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Comparison of In Vivo Simulation Training Compared to Video Simulation Training for Identifying Clinical Markers of Distress When Feeding Preterm Infants

Emily M. Wagner
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Comparison of In Vivo Simulation Training Compared to Video Simulation Training for Identifying Clinical Markers of Distress when Feeding Preterm Infants

A thesis presented to the faculty of the Department of Audiology and Speech Language Pathology of East Tennessee State University

In partial fulfillment of the requirements for the degree of Master of Science in Speech Language Pathology

by

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May 2016

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Key words: Simulation training, speech-language pathology (SLP), preterm infant distress
ABSTRACT

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by

Emily Wagner

Preterm infants have multiple health complications due to their underdeveloped neurological systems. Bottle-feeding difficulties are one complication that leads to pulmonary illness secondary to aspiration. Preterm infants exhibit clinical markers when experiencing distress during bottle-feeding. Training caregivers to identify clinical markers reduces the risk for aspiration. Simulation training provides a safe learning environment without harming patients. Twenty-two speech-language pathology and pre-requisite students divided into two simulation groups, video-simulation (N=12) and in-vivo simulation (N=10), were trained to document clinical markers of distress exhibited by preterm infants and make clinical judgments about bottle-feeding. Students rated their levels of anxiety during simulation training. Results revealed that students trained using video-simulation performed with higher clinical judgment scores and lower anxiety levels than students who received in-vivo training. Students’ knowledge of and ability to identify distress markers in preterm infants during bottle-feeding significantly improved after training in both groups without group differences.
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CHAPTER 1

INTRODUCTION

Infants born prematurely often experience multiple health complications. As a result, preterm birth is the leading cause of death in children under the age of five (WHO, 2014). Preterm birth predisposes infants to impaired physiological functions and developmental delays due to their underdeveloped systems, such as difficulty coordinating oral feeding and respiration (Als, 1982). If the warning signs that suggest infants aspirate milk into their lungs go undetected, the preterm infant will suffer from multiple infections due loss of oxygen and/or foreign substances entering the lungs. Training health care providers to recognize these warning signs could help prevent aspiration from occurring in preterm infants (Ferguson, Estis, Evans, Dagenais, & VanHangehan, 2015). Innovative training methods can improve clinical judgment skills for identifying and managing prandial aspiration to decrease the risk of pulmonary illness in preterm infants.

Mathisen, Carey, and O’Brien, (2012) stated that the implementation and interpretation of feeding and swallowing evaluations plus the determination of a preterm infant’s readiness to feed is one of the many responsibilities of a speech-language pathologist (SLP). Due to the high vulnerability of preterm infant population, SLPs need to be trained to provide safe and effective dysphagia treatment for the preterm infants (Mathisen et al., 2012). The ability of an SLP to identify and understand the warning signs of aspiration displayed by preterm infants is crucial, especially during oral feeding, and should be incorporated prior to clinical practice. Ferguson et al. (2015) compared lecture to video-simulation training methods on students’ ability to identify physiological warning signs and behavioral distress cues in preterm infants during oral feeding. The study found that aspiration occurred on videofluoroscopy studies (VFSS) when nurses
documented coughing and desaturation. Yet other physiological warning signs of aspiration that are often observed in premature babies are apnea, bradycardia, desaturation, color change, tachypnea, coughing (Ferguson et al., 2015; Lau, Fucile, & Schanler, 2014). Behavioral distress cues that are displayed in premature infants are drooling, gulping, and sudden changes in muscle tone (Als, 1986; Ferguson, 2013; Lau et al., 2014; Shaker, 2010).

Simulation training methods provides safe and effective means for students and professionals to learn and practice therapy techniques, while reducing the risk of potential harm to patients (Buykx et al., 2012; Hope, Garside, & Prescott, 2011; Weller, Nestel, Marshall, Brooks, & Conn, 2012). Simulation is defined as the imitation of life-like scenarios through the use of varying degrees of technology, role play, case studies, and/or games to actively involve the student(s) while reducing the risk for potential harm (Hope et al., 2011). Due to the vulnerability of the preterm infant population, a prudent approach to train speech-language pathologists (SLPs) must be incorporated in educational programs prior to real-life treatment. Patient simulators allow individuals to transfer information learned in the classroom into actions through near real world scenarios. The transfer of classroom skills occurs through a learning hierarchy (Bouchard, 2011).

In 1956, a classification of different intellectual behaviors was mapped into a hierarchy by Benjamin Bloom to effectively describe the process of how students learn (Bouchard, 2011). The hierarchy begins with the basic foundation of the learning process and gradually increases to higher level learning; “remember, understand, apply, analyze, evaluate, and create” (Bouchard, 2011). Once the basic processing of learning occurs, individuals can then begin to apply that knowledge to abstract, higher level thinking and reasoning situations. Multiple teaching strategies are available and applicable to implement this learning hierarchy. However, not all
strategies are equally effective for all learners. Bloom’s taxonomy was created to provide teachers an opportunity to incorporate different strategies, as long as the levels in his hierarchy were adhered to (Bouchard, 2011). The use of simulation encourages the application of higher level thinking skills, as well as a safe environment to apply new clinical skills (Hope et al., 2011).

Buykx et al. (2012) developed and incorporated an educational simulation hierarchy into a simulation training session. The system involved the introduction to core knowledge required to effectively assess and treat the simulation patient, followed by a pretest, simulation day, posttest combine with a self-reflection discussion with the instructor and lastly feedback from the instructor. The literature refers to the advantages of using simulation training in educating future health professionals enhances critical thinking skills, increases student competency, and patient safety (Nerhing & Lashly, 2010). Simulation training allows instructors to create various clinical situations that students will likely encounter in the field (Weller et al., 2012). Therefore, students have the opportunity to safely practice clinical techniques in a safe learning environment to increase their clinical competency (Weller et al., 2012).

Experiential learning theory suggests that students learn best through experience (Hope et al., 2011). During simulation the student can physically see the direct consequences of their actions through trial and error (Beauchesne & Douglas, 2011; Hope et al., 2011). When an error is made, the opportunity to learn from the error is just as crucial as getting it right the first time (Krakovsky, 2007). Beauchesne and Douglas (2011) state that immediate feedback to an error allows students to immediate apply the new information to the simulation at hand. Learning is a process of discovering multiple ways of medically managing patients using correct clinical
judgments. Thus, due to the vulnerability of preterm infants, simulation training provides a safe opportunity for SLP graduate students to learn through experience in a safe environment.

SLPs have an important role as medical team members in treating preterm infants and often receive referrals for treating infants and children who exhibit swallowing and feeding disorders (Weir, McMahon, Barry, Masters, & Chang, 2009). According to the American Speech-Language-Hearing Association (ASHA), SLPs play a specific and crucial role in treating preterm infants’ swallowing disorders. Treating preterm infants during oral feeding involves the ability of the SLP to identify and assess the problem, in addition to the implementation of appropriate therapy techniques. ASHA further suggests that SLPs who assess and treat preterm infants should be knowledgeable about the following areas: communication, feeding, and swallowing evaluations, communication, feeding, and swallowing intervention, parent/caregiver education and counseling, and staff team education and collaboration (ASHA, 2004). Due to the vulnerability of preterm infants, SLPs should not only be knowledgeable and trained in specific evaluation and intervention techniques, but also recognize and correctly interpret the meaning of behavior displayed by preterm infants during oral feeding (Als, 1982; Ferguson et al., 2015; Shaker, 2010). Identification of specific distress markers will allow the SLP to provide the appropriate therapy to ensure the safety of the preterm infant. The purpose of this study is to compare pedagogic methodologies for training graduate students to assess preterm infant feeding behavior using video simulation and in-vivo simulation.
CHAPTER 2

LITERATURE REVIEW

Role of Speech-Language Pathologist in the Care of Preterm Infants

Speech-language pathologists (SLPs) evaluate and treat individuals with communicative, cognitive, and/or swallowing and feeding impairments/disorders across all ages and stages of life. Preterm infants, infants born at 37 weeks or before gestation, are the youngest clients SLPs treat in a medical setting (CDC, 2015). When an infant is born prematurely, he/she has neurological, structural, and developmental delays compared to infants born full term. The development of preterm infants’ anatomy, behavioral organization, and physiology is typically equivalent with their stage of intrauterine development. The role of the SLP is to safely evaluate and treat communication, feeding, and swallowing in preterm infants, as well as educating caregivers (ASHA, 2004).

In order for SLPs to holistically and safely treat premature infants, they must have knowledge of the appropriate and typical development of the prenatal, neonatal, and infancy stages. Along with the appropriate development of anatomy, behavioral organization, physiology, communication, cognition, feeding, and swallowing of infants (ASHA, 2004).

Assessments of preterm infants include evaluation of the preterm infant’s structure and functions (i.e., reflexes, oral motor and sensory skills, state of regulation, interaction with the environment, pre-feeding behaviors, feeding and swallowing behaviors, and postural control). Family interviews are critical to gather information regarding family medical history, as well as information the family’s cultural and ethical background and beliefs. Cultural beliefs must be
taken into consideration because certain assessments and treatment techniques may not be culturally acceptable (ASHA, 2004).

Furthermore, SLPs inform and educate caregivers regarding the information provided by the assessment, safe feeding techniques for treatment, and non-verbal forms of infant communications to look for during oral feeding, provide counseling to the family, and address any parental or caregiver concerns. Education of treatment techniques, such as the use of different types of bottle nipples or alternate options for nutrient intake (i.e., non-oral feedings) should be provided to the family and caregivers when necessary. Once a treatment plan is created with the family, SLPs will educate the family on how to provide safe oral feeding. Every preterm infant and family is unique and will require different methods of assessment and treatment. SLPs provide the most effective type of treatment and evaluation for that family, as well as guide them through the therapy process (ASHA, 2004). The extensive role of the SLP requires specific training. However, training novice SLPs to work with preterm infants raises concerns due to the vulnerability of the population. Simulation training is an effective way to successfully train professionals without putting a patient or client at harm.

**Learning Theory and Simulation**

When simulation is used as a training technique, it has proven to be more effective if the application is based on a specific learning theory (Inch, 2013). According to Hope et al. (2011) students learn more effectively through experiential learning when compared to students who just receive the information (e.g., a standard lecture). The experiential learning theory, as defined by Kolb, describes a four step learning cycle which allows students to not only gain knowledge, but learn to apply this knowledge into a real life situation (Poore, Cullen, & Schaar, 2014). The four steps in this learning theory involve a concrete learning experience, an opportunity for
reflective observation, abstract conceptualization, and active experimentation. The experiential learning theory is fitting for simulation training as the concrete experience occurs when students begin interacting with the patient simulator (Poore et al., 2014). After students interact with the patient simulator, they reflect on their observations of the experience. The reflection is then followed by abstract conceptualization, in which students assess their performance and reflect on alternate methods that could have been applied to better the outcome of the simulation situation. Finally, students participate in active experimentation, which allows them to apply what they have learned to patient simulation scenario; and transfer the new information into future practices (Poore et al., 2014). In order to successfully learn and functionally apply knowledge, students must achieve a form of all four of the previously mentioned levels of learning (Poore et al., 2014). The process of experiential learning theory encourages the opportunity for students to continuously reflect on their knowledge gained, discuss the application of that knowledge, and physically apply that knowledge to a simulation situation (Buykx et al., 2012; Poore et al., 2014). According to a study by Buykx et al. (2012) this process results in a more positive clinical experience.

Burns, O’Donnell, and Artman (2010) emphasize the importance of critical thinking and problem solving skills to all clinical situations. Bloom’s Taxonomy is a hierarchy in which the application of these critical thinking and problem solving skills must be achieved to result in the application of higher level thinking (Bouchard, 2011). Bloom’s original hierarchy was updated by Anderson in the 1990s to accommodate the changes within the methods used in research and education today. The revision of Bloom’s Taxonomy remained consistent with the hierarchical structure of how we learn, lower levels to higher levels; however, significant changes in terminology occurred. The updated hierarchy begins with the basic foundation of the learning
process and gradually increases to higher level learning; “remember, understand, apply, analyze, evaluate, and create” (Bouchard, 2011). Application of this hierarchy can be seen in forms of simulation training. Ewing (2015) conducted a study comparing video simulation training and in vivo simulation training for graduate level speech-language pathology students regarding distress markers in preterm infant oral feeding trials. The study found that novice students’ who were video trained and video tested performed better than students who were in vivo trained. (Ewing, 2015) stated that these results may be due to increased stress levels experienced during the learning process for students trained using in vivo simulation. Students were expected to perform at the top of the hierarchy prior to experiencing learning opportunities at the lower levels of hierarchy.

**Learning Through Simulation**

Learning and training through the use of high fidelity patient simulators (HFPS) allows students to effectively apply Kolb’s four cycles of learning, as described above. During simulation the student can physically see the direct consequences of their actions through trial and error (Beauchesne & Douglas, 2011; Hope et al., 2011). When an error occurs, the opportunity to learn from the error is just as crucial as getting it right the first time (Krakovskey, 2007). Beauchesne and Douglas (2011) state that immediate feedback to an error allows student to immediate apply the new information to the simulation at hand. Learning is a process of discovering numerous wrong methods, as well as the correct method. Simulation training provides an opportunity for SLP graduate students to learn through experience by applying their knowledge in a controlled environment; an environment that does not put clients (i.e., preterm infants) in harm’s way.
McGaghie, Issenberg, Cohen, Barsuk, and Wayne (2011) conducted a meta-analysis comparing a traditional in-class teaching to a simulation-based medical education combined with deliberate practice. In order for deliberate practice to be effective, it requires motivated learners, defined learning objectives, appropriate difficulty levels, focused and repetitive practice, reliable measurements which provide informative feedback, monitoring and error correction, evaluation and performance that reaches near mastery, and advancement to the next task. McGaghie et al. (2011) emphasize the importance of simulation-based education, especially those in the medical field, to better prepare them with real world skills and knowledge application for their future. A total of fourteen articles were selected based on inclusion criteria from a total of 328 articles, due to the absence of deliberate practice. All outcomes of the selected articles suggested simulation-based education was superior to the traditional forms of teaching (McGaghie et al., 2011). Furthermore, the study mentioned that there is an increasing evidence that the skills learned in simulation training do improve the overall care of the patients (McGaghie et al., 2011).

**Types of Simulation**

Simulation is a form of training experience that uses patient simulator to allow students to practice performance based skills without harming patients. The purpose of simulation training is to allow students the opportunity to critically think through scenarios, make clinical judgments, and to safely implement procedures in a safe learning environment without jeopardizing patient safety (Inch, 2013; Jeffries, 2005). Simulation training may use various platforms such as videos, virtual reality, and live interactions to integrate knowledge and skills performance (Bradley, 2006; Orzech, Palter, Reznick, Aggarwal, & Grantcharov, 2012).

There are various types of simulation that can be used in clinical training. Video simulation requires students to observe the target training in the form of a video. For example,
Dempsey, Iwata, Fritz, and Rolider (2012) compared clinicians’ ability to identify behavioral events during therapy if trained in vivo versus video in undergraduate students. This study defined in vivo simulation as observing scenarios in person with a live clinician and patient. Dempsey et al. (2012) reported that the in vivo form and the video form of training were effective in training observers. However, those with video training reached the training criteria in fewer sessions when compared to the in vivo group. Differences may reflect variability in training methods. For example, the video training used specific behaviors that were preselected and programed, whereas the client responses varied in the in vivo simulation scenarios. Dempsey et al. (2012) identified another benefit to video simulation, namely that it has the ability to train larger numbers of participants within a shorter time period. In vivo simulation required more time to train fewer participants due to limited time and space to accommodate participants.

Integrated simulators combine the use of full body mannequins or specific body parts with computer programs which allow the control of physiological outputs, such as a pulse (Bradley, 2006). These integrated patient simulators can be low, moderate or high-fidelity mannequins (Nehring & Lashley, 2010). Seropian, Brown, Gavilanes, and Driggers (2004) define fidelity as an imitation of realistic sounds, images and/or movements. Fidelity simulators replicate patients of all ages, sizes, and genders, providing students and healthcare providers with a wide variety of clinical scenarios generated through computer software, across all potential patient encounters (Bradley, 2006; Nehring & Lashley, 2010). Integrated simulators provide students and healthcare providers multiple opportunities to safely practice hands-on life-like medical scenarios (Wilson, Shepherd, Kelly, & Pitzner, 2005).

Patient simulation mannequins do have some disadvantages which may limit their widespread use in clinical training. They are expensive, with costs increasing based on the level
of fidelity (Wilson et al., 2005). Patient simulator mannequins also require significant amounts of time to program scenarios and learn how to operate the various technology involved (i.e., control monitors) (Jeffries, 2005). Although simulators are a highly rated learning tool, the cost and time required to successfully utilize a patient simulator can prove to be difficult, especially when faced with a timeline. The characteristics of low, moderate, and high fidelity simulators and the requirements for successful utilization of the potential of each form of simulation is discussed below.

**Low-Fidelity.** Low-fidelity simulators incorporate mannequins that provide gross motor movements and life-like sounds (i.e., heartbeat and breathing) (Nehring & Lashley, 2010; Wilson et al., 2005). When compared to moderate and high-fidelity simulators, low-fidelity simulators are considered the least interactive (Wilson et al., 2005). According to Seropian et al., (2004) low-fidelity simulators are beneficial when introducing new and basic produces. For example, a low-fidelity simulator is ideal for training nursing students on how to administer injections (Seropian et al., 2004; Yaeger et al., 2004). Wilson et al. (2005) studied participants’ perception of the realism of low-fidelity patient simulators to their perception of patient simulation training to other pedagogic methodologies. The results reported that the low-fidelity human patient simulator was preferred over other pedagogic methodologies because it provided life-like functions and components for improving clinical performance (Wilson et al., 2005).

**Moderate-Fidelity.** Moderate-fidelity simulators provide more realistic components to a clinical training scenario compared to low-fidelity simulators, but lack the essential prompts which encourage participants to fully engage the situation (Yaeger et al., 2004). Moderate-fidelity patient simulators, display auditory vital signs (e.g., heart rate and breathing), and programmed voicing abilities (Lisko & O’Dell, 2010; Nehring & Lashley, 2010). Although
breathing sounds are present in a moderate-fidelity simulator, chest movements to match the breathing sounds are not present (Yaeger et al., 2004). The lack of movement can eliminate the essences of realness to the situation, along with the sense of seriousness. However, like a low-fidelity patient simulator, the moderate-fidelity provides more life-like functions that can help students increase their skills in the clinic without risk of harming the patient.

**High-Fidelity.** High-fidelity patient simulators (HFPS) are utilized to create all of the elements of a clinical scenario (Jeffries, 2005). For example, high-fidelity simulators contain mechanical lungs which allow the mannequin to produce breathing sound and exhibit chest rise and chest fall (Bradley, 2006; Gordon, Wilkerson, Shaffer, & Armstrong, 2001; Yaeger et al., 2004). These simulators can be programmed to respond to the actions of the student and/or healthcare professional in training (Cant & Cooper, 2010). Blood pressure levels, limb movements and voicing sounds (e.g., coughing) are just a few of the multiple symptoms displayed by a high-fidelity patient simulator (Gordon et al., 2001). Alinier, Hunt, Gordon, and Harwood (2006) refer to the arrangement of environment and appropriate tools as a “High-Fidelity Simulation Platform.” The realism of high-fidelity patient simulators allows students to experience a clinical scenario in real-time and require the use of real medical equipment (Cant & Cooper, 2010; Nehring & Lashley, 2010).

An example of the application of a HFPS is demonstrated in a study by Buykx et al. (2012), in which three different groups of participants, at the undergraduate, postgraduate, and professional level, were all trained through the use of a HFPS. A HFPS was programmed to deteriorate at a rapid rate, requiring all participants to actively engage in the scenario to prevent the HFPS from dying (Buykx et al., 2012). The sudden deterioration of the simulator resulted in a majority of the participants, from all three levels of education, to experience anxiety (Buykx et
al., 2012). Other studies have also noted that HFPS deterioration scenarios caused participants to feel some form of anxiety during the simulation scenario (Beauchesne & Douglas, 2011; Ewing, 2015; Inch, 2013; Yaeger et al., 2004). This suggests that participants experienced the life-like feeling to the simulation.

Simulation learning requires divided attention between new information, the patient simulator, monitors associated with the simulator, and active participation. The Cognitive Learning Theory (CLT) states a person’s working memory can encode no more than four concurrent elements from working memory to long term memory (van Merrienboer & Sweller, 2010). These elements are only maintain for an average of 20 seconds before they are lost or stored as well. The CLT suggests that the type of attention required in a learning environment, divided or focused, can influence the amount of information transferred from working memory into long term memory. However, simulation training provides an effective means for students and health care provides to practice clinical skills in a safe and controlled environment.

The importance of clinical competence is essential for patient survival and can be practiced and assessed through simulation (Wilson et al., 2005). A systematic review conducted by Cant and Cooper (2010) concluded that simulation training demonstrated improvement in participants’ knowledge and skill, ability to critically think, and/or confidence post simulation training. Specifically, HFPS provide accurate clinical scenario experiences, allowing students to increase their clinical competency (Nehring & Lashley, 2010). It is clear that simulation training offers an exciting method to train SLP graduate students to work with vulnerable clients, such as premature infants. Since feeding dysfunction could be life threatening in this population, a life-like simulation setting would provide a safe context for students and clients.
Preterm Infant Feeding

An average of 3,950,000 babies are born in the United States of America each year (CDC, 2014). One in every nine of those births is preterm (CDC, Preterm births, 2014). Infants born prematurely often experience multiple health complications, which result in preterm birth being the leading cause of death in children under the age of five in the world (WHO, 2014). Developments in medical technology have led to increases in the survival rate of preterm infants; however, current technology is unable to recreate the intrauterine environment (Ais, 1982; Lau, 2006). The intrauterine environment provides appropriate timing, duration, and intensity of stimulation and nutrients to the infant for appropriate development, whereas the extrauterine environment (i.e., the neonatal intensive care units (NICU)) contains unnatural, random stimuli (Ais, 1982; Ross & Browne, 2002). The presence of unnatural stimuli can cause sensory overload for preterm infants. This overload can affect a preterm infant’s neurological development, therefore, affecting the infant’s overall development (Shaker, 2010).

Preterm infants have weak immune systems secondary to their underdeveloped systems, therefore they are at high risk for acquiring various and potentially fatal illness (Melville & Moss, 2013). Therefore, preterm infants who do survive, have an increased risk for multiple health problems. Bronchopulmonary dysplasia (BPD), for example, is a lung disease that occurs in premature infants as a result of respiratory failure (Morgan & Reily, 2006; Trembath & Laughon, 2012). Respiration is vital for sustaining life and has a crucial role in the feeding and swallowing process. Preterm infants with BPD are unable to develop a mature feeding pattern, resulting in the ability to successfully and safely oral feed (Morgan & Reily, 2006). In order to fully comprehend the complexity of feeding issues in preterm infants, it is necessary to understand the normal development of the swallowing process.
Development of the Swallowing Process

In order to orally feed safely, infants must coordinate sucking, swallowing, and breathing. A degree of neurological maturity is required to execute each individual step, before the coordination of all three steps can occur. There are two forms of sucking that occur in full term and preterm infants, non-nutritive and nutritive sucking (Barlow, 2009). Nutritive sucking occurs when the nutrients is being consumed from a bottle or breast; whereas non-nutritive sucking occurs when there is no consumption of nutrients, such as sucking on a pacifier (Barlow, 2009). As a result, non-nutritive sucking occurs independently from respiration because swallowing occurs less frequently when compared to nutritive sucking (Barlow, 2009). Unfortunately, successful non-nutritive sucking does not provide infants with a means for adequate nutrition, whereas nutritive sucking does. Infants alternate suction and expression within the oral cavity during nutritive sucking (Barlow, 2009; Fucile, Gisel, Schanler, & Lau, 2009; Lau, 2006). Suction helps draw the milk into the mouth through negative intraoral pressure occurring within the oral cavity (Fucile et al., 2009; Lau, 2006). Expression involves a stripping movement of the tongue, which allows milk to be extracted from the nipple (Barlow, 2009; Fucile et al., 2009; Lau, 2006). Lau (2014) states that immature sucking patterns consist of the expression stage only, which further suggest why preterm infants have difficulty latching on to a nipple when compared to a bottle.

In addition to mature sucking patterns, three phases of swallowing, namely the oral, pharyngeal and esophageal phase, must occur in a timely manner to reduce the risk of aspiration. During the oral phase, sucking and formation of a bolus occurs. The tongue then guides the bolus to the back of the mouth to begin the pharyngeal phase of the swallow. During the pharyngeal phase, a patterned swallowing response is initiated to transition a bolus past the airway, through
the pharynx and upper esophageal sphincter. The esophageal phase then transfers the bolus into the stomach (Lau, 2014). These three phases are further intertwined into the preterm infants’ ability to successfully coordinate a suck-swallow-respiration pattern during oral feeding to prevent aspiration. Once the bolus safely enters the esophagus, respiration must occur to allow in inhalation or exhalation of oxygen (Mizuno & Ueda, 2003). The swallowing process involves the coordination of many neurological systems.

**Problems Coordinating the Swallowing Process**

Neural control for synchronizing swallowing with respiration occurs within the central patterned generator (CPG), located in the brainstem (Barlow, 2009). The CPG coordinates the suck-swallow-respiration through sensory and motor information transmitted by the cranial nerves. When suck-swallow-breathe patterns are uncoordinated, infants may experience physiological and behavioral signs or markers of distress (Ferguson et al., 2015; Fucile et al., 2009). Shaker (2010) states the importance of identifying the clinical markers of preterm infant distress during feeding to prevent aspiration from occurring. Unidentified aspiration increases risk for life-threatening events and chronic pulmonary illnesses (Ferguson et al., 2015). The ability for an SLP to identify aspiration can reduce illness and infections which negatively impact the growth and development of the preterm infant. Due to underdeveloped neurologic systems, cranial nerve functioning and CPG may not have the ability to effectively communicate the necessary sensory-motor information, resulting in the preterm infant experiencing difficulty while oral feeding. Lack of sensory-motor information being sent to and from the CPG not only affects the coordination of sucking, but also affects safety of swallowing the extracted milk (Barlow, 2009). Due to the extensive neurological innervations which contribute to proper and safe swallowing, swallowing in preterm infants improves with neuromuscular maturation.
Timing is critical in order for safe swallowing to occur (Barlow, 2009; Lau, 2006). Uncoordinated timing and communication between sensory and motor information is due to the continuous development of a preterm infant’s sensory neural pathways and motor neural pathways (Ferguson et al., 2015; Park, 2012; Thoyre, 2007). Pausing respiration after a swallow will result in oxygen desaturation (Mizuno & Ueda, 2003). Abnormal bolus flow within these phases also increase infants’ risk for aspiration, due to the lack of oral control. Giambra and Meinzen-Derr (2010) define aspiration as unintentional movement of liquid or food below the level of the true vocal folds into the trachea.

Continuous health complications, such as BPD, result in further delays of preterm infant development, especially an infants’ ability to oral feed. Difficulty transitioning from tube feeding to oral feeding occurs in approximately 30% of the preterm infant population (Fucile et al., 2009; Shaker, 2010). The difficulty preterm infants’ experience while transitioning to oral feeding is mainly due to immature and uncoordinated suck-swallow-respiration patterns and low endurance (Fucile et al., 2009). The preterm infant brain is too immature to process and interpret sensory information, resulting in over sensitivity (Als, 1986). The over sensitivity of a preterm infant causes their system to shut down to their environment. If overstimulation during oral feeding occurs, the infant is at risk for shutting down during any one of the aforementioned stages of oral feeding. When this occurs, milk becomes trapped in lungs resulting in continuous pulmonary infection.

Continuous health complications require medical intervention such as vital machines, intravenous (IVs) and/or medications administered through needles. Painful sensation from such experiences causes negative sensory associations, which affects preterm infants’ oral feeding development (Shaker, 2010). Furthermore, birth weight and gestational age also have a
significant effect on a preterm infants’ ability to feed orally (Lau & Smith, 2011; Thoyre & Carlson, 2003b; Thoyre, 2007). According to Jadcherla, Wang, Vijaypal, and Leuthner (2010) the impact of the following comorbid illnesses can further affect preterm infants’ overall oral feeding ability: patent ductus arteriosus, neurological impairments, lung disease, and necrotizing enterocolitis. Bronchopulmonary dysplasia and intraventricular hemorrhage are two other life-threatening factors that affect a preterm infants development and feeding ability (Fucile et al., 2009). Oral feeding development in preterm infants is significantly impacted by comorbid illnesses and other conditional health complications. In order to effectively facilitate oral feeding in preterm infants, identification of the signs and symptoms of feeding distress are crucial.

**Identification of Feeding Distress in Preterm Infants**

Feeding difficulties of preterm infants have negative impacts on physical, biological, and mental growth and development (Thoyre, 2007). The presence of feeding difficulties results in the lack of appropriate nutrition and delayed or slow weight gain and growth (Ross & Browne, 2002). While evidence for feeding readiness is established in preterm infants, signs that indicate an increased risk for aspiration is not clearly established. Therefore, clinicians must rely on knowledge from observations, theory, and clinical experience to guide clinical decisions for increased risk for aspiration. Ferguson et al. (2015) retrospectively studied physiologic warning signs that suggested interrupted ventilation (apnea, bradycardia, desaturation, cyanosis, and coughing) and behavioral cues that suggested infant disorganization (muscle tone changes, drooling, and gulping) in preterm infants who did and did not aspirate on video fluoroscopic examination (VSS). The authors reported that when nurses documented coughing and desaturation during oral bottle feeding trials, aspiration was more likely to occur on a VSS.
These findings suggest that the ability to identify physiological and behavioral makers of disorganization demonstrated by the preterm infant feeding during oral feeding, can be used to for the feeder to recognize the infant is experience distress and/or lack of control. Therefore, identifying and stopping oral feeding when these signs and symptoms occur can reduce the occurrence of aspiration during preterm infant oral feedings trials.

**Physiologic Markers of Disorganization during Oral Feeding**

Preterm infants display both physiological and behavioral markers when experiencing distress during oral feeding (bottle or breast). Ferguson et al. (2015) identified physiological and behavioral markers that are crucial to recognize during the oral feeding of preterm infants. These markers were also used in a study by Ewing (2015), which compared the effectiveness of in vivo and video stimulation training to identify the physiological and behavioral markers of distress exhibited by preterm infants. A descriptions of the different markers follows:

**Apnea.** Apnea is the absence of breathing. Mathew (2011) states that apnea occurs as a result of a preterm infant’s unstable respiratory rhythms, due to an underdeveloped respiratory system. If the cessation of respiration is absent for a minimum of four seconds to be considered apnea (Thoyre & Carlson, 2003b). In preterm infants, apnea occurs more frequently during oral feedings due to the inability to coordinate swallowing and breathing because of an underdevelopment neurological system (Mathew, 2011). The airway shuts down when it detects entry of milk, however, due to the neurological delay, the airway does not always reopen, causing an apneic episode (Mathew, 2011).

**Bradycardia.** Bradycardia is a significant decrease in heart rate. In the preterm infant population, bradycardia is defined as a heart rate decrease below 100 beats per minute. Frequent
heart rate changes decrease preterm infants’ bottle feeding endurance; therefore limiting the amount of nutrients a preterm infant can consume during a single feeding (Ferguson et al., 2015).

**Desaturation.** Desaturation is a decrease of oxygen within the blood stream which results in disorganization and low energy levels during oral feeding (Thoyre & Carlson, 2003a). Typical saturation of peripheral oxygen (SpO₂) levels are defined at 90% or greater. SpO₂ levels are considered atypical when below 90%. If desaturation occurs during oral feeding, the infant becomes stressed and requires a long recovery period time.

Thoyre and Carlson (2003b) analyzed the occurrence of desaturation events in 22 preterm infants during oral feeding. Feedings were video recorded in a naturalistic setting. Desaturation occurred an average of 10.8 times during oral feeding. The preterm infants’ SpO₂ levels were below 90% during 20% of the time spent oral feeding. Fifty-nine percent of the desaturation events were considered mild, and 21% of the desaturation events were considered severe; concluding that a risk for desaturation is present near and after discharge in very low birth weight preterm infants (Thorye & Carlson 2003b).

**Cyanosis.** Cyanosis is a change in color that occurs around the perioral area. The skin appears to turn blue as a result of poorly oxygenated blood. Infants who present with cyanosis during oral feeding are at increased risk for tachypnea and aspiration (Ferguson et al., 2015).

**Tachypnea.** Tachypnea is a respiratory rate greater than 60 breathes per minute. Tachypnea occurs when preterm infants compensate for episodes of desaturation by increasing their breathing rate. A typical infant swallow can range from 0.35 to 0.7 seconds (Koenig, Davis, & Thatch, 1990). When tachypnea is experienced, infants have less than 0.3 seconds to inhale.
and exhale between swallows. Therefore resulting in infants not having enough time to breathe between swallows, increasing the risk for aspiration.

**Coughing.** Coughing is a physiological sign of a compromised airway. Coughing protects the cardiorespiratory systems from aspiration in children and adults (Ferguson et al., 2015). Thach (2007) stated that the maturation of the cough occurs on a continuum. Typically developing full term infants develop the laryngeal cough reflex approximately one month after birth. Prior to the development and maturation of the laryngeal cough reflex, the laryngeal chemoreflex (LCR) protects their airways. Stimulation of the LCR, results in a swallow response followed glottis closure. LCR is triggered when the infant begins to aspirate. The LCR automatically closes the airway until the milk is swallowed; once swallowed, the airway reopens and the full term infant can continue feeding. When preterm infants aspirate the LCR again closes to prevent milk from entering the pulmonary tract. However, the underdeveloped LCR does not automatically reopen the airway tract; resulting in the preterm infant experiencing distress through the presentation of clinical markers. In preterm infants, the LCR triggers prolonged glottis closure, resulting in apneic periods (Thach, 2007).

The aforementioned physiological markers of decline are indicators that the preterm infant is experiencing disorganization during feeding trials. Identification of these markers will reduce and prevent the occurrence of aspiration in preterm infants during bottle feeding; reducing the risk of diseases and infections secondary to aspiration.

**Behavioral Markers of Disorganization during Oral Feeding**

Full term and preterm infants communicate their tolerance or lack of tolerance for environmental stimuli through non-verbal cues. Stress or stability behavioral cues displayed by
the infant can indicate readiness or avoidance to orally feed (Liaw, Yuh, & Chang, 2005). Infants exhibit readiness for feeding through approach behaviors, such as a constant state of arousal, quiet breathing, calm facial expressions, and relaxed muscle tone (Shaker 1990). Infants indicate avoidance behaviors, e.g., gulping and leakage of fluid from the mouth. Contemporary evidence does not clearly link aspiration to preterm infants’ behavior. However, evidence does link preterm infants’ behavior to distress; suggesting that the demands of oral feeding are unmanageable in infants experiencing stress (Liaw et al., 2005). Based on these research findings, Ferguson et al. (2015) identified the following behavioral markers as characteristic avoidance cues, which may be sued to indicate distress during feeding by preterm infants:

**Gulping.** Gulping is defined as large, audible bolus swallows. Large swallows require longer periods of deglutition apnea, therefore increasing the risk for desaturation and aspiration. (Thoyre, Shaker, & Pridham, 2005).

**Drooling.** Drooling is described as leakage or spillage of formula or milk from the front and sides of the mouth; indicating that too much liquid has entered the oral cavity. Drooling occurs when compression only is the sucking patterns used to regulate milk flow (Shaker, 1990). Milk seeps out of the oral cavity to protect the airway, when the preterm infant is unable to control the amount of milk or formula.

**Muscle tone changes.** Muscle tone changes are displayed by the preterm infant when experiencing disorganization and distress (Giambra & Meinzen-Derr, 2010; Shaker, 2010). Giambra and Meinzen-Derr (2010) conducted a study to determine if muscle tone changes or hypotonia (defined as flaccid tone of muscles) was related to aspiration. The study used a videofluoroscopic swallow study to determine the occurrence of aspiration in 198 children; in which only 18% demonstrated aspiration and 21% experienced penetration (when liquid reaches
the level of the vocal folds but does not surpass the vocal folds). Of those 18%, changes in muscle tone, among other variables such as developmental delay and cerebral palsy, were demonstrated and documented along with aspiration (Giambra & Meinzen-Derr, 2010).

It is crucial for a SLP to consider behavioral markers of distress and disorganization exhibited by preterm infants during oral feeding to reduce the risk of aspiration. SLPs need to be skilled in assessing the oral feeding skills of the preterm infant prior to and during oral feeding, to determine if the infant is capable of safe oral feeding.

**Assessment of Preterm Infant Oral Feeding Skills**

Identification of preterm infant oral feeding skills can be identified through the utilization through of subjective and objective measures. Objective measures provide numerical data which eliminates the potential for bias, clinical errors, and the lack of clinical skill. Subjective measures comprise of highly variable information among professionals (Ferguson et al., 2015). Each assessment contributes credible information that can be utilized in the treatment of preterm infants exhibiting oral feeding problems.

**Subjective Measurements of Preterm Infant Oral Feeding Skills**

Preterm infant sucking and swallowing behaviors can be directly measured through multiple assessments, however, many of these assessments are invasive and tend increase stress on the preterm infant. Fortunately, two non-invasive subjective measures do exist and are available to assess feeding skills (da Costa & van der Schans, 2005).

The Neonatal Oral Motor Assessment Scale (NOMAS) is an observational scale measuring an infants’ nutritive and non-nutritive sucking skills (Törölä, Lehtihalme, Yliherva, & Olsén, 2012). The scale classifies 28 items into the following three categories: normal,
disorganized, or dysfunctional. The NOMAS assesses coordination of the infants’ oral movements during non-nutritive sucking and the first two minutes of oral feeding (da Costa & van der Schans, 2005). A disorganized score means that the preterm infants displays an uncoordinated sucking pattern, whereas a dysfunctional score indicates abnormal tongue and jaw movement during oral feeding (Törölä et al., 2012).

The Early Feeding Skills Assessment (EFS) checklist consists of 36 items that evaluate a preterm infants readiness, as well as tolerance for oral feeding (Thorye, Shaker, & Pridham, 2005). Oral skills are evaluated in the first five minutes, throughout the entire feeding, and five minutes post oral feeding. Measuring the preterm infants’ oral feeding skills during feeding trials is important to determine the infants’ endurance. The EFS measures whether the infant can remain engaged with oral feeding, maintain organization of suck-swallow respiration, and maintain stability during oral feeding. Each factor plays a role in identifying the preterm infant’s ability to safely oral feed and reduce the risk of a compromised airway, if the infant is not ready or tolerant of oral feeding (Thorye et al., 2005).

A third assessment that provides a means of observing all of the phases of swallowing is known as a videofluoroscopy swallow study (VFSS). A VFSS is an invasive instrumental assessment, which requires specific technology, to provide an x-ray video of a swallow. This video allows medical professionals and SLPs to identify the location of and the error that occurs during a swallow (Sheppard & Fletcher, 2007). The results of VFSS are based on professional opinion. The consistency of what is swallowed depends on the patient being examined. In the case of preterm infants, liquid or milk is infused with a minimal amount of barium, in order to see the formation and movement of the bolus in all four phases of swallowing. A VFSS can
determine the presence of aspiration during oral feeding, even if the infant does not display overt signs of aspiration (i.e., coughing); this is known as silent aspiration (Weir et al., 2011).

Weir et al. (2011) conducted a study comparing the results of VFSS on preterm infants and found that over half of the participants silently aspirated while oral feeding. If undetected, aspiration can lead to lung infections, further inhibiting the physiological stability of the preterm infant (Weir et al., 2011). However, if and when aspiration is detected, SLPs need to know how to modify oral feeding to reduce aspiration from occurring. Unfortunately, due to the high vulnerability of the preterm infant population, having inexperienced SLPs working with the preterm infant population can increase preterm infants’ risk of aspiration and other fatal ailments secondary to oral feeding. Simulation training is an effective means to train SLP students in a controlled environment, to reduce the risk of aspiration occurring in preterm infants during oral feeding.

**Objective Measurements of Preterm Infant Oral Feeding Skills**

Objective measures reduce human error by providing numerical data. In 1997, Lau, Sheena, Shulman, and Schanler defined oral feeding skills (OFS) as preterm infants’ proficiency (PRO) and the rate of milk transfer. OFS matrix provides objective, numerical data through the calculation of the rate of milk transfer is measured throughout the entire oral feeding. PRO is the percentage of the volume taken during the first five minutes of oral feeding and can be used to estimate the endurance and fatigue experienced by the infant based off of these initial five minutes (Lau et al., 1997). OFS scores are divided into four levels which are illustrated in the matrix below (Figure 1) (Lau & Smith, 2011).
Lau and Smith (2011) conducted a study to determine whether the OFS matrix could be used as an effective objective measurement tool. Sixty-six preterm infants, with only the diagnosis of prematurity, participated in the study. Each preterm infant’s oral feeding skills were measured using the OFS matrix, from their first oral feeding trial until oral feeding occurred independently. Lau and Smith (2011) concluded that the use of OFS as an objective measurement is appropriate to assist in the assessment of a preterm infants’ capabilities to oral feed. Currently, as far as could be determined, this is the only objective measure available. Unfortunately, due the dearth of objective measurements, it is crucial to train future SLPs to identify subjective, behavioral markers of distress exhibited by preterm infants during oral feeding. Recognition of these markers are indicators of when to stop oral feeding, and prevent aspiration secondary to preterm infant disorganization from occurring.

**Purpose of the Present Investigation**

The purpose of the present investigation is to compare the effects of online lecture plus video simulation training to online lecture plus in vivo simulation training on speech-language pathology students’ knowledge of feeding and swallowing difficulties in preterm infants,
documentation accuracy of behavioral and physiological clinical markers, clinical judgement
decisions, and anxiety levels during pretesting and post-testing. The following research questions
are included in the present investigation:

Research Question 1: Does students’ documentation accuracy of clinical markers
indicative of preterm infant oral feeding distress differ when trained using an online lecture plus
video simulation method or an online lecture plus in vivo simulation laboratory?

Research Question 2: Does knowledge for assessing preterm infant feeding and
swallowing safety differ for students trained using an online lecture plus video simulation
method or an online lecture plus in vivo simulation laboratory?

Research Question 3: Do students use better clinical judgment skills when evaluating
feeding and swallowing distress in preterm infants when trained using an online lecture plus
video simulation method or an online lecture plus in vivo simulation laboratory?

Research Question 4: Do graduate students’ post-testing anxiety levels differ between
groups when trained using an online lecture plus video simulation method or an online lecture
plus in vivo simulation laboratory?

The following hypotheses were proposed:

Hypothesis 1: Students trained using an online lecture plus in vivo simulation training
format will document clinical markers indicative of preterm infant oral feeding distress more
accurately than students trained using an online lecture plus video simulation training format.

Hypothesis 2: After training, both groups of students trained will exhibit similar gains in
knowledge for assessing preterm infant oral feeding.
Hypothesis 3: Students trained using an online lecture plus in vivo simulation will use better clinical judgment skills when evaluating feeding and swallowing distress in preterm infants than students trained using an online lecture plus video simulation method.

Hypothesis 4: Students who participate in an online lecture plus in vivo training laboratory will have less anxiety during in vivo post-testing than students trained using an online lecture plus video simulation method.
CHAPTER 3

METHODS

The researcher examined the use of high-fidelity patient simulators as a pedagogical strategy for training speech-language pathology (SLP) students to recognize distress signs in preterm infants during bottle feeding.

The aim of the study was to compare and measure the effects of a prerecorded lecture plus video simulation training to a prerecorded lecture plus in vivo simulation training of SLP students’ performance on: (1) knowledge of preterm infant feeding markers indicating distress, (2) making clinical judgments regarding preterm infant feeding distress markers, (3) accurate documentation of clinical markers indicating distress during preterm infant bottle feeding, and (4) participants’ perceived levels of anxiety during each scenario.

Research Design

A quasi-experimental design was selected to compare two different simulation training methodologies, video and in vivo, on SLP students to identify distress signs in preterm infants during bottle feeding. A pre-test/post-test design was used to determine if outcome measures differed across two different pedagogic methodologies (Orlikoff, Schiavetti, & Metz, 2015).

Research Context

This study was conducted in a university setting as part of a larger laboratory requirement for graduate level SLP students. Approval was granted by the East Tennessee State University’s (ETSU) Institution Review Board to conduct this study with students enrolled in the graduate Dysphagia course plus Dysphagia Laboratory and the undergraduate course, CDIS-4027 Speech
and Hearing Science II. The primary investigator conducted this study under direction of graduate faculty in the Department of Audiology and Speech-Language Pathology at ETSU.

The Dysphagia course is a required three credit course in the Masters of Speech-Language Pathology curriculum. The course objectives were for students to acquire advanced mastery knowledge of normal swallowing neurophysiology, developmental aspects of swallowing, and evaluation and management of disordered swallowing across a life-span. The Dysphagia course was accompanied by an interactive, one credit Dysphagia Laboratory Course. During the preterm infant laboratory, prerecorded online content provided a basis for understanding embryonic development, preterm infant development in the extrauterine environment, signs of distress that relate to impaired swallowing, and guided correct clinical judgment scenarios. Students accessed the 30 minute self-paced, pre-recorded online PowerPoint® lecture through ETSU’s survey platform.

Speech and Hearing Science II is a prerequisite undergraduate course for entrance into a Speech-Language Pathology Masters program. The course objectives were for students to acquire knowledge of the speech and hearing systems, acoustic physiology of the auditory periphery, and tools for speech and hearing science research. The Speech and Hearing Science II course was accompanied by an interactive, one credit Speech and Hearing Science II Laboratory Course. During the laboratory, instrumentations used in speech and hearing science, the physiology of the speech and hearing system, and the acoustic physiology of the auditory periphery system were demonstrated.
Research Ethics

East Tennessee State University and the American Speech and Hearing Association (ASHA) adhere to a code of ethics in order to ensure the value and integrity of research in the SLP profession (Horner & Minifie, 2011). Respect for persons was addressed through informed consent. Each participant signed consent after the purpose of the study and their participation was verbally explained to them by a professor in the department. The informed consent documents were stored by the professor until final grades were submitted to eliminate potential bias in course grading. The participants’ wellbeing was a goal at all times and the research did not involve any risk to the participants. Participating in the research had the potential to increase knowledge regarding bottle feeding in preterm infants. Beneficence and risk were therefore sufficiently addressed.

Participants

Sample Methods

A convenience sample of graduate level speech-language pathology and undergraduate level prospective SLP students was selected for the present investigation.

Random Sampling

Initially, graduate student participants were randomly assigned to one of two groups using a random number generator. Twelve participants were randomly assigned to the video simulation training group (VT group). Thirteen participants were randomly assigned to the in vivo patient simulation training group (IT group). The target sample population was graduate level SLP participants. However, data from eight participants from the IT group was excluded due to technical difficulties with the patient simulator, Premie HAL® Model S3010 high-fidelity...
simulation mannequin (Premie HAL). Therefore, a convenience sample of five undergraduate students were recruited as volunteers to participate in the IT group. See Table 1 for a description of the participants.

All undergraduate students who were recruited were final semester graduating seniors with a minor in Communication Sciences and Disorders at ETSU. The undergraduate level participants completed the identical preterm infant laboratory course as volunteers. The participants are described in Table 1.

Table 1

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<th>Description of Participants (N=22)</th>
<th>Characteristics</th>
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Materials and Instrumentation

Simulation Scenarios

Simulation scenarios used in this study were created by Ferguson et al. (2015) and used by Ferguson et al. (2015) and Ewing (2015) to train and measures skill performance of students to identify and understand distress in bottle feeding preterm infants. Ferguson et al. (2015) created video training scenarios consisting of a video recording of a high fidelity Baby HAL® Model S3010 patient simulator (Baby HAL) which was edited into a split-screen format. During
each split-screen video scenario, participants observed the patient simulator bottle feeding on the left-hand side and a vital sign monitor on the right-hand side of the screen. See Figure 2 for an example of the video recorded scenarios. The same patient scenarios were programmed into Premie HAL® and were activated using a controller monitor during the in vivo simulation training and post-testing. Vital signs were displayed on a separate monitor. See Figure 3.

*Figure 2. Pre-Test Video Simulation Scenarios*

*Figure 3. Post-Testing Format*
The vital signs displayed by both Baby HAL® and Premie HAL® included heart rate, oxygen saturation levels, and respiratory rate. Each patient simulator was programmed to gulp, become cyanotic (blue) and recover, and cough. Each scenario contained pertinent medical and feeding information that was communicated to participants in a written format. See Appendix A for a detailed description of training scenarios and Appendix B for a detailed description of pre- and post-test scenarios.

**Measurement Instrumentation**

**Knowledge Test.** A 10 question Knowledge Test was used to determine a change in students’ knowledge for preterm infant feeding, (Appendix C). Ferguson et al. (2015) developed the Knowledge Test that consisted of three open-ended list questions, three fill-in-the-blank, and four multiple choice questions. The use of the identical Knowledge Test provides a means to compare the different simulation trainings in Ferguson et al. (2015) and Ewing (2015) to the present study; allowing the researcher to identify similarities and differences between trainings.

**Clinical Judgment Checklist and Coding Guidelines.** Clinical Judgment was used to code student data on performance accuracy of clinical markers indicating distress and making appropriate recommendations (Appendix D). Ferguson et al. (2015) created guidelines to assist participants with the incorporation of specific criteria during an open-ended documentation format. The guidelines included the PES prompts developed by NAND (2005); namely (P) the problem; (E) etiology of the problem; and (S) the signs and symptoms associated with the problem. Ferguson et al. (2015) further incorporated (C) the cause and (R) recommendations. The open-ended documentation guidelines written by Ferguson et al. (2015) were also incorporated in Ewing’s (2015) study to investigate the documentation accuracy of graduate-level speech language pathology students.
Clinical Judgement Checklists were developed to resemble an online Hospital Medical Record (HMR) format. Documentation of clinical markers and clinical judgments were completed through the use of the Clinical Judgment Checklist. Clinical Judgement documentation required participants to determine the presence of a problem, etiology of the problem, signs and symptoms exhibited, if an increased risk for aspiration was present, and correct clinical recommendations.

**Anxiety Rating Scale.** An 11-point anxiety rating scale was developed to determine if students’ perceived levels of anxiety differed from pre- to post-test conditions and between groups (located at the bottom of Appendix D). The cognitive learning theory (CLT) suggests that the state of a person’s mind can affect their ability to process and learn new information (Fraser et al., 2012). Therefore, the researcher developed a perceived anxiety rating scale for participants to document the level of anxiety they were experiencing for each scenario.

**Procedure**

The procedures followed in the current investigation are illustrated in Figure 4. Each step will be discussed beginning with orientation to the patient simulator and ending with a description of post-testing.
Orientation

All the participants were oriented to the high-fidelity patient simulator regardless of group assignment. Participants were introduced to the mannequin in groups of two or three for 15 to 20 minutes. During this time, participants held the patient simulator, listened to it cry and gulp, picked it up, moved it from arm to arm, observed color changes, and transitioned it to back to the bouncy seat. No additional information, aside from this introduction, was provided during orientation; all questions were deferred to training.

Pre-Testing

Pre-testing provided a baseline measure of knowledge, clinical judgement skills, documentation accuracy for clinical markers, and perceived anxiety levels across all participants. All of the pre-test simulation scenarios were in video format. Both groups were provided a web-
link to access the Knowledge Test and four two-minute video simulation scenarios depicting a patient simulator bottle feeding (Figure 2). Participants documented the identification of clinical markers and clinical judgement on the Clinical Judgement Checklist (Appendix D). Participants individually took the pre-test on their personal laptops in a classroom setting.

**Video Scenarios.** Video scenarios were displayed in the split-screen format, as illustrated in Figure 2. Medical history and feeding performance measures were provided for each video scenario. Medical history included gestation age and medical diagnoses; feeding performance included prescribed feeding amount, the volume of milk consumed in five minutes, the total volume of milk consumed, and the time required to consume the total volume of milk. After each two-minute video simulation scenario, participants documented observed clinical markers, their clinical judgment regarding the quality and safety of the bottle feeding scenario, and their perceived level of anxiety onto the Clinical Judgment Checklist (Appendix D).

**Training**

The pre-recorded, self-paced, online, PowerPoint® lecture was observed by all participants within 24 hours prior to video or in vivo training. During both training formats, the instructor demonstrated and defined all of the clinical markers presented in online prerecorded lecture training.

**Video Training.** Four, two-minute scenarios in the online split-screen format were used to provide an interactive learning experience, as seen in Figure 2. During video simulation training, participants analyzed these four scenarios in groups of four with the instructor. After each scenario was presented, eight to 10 minutes was allotted for direct instruction, analysis,
questions, and debriefing. Participants were guided and informed of the process for making correct clinical judgments.

**In Vivo Training.** In vivo training consisted of the identical four two-minute scenarios used in video scenarios. Each scenario was pre-programmed in the Premie HAL® patient simulator. During in vivo training, participants analyzed the four scenarios in groups of two to four with an instructor. Each participant held the infant simulator for one or two scenarios. After each scenario was presented, eight to 10 minutes was allotted for direct instruction, analysis, questions, and debriefing. Participants were guided and informed of the process for making correct clinical judgments while holding the patient simulator.

**Post-Testing**

Post-test scenarios were presented by a trained controller and video recorded for reliability purposes. Post-testing provided a measure of participants’ knowledge, clinical judgement skills, documentation accuracy for clinical markers, and perceived anxiety levels across all participants after training. All of the post-test simulation scenarios were in in vivo format. Participants from both the IT and VT groups individually completed an in vivo post-test immediately after simulation training.

Post-testing was done individually and consisted of participants holding and bottle feeding the Premie HAL® patient simulator for four two-minute scenarios. Participants entered a room with the Premie HAL patient simulator in a bouncy seat, next to a vital sign monitor and plastic bottle (Figure 3). Participants were provided a packet of four Clinical Judgement Checklist sheets. The top of each checklist sheet provided the infant’s medical and feeding history. After participants reviewed the medical history and picked up the Premie HAL patient
simulator, the researcher began the scenario. As in pre-testing, once a two-minute simulation scenario was completed, participants documented their observed clinical markers, their clinical judgment regarding the quality and safety bottle feeding scenario, and their perceived level of anxiety onto the Clinical Judgment Checklist (Appendix D). Once all four scenarios were completed, each participant took the 10-question Knowledge Test. Students were allowed access to the notes from the prerecorded, self-paced, PowerPoint® lecture.

Data Recording

Students’ answers were coded according to a rubric originally created by Ferguson et al. (2015) and used by Ewing (2015). Ferguson modified an assessment tool developed by Fero et al. (2010) and Ferguson et al. (2015) modified version scores each scenario across the following six categories: recognition of the problem, identification and documentation of behavioral and physiological markers, appropriate recommendations, documentation of the rationale, identification and documentation of pulmonary risk, and accuracy of the calculation of Oral Feeding Skills (OFS). For the purposes of the current investigation, OFS skills were not calculated due to grading deadlines for the graduate students Dysphagia course.

The same Knowledge Test and Clinical Judgement rubric provided means for a direct comparison of the different pedagogic methodologies and insight to the effectiveness of each method across Ferguson et al. (2015), Ewing (2015), and the present study. The Knowledge Test and number of Clinical Markers correctly identified were scored based on the number correct. Clinical Judgment scores were added per each scenario, then averaged for the four scenarios presented in pre- and post-testing. Perceived anxiety levels of the four scenarios were averaged for pre- and post-testing.
Data Analysis

Results were analyzed by using descriptive and inferential statistical procedures: one way analysis of variance (ANOVA), 2(group) X 2(time) repeated measures ANOVA, and Pillai’s Trace (Orlikoff et al., 2015).

Reliability

Inter- and intra-rater reliability were calculated across all measurement instruments for 20% of participant responses from the present study. A second rater, a qualified SLP, independently coded 20% of participant responses for inter-rater reliability.

Validity

Measurement instrumentation and simulation scenarios were examined for validity in the Ferguson et al. (2015) study by the primary researcher, a faculty advisor, and a specialist in swallowing in the NICU. Each scenario was validated and used in both Ewing (2015) and the present investigation.
CHAPTER 4

RESULTS

A quasi-experimental, pre-test/post-test design was used to compare and measure the effects of a prerecorded lecture plus video simulation training (VT) to a prerecorded lecture plus in vivo simulation training (IT) on students’ knowledge gained, ability to identify clinical markers, clinical judgment scores, and perceived levels of anxiety. Dependent variables were scores from the knowledge test (max score = 10), identification of clinical markers (max score = 12), clinical judgment (max score = 24), and levels of anxiety (min score = 0 [completely relaxed]; max score = 10 [panicked]).

The results will first be discussed in terms of identifying subgroup differences within the IT group that may affect that groups overall results. Subgroup differences will be followed by a comparison of the ability to accurately document Clinical Markers, Knowledge Test Scores, accurate Clinical Judgment Scores, and Perceived Anxiety Levels between the VT and IT group’s pre- and post-test scores.

**Calculated Means, Standard Deviations, and Ranges for VT and IT Groups**

Dependent variables as a function of group were used to measure outcomes for research questions one through four. Table 2 illustrates the calculated means, standard deviations, and ranges for the VT and IT groups across all dependent variables.
Table 2

*Calculated Means, Standard Deviations, and Ranges for the VT and IT Groups Across all Dependent Variables (N=22)*

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Video Trained Group N = 12</th>
<th>In Vivo Trained Group N=10</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>KT</td>
<td>.167</td>
<td>.39</td>
</tr>
<tr>
<td>Max = 10</td>
<td>8.83</td>
<td>.94</td>
</tr>
<tr>
<td>CJ</td>
<td>8.58</td>
<td>4.17</td>
</tr>
<tr>
<td>Max = 24</td>
<td>16.83</td>
<td>2.66</td>
</tr>
<tr>
<td>Total CM</td>
<td>3.25</td>
<td>2.49</td>
</tr>
<tr>
<td>Max = 12</td>
<td>10.58</td>
<td>.99</td>
</tr>
<tr>
<td>PA</td>
<td>3.71</td>
<td>1.87</td>
</tr>
<tr>
<td>Min = 0; Max = 10</td>
<td>3.23</td>
<td>1.48</td>
</tr>
</tbody>
</table>

*Note.* M = Mean, SD = Standard Deviation, CM = Clinical Markers Identified.

**IT Subgroup (Graduate to Undergraduate) Comparison**

Prior to analyzing group differences to answer the research questions, statistical analyses were conducted on subgroups within the IT group. One way ANOVA was computed on the subgroups (graduates and undergraduates) within the IT group to determine the presence of heterogeneous differences on dependent variables. Table 3 displays the calculated means and standard deviation scores between the graduate and undergraduate level students within the IT group.
Table 3

Means and Standard Deviations of Pre- and Post- Knowledge Test Scores (KT), Clinical Judgment Scores (CJ), and Perceived Anxiety Scores (PA) Between Graduate Level Students and Undergraduate Level Students in the IT Group (N = 10)

<table>
<thead>
<tr>
<th>Outcome Measures</th>
<th>Graduate Level Students N=5</th>
<th>Undergraduate Level Students N=5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>KT Pre</td>
<td>1.80</td>
<td>1.09</td>
</tr>
<tr>
<td>KT Post</td>
<td>8.40</td>
<td>1.95</td>
</tr>
<tr>
<td>CJ Pre</td>
<td>8.00</td>
<td>3.39</td>
</tr>
<tr>
<td>CJ Post</td>
<td>11.80</td>
<td>1.64</td>
</tr>
<tr>
<td>PA Pre</td>
<td>4.40</td>
<td>1.04</td>
</tr>
<tr>
<td>PA Post</td>
<td>5.55</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Note. IT = In vivo trained group, M = mean, SD = Standard Deviation

A 2x2 repeated measures ANOVA was conducted to compare pre- and post-test CJ scores between graduate and undergraduate students within the IT group. Table 4 shows the results of the ANOVA. Group was the between subject variable with two levels (graduate and undergraduate). Time was the within subjects variable with two levels (pre-and post-test). ANOVA results revealed a main effect of time, \( F(1,8) = 29.623, p = .001 \); no main effect of group was found, \( F(1,8) = .610, p = .457 \). These results are further explained by a significant group x time interaction, \( F(1,8) = 6.61, p = .03 \). Results indicate that pre-test knowledge for CJ was higher for graduate students (\( M = 8.00 \)) than undergraduate students (\( M = 5.40 \)). However, after training, CJ scores were higher for undergraduate (\( M = 16.0 \)) than graduate students (\( M = 11.80 \)).
Table 4

ANOVA Results for Clinical Judgment Scores and Perceived Anxiety Levels for Graduate and Undergraduate Level Students in the IT Group

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>df</th>
<th>MS</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Judgment</td>
<td>Time</td>
<td>1</td>
<td>259.20</td>
<td>29.62</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>1</td>
<td>3.20</td>
<td>.61</td>
</tr>
<tr>
<td></td>
<td>Time x Group</td>
<td>1</td>
<td>57.80</td>
<td>6.60</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>8</td>
<td>8.75</td>
<td></td>
</tr>
<tr>
<td>Perceived Anxiety</td>
<td>Time</td>
<td>1</td>
<td>1.65</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>1</td>
<td>44.25</td>
<td>24.90</td>
</tr>
<tr>
<td></td>
<td>Time x Group</td>
<td>1</td>
<td>1.65</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Error</td>
<td>8</td>
<td>1.56</td>
<td></td>
</tr>
</tbody>
</table>

Note. Bolded text indicates statistically significant results.

A 2(group) X 2(time) repeated measures ANOVA was used to compare pre- and post-test PA levels between graduate and undergraduate students within the IT group. Group was the between subject variable with two levels (graduate and undergraduate). Time was the within subjects variable with two levels (pre-and post-test). The following assumptions were tested and met: independence of observation, normal distribution of dependent variable, homogeneity of variances. ANOVA results revealed no main effect of time, $F(1,8) = 1.06, p = .33$. A main effect of group was revealed, $F(1,8) = 24.91, p = .00$. No group by time interaction was found, $F(1,8) = 1.06, p = .33$. Results indicate that pre-test PA levels were higher for graduate students ($M = 4.40$) than undergraduate students ($M = 2.00$) and even higher in post-test scores; graduate students ($M = 5.50$), undergraduate students ($M = 2.00$). Therefore, PA levels of undergraduate students could have affected the PA mean for the IT group.
Comparison of VT to IT Group’s Results

Comparison of Clinical Marker Documentation

Research question one investigated whether students trained using an online lecture plus video simulation method or an online lecture plus in vivo simulation laboratory document clinical markers indicative of preterm infant bottle feeding distress more accuracy. Question one was tested using a repeated measures mixed model 2(group) X 2(time) repeated measures ANOVA to examine group differences for clinical markers documented from training. Group was the between subject variable with two levels (VT and IT). Time was the within subjects variable with two levels (pre-and post-test). The following assumptions were tested and met: independence of observation, normal distribution of dependent variable, homogeneity of variances. Results revealed a main effect of time, $F(1,20) = 193.539, p = .000$, partial $\eta^2 = .906$, with a large effect. See Figure 5. Post-test scores were significantly higher than pre-test scores without group differences. No main effect of group was found, $F(1,20) = .012, p = .913$, partial $\eta^2 = .001$.

![Figure 5. Mean Number of Accurately Documented Clinical Markers in Pre- and Post-Testing (N=22)](image-url)
There was no group by time interaction, $F(1,20) = 1.112$, $p = .304$, partial $\eta^2 = .053$. The results of video and in vivo training on accurately documented clinical markers during pre- and post-testing are illustrated in Figure 5.

**Comparison of Knowledge Test Scores**

Research question two investigated whether students’ knowledge for assessing preterm infant bottle feeding and swallowing safety differed for students trained using an online lecture plus video simulation method or an online lecture plus in vivo simulation laboratory. Question two was tested using a repeated measures mixed model 2(group) X 2(time) repeated measures ANOVA to examine group differences for knowledge gained from training. Group was the between subject variable with two levels (VT and IT). Time was the within subjects variable with two levels (pre-and post-test). The following assumptions were tested and met: independence of observation, normal distribution of dependent variable. The assumption of equal covariance matrices was violated as evidenced by significant Box’s Test of Equality of Covariance Matrices, $F(2,26) = 4.669$, $p = .003$. To account for the violation Pillai’s Trace was used to test for significance and the alpha was changed from .05 to .01 to decrease the risk of a Type I error. See Figure 6.

Results suggest a trend toward a group x time interaction. However, after adjusting for heterogeneous covariance matrices, no group x time interaction was present, $F(1,20) = 7.67$, $p = .012$, partial $\eta^2 = .277$. Results revealed a main effect of time, $F(1,20) = 338.925$, $p = .000$, partial $\eta^2 = .944$. Both groups’ Knowledge Test scores increased after training. No main effect of group, $F(1,20) = 568.390$, $p = .451$, partial $\eta^2 = .029$ was found. The effect of video and in vivo training on the KT during pre- and post-testing are displayed in Figure 6.
Comparison of Clinical Judgment Skills

Research question three examined whether students’ used better clinical judgment skills when evaluating preterm infant distress during bottle feeding and swallowing when trained using an online lecture plus video simulation method or an online lecture plus in vivo simulation laboratory. Question three was tested using a repeated measures mixed model 2(group) X 2(time) ANOVA to examine group differences for clinical judgement skills from training. Group was the between subject variable with two levels (VT and IT). Time was the within subjects variable with two levels (pre- and post-test). The following assumptions were tested and met: independence of observation, normal distribution of dependent variable, and homogeneity of variances. Results revealed a main effect of time, $F(1,20) = 56.33, p = .000$, partial $\eta^2 = .738$, with a large effect. A significant difference occurred between pre- and post-test scores meaning both groups scored higher after training without group differences. A main effect of group was found, $F(1,20) = 6.01, p = .024$, partial $\eta^2 = .231$. It should be noted that within the IT group, the
undergraduate scores increased the overall mean value in the IT group, as shown in Table 3. No group by time interaction was found, \( F(1,20) = .260, p = .615 \), partial \( \eta^2 = .013 \).

Both groups increased their ability to correctly document of clinical markers after training with similar scores. Figure 7 demonstrates the effect of video and in vivo training on clinical judgment during pre- and post-testing.

![Figure 7. Mean of Pre- and Post-Test Clinical Judgment Scores between VT and IT Groups (N=22)](image)

**Comparison of Perceived Anxiety Skills**

Research question four investigated if students’ post-testing anxiety levels differed when trained using an online lecture plus video simulation method or an online lecture plus in vivo simulation laboratory. Question four was tested using a repeated measures mixed model 2(group) X 2(time) ANOVA to examine group differences for perceived anxiety levels from training. Group was the between subject variable with two levels (VT and IT). Time was the within subjects variable with two levels (pre-and post-test). The following assumptions were tested and met: independence of observation, normal distribution of dependent variable, homogeneity of variances. Results revealed no main effect of time, \( F(1,20) = .010, p = .922 \), partial \( \eta^2 = .000 \).
See Figure 8. No main effect of group was found, $F(1,20) = .001, p = .976$, partial $\eta^2 = .000$.

There was no group by time interaction, $F(1,20) = 1.185, p = .289$, partial $\eta^2 = .056$.

![Figure 8. Pre- and Post-Test Means of Perceived Anxiety Levels (N = 22)](image)

**Reliability**

Intra- and inter-rate reliability were calculated were calculated for 20% of participants’ responses from the following measurement instrumentation: Knowledge Test, Clinical Judgement, and Perceived Anxiety Levels. One hundred percent of the responses were coded, then 20% were re-coded by the primary investigator. Intra-rater reliability was calculated for the Knowledge Test pre-test scores ($r = 1.00, p = .01$); Knowledge Test post-test scores ($r = .910, p = .05$); Clinical Judgment pre-test scores ($r = .853, p = .01$); Clinical Judgment post-test scores ($r = .918, p = .01$); Perceived Anxiety Levels pre-test ($r = 1.00, p = .01$); and Perceived Anxiety Levels post-test ($r = 1.00, p = .01$). Twenty percent of the responses were coded by a second trained person for inter-rater reliability using an answer key and coding sheet (Appendix B). Inter-rater reliability was calculated for the Knowledge Test pre-test scores ($r = 1.00, p = .01$); Knowledge Test post-test scores ($r = .891, p = .05$); Clinical Judgment pre-test scores ($r = .874, p$)
= .01); Clinical Judgment post-test scores (r = .924, p = .01); Perceived Anxiety Levels pre-test (r = .998, p = .01); and Perceived Anxiety Levels post-test (r = .999, p = .01). Any discrepancies were resolved by consensus.
CHAPTER 5

DISCUSSION

Summary of Research Questions and Results

The first aim of the present study was to determine if students receiving an online lecture plus video simulation training (VT group) clinical marker documentation accuracy differed compare too students who received an online lecture plus in vivo simulation training (IT group). It was hypothesized that students in the IT group would document clinical markers indicative of preterm infant bottle feeding more accurately than students in the VT group. This hypothesis was not confirmed. Results illustrated that both VT and IT groups significantly improved accurate documentation of clinical markers indicative of preterm infant bottle feeding distress.

The second aim of this study was to determine if students’ knowledge for assessing preterm infant feeding and swallowing safety differed between groups (VT compared to IT). It was hypothesized that both groups will exhibit similar gains in knowledge for assessing preterm infant bottle feeding and swallowing. The results confirmed this hypothesis.

The third aim of this study was to determine if students use better clinical judgment skills when evaluating feeding and swallowing distress in preterm infant bottle feeding if they were in the VT group or in the IT group. It was hypothesized that students trained in the IT group will use better clinical judgment skills when evaluating feeding and swallowing distress signs in preterm infant bottle feeding than students in the VT group. Results did not confirm this hypothesis. Both groups increased their clinical judgment skills when evaluating feeding and swallowing distress in preterm infant bottle feedings; however, the VT group demonstrated significantly higher clinical judgment skills.
The fourth aim of this study was to identify if students’ perceived post-test anxiety levels differed between groups. It was hypothesized that students who participated in the IT group will have less anxiety during in vivo post-testing than students trained in the VT group. This hypothesis was not confirmed. Results revealed that the IT group had slightly greater levels of anxiety in post-testing than the VT group. However, when the IT subgroups (graduates and undergraduates) were analyzed, the undergraduates’ level of anxiety may have reduced the IT groups overall anxiety levels.

**Effects of Training and Group Differences**

**Clinical Marker Documentation**

Video and in vivo stimulation training significantly improved students’ ability to accurately document clinical markers during preterm infant bottle feeding. There were no significant group differences, however students in the VT group scored marginally higher post-test scores than students in the IT group during post-testing: yet these group differences were not significant (VT mean = 10.58; IT mean = 10.00). Therefore, results suggest that both methods of simulation training are effective for increasing students’ ability to accurately document clinical markers indicating distress during preterm infant bottle feeding.

**Knowledge Gained**

Both simulation training methods significantly increased Knowledge Test scores without group differences. The results suggest that both methods provided sufficient material to increase participants’ knowledge. The use of personal notes may have assisted with participants’ ability to recall information discussed from the prerecorded online lecture. Results proved that brief web-based training significantly increased participant knowledge.
Clinical Judgment Skills Gained

Video simulation and in vivo simulation training significantly improved students’ ability to produce accurate clinical judgment decisions. However, there was a moderately significant group difference. The VT group performed better in pre- and post-testing compared to the IT group. The VT group required focused attention when trained in the video simulation format. The IT group was exposed to the following two confounding factors, simulator complications and divided attention. The two confounding factors could have altered participants in the IT group ability to effectively store and recall information as well as the VT group.

The first unexpected confounding factor resulted from complications regarding the functioning of the Premie HAL® patient simulator. The simulator required repairs in the middle of the IT groups’ training and post-testing. Last minute training schedule changes occurred when the patient simulator failed, which could have increased participants’ stress levels. Graduate students were given the option to accept or decline the last minute changes due to conflicting schedules. Not all graduate level participants were able to participate as originally planned. Therefore, after the patient simulator was repaired, undergraduate students were recruited as volunteers to increase the sample size of the IT group.

The second confounding factor was an increase in required divided attention during training among students in the IT group. The VT group observed a two minute split screen video simulation clip (Figure 1) and recorded information on the Clinical Judgment Checklist. Students in the IT group held Premie HAL® patient simulator in one hand, feed the patient simulator a bottle with other hand, monitored vital signs on the monitor, and watched the infant for changes in complication during the two minute scenario. Following these two minutes training scenarios, students in the IT group returned the infant simulator to bed and document their observations on
the Clinical Judgment Checklist. Harrison, Mullet, Whiffen, Ousterhout, and Einstein (2014) stated that divided attention could interfere with novel students’ ability to fully process the target information and therefore resulting in difficulty with spontaneous retrieval. This finding suggests that the most beneficial time to introduce hands-on training with a patient simulator is after core background knowledge is learned.

Simulation is supported by literature to be an effective form of learning through active learning (Burns et al., 2010; Buykx et al., 2012; Gordon et al., 2001; Yaeger et al., 2004). However, the Cognitive Learning Theory (CLT) suggests that working memory is limited to holding five to nine individual elements of information; yet, no more than four concurrent elements can be processed for encoding to long-term memory (van Merrienboer & Sweller, 2010). Elements of information are only maintained for an average of 20 seconds before it is either lost or stored. Students in the IT group were required to deal with 6 to 10 elements during training. As such, elements were lost rather than encoded for later retrieval. Therefore supporting the moderately significant group difference found between the VT and IT group for clinical judgement skills gained.

**Perceived Anxiety Levels**

In the current study, perceived anxiety and performance appear to be inversely related, which is consistent with current literature and theoretical assumptions. High levels of anxiety for the graduate students in the IT group may have interfered with accurate clinical judgment scores. These results are masked by low levels of perceived anxiety for undergraduates within the same group. The source of increased anxiety may be questioned in this study. Were graduate students’ more anxious because of study procedures or because they were being graded? Given that undergraduate volunteers reported significantly lower levels of anxiety, the latter is most
plausible. Regardless of the primary source of anxiety, current simulation literature and results from this investigation support an inverse relationship between performance and anxiety.

Ewing (2015) studied 52 graduate students who were divided into two groups: video simulation trained and in vivo simulation trained. During simulation training students observed clinical markers in either video or in vivo simulation format before post-testing in video format (see Figure 2). Ewing (2015) video recorded participants during training scenarios. While reviewing video recordings of participants in both groups, she noted that many of the participants in the in vivo trained group behaviorally exhibited high levels of stress, whereas participants in video trained group did not exhibit increased levels of stress. Ewing (2015) concluded that increased stress levels may have contributed to group differences on clinical marker identification observed during post-testing. Burns et al. (2010) reported that when a patient simulator began to rapidly decline, participants were more anxious and had a lower situational awareness. The increase of anxiety in the IT group, could have attributed to the overall decrease of clinical judgment scores compared to the VT group.

Lower levels of awareness may impact participants’ ability to attend during a target-learning task. Harrison et al. (2014) reported that during simulation training, increased strain on divided attention reduces the amount of information retrained in long-term memory. Results from the current study anecdotally support these findings. Although the differences between groups in both pre- and post-testing were not statistically significant, students in the VT group focused on the target learning objective through specific video images alone. Students in the IT group learned target concepts in an environment that required them to attend to a minimum of four elements. Participants attended to the monitor, patient simulator, angle of the bottle, and the clinical judgment criteria. As novice learners, salient concepts were not previously encoded into
schemas within long-term memory. Therefore, students in the IT group were unable to rely on previous concepts or procedural knowledge during the learning task. Students in the VT group learned through a focused attention task, therefore, they did not require previous knowledge to encode the new information. Thus suggesting that novice students learn better in an environment in which new information is acquired through focused attention; and divided attention (hands-on-simulation experiences) are more effective for improving clinical skills.

**Clinical Implications**

The video and in vivo simulation training methodologies used in the present investigation improved novice students’ knowledge and ability to identify physiological and behavioral markers of distress, and make appropriate clinical judgments based on their observations during preterm infant bottle feeding scenarios. The information provided in the simulation trainings are fundamental for SLP students who will be practicing in the NICU setting. Identifying the behavioral and physiological clinical markers during bottle feeding can alert caregivers of preterm infants’ decline. The present study supported Ferguson’s et al. (2015) and Ewing’s (2015) findings of simulation training being an effective format for students to learn core knowledge regarding preterm infant development, identification of clinical markers indicative of distress, and make appropriate clinical judgments. Safe oral feeding is not only a requirement for preterm infants to be discharged from the hospital, but it also prevents the risk of aspiration; therefore preventing any type of pulmonary infection (Barlow, 2009; Thach, 2007).

Behavioral and physiological clinical markers of distress are effective indicators provided by the preterm infant to determine their tolerance successful oral intake (Ferguson et al., 2015). Identification of these markers can prevent aspiration from continuously occurring. Results of the current study suggest that using video simulation training for novice learners in ETSU’s SLP
graduate program is an effective pedagogical tool. Given the cost of high fidelity simulators, these results may be used to support a less expensive method of initial training for SLP graduate students, namely video simulation training. Graduate programs that desire to train advanced levels of skills performance may target hand-on performance skills that integrate various levels of attention and clinical judgment though in vivo training. The method of implementation remains open for further study. However, the use of high-fidelity patient simulators to train SLP students in the skill of interpreting preterm infant non-verbal behavior for judging increased risk for aspiration is an effective and safe pedagogical approach. Through patient simulation, students learn new skills without endangering the health of preterm infants.

**Study Limitations**

The following limitations noted in the present investigation may be used to guide future research. One confounding factor that affected participation in scenarios was the technical difficulties with the Premie HAL® patient simulator. These implications resulted in procedural confounds for in vivo training that may have negatively influenced this approach to training. Documentation accuracy may have been affected for the five graduate students in the IT group due to the Premie HAL®’s malfunctioning mid-scenario. Furthermore, because of the technical difficulties, the original training and post-testing schedule had to be modified resulting in different instructors for training. Therefore, undergraduate students recruited as volunteers and were scheduled in small groups to meet with an instructor for in vivo training and in vivo post-testing.

A second limitation was the forced inclusion of undergraduate students observed the prerecorded online PowerPoint® lecture at home, where the environment could not be controlled. The incorporation of undergraduates allowed for an acceptable sample size.
A third limitation was that students were allowed to bring notes from the prerecorded online training to the post-Knowledge Test. This may have inflated the post-Knowledge Test scores. The post-Knowledge Test was also vulnerable to inflated scores because it required students to recall information. Whereas, Clinical Judgment required students to apply and make decisions based on the information learned in training rather than just recall the information. Therefore, Clinical Judgment scores were not vulnerable to inflation and may demonstrate a more accurate example of what was learned by both the VT and IT groups.

**Future Research**

Findings from the present study illustrated significant pre- to post-test increases in both the video simulation training format (VT) and in vivo simulation training format (IT). However, the VT group had higher scores for identification of Clinical Markers and the Knowledge Test, and significantly higher scores for Clinical Judgement. Post-test perceived anxiety levels were lower in students in the VT group. Lower levels of perceived anxiety may be a result of greater confidence in their knowledge because the VT group learned in a focused not divided attention environment.

The CLT suggests unknown limitations when working memory accesses information from long term memory (van Merrienboer & Sweller, 2010). Further research should therefore consider providing students pertinent background information in an online prerecorded lecture format, followed by an interactive practice and review of the information during video simulation training, followed by practicing and post-testing through in vivo simulation.

To more accurately assess students’ perceived anxiety levels, a galvanic skin response (GSR) could be incorporated. A GSR measures an individual’s emotion through electrodermal
activity (Phitayakorn, Mhpe, Minehart, & Pian-Smith, 2015). The use of a GSR could allow researchers to identify if students’ bodies are responding similarly to the students’ perceptions of their body’s reaction. These findings could further support anxiety’s influence on memory and learning.

**Conclusion**

Patient simulation training is an effective means for increasing SLP students’ basic knowledge, clinical judgment skills, and identification of clinical markers of distress in preterm infants during bottle feeding. Simulation training provides students with the opportunity to learn in a safe and controlled environment, in which they can practice skills, make mistakes, and increase their knowledge and clinical judgment skills. Currently, it appears that speech-language pathology graduate programs in general do not provide many opportunities for students to practice simulation training. SLPs working in the medical setting are required to make judgments regarding whether patients can safely orally feeding or not. These judgments require SLPs to simultaneously consider multiple health factors such as heart rate and heart health, aspiration risk, pulmonary health, alternative nutritional options, as well as the patient’s personal values. Inappropriate clinical judgment can result in mild, moderate, or severe health decline of the preterm infant. Simulation technology provides multiple opportunities to practice clinical skills without risking the safety of the patient, as well as increasing the clinical competence of SLP graduate students.
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doi:10.5694/mja10.11474

doi:10.1016/j.nedt.2004.10.004

### APPENDICES

**APPENDIX A**

**Training Scenario Answer Key**

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<th>Category Description</th>
<th>Met Expectation: #1</th>
<th>Pg 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Problem</td>
<td>o No problem; Tolerated feeding well</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reports essential data</td>
<td>Documented ALL the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physiologic NONE</td>
<td>o None required</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral NONE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and</td>
<td>Documented ONE of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>recommendations</td>
<td>o Continue oral feeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends advancing feeding</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action</td>
<td>Documented rationales for recommendations  due to: <strong>Any One</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>in #3</td>
<td>o Tolerated without physiologic decline</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o OFS Level 4: correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o No safe feeding; not distress; breathing normal</td>
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**Total number met = #___________**

<table>
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<th>Pg 11</th>
</tr>
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<td>o Difficulty feeding (any suggestion of problem accepted)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reports essential data</td>
<td>Documented ALL the following:</td>
<td></td>
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<tr>
<td></td>
<td>Physiologic ONE</td>
<td>o Muscle tone changes</td>
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</tr>
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<td></td>
<td>Behavioral ALL</td>
<td>o Drooling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drooling included: # 2 is ___</td>
<td>o Coughing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drooling excluded: # 2 is ___</td>
<td>o Gulping (large/loud swallows – they define it)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and</td>
<td>Documented Both of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>recommendations</td>
<td>o Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action</td>
<td>Documented rationales for hold feeding and recommendations due to: <strong>Any One</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>in #3</td>
<td>o Muscle tone changes, drooling, gulping, or coughing</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Disorganized infant</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o Yes pulmonary health, diff breathing, working to ventilate, respiratory compromise</td>
<td></td>
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</table>

**Total number met #___________ drooling included #___________ drooling excluded**

---

78
<table>
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<td>2</td>
<td>Reports essential data</td>
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</tr>
<tr>
<td></td>
<td>Physiologic ALL</td>
<td>- Desaturation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral ALL</td>
<td>- Drooling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drooling included: # 2 is ___</td>
<td>- Coughing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Drooling excluded: # 2 is ___</td>
<td>- Tachypnea</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>- Documented Both of the following:</td>
<td></td>
</tr>
<tr>
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<td></td>
<td>- Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action in #3</td>
<td>- Documented rationales for hold feeding and recommendations due to: Any One</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Desaturation, drooling, coughing, tachypnea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Global statement of physiologic decline and/or behavioral disorganization</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>- Yes</td>
<td>pulmonary health, diff breathing; working to ventilate; respiratory compromise</td>
</tr>
<tr>
<td></td>
<td>Total number met</td>
<td># __________</td>
<td>drooling included # __________</td>
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<th>Pg 13</th>
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<td>Reports essential data</td>
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<td>Physiologic ALL</td>
<td>- Coughing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral NONE</td>
<td>- Apnea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Color change/cyanosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Desaturation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bradycardia <em>may doc chg in muscle tone not coded</em></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>- Documented Both of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action in #3</td>
<td>- Documented rationales for hold feeding and recommendations due to: Any One</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Coughing, color change/cyanosis, desaturation, bradycardia or global statement of physiologic decline, infant experienced unstable vital signs,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>- Yes</td>
<td>pulmonary health, diff breathing; working to ventilate; respiratory compromise</td>
</tr>
<tr>
<td></td>
<td>Total number met</td>
<td># __________</td>
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## APPENDIX B

### Pre- and Post-Test Scenario Answer Key

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</tr>
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<td>Problem</td>
<td>o Difficulty feeding (any suggestion of problem accepted)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Reports essential data</td>
<td>Documented ALL the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physiologic ALL</td>
<td>o Desaturation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral NONE</td>
<td>o Bradycardia (may doc chg muscle activity but not code)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>Documented Both of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
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</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action in #3</td>
<td>Documented rationales for hold feeding and recommendations due to: <strong>Any One</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o desaturation, bradycardia or global statement of physiologic decline, infant experienced unstable vital signs,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o Yes: pulmonary health, diff breathing: working to ventilate; respiratory compromise</td>
<td></td>
</tr>
<tr>
<td>Total number met =</td>
<td>#</td>
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<tr>
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<td>o Difficulty feeding (any suggestion of problem accepted)</td>
<td></td>
</tr>
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<td>Reports essential data</td>
<td>Documented ALL the following:</td>
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</tr>
<tr>
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<td>o Coughing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral NONE</td>
<td>o Apnea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Color change/cyanosis</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Desaturation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Bradycardia <em>may doc chg in muscle tone not coded</em></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>Documented Both of the following:</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>o Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action in #3</td>
<td>Documented rationales for hold feeding and recommendations due to: <strong>Any One</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Coughing, color change/cyanosis, desaturation, bradycardia or global statement of physiologic decline, infant experienced unstable vital signs,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o Yes: pulmonary health, diff breathing: working to ventilate; respiratory compromise</td>
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</tr>
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<td>Total number met</td>
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80
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<td>Reports essential data</td>
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<td>Physiologic ALL</td>
<td>o Desaturation</td>
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<tr>
<td></td>
<td>Behavioral NONE</td>
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</tr>
<tr>
<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>Documented ONE of the following:</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Continue oral feeding with caution</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends some technique to compensate for mild desaturation</td>
<td></td>
</tr>
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<td>Provides rationale to support action in #3</td>
<td>Documented rationales recommendations due to: Any One</td>
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<tr>
<td></td>
<td></td>
<td>o Desaturation OR treatment suggested: pacing, change position to compensate for mild desaturation etc</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>o OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o No (no distress; ok to say yes if relate to desaturation)</td>
<td></td>
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<td>Physiologic ONE</td>
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<td></td>
<td>Behavioral ALL</td>
<td>o Drooling</td>
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<td></td>
<td>Drooling included: # 2 is _____</td>
<td>o Tachypnea</td>
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</tr>
<tr>
<td></td>
<td>Drooling excluded: # 2 is _____</td>
<td>o Gulping (large/loud swallows – they define it)</td>
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</tr>
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<td>3</td>
<td>Initiates intervention and recommendations</td>
<td>Documented Both of the following:</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>o Stop oral feeding: hold oral feeding, tube feed remaining volume</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Recommends feeding and swallowing evaluation consult, OT, SLP, MBS</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Provides rationale to support action in #3</td>
<td>Documented rationales for hold feeding and recommendations due to: Any One</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Muscle tone changes, drooling, gulping, or tachypnea</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Disorganized infant</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>o Therapeutic intervention to compensate</td>
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</tr>
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<td></td>
<td></td>
<td>o OFS Level is correct</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Aspiration possible</td>
<td>o Yes (pulmonary health, diff breathing working to ventilate respiratory compromise)</td>
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Total number met = #________ drooling included #________ drooling excluded
APPENDIX C

Knowledge Test and Answer Key

Name __________________________

Pre-/Post-Test

Knowledge Test Questions for pre/post-test conditions

1. Airway protection in premature infants is primarily a function of the _______.
   A. Laryngeal chemoreflex (LCR)
   B. Cough Reflex
   C. Irritant Reflex
   D. Laryngeal-Cough Reflex
   E. I do not know

2. When a preterm infant’s heart rate decreases below _______ beats per minute the infant has experienced bradycardia.
   A. 120
   B. 110
   C. 100
   D. 90
   E. I do not know

3. In infants the cough reflex develops at ____ weeks gestation.
   A. 32 weeks
   B. 36 weeks
   C. 40 weeks
   D. 44 weeks
   E. I do not know

4. Premature infants may have extreme responses to airway protection reflexes, which can be observed in non-verbal behavior. List three extreme responses that may occur when airway protection reflexes are triggered in premature infants. Prolonged apnea, bradycardia, desaturation, color change, cyanosis, tachypnea, or coughing.

5. When a preterm infant’s oxygen desaturation decreases below _______ SP02 during bottle feeding the infant has experienced desaturation.
   A. 92%
   B. 90%
   C. 85%
   D. 95%
   E. I do not know

6. Disorganization may precede aspiration during bottle feeding. List three behavioral clinical markers that indicate an infant is disorganized. shut-down, drooling, gulping, change in muscle tone, grunting, finger splay, arching, hyper-alert, gaze aversion, slack jaw, sighing, regurgitation, worried face, tongue protrusion, yawn, flaccidity, startle, eyes closed, facial grimace, limb extension, mottled or cyanotic, apnea, bradycardia, rapid heart, or respiratory rate.

7. List three disengagement cues an infant displays when they are not ready to feed orally. Grunting, finger splay, arching, hyper-alert, gaze aversion, slack jaw, sighing, regurgitation, worried face, tongue protrusion, yawn, flaccidity, startle, eyes closed, facial grimace, limb extension, mottled or cyanotic, apnea, bradycardia, rapid heart, or respiratory rate.

8. The brain and sensory organs, along with their neural connectivities, are highly influenced by___________. Environment.


10. Coordination of sucking, swallowing, and breathing matures at _____ weeks gestation. 37.
APPENDIX D

Clinical Judgment Checklist

Name: ________________________ E#: _____________________ Pre-/Post-test Scenarios

Scenario K (#3)

<table>
<thead>
<tr>
<th>Medical History</th>
<th>Feeding Performance</th>
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<tbody>
<tr>
<td>Birth Gestation</td>
<td>31 weeks</td>
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<tr>
<td>Birth Weight</td>
<td>2030 gms</td>
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<td>DX</td>
<td>Prematurity, BPD, PDA, &amp; Reflux</td>
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<tr>
<td>Current Gestation</td>
<td>36 weeks</td>
</tr>
<tr>
<td></td>
<td>Infant drank 5 minutes</td>
</tr>
<tr>
<td></td>
<td>Duration of feeding minutes</td>
</tr>
</tbody>
</table>

Documentation of Clinical Judgment

Problem:

- [ ] Yes
- [ ] No
- [ ] I don’t know

Etiology:

- [ ] Prematurity
- [ ] Bronchopulmonary Dysplasia
- [ ] Patent Ductus Arteriosus
- [ ] Reflux
- [ ] Interventricular Hemorrhage
- [ ] Necrotizing Enterocolitis
- [ ] I don’t know

Signs and Symptoms:

- [ ] Desaturation
- [ ] Apnea
- [ ] Tachypnea
- [ ] Cyanosis
- [ ] Coughing
- [ ] Bradycardia
- [ ] Gulping
- [ ] Drooling
- [ ] Change in Muscle Tone
- [ ] I don’t know

Aspiration Risk:

- [ ] Yes
- [ ] No
- [ ] I don’t know

Recommendation:

- [ ] Continue Feeding
- [ ] Discontinue Feeding
- [ ] Modify Feeding
- [ ] Complete Modified Barium Swallow
- [ ] I don’t know

Anxiety Rating

0 = Completely Relaxed 1 = Calm 2 = Uneasy 3 = On Edge 4 = Insecure 5 = Tense 6 = Nervous 7 = Anxious 8 = Stressed 9 = Shaky 10 = Panicked
Scenario L (#4)

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<tbody>
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<td>26 weeks</td>
</tr>
<tr>
<td>Birth Weight</td>
<td>980 gms</td>
</tr>
<tr>
<td>DX</td>
<td>Prematurity, IVH-II, &amp; BPD</td>
</tr>
<tr>
<td>Current Gestation</td>
<td>34 weeks</td>
</tr>
<tr>
<td>MD Prescribe Volume</td>
<td>35 ml</td>
</tr>
<tr>
<td>Infant drank 5 minutes</td>
<td>2 ml</td>
</tr>
<tr>
<td>Infant drank total (ml)</td>
<td>8 ml</td>
</tr>
<tr>
<td>Duration of feeding</td>
<td>15</td>
</tr>
</tbody>
</table>

Documentation of Clinical Judgment

Problem:
- [ ] Yes
- [ ] No
- [ ] I don’t know

Etiology:
- [ ] Prematurity
- [ ] Bronchopulmonary Dysplasia
- [ ] Patent Ductus Arteriosus
- [ ] Reflux
- [ ] Interventricular Hemorrhage
- [ ] Necrotizing Enterocolitis
- [ ] I don’t know

Signs and Symptoms:
- [ ] Desaturation
- [ ] Apnea
- [ ] Tachypnea
- [ ] Cyanosis
- [ ] Coughing
- [ ] Bradycardia
- [ ] Gulping
- [ ] Drooling
- [ ] Change in Muscle Tone
- [ ] I don’t know

Aspiration Risk:
- [ ] Yes
- [ ] No
- [ ] I don’t know

Recommendation:
- [ ] Continue Feeding
- [ ] Discontinue Feeding
- [ ] Modify Feeding
- [ ] Complete Modified Barium Swallow
- [ ] I don’t know

Anxiety Rating

Scenario J (#2)

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<td>Birth Weight</td>
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<td>35 weeks</td>
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<tr>
<td>MD Prescribe Volume (ml)</td>
<td>45 ml</td>
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<td>Infant drank 5 minutes</td>
<td>15 ml</td>
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<td>Infant drank total (ml)</td>
<td>30 ml</td>
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<tr>
<td>Duration of feeding minutes</td>
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</tbody>
</table>

Documentation of Clinical Judgment

Problem:
- [ ] Yes
- [ ] No
- [ ] I don’t know

Etiology:
- [ ] Prematurity
- [ ] Bronchopulmonary Dysplasia
- [ ] Patent Ductus Arteriosus
- [ ] Reflux
- [ ] Interventricular Hemorrhage
- [ ] Necrotizing Enterocolitis
- [ ] I don’t know

Signs and Symptoms:
- [ ] Desaturation
- [ ] Apnea
- [ ] Tachypnea
- [ ] Cyanosis
- [ ] Coughing
- [ ] Bradycardia
- [ ] Gulping
- [ ] Drooling
- [ ] Change in Muscle Tone
- [ ] I don’t know

Aspiration Risk:
- [ ] Yes
- [ ] No
- [ ] I don’t know

Recommendation:
- [ ] Continue Feeding
- [ ] Discontinue Feeding
- [ ] Modify Feeding
- [ ] Complete Modified Barium Swallow
- [ ] I don’t know

Anxiety Rating

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Scenario P (#8)

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<td>Birth Weight</td>
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<tr>
<td>MD Prescribe Volume (ml)</td>
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<td>Duration of feeding minutes</td>
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Documentation of Clinical Judgment

Problem:
- Yes
- No
- I don’t know

Etiology:
- Prematurity
- Bronchopulmonary Dysplasia
- Patent Ductus Arteriosus
- Reflux
- Interventricular Hemorrhage
- Necrotizing Enterocolitis
- I don’t know

Signs and Symptoms:
- Desaturation
- Apnea
- Tachypnea
- Cyanosis
- Coughing
- Bradycardia
- Gulping
- Drooling
- Change in Muscle Tone
- I don’t know

Aspiration Risk:
- Yes
- No
- I don’t know

Recommendation:
- Continue Feeding
- Discontinue Feeding
- Modify Feeding
- Complete Modified Barium Swallow
- I don’t know

Anxiety Rating

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Name:____________________________E#:_____________________ Training Scenarios

Scenario I (#1)

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<tbody>
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<td>Birth Gestation 28 Weeks</td>
<td>MD Prescribe Volume (ml) 20 ml</td>
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<td>Birth Weight 1200 gms</td>
<td>Infant drank 5 minutes 8 ml</td>
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<td>DX Prematurity</td>
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<td>Current Gestation 34 Weeks</td>
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Documentation of Clinical Judgment

Problem:

☐ Yes  ☐ No  ☐ I don’t know

Etiology:

☐ Prematurity
☐ Bronchopulmonary Dysplasia
☐ Patent Ductus Arteriosus
☐ Reflux

☐ Interventricular Hemorrhage
☐ Necrotizing Enterocolitis
☐ I don’t know

Signs and Symptoms:

☐ Desaturation
☐ Apnea
☐ Tachypnea
☐ Cyanosis
☐ Coughing
☐ Bradycardia

☐ Gulping
☐ Drooling
☐ Change in Muscle Tone
☐ I don’t know

Aspiration Risk:

☐ Yes  ☐ No  ☐ I don’t know

Recommendation:

☐ Continue Feeding
☐ Discontinue Feeding
☐ Modify Feeding

☐ Complete Modified Barium Swallow
☐ I don’t know

Anxiety Rating

0 Completely Relaxed
1 Calm
2 Uneasy
3 On Edge
4 Insecure
5 Tense
6 Nervous
7 Anxious
8 Stressed
9 Shaky
10 Panicked
Scenario M (#5)

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<td>MD Prescribe Volume (ml) 15 mls</td>
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<td>Infant drank</td>
<td>Infant drank 5 minutes 2 mls</td>
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<td>Infant drank total</td>
<td>Infant drank total (ml) 15 mls</td>
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<td>Duration of feeding</td>
<td>Duration of feeding minutes 10 minutes</td>
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Documentation of Clinical Judgment

Problem:

☐ Yes         ☐ No         ☐ I don’t know

Etiology:

☐ Prematurity            ☐ Interventricular Hemorrhage
☐ Bronchopulmonary Dysplasia ☐ Necrotizing Enterocolitis
☐ Patent Ductus Arteriosus ☐ I don’t know
☐ Reflux

Signs and Symptoms:

☐ Desaturation          ☐ Gulping
☐ Apnea                 ☐ Drooling
☐ Tachypnea             ☐ Change in Muscle Tone
☐ Cyanosis              ☐ I don’t know
☐ Coughing              ☐ Bradycardia
☐ Bradycardia

Aspiration Risk:

☐ Yes         ☐ No         ☐ I don’t know

Recommendation:

☐ Continue Feeding       ☐ Complete Modified Barium Swallow
☐ Discontinue Feeding    ☐ I don’t know
☐ Modify Feeding

Anxiety Rating

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Scenario N (#6)

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<td>Birth Weight</td>
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<tr>
<td>Current Gestation</td>
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<tr>
<td>MD Prescribe Volume (ml)</td>
<td>15 mls</td>
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<tr>
<td>Infant drank 5 minutes</td>
<td>9 mls</td>
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<tr>
<td>Infant drank total (ml)</td>
<td>9 mls</td>
</tr>
<tr>
<td>Duration of feeding minutes</td>
<td>15 minutes</td>
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Documentation of Clinical Judgment

Problem:

☐ Yes  ☐ No  ☐ I don’t know

Etiology:

☐ Prematurity
☐ Bronchopulmonary Dysplasia
☐ Patent Ductus Arteriosus
☐ Reflux
☐ Interventricular Hemorrhage
☐ Necrotizing Enterocolitis
☐ I don’t know

Signs and Symptoms:

☐ Desaturation
☐ Apnea
☐ Tachypnea
☐ Cyanosis
☐ Coughing
☐ Bradycardia
☐ Gulping
☐ Drooling
☐ Change in Muscle Tone
☐ I don’t know

Aspiration Risk:

☐ Yes  ☐ No  ☐ I don’t know

Recommendation:

☐ Continue Feeding
☐ Discontinue Feeding
☐ Modify Feeding
☐ Complete Modified Barium Swallow
☐ I don’t know

Anxiety Rating

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### Scenario L (#4)

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<tr>
<td>Birth Weight</td>
<td>Infant drank 5 minutes</td>
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<tr>
<td>980 gms</td>
<td>2 ml</td>
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<tr>
<td>DX</td>
<td>Infant drank total (ml)</td>
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<td>Prematurity, IVH-II, &amp; BPD</td>
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</tr>
<tr>
<td>Current Gestation</td>
<td>Duration of feeding minutes</td>
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<tr>
<td>34 weeks</td>
<td>15</td>
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**Documentation of Clinical Judgment**

**Problem:**
- Yes
- No
- I don’t know

**Etiology:**
- Prematurity
- Bronchopulmonary Dysplasia
- Patent Ductus Arteriosus
- Reflux
- Interventricular Hemorrhage
- Necrotizing Enterocolitis
- I don’t know

**Signs and Symptoms:**
- Desaturation
- Apnea
- Tachypnea
- Cyanosis
- Coughing
- Bradycardia
- Gulping
- Drooling
- Change in Muscle Tone
- I don’t know

**Aspiration Risk:**
- Yes
- No
- I don’t know

**Recommendation:**
- Continue Feeding
- Discontinue Feeding
- Modify Feeding
- Complete Modified Barium Swallow
- I don’t know

**Anxiety Rating**

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<td>Tense</td>
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VITA

EMILY WAGNER

Education: Hammonton High School, Hammonton, New Jersey

B.S. Speech Language Pathology and Audiology, Stockton University, Galloway, New Jersey 2014

M.S. Speech Language Pathology, East Tennessee State University, Johnson City, Tennessee 2016

Professional Experience: Graduate Assistant, East Tennessee State University, 2014-2016

Graduate Clinician, East Tennessee State University, 2014-2016

Honors and Awards: FIPSE Graduate Fellow, East Tennessee State University, 2014-2015