and assessing the feasibility and resources required to implement practice sessions are important steps in meeting the goal of achieving QSEN competencies related to patient safety.

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EXECUTIVE SUMMARY

Deliberate Practice to Achieve Safety Competencies

Recruitment: Recruitment started later in the semester than originally planned (first week of November 2014 rather than the end of September, early October) due to arranging time to meet with faculty involved in the Graduate Entry Program and scheduling the best times to recruit participants. Even though participants had been asked to sign up for their three sessions once their consents were given, many participants signed up for only one session at that time since the schedule for the entire semester had not yet been posted. Recruitment was lower than anticipated: only 19 of 32 students. Due to the delay in recruitment, the deliberate practice (DP) sessions and control sessions did not begin until Thursday, November 13, 2014. High attrition occurred before the sessions began: Only 14 of the 19 participants attended the first session, and 13 attended all sessions except the videotaping. A total of 12 participants (5 intervention and 7 control) completed the study in total.

Weekly Sessions: The study took place over an 8-week period (November 13 through December 23, 2014) instead of the planned 6 weeks. Only two sessions were rescheduled during this time due to snow cancellations or sickness. Because of illness, one participant in the intervention group could make up only two sessions on 1 day, near the end of the study period (December 23rd, when one 1-hour session instead of two half-hour sessions were held). This may have impacted her score on the videotaped scenario.

Only 26 of the sessions were completed within the 30-minute time allotted. The other 25 sessions went over slightly by 5 to 10 minutes due to the increasing complexity of the intravenous scenarios for the intervention group. To ensure that the control and

intervention groups received the same amount of time, a previously learned skill was added to the control group's third scenario.

Another problem encountered during the first two DP sessions with many of the participants was that they only completed one page of the two-page Simulation Design Scale (SDS). During the first and second sessions, the SDS forms had not been stapled together, so the participant would frequently complete whichever page was on top of the pile. I did not realize this was occurring until completion of the second DP sessions when data compilation was beginning. To remedy this, for the third session only, one SDS (now stapled) was left on the counter with one envelope, and the participant was reminded that there were two pages to be completed. Unfortunately, some of the data (27.7%) regarding the design of the first and second simulation sessions are missing.

20-Minute Videotaped Scenarios: Six of the 12 videotaped scenarios went over the 20-minute time allotment (overages ranged 2–17 minutes). Also, one of the participants in the control group mentioned that their clinical group, since they were starting a new clinical rotation, had just reviewed IV skills the day before. It is unclear if all the participants were included in this IV review the day before videotaping, and how much this review impacted the final medication administration scores is unknown. Two iPads were used to capture the scenarios from different angles. The reviewers did find it difficult to hear some of the recordings and, because of this, some participants may not have received points on the medication administration record even if they had verbalized what they would do. Since two iPads were used to videotape each participant's performance at different angles, there were 24 videotapes to review. This was very time-consuming since the videos ranged from 14 to 38 minutes long. If the reviewers had to

review both recordings for each participant, it would take them anywhere from 5.6 hours to 15.2 hours each to review. In the future, better equipment will be utilized for recording scenarios at the best angle.

Data Analysis: Data analysis was carried out as described in the proposal with the following exceptions:

- In addition to the t-test, the Wilcoxon rank-sum and Mann-Whitney were also performed to determine pre- and post-scores of the IVPSCS, SSSCS, and the SIC change in outcomes between the control and experimental groups. Results were consistent.
- In addition to the Pearson coefficients, Spearman correlations were performed to examine the correlations between the variables—highest level of education, healthcare experience, IVPSCS (post), SSSCS (Post), SIC (Post) and the three phases of the medication checklist—preparation, administration, and evaluation—scores, were conducted. The results of the Pearson and Spearman correlations were similar.
- In addition to the Independent t-test, Fisher’s exact chi-square tests were used to examine differences between groups (those who completed the study in entirety and those who dropped out and those who were in the intervention group and those in the control group) for age, gender, ethnicity, race, previous healthcare experience, and outcomes. Results were consistent with the exception of age. An Independent T-Test for continuous age for the original 19 participants was statistically significant (.002). However, since the data did not meet the criteria for an independent T-Test a Fisher exact test was performed for categorical age and it was not statistically significant (.232).
- In addition to the Student’s t test, the Wilcoxon rank sum was conducted to compare differences in video scores between the control and intervention groups. The results were similar.
- Spearman rho to assess inter-rater reliability scores of the Medication Administration Checklist was determined to be unnecessary given the small sample and lack of discrepancies in rating.
- Since no discrepancies existed in the content analysis of the open-ended data from the Post-Intervention Survey, 100% agreement, Cohen’s Kappa for assessing inter-rater reliability was not completed for this small sample group.

SLIDE PRESENTATION

Pages 56–88

Deliberate Practice to Achieve Safety Competencies

D. LEVEILLE, MS, RN, CNL

Medication Errors

Contribute to Quality & Safety Concerns

- MEDMARX (2013), received over 1.3 million medication error reports, most errors being caused by drugs administered via parenteral (via needle, IV, IM, SQ) route (MedMarx, 2013).
- Medication errors are estimated to harm 1.5 million patients annually with 7,000 deaths costing upwards of a billion dollars (IOM, 2006).
- Lack of experience and knowledge with intravenous medication preparation and administration is the causal factor of these medication errors ; not limited to high risk medications. (Abbasinazari, 2011; Anselmi, Peduzzi, & Dos Santos, 2007; Beckett, Sheehan, & Reddan, 2012; Deters, Prasa, Hentschel, & Schaper, 2009; Ferner, 2001; Ferner et al., 2001; Hicks & Becker, 2006; Husch et al., 2005; Jones & Treiber, 2010; Keers, et al., 2013a; Nguyen et al., 2014; Rooker & Gorard, 2007; Seki & Yamazaki, 2006)

Medication Errors by Nurses: Cause for Concern

- The National Council for State Boards of Nursing reported that more than 40% of new nurse graduates report making medication errors (NCSBON, 2013)
- Multiple studies reported 65% and 78% of nurses admitting to making medication errors (Cheragi, Manoocheri, Mohammadnejad, & Ehsani, 2013; Jones & Treiber, 2010)
- The most prevalent cause of student nurse errors was students' performance deficits (MedMarx, 2013)

Nursing Students & New Nurses High Risk for Medication Errors

- Inadequate training and experience with the administration of intravenous medications leaving new nurses/students **vulnerable to medication errors** (Dilles, Vander Stichele, Van Bortel, & Elseviers, 2011; Vaismoradi, Jordan, Turunen, & Bondas, 2014; Valdez, de Guzman, & Escolar-Chua, 2013).
- An increase in Accelerated programs is anticipated, research has found their clinical performance similar (Oermann, Alvarez, O'Sullivan & Foster, 2010) *or slightly lower* (Rafferty & Lindell, 2011) than their traditional baccalaureate counterparts during the first year of practice.
- NCSBN (2013) annual survey results (N=1,750) revealed an increase in the number of newly licensed nurses who are not clinically competent to practice as entry-level nurses.

Deliberate Practice to Address Inadequate Medication Administration Skills

- Effective teaching strategies that support the development and enhancement of skills required for safe medication management practices are needed.
- Deliberate practice, repetition of a skill under the supervision of an expert mentor to achieve mastery, has been used in medical education to develop and maintain competency with positive effects (Crochet, Aggarwal, Dubb, Siprin, Rajaretnam...Darzi, 2011; Duvivier, van Dalen, Muijtjens, Moulaert, van der Vleuten & Scherpbier, 2011; McGaghie, Issenberg, Cohen, Barsuk, & Wayne, 2011; Nesbitt, St. Julien, Absi, Ahmand, Grogan,...Putnam, 2013).
- Only recently has DP been examined in nursing with positive outcomes (Hauber, Cormier, & Whyte, 2010; Liou, Chang, Tsai, & Cheng, 2013; Oermann et al., 2011) .

The **purpose** of this feasibility study was to explore the use of deliberate practice (DP) with second-degree nursing students in developing and maintaining fundamental intravenous medication management practices required for safe practice.

The specific aims of this study were:

- (a) to evaluate the feasibility, acceptability, and satisfaction of using DP to teach safe medication administration of intravenous medications, and
- (b) to measure the preliminary efficacy of a DP intervention at improving the confidence and skills of second degree nursing students ability to safely prepare, administer and monitor the effects of intravenous medications.

Theoretical/Conceptual Framework

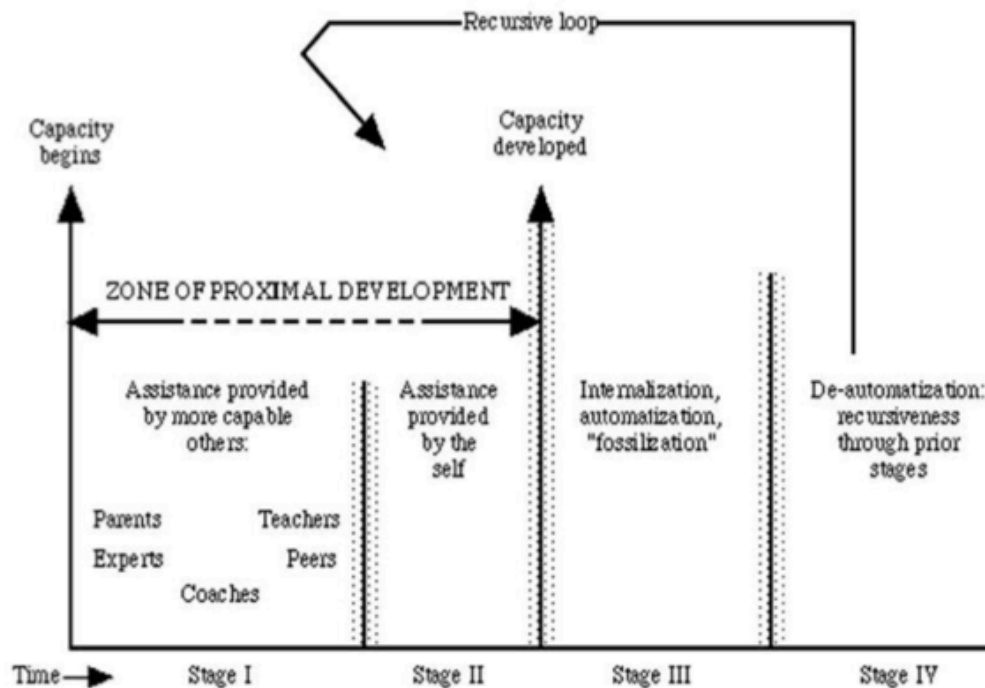


Figure 1. Zone of Proximal Development. From Rousing minds to life: Teaching, learning, and schooling in social context, by R. Tharp and T. Gallimore, 1988, p. 250. Copyright Cambridge University Press (1988) Reprinted with permission.

Stage I & II:

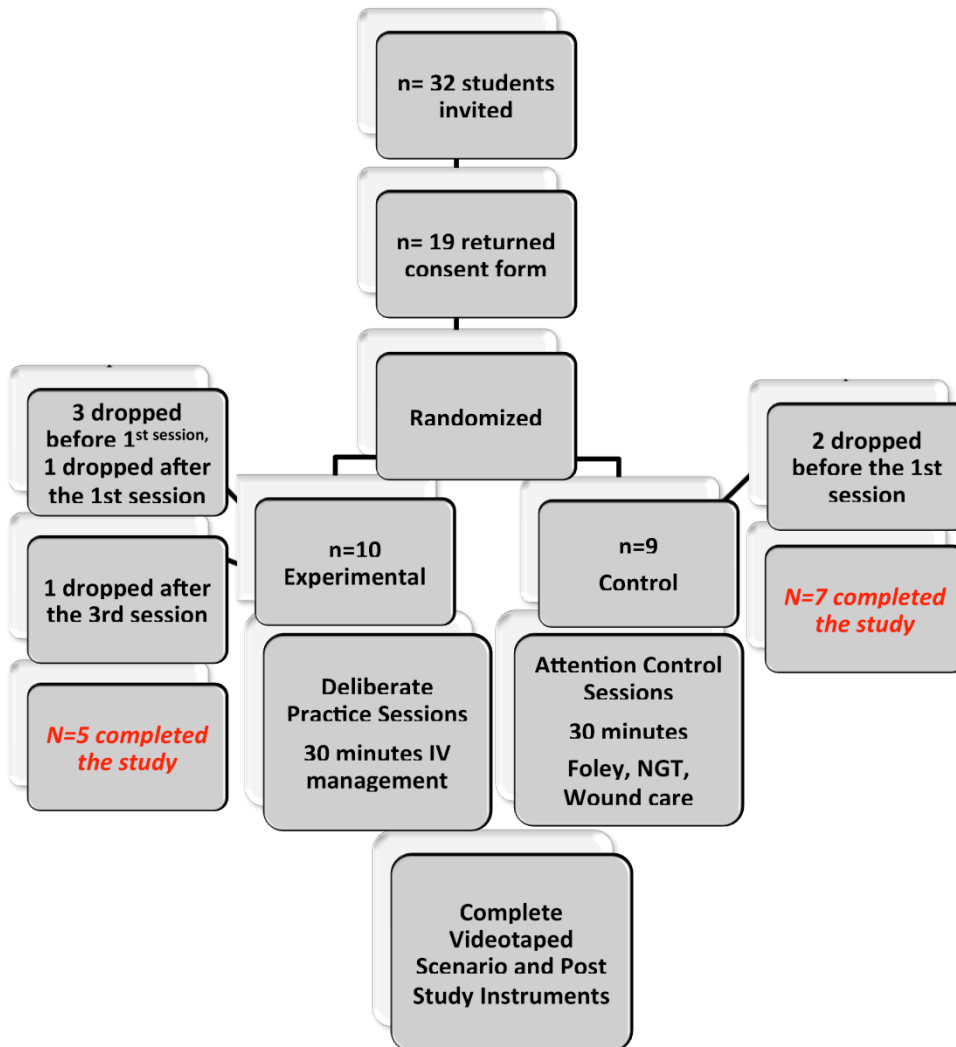
- A teacher or peer (MKO) can facilitate learning in the ZPD

Stage III:

- Skill must be deliberately practiced (DP) in order to achieve competency (internalization/ automatization)

Stage IV:

- If skill not DP, then skill/ competency will be lost (deautomatization)



Method:
 A two-arm, single-blind, RCT management was used to examine a deliberate practice teaching intervention to teach skills associated with safe IV medication

The intent of the study was to provide specific feasibility data

- Feasibility**
- achievable recruitment
 - acceptability of randomization
 - participants' completion of assessments
 - retention of an active intervention group using deliberate practice; and
 - adherence to learning protocol for deliberate practice
- Preliminary Efficacy:**
- optimal outcome measures, and
 - preliminary data for a robust sample size calculation for a future powered study for efficacy

Human Subject Considerations

- PI and research team members are not faculty for the population being recruited.
- Student results/performance was not shared with faculty in the GEP program.
- Participation in study was voluntary, no penalties for non-participation or withdrawing from the study.
- Participants were informed of the study requirements, risks and realistic benefits.
- IRB approved consent forms were reviewed and signed prior to participation.
- All data was de-identified, coded and stored in a locked file cabinet in a research team members office at the university.
- The ID codes were only known to the PI.
- A supportive environment was provided throughout the study.

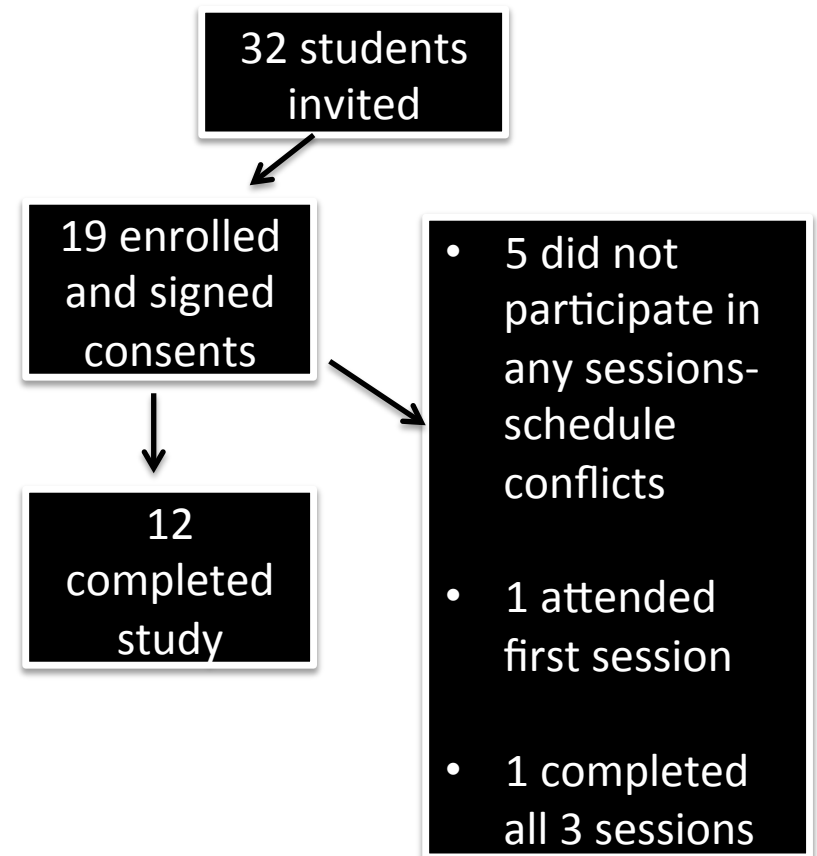
Convenience Sample: Accelerated Graduate Nursing Program

Inclusion criteria

- First-year, first-semester students enrolled in graduate nursing program in northeastern US

Exclusion criteria

- Students who had received special training in IV medication administration prior to entering the program
- Students who previously held or presently have a position where IV skills are used (none met the exclusion criteria)



Measures

Instrument	Description
Demographic Data Form	Age, gender, ethnicity, race, education (1 st degree major/minor), and prior healthcare experience.
Intravenous Pump Self-Confidence Survey (IVPSSCS)	Pre/post confidence with IV pumps, 10-item, 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) demonstrated good internal consistency (Luctkar-Flude, Pulling, & Larocque, 2012). Cronbach's alpha = 0.85 for this study
Safety Skills Self-Confidence Survey (SSSCS)	Pre/post confidence with safety skills, 10-item, 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). Cronbach's alpha = 0.89 for this study.
Skills Inventory Checklist (SIC)	Pre-intervention instrument to determine participants' skill sets prior to participating in the sessions.
Simulation Design Scale (SDS)	20-item, 5-point Likert-scale to measure the presence of specific features in the simulation design, and the importance of those features to the learner (1 = Strongly Disagree, 5 = Strongly Agree) (Jeffries, 2006; National League of Nursing, 2014). Cronbach's alpha was 0.791 for the presence of features, and 0.87 for the importance of features for this study.
Feasibility, Resource Tracking Form	To record the time required to set-up laboratory, track availability and usage of supplies, and laboratory time.
Participant Progression Form	Tracked participant progression through the ZPD. Participants were ranked according to the number of prompts they required to complete the scenario.
Medication Administration Checklist	Performance of behaviors for the videotaped scenario were graded as completing or not completing steps involved in each phase of medication administration (preparation 17; administration 29; and evaluation 14, steps completed were added for overall score). Content validity was established through peer review by four content experts with a CVI of 1.00.
Post-Intervention Survey Questionnaire	The survey contained four open-ended questions to assess expectancies and intervention preferences and a 19-item 7-point Likert scale (0 = No Opinion, 1 = Strongly Disagree, 6 = Strongly Agree) related to receipt of intervention content, practice sessions experience, previous and concurrent IV medication experience, and any sharing of information related to participation in practice sessions. Face validity of the survey was established by review of two experienced nursing faculty researchers.

Procedures

IRB Approval
Recruitment

Consent
Randomization
Pre-Study Instruments

Deliberate
Practice
Sessions

20 minute
Videotaped
Scenario

• Participant Progression
• Simulation Design Scale
• Feasibility Tracking Form

• IVPSSCS
• SSSCS
• Post-Intervention
Survey
• Medication
Administration
Checklist

• Demographics
• IVPSSCS
• SSSCS
• SIC

Notes:

- *IV Pump Self Confidence Survey (IVPSSCS)*
- *Safety Skills Self-Confidence Survey (SSSCS)*
- *Skills Inventory Checklist (SIC)*

Intervention Fidelity

- Each DP session was audiotaped for random periodic review.
 - One audiotaped session was selected each week and reviewed by a member of the dissertation committee to allow for problems and drift from protocol to be addressed
- All sessions were delivered individually by the PI to maximize consistency.

Characteristic of Sample (n=19) & Control and Intervention Groups (n=12)

Characteristic	Total Consented	Consented but did not Complete	*p** n=19	Consented and completed		*p** n=12
	Frequency (%)	Frequency (%)		Control Frequency (%)	Intervention Frequency (%)	
Gender			.60			1.00
Female	15 (78.9%)	5 (71.4%)		6 (50%)	4 (33.3%)	
Male	4 (21.1%)	2 (28.6%)		1 (8.3%)	1 (8.3%)	
Ethnicity			.24			.58
Not Hispanic or Latino	15 (83.3%)	7 (100.0%)		4 (33.3%)	4 (33.3%)	
Other	3 (16.7%)	0 (0.0%)		3 (25%)	1 (8.3%)	
Race			.76			.72
Asian	3 (15.8%)	1 (14.3%)		2 (16.7%)	0 (0%)	
Black or African American	2 (10.5%)	0 (0%)		1 (8.3%)	1 (8.3%)	
White	14 (73.7%)	6 (85.7%)		4 (33.3%)	4 (33.3%)	
Age			.23			.21
20 - 24	9 (47.4%)	5 (71.4%)		4 (33.3%)	0 (0%)	
25 - 29	5 (26.3%)	2 (28.6%)		1 (8.3%)	2 (16.7%)	
30 - 34	4 (21.1%)	0 (0%)		2 (16.7%)	2 (16.7%)	
35 - 39	1 (5.3%)	0 (0%)		0 (0%)	1 (8.3%)	
Highest Level of Education			.50			.15
Bachelors	17 (89.5%)	7 (100.0%)		7 (58.3%)	3 (25%)	
Masters	2 (10.5%)	0 (0%)		0 (0.0%)	2 (16.7%)	
Healthcare Experience (Yrs)			.66			.01
Less than 1	5 (26.3%)	2 (28.6%)		0 (0%)	3 (25%)	
1.00 - 1.99	4 (21.1%)	3 (42.9%)		1 (8.3%)	0 (0%)	
2.00 - 2.99	1 (5.3%)	0 (0%)		1 (8.3%)	0 (0%)	
3.00 - 3.99	4 (21.1%)	1 (14.3%)		3 (25%)	0 (0%)	
4.00 - 4.99	3 (15.8%)	1 (14.3%)		2 (16.7%)	0 (0%)	
5 or More	2 (10.5%)	0 (0%)		7 (58.3%)	5 (41.7%)	

Demographics Participants and Drop Outs

Significant Difference in health care experience ($p=.010$) between the control and intervention groups

Specific Aim # 1: Descriptive statistics were used to evaluate satisfaction of DP sessions

Use the following rating system when assessing the simulation design elements: 1 - Strongly Disagree with the statement 2 - Disagree with the statement 3 - Undecided - you neither agree or disagree with the statement 4 - Agree with the statement 5 - Strongly Agree with the statement NA - Not Applicable; the statement does not pertain to the simulation activity performed.							Rate each item based upon how important that item is to you . 1 - Not Important 2 - Somewhat Important 3 - Neutral 4 - Important 5 - Very Important				
Item	1	2	3	4	5	NA	1	2	3	4	5
Objectives and Information											
1. There was enough information provided at the beginning of the simulation to provide direction and encouragement.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
2. I clearly understood the purpose and objectives of the simulation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
3. The simulation provided enough information in a clear matter for me to problem-solve the situation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
4. There was enough information provided to me during the simulation.											
5. The cues were appropriate and geared to promote my understanding.											
Support											
6. Support was offered in a timely manner.											
7. My need for help was recognized.											
8. I felt supported by the teacher's assistance during the simulation.											
9. I was supported in the learning process.											
Problem Solving											
10. Independent problem-solving was facilitated.											
11. I was encouraged to explore all possibilities of the simulation.											
12. The simulation was designed for my specific level of knowledge and skills.											
13. The simulation allowed me the opportunity to prioritize nursing assessments and care.											
14. The simulation provided me an opportunity to goal set for my patient.											

The students were very satisfied with the simulation scenarios, with an average response of 4.8/5 reflecting strongly agreed/very important for both design and importance.

Specific Aim # 1: Descriptive statistics were used to evaluate feasibility, student acceptability and satisfaction of using DP

Exit Survey Results (Deliberate Practice Session Satisfaction and Feasibility; N = 12)

Post-Intervention Survey	Strongly Agree n(%)	Agree n(%)	Somewhat Agree n(%)	Somewhat Disagree n(%)	Disagree n(%)	Strongly Disagree n(%)
Participation beneficial.	9 (75%)	2(16.7%)	1(8.3%)			
Scenarios realistic.	10(83.3%)		1(8.3%)		1(8.3%)	
Sufficient support/guidance.	9(75%)	2(16.7%)	1(8.3%)			
The time not burdensome.	7(58.3%)	4(33.3%)			1(8.3%)	
The time allotted adequate.	7(58.3%)	5(41.7%)				
Weekly sessions more helpful.	7(58.3%)	3(25%)			1(8.3%)	1(8.3%)
Monthly sessions enough.		3(25%)	1(8.3%)		6(50%)	2(16.7%)
One session on a topic not enough.	3(25%)	6(50%)	1(8.3%)		1(8.3%)	1(8.3%)
Three IV sessions were too few.		5(41.7%)	1(8.3%)			1(8.3%)
Three IV sessions were too many.					2(16.7%)	6(50%)
Three IV sessions were adequate.	1(8.3%)	2(16.7%)	1(8.3%)		2(16.7%)	2(16.7%)
DP is essential in nursing programs.	8(66.7%)	3(25%)	1(8.3%)			
Sessions would be helpful with peer.		2(16.7%)	1(8.3%)	1(8.3%)	1(8.3%)	6(50%)
An expert nurse is essential.	5 (41.7%)	6 (50%)	1(8.3%)			

Note. Overreporting of satisfaction with IV procedures may be due to students in the control group misreading Statement "Three IV sessions were adequate".

Specific Aim # 1: Quantitative content analysis (Bryman, 2008) was used to evaluate feasibility and student acceptability and satisfaction of using DP

What did you think of the practice sessions (your overall opinion)?

“Extremely helpful. I feel very busy in school and the time requirement was not a burden. I learned more than in class and clinical because of the 1:1 experience.”

(Common themes- beneficial-Increased learning/confidence, not burdensome/helpful: “helpful, allowed critical thinking, increased confidence, not burdensome/stress free”)

How could the practice sessions be improved?

“More of them. The more practice I get the better I feel about my nursing skills/knowledge. Perhaps even, once we become competent at a skill teaching other students”

“I think that if the practice sessions were incorporated into the curriculum in the future (or something similar) it would be beneficial”

(Common Themes- More practice (frequency/duration/skills): “more sessions/longer, integrate into the program, know skill before/more skills i.e. trach care/ IV skills/ skill session then scenario”)

Specific Aim # 1: Quantitative content analysis (Bryman, 2008) was used to evaluate feasibility and student acceptability and satisfaction of using DP

Are there any changes we could make that would have made it easier for you to participate in these practice sessions?

“Maybe open slots immediately before or after class would have made scheduling easier.”

“It would be helpful if I knew the skill to be practiced before the session so I could review concepts.”

(Common themes: time-easy to participate/flexible/more time; skills-preparation/more skills)

Specific Aim #2: Pre-Test vs. Post-Test Change in Confidence

Differences in Pre-Test vs. Post-Test Change in Confidence Measures Between Control and Intervention Groups (N = 12)

		N	Mean		Change	S.D. Change	t	Sig.	Cohen's d	95% Confidence Interval for Difference	
			Pre-	Post-						Lower Bound	Upper Bound
IVPSSCS	Control	7	2.71	3.77	1.04	0.374	-1.339	0.210	-0.859	-1.22	0.30
	Intervention	5	2.97	4.14	1.50	0.800					
SSSCS	Control	7	2.83	3.89	0.89	0.442	0.113	0.913	0.072	-0.54	0.60
	Intervention	5	2.49	3.28	0.86	0.434					
SIC	Control	7	2.13	2.33	0.17	0.459	0.129	0.900	0.087	-0.55	0.62
	Intervention	5	1.91	2.07	0.13	0.380					

Note. IVPSSCS = Intravenous Pump Self-Confidence Survey; SSSCS = Safety Skills Self-Confidence Survey; SIC = Skills Inventory Checklist.

Paired sample t-tests (significance level set at $P \leq .1$, 2-tailed test) were used to address to measure the preliminary efficacy of a DP intervention at improving confidence of second-degree nursing students to safely administer and monitor IV medications

Post-Intervention Survey Results (Efficacy; N= 12)

Post-Intervention Survey Question	Strongly Agree n(%)	Agree n(%)	Somewhat Agree n(%)	N/A n(%)
I feel that my participation in this study has increased my ability to provide safer nursing care.	7(58.3%)	4(33.3%)	1(8.3%)	
Participating in these practice sessions has increased my ability to safely—				
• prepare IV medications	5(41.7%)	5(41.7%)	1(8.3%)	1(8.3%)
• administer IV medications	6(50%)	5(41.7%)	1(8.3%)	
• monitor IV medications	5(41.7%)	5(41.7%)	1(8.3%)	1(8.3%)
• prime, thread IV fluids	6(50%)	4(33.3%)	1(8.3%)	1(8.3%)
• program pump, assess IV site	5(41.7%)	5(41.7%)	1(8.3%)	1(8.3%)
• monitor continuous IV fluids	4(33.3%)	5(41.7%)	1(8.3%)	2(16.7%)
• use IV pumps	4(33.3%)	6(50%)	2(16.7%)	
• insert foley	5(41.7%)	2(16.7%)	1(8.3%)	3(25%)
• monitor foley catheters	4(33.3%)	2(16.7%)	1(8.3%)	5(41.7%)
• perform dressing changes	4(33.3%)	3(25%)	1(8.3%)	4(33.3%)
Participating in the practice sessions helped me better understand Quality and Safety Education for Nurses (QSEN).	3(25%)	4(33.3%)	5(41.7%)	
Participating in the practice sessions increased my awareness of the importance of evaluating nursing care.	7(58.3%)	5(41.7%)		

Note. Overreporting of satisfaction with IV procedures may be due to students in the control group misreading Statement 2.

Specific Aim # 2: Descriptive statistics were used to evaluate Preliminary Efficacy of using DP

Participation in the study increased:

- Ability to provide safer care
- Skill performance
- Understanding of QSEN
- Awareness of the importance of evaluating care

Difference in Outcomes: Medication Administration Checklist Scores

Differences in Outcome (Medication Administration Checklist of Videotaped Session) Scores Between Control and Intervention Groups (Student's t; N = 12)

Phase	Steps		N	Mean	S.D.	t	95% Confidence Interval for Difference		
							Sig.	Lower Bound	Upper Bound
Prep	17	Control	7	6.23	2.39	-2.37	0.04	-6.23	-0.19
		Intervention	5	9.44	2.21				
Admin	29	Control	7	11.64	3.25	-1.97	0.08	-8.86	0.55
		Intervention	5	15.80	4.09				
Evaluation	14	Control	7	2.14	1.57	-0.92	0.39	-5.46	2.55
		Intervention	5	3.60	3.29				
Overall	60	Control	7	20.01	4.77	-2.30	0.04	-17.37	-0.28
		Intervention	5	28.84	8.55				

Note: Prep= Preparation phase of intravenous medication administration; Admin = Administration phase of intravenous medications; Evaluation = Evaluation of effects of the administered intravenous medications; Overall = overall score on the medication administration checklist
Significance refers to Mann-Whitney

Specific Aim #2: Preliminary efficacy of a DP intervention at improving the skills of second-degree nursing students to safely prepare, administer, and monitor IV medications and their subsequent effects.

	Prep	Admin	Eval	Overall
Age	0.287 (0.366)	0.480 (0.115)	-0.124 (0.702)	0.315 (0.318)
Highest Level of Education	0.073 (0.821)	0.245 (0.443)	-0.242 (0.449)	0.079 (0.807)
Healthcare Experience	0.490 (0.106)	0.424 (0.170)	0.299 (0.345)	0.491 (0.105)
IVPSSCS (post)	0.293 (0.356)	0.561 (0.058)	0.489 (0.106)	0.552 (0.063)
SSSCS (post)	-0.244 (0.445)	-0.199 (0.535)	0.066 (0.840)	-0.171 (0.595)
SIC (post)	-0.248 (0.461)	-0.196 (0.563)	0.463 (0.152)	-0.050 (0.884)
Prep	1	0.751 (0.005)	0.337 (0.285)	0.857 (< 0.001)
Admin	0.751 (0.005)	1	0.433 (0.160)	0.929 (< 0.001)
Eval	0.337 (0.285)	0.433 (0.160)	1	0.660 (0.019)
Overall	0.857 (< 0.001)	0.929 (< 0.001)	0.660 (0.019)	1

Pearson coefficients were used to compare correlations between highest level of education, healthcare experience, and outcomes.

Specific Aim #2: Assessing objective preliminary efficacy via a Videotaped Scripted Scenario

Admitting Dx: Diverticulitis

Allergies: Demerol, PCN

PMH: CHF, diverticulitis, Type 2 Diabetes, Artherosclerosis

65 year old female patient admitted 2 days ago from home with abdominal pain, nausea vomiting, diarrhea.

MORNING REPORT: She has an IV in her left antecubital with D5 ½ NS with 20 KCL infusing and one in her right forearm that is clamped.

Her morning labs today were: Labs: NA+ 141 mEq/L, K+ 5 mEq/L, Glucose 88 mg/dl, WBC 14K (cells/mL).

VS: T 99.1F, P 99 NSR, BP 140/82, RR 20, SP02 95% RA

Patient reporting **abdominal pain 8/10** while you are receiving report, the night nurse states she is due for her 25mcg of Fentanyl IVP, she is also due for an 0800 antibiotic.

0800 medications DUE:

- Fentanyl 25 mcg IVP
- Invanz 500mg/100mL NS IVPB
- Continuous drip D5 ½ with 20KCL 75mL/hr **ALREADY INFUSING**

20 minute videotaped scenario

- Actual time ranges: **14-38min**

Reviewed and rated using Medication Administration Checklist

- **Preparation Phase:** 17 items
- **Administration Phase:** 29 items
- **Evaluation/Monitoring Phase:** 14 items

- **OVERALL SCORE:** 100% = 60 points

- Checklists compared for inter-rater reliability
- Differences in evaluation were resolved by discussion between the raters

PREPARATION PHASE OF MEDICATION ADMINISTRATION

<ul style="list-style-type: none"> <input type="checkbox"/> 1. Reviews orders (VERBALIZES) <input type="checkbox"/> 2. VERBALIZES Patient's allergies <ul style="list-style-type: none"> • PCN & Demerol <input type="checkbox"/> 3. Verbalizes 5 rights while preparing medications <ul style="list-style-type: none"> <input type="checkbox"/> Patient <input type="checkbox"/> Time <input type="checkbox"/> Drug <input type="checkbox"/> Route <input type="checkbox"/> Dose <input type="checkbox"/> 4. Verbalizes 3 checks <ul style="list-style-type: none"> <input type="checkbox"/> pulling med from pyxis <input type="checkbox"/> preparing and <input type="checkbox"/> just before administration 	<p>MAR: IVP Fentanyl 25 mcg (100mcg/1mL)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 5. Checks to confirm when last dose received and effectiveness (VERBALIZES FINDINGS) <ul style="list-style-type: none"> o last received 0630 this A.M. o good effect <input type="checkbox"/> 6. Verbalizes dose 0.25 mL <input type="checkbox"/> 7. Selects a 1mL or 3 mL syringe <input type="checkbox"/> 8. Verbalizes using a filtered needle <input type="checkbox"/> 9. Draws up medication <input type="checkbox"/> 9a. (OPTIONAL) May draw up some saline to increase volume in order to administer over 1-2 minutes <input type="checkbox"/> 10. Discards vial and filtered needle in sharps box or appropriate container <input type="checkbox"/> 11. Caps syringe, maintaining sterility <input type="checkbox"/> 12. VERBALIZES checking compatibility with continuous IVF (COMPATIBLE) <input type="checkbox"/> 13. Obtain a 5-10mL Saline flush and alcohol swab <input type="checkbox"/> 14. Labels syringe <p>MAR: IVPB: Invanz (ertapenem) Advantage Bag 500mg/100mL NS IVPB q12h</p> <ul style="list-style-type: none"> <input type="checkbox"/> 15. Verbalizes 5 rights <ul style="list-style-type: none"> <input type="checkbox"/> Patient <input type="checkbox"/> Time <input type="checkbox"/> Drug <input type="checkbox"/> Route <input type="checkbox"/> Dose <input type="checkbox"/> 16. Verbalizes 3 checks (same as #4) <input type="checkbox"/> 17. Verbalizes checking compatibility NOT COMPATIBLE WITH DEXTROSE SOLUTIONS
---	---

Specific Aim #2: Preliminary Efficacy Medication Administration Checklist "Preparation Phase"

Control Group Scores

Range: 3-9 (18-53%) completed steps out of 17 steps

Intervention Group Scores

Range: 8-13 (47-76%) completed steps out of 17 steps

P=0.04

Medication Administration Checklist

“Administration Phase”

Control Group Scores

Range: 8-17 (27.5 - 58.6%) completed steps out of 29 steps

Intervention Group Scores

Range: 11-22 (37.9-75.8%) completed steps out of 29 steps

$P = 0.08$

ADMINISTRATION PHASE

- | | |
|--|---|
| <ul style="list-style-type: none"> <input type="checkbox"/> 1. Verbalizes Washes hands or uses sanitizer before approaching patient <input type="checkbox"/> 2. Introduces self <input type="checkbox"/> 3. Identifies patient (2 identifiers: ASKS name and DOB while looking at arm band) <input type="checkbox"/> 4. Assesses patient's pain <input type="checkbox"/> 5. Documents pain assessment- before leaving bedside <input type="checkbox"/> 6. Ask about allergies <input type="checkbox"/> 7. Provides patient information about the medications (must state all of the following to earn point) <ul style="list-style-type: none"> <input type="checkbox"/> what is being administered <input type="checkbox"/> dose of the medications being administered <input type="checkbox"/> why they are being administered (their intended effect) <input type="checkbox"/> adverse/side effects to watch for <input type="checkbox"/> 8. VERBALIZES 3rd check of medications (states what is being administered while comparing to MAR) <input type="checkbox"/> 9. Assesses IV site for infection, infiltration, phlebitis (VERBALIZES) <input type="checkbox"/> 10. Verbalizes checking date IV was inserted (WITHIN DATE, INSERTED YESTERDAY) <input type="checkbox"/> 11. Assesses patency of IV by pinching continuous tubing and watching for positive blood return or uses NS flush to assess how catheter flushes (VERBALIZES PATENCY IE.. EASY FLUSH OR POSITIVE BLOOD RETURN OBSERVED) | <p>IVP: FENTANYL ADMINISTRATION</p> <ul style="list-style-type: none"> <input type="checkbox"/> 12. Checks patients Vital Signs (WITHIN NORMAL LIMITS) <input type="checkbox"/> 13. Pauses continuous infusion <input type="checkbox"/> 13a. May check compatibility here (COMPATIBLE) should have checked at preparation phase – earn only 1 point if checked here or earlier <input type="checkbox"/> 14. Swabs port closest to IV site for 15 seconds with alcohol swab <input type="checkbox"/> 15. Administers Fentanyl at the prescribed rate (VERBALIZES RATE 1-2 MINUTES) <input type="checkbox"/> 15a. If at Y-Site then bend tubing to prevent medication from backflushing. <input type="checkbox"/> 16. Swabs port again for 15 seconds and flushes at the same rate with NS <input type="checkbox"/> 17. Resumes IV pump <p>IVPB: INVANZ (ERTAPENEM) ADMINISTRATION</p> <ul style="list-style-type: none"> <input type="checkbox"/> 18. Verbalizes NOT COMPATIBLE WITH DEXTROSE <input type="checkbox"/> 19. Dr. calls and makes change from Invanz before it is hung to Gentamicin 80mg/100mL q12h IVPB. Student checks compatibility. (It is compatible with current IVF) <input type="checkbox"/> 20. Assesses IV site again (VERBALIZING NO INFECTION, PHLEBITIS, INFILTRATION AND WITHIN DATE) <input type="checkbox"/> 21. FLUSHES with NS TO ENSURE PATENCY <input type="checkbox"/> 22. Spikes the medication bag with secondary tubing – keeping spike sterile <input type="checkbox"/> 23. Primes tubing with the medication, can back prime, <input type="checkbox"/> 24. Dates and times the new secondary tubing <input type="checkbox"/> 25. Programs pump VERBALIZES RATE PROGRAMMED INTO PUMP 100ML/HR <input type="checkbox"/> 26. Maintains sterility of the tubing connector <input type="checkbox"/> 27. Swabs IV site with alcohol swab for 15 seconds <input type="checkbox"/> 28. Attaches IV <input type="checkbox"/> 29. Starts Pump |
|--|---|

Medication Administration Checklist “Evaluation/Monitoring Phase”

Continuous infusion:

- 1. Verbalizes D5 ½ NS with 20 KCL Infusing at 75mL/hr ordered
 - Pump programmed at **150mL/hr WRONG RATE**
- 2. Recognizes and verbalizes wrong rate should be **75mL/hr**
- 3. Changes to correct rate 75mL/hr
- 4. Assess patient for signs and symptoms of fluid overload – checks for signs such as shortness of breath, Lung sounds, pedal edema, weight gain – or verbalizes these.
- 5. Checks K+ level to make sure still requires KCL contained in infusion
- 6. Verbalizes need to call MD to report rate of infusion incorrect for unknown amount of time
- 7. Verbalizes need to request order to remove KCL from infusion (K+ IS 5.0 mEq/L)
- 8. VERBALIZE A VARIANCE/INCIDENCE REPORT NEEDS TO BE PREPARED

Ongoing Monitoring/Evaluation

- 9. Verbalize would re-evaluate effectiveness of Fentanyl in 20 minutes and document findings
- 10. Verbalize assessing IV site frequently while patient receiving IVPB and continuous infusion
- 11. Verbalizes would monitor fluid balance via I/O, VS/BP
- 12. Verbalizes would monitor electrolytes
- 13. Verbalizes would monitor for infection: WBC, Temp – improvement with antibiotic
- 14. Verbalizes would monitor for s/e of medications i.e. superinfections with antibiotic use, fever, swelling, diarrhea, nausea/vomiting, confusion, headache, seizures, C. Difficile

Control Group Scores

Range: 0-4 (0-28.6%) completed steps out of 14 steps

Intervention Group Scores

Range: 0-7 (0=50%) completed steps out of 14 steps

P= 0.4

NEEDS TO BE REEVALUATED
VARIANCE/INCIDENCE REPORT

**VIDEOTAPED SCENARIO
(MEDICATION ADMINISTRATION SCORES)**

Group Assignment	Time to Complete in Minutes	Preparation Phase Score	Administration Phase Score	Evaluation Phase Score	Final Score
<i>Control</i>	<i>Range: 14-28 min</i>	<i>Range: 3-9/17</i>	<i>Range: 8-17/29</i>	<i>Range: 0-4/14</i>	<i>Range: 15.6-27/60</i>
	21	7.6	8	0	15.6
	19	6	9	1	16
	14	3	9	4	16
	17	4	11.5	4	19.5
	21	5	13	2	20
	28	9	14	3	26
	23	9	17	1	27
<i>Experimental</i>	<i>Range: 19-38 min</i>	<i>Range: 8-13/17</i>	<i>Range: 11-22/29</i>	<i>Range: 0-7/14</i>	<i>Range: 20-42/60</i>
	19	8	11	1	20
	25	8	14	3	25
	38	8	17	0	25
	31	10.2	15	7	32.2
	27	13	22	7	42

Post-Intervention Survey: Sharing of Information

Shared: Response Frequencies

Information Shared	Frequency of Response					
	None	Very Little	Some	A lot	Most but not all	All
By You	3	8	1	0	0	0
With You	4	7	1	0	0	0

most of the participants shared information about their participation with others but most described it as “very little.”

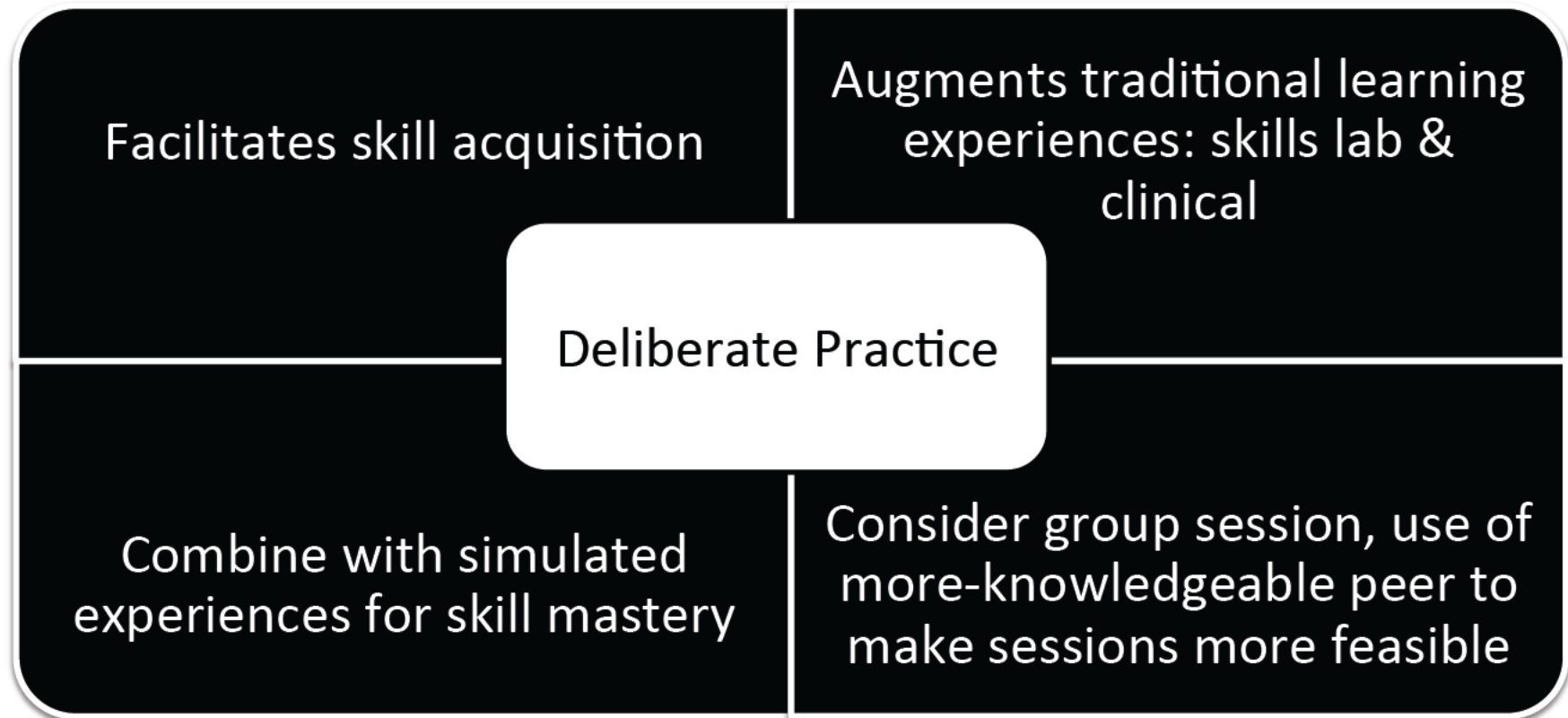
Limitations

- Single geographic location with students from single nursing program
- Experience gained outside of study (concurrent clinical experiences a confounding factor -including retraining on IV pumps within a week or same week as videotaped scenario)
- Simulated experiences; real-life scenarios may have different outcomes
- Three DP sessions did not allow for progression through Vygotsky's Zone of Proximal Development (slower progression due to complexity of scenarios)
- Limited "prime-time" slots - only one researcher conducting sessions
- Communication between participants may have disrupted blindness of groups (an attempt to control for this limitation was made by asking participants not to share information regarding the study)

Implications for Nursing Education

- Large effect size estimates were seen with preparation, administration and students' overall score supporting the value of using DP in nursing education.
- Statistically significant between-group differences were found in this RCT despite the small sample size, indicating that the use of DP had a large effect on performance; these findings support previous research related to the use of DP in skill acquisition.
- Traditional learning experiences such as skills lab and clinical experiences during the study did not have a sufficient impact on student's ability to perform necessary skills related to management of IV medications.
- Dose and frequency of DP sessions necessary for safe IV medication management needs to be determined.
- Low recruitment and high attrition indicates extra DP sessions may not be feasible due to tight schedules in accelerated programs. Creative methods of providing DP will be needed (open-lab, peer-teaching, group sessions, or integration of DP into the program itself)

Deliberate Practice: Implications for Nursing Education



DISSEMINATION PLAN

The primary description of this dissertation work was submitted as a manuscript on January 26th, 2016 to the *Journal of Nursing Education* for review and consideration for publication.

APPENDIX A

DEMOGRAPHIC DATA FORM

ID NUMBER _____

Gender: Male _____
Female _____

Age in years: _____

Ethnicity:

Hispanic or Latino _____
Not Hispanic or Latino _____
Unknown (individuals not reporting ethnicity) _____
Other: _____
Prefer not to state _____

Race:

American Indian/Alaska Native _____
Asian _____
Native Hawaiian or other Pacific Islander _____
Black or African American _____
White _____
More than one race _____
Unknown or not reported _____
Other: _____
Prefer not to state _____

Education:

Type of Degree	Major	Year Earned
Associates (AS, AD), Bachelors (BA/BS), Masters (MA/MS) or other		

Healthcare Experience:

Do you have any previous healthcare work experience?
Yes _____ No _____

If yes, please select the type of position you held and state the number of years employed in that position:

Please check those applicable	Position Held	Number of Years	If you held this position more than 5 years ago please state date held
	Paramedic		
	EMT		
	Nursing Assistant		
	Home Health Aide		
	Orderly		
	Physical Therapist		
	Occupational Therapist		
	Nutritionist		
	Unit or Clinic Secretary/Receptionist		
	Radiology technician		
	Other:		

APPENDIX B

IV PUMP SELF-CONFIDENCE SURVEY

Study Participant # _____

Date: _____

Self-Confidence in IV Pump Skills	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel confident priming the IV administration set and inserting it into the IV pump in the skills lab	1	2	3	4	5
2. I feel confident programming a basic IV infusion using the IV pump in the skills lab	1	2	3	4	5
3. I feel confident programming a secondary medication bolus infusion using the IV pump in the skills lab	1	2	3	4	5
4. I feel confident programming a secondary medication continuous infusion using the IV pump in the skills lab	1	2	3	4	5
5. I feel more prepared for clinical as a result of participating in the IV pump skills lab	1	2	3	4	5
6. I feel confident priming the IV administration set and inserting it into the IV pump in the clinical area	1	2	3	4	5
7. I feel confident programming a basic IV infusion using the IV pump in the clinical area	1	2	3	4	5
8. I feel confident programming a secondary medication bolus infusion using the IV pump in the clinical area	1	2	3	4	5
9. I feel confident programming a secondary medication continuous infusion using the IV pump in the clinical area	1	2	3	4	5
10. I feel confident using other technical medical devices in the clinical area	1	2	3	4	5

APPENDIX C

SAFETY SKILLS SELF-CONFIDENCE SURVEY

ID # _____

Date: _____

Self-Confidence in Safety Skills	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel confident in my ability to safely insert a urinary catheter	1	2	3	4	5
2. I feel confident in my ability to identify complications associated with urinary catheters	1	2	3	4	5
3. I feel confident in my ability to perform nursing measures to reduce/prevent complications associated with urinary catheters	1	2	3	4	5
4. I feel confident in my ability to safely perform dressing changes	1	2	3	4	5
5. I feel confident in my ability to identify complications associated with dressing changes	1	2	3	4	5
6. I feel confident in my ability to perform nursing measures to reduce/prevent complications associated with dressing changes	1	2	3	4	5
7. I feel confident in my ability to safely initiate gastric tube feedings	1	2	3	4	5
8. I feel confident in my ability to identify complications that may occur in patients receiving gastric tube feedings	1	2	3	4	5
9. I feel confident in my ability to perform nursing measures to reduce/prevent the occurrence of complications associated with nasogastric tube feedings.	1	2	3	4	5
10. I feel confident in my understanding of Quality and Safety Education for Nurses (QSEN)	1	2	3	4	5

APPENDIX D

SKILLS INVENTORY CHECKLIST

Participant #: _____

Date _____

Please check the number of times you have performed the following activities since you started this nursing program.

	0	1-2 times	3-5 times	6-10 times	>10 times
Administered oral medications					
Administered topical medications					
Administered a metered dose inhaler					
Administered Ophthalmic medications					
Administered medications via a gastric tube (nasal/oral gastric/jejunum/percutaneous)					
Administered Intravenous Push (IVP) medications					
Administered Intravenous Piggyback (IVPB) medications					
Administered Continuous IV infusion					
Performed tracheostomy care					
Applied sequential compression device (SCD)					
Inserted a peripheral intravenous catheter (line)					
Inserted a urinary (foley) catheter					
Changed a dressing					
Cared for a patient receiving tube feedings					
Cared for a patient with a chest tube					

APPENDIX E
SIMULATION DESIGN SCALE

In order to measure if the best simulation design elements were implemented in your simulation , please complete the survey below as you perceive it. There are no right or wrong answers, only your perceived amount of agreement or disagreement. Please use the following code to answer the questions.

Use the following rating system when assessing the simulation design elements:

- 1 - Strongly Disagree with the statement
- 2 - Disagree with the statement
- 3 - Undecided - you neither agree or disagree with the statement
- 4 - Agree with the statement
- 5 - Strongly Agree with the statement
- NA - Not Applicable; the statement does not pertain to the simulation activity performed.

Rate each item based upon how important that item is **to you**.

- 1 - Not Important
- 2 - Somewhat Important
- 3 - Neutral
- 4 - Important
- 5 - Very Important

Item	1	2	3	4	5	NA	1	2	3	4	5
Objectives and Information											
1. There was enough information provided at the begining of the simulation to provide direction and encouragement.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
2. I clearly understood the purpose and objectives of the simulation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
3. The simulation provided enough information in a clear matter for me to problem-solve the situation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
4. There was enough information provided to me during the simulation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
5. The cues were appropriate and geared to promote my understanding.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Support											
6. Support was offered in a timely manner.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
7. My need for help was recognized.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
8. I felt supported by the teacher's assistance during the simulation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
9. I was supported in the learning process.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5

Simulation Design Scale (Student Version)

Use the following rating system when assessing the simulation design elements:

- 1 - Strongly Disagree with the statement
- 2 - Disagree with the statement
- 3 - Undecided - you neither agree or disagree with the statement
- 4 - Agree with the statement
- 5 - Strongly Agree with the statement
- NA - Not Applicable; the statement does not pertain to the simulation activity performed.

Rate each item based upon how important that item is **to you**.

- 1 - Not Important
- 2 - Somewhat Important
- 3 - Neutral
- 4 - Important
- 5 - Very Important

Item	1	2	3	4	5	NA	1	2	3	4	5
Problem Solving											
10. Independent problem-solving was facilitated.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
11. I was encouraged to explore all possibilities of the simulation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
12. The simulation was designed for my specific level of knowledge and skills.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
13. The simulation allowed me the opportunity to prioritize nursing assessments and care.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
14. The simulation provided me an opportunity to goal set for my patient.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Feedback/Guided Reflection											
15. Feedback provided was constructive.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
16. Feedback was provided in a timely manner.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
17. The simulation allowed me to analyze my own behavior and actions.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
18. There was an opportunity after the simulation to obtain guidance/feedback from the teacher in order to build knowledge to another level.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
Fidelity (Realism)											
19. The scenario resembled a real-life situation.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5
20. Real life factors, situations, and variables were built into the simulation scenario.	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5	<input type="radio"/> NA	<input type="radio"/> 1	<input type="radio"/> 2	<input type="radio"/> 3	<input type="radio"/> 4	<input type="radio"/> 5

APPENDIX F

FEASIBILITY/RESOURCE TRACKING FORM	
DP Session #: _____ Date: _____ Time: _____	Lab Space Reserved From _____ to _____ # of Participants Seen: _____
Was there any difficulty reserving lab space? Y/N If yes, briefly explain: How much time was required to prepare the lab? _____ • Any problems in preparing the lab? Y/N If yes, briefly explain: Any problems experienced while using the lab? Y/N If yes, briefly explain: Scenario: _____ • Supplies used • Any problems obtaining supplies; i.e., IV pump? If yes, briefly explain: • Were scenarios completed on time? N/Y If no, explain:	
<div style="border: 1px solid black; padding: 5px; min-height: 150px;"> Additional comments: </div>	

APPENDIX G

PARTICIPANT PROGRESSION FORM													
<p>Zone of Proximal Development Ranking Criteria: 0–2 prompts = Zone 3 (Independent/Competent) 3–6 prompts = Zone 2 (Required little assistance performing skill) >6 prompts = Zone 1 (Required assistance to perform skill)</p>													
<p>Participant #: _____ Date/Time: _____ Scenario: _____ Time started: _____ Time completed: _____</p>													
<p>Number of prompts required/When</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tbody> <tr><td style="width: 50%; text-align: center;">1</td><td style="width: 50%; text-align: center;">7</td></tr> <tr><td style="text-align: center;">2</td><td style="text-align: center;">8</td></tr> <tr><td style="text-align: center;">3</td><td style="text-align: center;">9</td></tr> <tr><td style="text-align: center;">4</td><td style="text-align: center;">10</td></tr> <tr><td style="text-align: center;">5</td><td style="text-align: center;">11</td></tr> <tr><td style="text-align: center;">6</td><td style="text-align: center;">12</td></tr> </tbody> </table>		1	7	2	8	3	9	4	10	5	11	6	12
1	7												
2	8												
3	9												
4	10												
5	11												
6	12												
<p>Zone of Proximal Development Ranking: _____</p> <p>Comments:</p> 													

APPENDIX H

MEDICATION ADMINISTRATION CHECKLIST FOR VIDEOTAPED SCENARIO

Admitting Dx: Diverticulitis

Allergies: Demerol, PCN

PMH: CHF, diverticulitis, Type 2 Diabetes, Artherosclerosis

65 year-old-female patient admitted 2 days ago from home with abdominal pain, nausea, vomiting, diarrhea.

MORNING REPORT: She has an IV in her left antecubetal with D5 ½ NS with 20 KCL infusing and one in her right forearm that is clamped.

Her morning labs today were: Labs: NA+ 141 mEq/L, K+ 5 mEq/L, Glucose 88 mg/dl, WBC 14K (cells/mL).

VS: T 99.1F, P 99 NSR, BP 140/82, RR 20, SP02 95% RA

Patient reporting **abdominal pain 8/10** while you are receiving report, the night nurse states she is due for her 25mcg of Fentanyl IVP, she is also due for an 0800 antibiotic.

0800 medications DUE:

- Fentanyl 25 mcg IVP
- Invanz 500mg/100mL NS IVPB
- Continuous drip D5 ½ with 20KCL 75mL/hr **ALREADY INFUSING**

NO PROMPTS

NO REVIEW OF KEY SAFETY CONCEPTS

PREPARATION PHASE OF MEDICATION ADMINISTRATION

<p><input type="checkbox"/> 1. Reviews orders (VERBALIZES)</p> <p><input type="checkbox"/> 2. VERBALIZES Patient's allergies</p> <ul style="list-style-type: none"> • PCN & Demerol <p><input type="checkbox"/> 3. Verbalizes 5 rights while preparing medications</p> <ul style="list-style-type: none"> <input type="checkbox"/> Patient <input type="checkbox"/> Time <input type="checkbox"/> Drug <input type="checkbox"/> Route <input type="checkbox"/> Dose <p><input type="checkbox"/> 4. Verbalizes 3 checks</p> <ul style="list-style-type: none"> <input type="checkbox"/> pulling med from pyxis <input type="checkbox"/> preparing and <input type="checkbox"/> just before administration 	<p>MAR: IVP Fentanyl 25 mcg (100mcg/1mL)</p> <p><input type="checkbox"/> 5. Checks to confirm when last dose received and effectiveness (VERBALIZES FINDINGS)</p> <ul style="list-style-type: none"> ○ last received 0630 this A.M. ○ good effect <p><input type="checkbox"/> 6. Verbalizes dose 0.25 mL</p> <p><input type="checkbox"/> 7. Selects a 1mL or 3 mL syringe</p> <p><input type="checkbox"/> 8. Verbalizes using a filtered needle</p> <p><input type="checkbox"/> 9. Draws up medication</p> <p><input type="checkbox"/> 9a. (OPTIONAL) May draw up some saline to increase volume in order to administer over 1-2 minutes</p> <p><input type="checkbox"/> 10. Discards vial and filtered needle in sharps box or appropriate container</p> <p><input type="checkbox"/> 11. Caps syringe, maintaining sterility</p> <p><input type="checkbox"/> 12. VERBALIZES checking compatibility with continuous IVF (COMPATIBLE)</p> <p><input type="checkbox"/> 13. Obtain a 5-10mL Saline flush and alcohol swab</p> <p><input type="checkbox"/> 14. Labels syringe</p> <p>MAR: IVPB: Invanz (ertapenem) Advantage Bag 500mg/100mL NS IVPB q12h</p> <p><input type="checkbox"/> 15. Verbalizes 5 rights</p> <ul style="list-style-type: none"> <input type="checkbox"/> Patient <input type="checkbox"/> Time <input type="checkbox"/> Drug <input type="checkbox"/> Route <input type="checkbox"/> Dose <p><input type="checkbox"/> 16. Verbalizes 3 checks (same as #4)</p> <p><input type="checkbox"/> 17. Verbalizes checking compatibility NOT COMPATIBLE WITH DEXTROSE SOLUTIONS</p>
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ADMINISTRATION PHASE

<ul style="list-style-type: none"> <input type="checkbox"/> 1. Verbalizes Washes hands or uses sanitizer before approaching patient <input type="checkbox"/> 2. Introduces self <input type="checkbox"/> 3. Identifies patient (2 identifiers: ASKS name and DOB while looking at arm band) <input type="checkbox"/> 4. Assesses patient's pain <input type="checkbox"/> 5. Documents pain assessment- before leaving bedside <input type="checkbox"/> 6. Ask about allergies <input type="checkbox"/> 7. Provides patient information about the medications (must state all of the following to earn point) <ul style="list-style-type: none"> <input type="checkbox"/> what is being administered <input type="checkbox"/> dose of the medications being administered <input type="checkbox"/> why they are being administered (their intended effect) <input type="checkbox"/> adverse/side effects to watch for <input type="checkbox"/> 8. VERBALIZES 3rd check of medications (states what is being administered while comparing to MAR) <input type="checkbox"/> 9. Assesses IV site for infection, infiltration, phlebitis (VERBALIZES) <input type="checkbox"/> 10. Verbalizes checking date IV was inserted (WITHIN DATE, INSERTED YESTERDAY) <input type="checkbox"/> 11. Assesses patency of IV by pinching continuous tubing and watching for positive blood return or uses NS flush to assess how catheter flushes (VERBALIZES PATENCY IE.. EASY FLUSH OR POSITIVE BLOOD RETURN OBSERVED) 	<p><u>IVP: FENTANYL ADMINISTRATION</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> 12. Checks patients Vital Signs (WITHIN NORMAL LIMITS) <input type="checkbox"/> 13. Pauses continuous infusion <input type="checkbox"/> 13a. May check compatibility here (COMPATIBLE) should have checked at preparation phase – earn only 1 point if checked here or earlier <input type="checkbox"/> 14. Swabs port closest to IV site for 15 seconds with alcohol swab <input type="checkbox"/> 15. Administers Fentanyl at the prescribed rate (VERBALIZES RATE 1-2 MINUTES) <input type="checkbox"/> 15a. If at Y-Site then bend tubing to prevent medication from backflushing. <input type="checkbox"/> 16. Swabs port again for 15 seconds and flushes at the same rate with NS <input type="checkbox"/> 17. Resumes IV pump <p><u>IVPB: INVANZ (ERTAPENEM) ADMINISTRATION</u></p> <ul style="list-style-type: none"> <input type="checkbox"/> 18. Verbalizes NOT COMPATIBLE WITH DEXTROSE <input type="checkbox"/> 19. Dr. calls and makes change from Invanz before it is hung to Gentamicin 80mg/100mL q12h IVPB. Student checks compatability. (it is compatible with current IVF) <input type="checkbox"/> 20. Assesses IV site again (VERBALIZING NO INFECTION, PHLEBITIS, INFILTRATION AND WITHIN DATE) <input type="checkbox"/> 21. FLUSHES with NS TO ENSURE PATENCY <input type="checkbox"/> 22. Spikes the medication bag with secondary tubing – keeping spike sterile <input type="checkbox"/> 23. Primes tubing with the medication, can back prime, <input type="checkbox"/> 24. Dates and times the new secondary tubing <input type="checkbox"/> 25. Programs pump VERBALIZES RATE PROGRAMMED INTO PUMP 100ML/HR <input type="checkbox"/> 26. Maintains sterility of the tubing connector <input type="checkbox"/> 27. Swabs IV site with alcohol swab for 15 seconds <input type="checkbox"/> 28. Attaches IV <input type="checkbox"/> 29. Starts Pump
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EVALUATION/MONITORING PHASE

<u>Continuous infusion:</u>	<u>Ongoing Monitoring/Evaluation</u>
<p><input type="checkbox"/> 1. Verbalizes D5 ½ NS with 20 KCL Infusing at 75mL/hr ordered</p> <p style="padding-left: 40px;"><input type="checkbox"/> Pump programmed at 150mL/hr WRONG RATE</p> <p><input type="checkbox"/> 2. Recognizes and verbalizes wrong rate should be 75mL/hr</p> <p><input type="checkbox"/> 3. Changes to correct rate 75mL/hr</p> <p><input type="checkbox"/> 4. Assess patient for signs and symptoms of fluid overload – checks for signs such as shortness of breath, Lung sounds, pedal edema, weight gain – or verbalizes these.</p> <p><input type="checkbox"/> 5. Checks K+ level to make sure still requires KCL contained in infusion</p> <p><input type="checkbox"/> 6. Verbalizes need to call MD to report rate of infusion incorrect for unknown amount of time</p> <p><input type="checkbox"/> 7. Verbalizes need to request order to remove KCL from infusion (K+ IS 5.0 mEq/L)</p> <p><input type="checkbox"/> 8. VERBALIZE A VARIANCE/INCIDENCE REPORT NEEDS TO BE PREPARED</p>	<p><input type="checkbox"/> 9. Verbalize would re-evaluate effectiveness of Fentanyl in 20 minutes and document findings</p> <p><input type="checkbox"/> 10. Verbalize assessing IV site frequently while patient receiving IVPB and continuous infusion</p> <p><input type="checkbox"/> 11. Verbalizes would monitor fluid balance via I/O, VS/BP</p> <p><input type="checkbox"/> 12. Verbalizes would monitor electrolytes</p> <p><input type="checkbox"/> 13. Verbalizes would monitor for infection: WBC, Temp – improvement with antibiotic</p> <p><input type="checkbox"/> 14. Verbalizes would monitor for s/e of medications i.e. superinfections with antibiotic use, fever, swelling, diarrhea, nausea/vomiting, confusion, headache, seizures, C. Difficile</p>

ADDITIONAL COMMENTS:

Score:

- **Preparation Phase:** performed _____/17
- **Administration Phase:** performed _____/29
- **Evaluation/Monitoring Phase:** performed _____/14

OVERALL SCORE: _____/60

APPENDIX I

POST-INTERVENTION SURVEY

ID # _____

Kindly circle the best response (0–6) to the following questions.

0 = No Opinion, 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Somewhat Agree, 5 = Agree, 6 = Strongly Agree, NA = Not Applicable	
1. Participating in the practice sessions was beneficial.	0 1 2 3 4 5 6 NA
2. I feel that my participation in this study has increased my ability to provide safer nursing care.	0 1 2 3 4 5 6 NA
3. The skill session scenarios were realistic.	0 1 2 3 4 5 6 NA
4. I feel I received sufficient support/guidance during the skill sessions.	0 1 2 3 4 5 6 NA
5. Participating in these practice sessions has increased my ability to safely:	0 1 2 3 4 5 6 NA
a. insert foley	0 1 2 3 4 5 6 NA
b. care for (monitor) patients with foley catheters	0 1 2 3 4 5 6 NA
c. perform dressing changes	0 1 2 3 4 5 6 NA
d. prepare IV medications	0 1 2 3 4 5 6 NA
e. administer IV medications	0 1 2 3 4 5 6 NA
f. monitor patients receiving IV medications	0 1 2 3 4 5 6 NA
g. prepare continuous IV fluids (prime tubing, thread into IV pump)	0 1 2 3 4 5 6 NA
h. administer continuous IV fluids (program pump, assess IV site/patency)	0 1 2 3 4 5 6 NA
i. monitor patients receiving continuous IV fluids	0 1 2 3 4 5 6 NA
j. use intravenous pumps	0 1 2 3 4 5 6 NA
k. initiate gastric tube feedings	0 1 2 3 4 5 6 NA
l. monitor patients receiving gastric tube feedings	0 1 2 3 4 5 6 NA
m. calculate medications	0 1 2 3 4 5 6 NA
6. Participating in the practice sessions helped me better understand Quality and Safety Education for Nurses (QSEN).	0 1 2 3 4 5 6 NA
7. Participating in the practice sessions increased my awareness of the importance of evaluating nursing care.	0 1 2 3 4 5 6 NA
8. The time required to attend the practice sessions was not burdensome.	0 1 2 3 4 5 6 NA
9. The time allotted for each practice session was adequate.	0 1 2 3 4 5 6 NA
10. I would find it more helpful to have a deliberate practice session weekly	0 1 2 3 4 5 6 NA
11. Monthly deliberate practice sessions are frequent enough.	0 1 2 3 4 5 6 NA
12. One practice session on a specific topic was not enough.	0 1 2 3 4 5 6 NA
13. Three practice sessions on IV medication administration was too few.	0 1 2 3 4 5 6 NA
14. Three practice sessions on IV medication administration was too many.	0 1 2 3 4 5 6 NA
15. Three practice sessions on IV medication administration was adequate.	0 1 2 3 4 5 6 NA
16. I think deliberate practice sessions are essential to include in nursing educational programs.	0 1 2 3 4 5 6 NA
17. The practice sessions would have been just as helpful if I was working with a more knowledgeable peer rather than an expert nurse.	0 1 2 3 4 5 6 NA
18. Working with an expert nurse during the practice sessions was essential.	0 1 2 3 4 5 6 NA
19. I think I was in the group that was testing a new way of developing and refining a specific skill.	0 1 2 3 4 5 6 NA

5. Frequently during studies, participants are asked about the study, and information is shared. In order for us to account for this, we need to know how much information may have been shared.

a. Please circle below how much information you shared about your practice sessions for this study with other GEP students.

0 = None 1 = very little 2 = some 3 = a lot 4 = most but not all 5 = all

b. Please circle below how much information other participants shared about their participation in practice sessions for this study with you.

0 = None 1 = very little 2 = some 3 = a lot 4 = most but not all 5 = all

6. Please share any other thoughts you have about your experiences participating in these sessions?