The Efficacy of a Gamification Platform on the Professional Development of Different Generations of Critical Care Nurses

By

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The Efficacy of a Gamification Platform on the Professional Development of Different
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Ongoing professional educational needs for critical care nurses in the modern critical care environment are at an all-time high. Patient acuity and technology have significantly increased, while resources for critical care has decreased (Nates et al., 2016). Professional development activities are poorly attended, costly, and have uncertain outcomes (Viljoen, Coetzee, & Heyns, 2017). The goal of this quantitative, retrospective, comparative project was to evaluate the efficacy of a brief, online, spaced learning, education platform (Qstream) as an option for the professional development of critical care nurses. This project was explicitly designed to identify if the age of the nurse affects their engagement and competency scores. Qscores are analytics automatically calculated by the Qstream learning management device that reflects competency and engagement. The advanced statistical analysis sought to find a relationship between Qscores and the age of the participants. Institutional Review Board (IRB) approval was obtained from both the study institution and American Sentinel University before beginning any data collection.

The significant finding for this project was Qstream competency and engagement were not affected by the age of the nurse ($F (2, 115) = .62, p = .539$). The average participant gain in competency was 24%. A significant education cost savings were noted ($46,900 in 2018$) as compared with didactic or online modules educational platforms. In conclusion, Qstream is an effective platform for the professional development of all generations of bedside nurses.
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SECTION I: INTRODUCTION

Nurses are the largest providers of healthcare and are a symbol of trust to the American public. Nursing has ranked as the most trusted occupation in America for the past fifteen years (American Nurses Association, 2016). This reputation demands excellence in nursing practice to optimize patient outcomes. However, excellence is not easily achieved in the current healthcare environment.

Several factors play a role in preventing organizations from achieving practice excellence. First, the workload has increased significantly, for the bedside registered nurses working in the acute care setting, due to increasing patient acuity, electronic charting, and quality measures (Higgins et al., 2017). The current nursing shortages have resulted in bedside intensive care nurses being younger and less experienced (Galletta, Portuguese, Mereu, & Contu, 2016). Administration scrutinizes financial budgets that include nursing staffing and daily productivity. Quality care demands have made nursing responsible for falls, infections, and pressure ulcers (American Nurses Association, 2016). Finally, a complex clinical environment with rapidly changing clinical guidelines and increased technology has created a need for ongoing professional development needs for critical care nurses.

Innovative solutions are vital to providing excellence in care and overcome the barriers of the current practice environment. Critical care nurses work at the bedside to prevent adverse events from harming patients. Therefore, leveraging technology that can strengthen the knowledge base of the nurse will enhance the human factors aspect of the safety surveillance process of the error recovery process (Henneman, 2017). The innovative solutions must also be applied to nursing education methodology in an acute care setting. Methods have historically
been didactic, skill fair based, online modules, or even simulation. These learning methods are effective; however; they require a considerable time commitment, which translates into increased financial burdens.

As our healthcare environment continues to rise in complexity, nurse educators are struggling to maintain the nursing competency required for safe patient care in an effective and financially responsible way. Highly technical, lifesaving modalities require critical care nurses to stay relevant. Didactic presentations involve passive learning and do not evaluate the learning outcomes of individuals. Participants listen but may not comprehend the information. Often in these situations, retention is assumed but not measured. Waste is also noted as expert staff endures hours of mandatory yearly training for skills they already possess and demonstrate clinically daily to meet increased regulatory requirements require documentation of metrics to validate staff knowledge. “Nursing readiness for practice and competence is a topic that strikes at the core of quality patient outcomes and the patient’s perception of care; each affecting criteria for payer reimbursement” (Martin & LaVigne, 2016, p.26).

No group of nurses illustrates these internal factors better than the critical care nurses who treat the sickest patients in the United States healthcare system. Over five and a half million patients require intensive care annually (Cox & Schallom, 2017). Historically, novice nurses were forbidden to practice in critical care units due to the high patient acuity. However, due to the current nursing shortages, bedside intensive care nurses are younger and are less experienced. This dynamic is forcing the inexperienced nurse to be at the bedside of the sickest of our population. Understanding the complexity of the current nursing practice environment has led to the search for a solution. In this project, the writer will evaluate an online, brief, spaced learning
platform, (Qstream), as an innovative educational solution for critical care nurses in the acute care setting. This platform is aimed at establishing competence, excellence in the delivery of care, in an efficient, effective, and fiscally accountable manner.

The Qstream platform is based on the spaced learning retrieval and is an effective strategy to assist cognitively impaired elderly patients in preserving memory. Through frequent short exposure to content, short-term memories become long-term memories (Han et al., 2017). Repetition, of material in spaced intervals, is preferable to achieving long-term retention. The biochemical makeup of humans predisposes spaced learning to be an effective strategy (Smolen, Zhang, & Byrne, 2016).

Too often in the professional development of nurses, a mass effect provides an education bolus. The information presented is too much, too fast without individualization to the current knowledge of the learner. Current critical care nursing professional development modalities lack knowledge retention strategies. Qstream is an innovative technology that maximizes the effects of education through spaced learning techniques and active learning. Qstream addresses both the internal and external perspectives of the contemporary issues which are facing inpatient professional development professionals.

The outcomes of this innovative platform were evaluated across different generations of critical care nurses to assess trends in proficiency and engagement scores. This author will identify trans-generational solutions to competency and proficiency problems facing today’s critical care nurses. Nursing leaders will find value in predicting the effects of a gaming platform on all generations of nurses.
This project evaluated an online, brief, spaced learning platform as an innovative educational solution for critical care nurses in the acute care setting. Division of this study is three sections. This writer will define the need for innovative interventions for the education of bedside nurses, the significance/nature of the problem, background, literature review, and describe the theoretical framework of the United Theory of Technology Acceptance (UTAUT) in Section I. The study’s evaluation design, sample population, setting, and instrumentation will be outlined in Section II. Finally, in Section III, the writer will discuss the outcomes of the program evaluation describing any future implications for nursing practice.

**Background of the Problem**

Contemporary issues affecting the professional development of critical care nurses involve both external and internal factors. Internal perspectives identified in the literature as influencing nursing competency are generational learning preferences, dynamic practice environments, and the work-life balance of the nurses. External perspectives recognized in research include accreditation requirements, safety/quality issues, and the healthcare technology boom.

**Internal Factors**

Internal factors that influence the professional development of critical care nurses can often not be influenced by nursing leaders. Recognition of the significance of the following internal factors can assist nursing leaders in creating innovative learning platforms to meet the needs of bedside nurses.

**Generational learning preferences.** Educational preferences in nurses have generational differences. As opposed to older generations of nurses who are content with
traditional classroom presentations, millennials present challenges for educators to capture and retain their attention. Millennials prefer active learning modalities with immediate feedback (Montenery et al., 2013). The millennial generation enjoys constant feedback and instant results. Communication platforms that are the flexible and instant appeal to this subset of nurses (Diesing, 2016).

**Changing practice environment.** A dynamic practice environment is another confounding variable as the current rate of quality improvement literature moves the target of evidence-based practice, increasing the need for ongoing staff education (Numminen et al., 2014). Due to the volume of information, competency establishment and maintenance is a constant challenge for professional development specialists, and current methods are wrought with pitfalls and complications. This study’s site hospital requires 20 online modules for the 2018 annual education for all nurses. The education time equates to eight hours for the average nurse. Yearly critical care competencies for critical care nurses at the study hospital are more than 30 per year. The number of competencies does not include any training on new products, protocols, order sets, and changes in evidence-based practices. This exhaustive list demonstrates a need to streamline education, clearly document learning outcomes, and space education to maximize retention.

Adding to the increased required competency load for nurses, the acuity of patients has risen. Patients that would have died 20 years ago are living with advanced bedside technologies (Montgomery, Grocott, & Mythen, 2017). Mastering the safe use of this technology requires time and experience to master. In addition to extensive initial training, periodic education updates are necessary for updates in evidence-based practice and technology.
**Work life balance.** Work-life balance is an essential component of retaining nurses (Rushton, C., Batcheller, J., Schroeder, K., & Donohue, J., 2015). Nurses are expected to attend mandatory in-services after their twelve-hour shift, come in on their day off, and complete mandatory online modules at home. The flexibility of online learning permits personal life convenience but also requires accountability. Critical Care nurses do not consistently attend formal in-services during their shifts or on their days off (Viljoen, M., Coetzee, I., & Heynes, T. 2017). Unit productivity metrics do not traditional permit for significant non-productive on-shift education.

**External Factors**

External factors affecting the professional development of nurses often change frequently. The nursing professional development specialists need to understand these factors to plan for the competency needs of bedside nurses.

**Accreditation requirements.** Accreditation agencies are organizations designed to create standards to keep patients safe. If hospitals do not meet accreditation standards, their reputation suffers, and patient volume is at risk. Consistent violations can result in hospital closures, which decreases patients’ access to healthcare. The Joint Commission (TJC) and Centers for Medicare Services (CMS) inspect hospitals and influence the degree of reimbursement if standards of care are not met. Also, specialty programs such as trauma, bariatrics, and chest pain all require specific annual learning objectives to keep programs established. The Occupational Safety and Health Organization and The Centers for Disease Control mandate yearly training for hospital staff. Blood bank and laboratory designation requires yearly training (The Joint Commission, 2018).
Quality/safety metrics. Quality metrics have changed bedside practice by identifying all hospital-acquired events as failures. While quality initiatives improve patient care and outcomes, they require significant educational support and personal expertise to inform frontline-caregivers of constantly changing standards. Quality initiative targets are generated from data collecting sources such as hospital-acquired infections, sentinel events, and weak performance metrics. Improvement plans often include staff education and competency documentation. Loop closure from the root cause analysis of an adverse event must be demonstrated. Long, online learning modules are the typical educational solution selected for these situations, but as previously mentioned, nursing staff report dissatisfaction with online learning modules due to the lack of engagement and passive learning.

Healthcare technology boom. Technology has exploded in healthcare, and bedside nurses are practicing far differently than the past decade. Nurses have less time for on-shift education due to the increased demands of the electronic medical record (EHR). Higgins et al. (2017) shadowed 79 nurses on four inpatient units and found “nurses spend an average of 33% of a shift interacting with technology including time in the EHR” (p. 212). Increased time looking into a computer, limits face-to-face patient interactions and care activities such as medication administration. “Macro-level analysis revealed that indirect care constituted approximately 58% of the nurses’ work, whereas direct patient care comprised only 22% of a 12-hour shift” (Higgins et al., 2017, p. 212). An innovative, short professional development platform such as Qstream provides nurses with more time to spend with bedside nursing care.

Despite the increased workload of electronic medical records, nurses have embraced another form of technology--online learning. Karaman (2011) used a survey method quantitative
study to reveal perception levels and relationship with online learning among a sample of 1041 Registered Nurses. Nurses who had the highest computer usage were the most positive about online learning. The nurses’ perceptions of online programs were not affected by their ages or lengths of working experiences. The difference between attitudes of nurses living in urban areas and those living in rural areas was not significant (Karaman, 2011). In today’s era of electronic medical records, all practicing bedside nurses use computers on a daily basis and should embrace online learning platforms. This study will examine if nurses of all generations will accept a gamification-learning platform as a professional development strategy.

**Current Educational Strategies.** In addition to the internal and external barriers to successful competency and proficiency management, education needs require prioritization to prevent overload and burnout. This prioritization requires critical thinking and communication of the clinical nurse leaders and be delivered in an efficient and inventive manner. Beginning with an education decision matrix that provides a structure to rank educational needs can assist with choosing the appropriate modality. Examples of these needs include mandatory, didactic, safety huddle information, or online modules.

Historically, documentation of one hundred percent completion of a learning module, class, skills fair, or checklist fulfills an education need (Martin & LaVigne, 2016, p. 32). Skills fairs are the venue of choice to achieve full documentation compliance to complete the nursing staffs’ education records. Skills fairs create passive learning experiences with little interaction and understanding. Furthermore, costs associated with the skills fair approach are high, with a large number of salary educators necessary to man stations, equipment, and staff nurse time.
Online modules have been another learning modality that attempts to achieve 100% compliance. However, these methods cannot customize learning experiences to individual learners, and present to novice, advanced beginners, and proficient nurses all the same even though their pre-existing knowledge levels are all different. The lack of customization does not intellectually stimulate expert staff and stifles professional growth.

The professional development of critical care nurses is a dynamic issue with both internal and external implications. Nursing leaders need to recognize these factors to develop a comprehensive education plan to meet the needs of bedside nurses. This study will examine a platform called Qstream and will seek to determine if the innovative platform is a viable solution for the professional development of critical care nurses.

**Review and Summary of Relevant Literature**

This project assessed the efficacy of a unique educational platform for the professional development of critical care nurses. The presence of generational differences in the acceptance of new technology was explored. Engagement and proficiency scores were monitored and compared across different generations of critical care nurses.

The reason for the study is to seek a solution to meet the vast educational needs of bedside critical care nurses. Due to the boom in life-saving technology, the patients are sicker than ever. Regulatory and quality metrics requirements are growing. Required competencies are very expensive. Financial stewardship is an essential competency for nursing leaders. The cost of a one-hour live didactic training in the hospital is “$35.03 per nurse with online learning $32.78 per hour” (Opperman, Liebig, Bowling, Johnson, & Harper, 2016, p. 178). The short
nature of the Qstream platform allows completion during shift. A reduction in non-productive time decreases costs and gives nurses time to provide quality care.

The literature review involved searching the databases CINAHL, ProQuest, and OVID. Keywords searched included: Critical Care Nurses, Generational Differences in Education, Generational Learning Preferences, Generations and Nursing, Generations and Technology, Nursing Professional Development, Higher Education and Nursing, Technostress, Electronic Health Records, Social Media and Nursing, Critical Thinking and Nursing, Donation after Cardiac Death, Nursing and Technology, Spaced Education, Nursing Education in Critical Care, Competency, Gamification, and Organ Donation. Limiters on the research included: English language, peer-reviewed, and full text. The literature search was conducted from September 2017 until August 2018.

**Population**

Critical care nurses treat the sickest patients in the United States healthcare system. Over five and a half million patients require intensive care annually (Cox & Shalom, 2017). Patient acuity has risen over the past twenty years due to increased lifespan, chronic illnesses, and innovative increases in life-saving technology. The American public holds nurses in the highest standing of all professionals (American Nurses Association, 2016). In addition to extensive initial training, periodic education updates are necessary for changes in technology, clinical practice, and accreditation standards.

**Retention of nurses.** Retention of experienced critical care nurses is a priority for nursing leaders. The national statistics concerning the nursing shortage are sobering. The nursing shortage is compounded by increased demands for positions, high turnover rates, and the
aging nursing workforce. The American Nurses Association (ANA) (2018) stated there would be more registered nurse jobs available by 2022 than any other profession in America with 1.1 million additional nurses needed to support the health system (American Nurses Association 2018; US Bureau of Labor Statistics, 2018). One-third of the nursing workforce will retire in the next 10-15 years (Haddad & Toney-Butler, 2018). Nursing schools are unable to meet the hospitals’ demands for nurses. In 2017, nursing schools rejected over 56,000 qualified applicants from undergraduate nursing programs. The lack of nursing faculty and clinical sites are cited in the literature as the primary reasons for schools to limit admission to nursing programs (Knowles, 2018).

Nursing turnover rates reflect the strength of nursing leadership. The national turnover rate for bedside acute care nurses is 9% to 37% (Nursing Solutions, 2016). The current hospital vacancy rate for registered nurses is 8% with an average recruiting time of five to 108 days. The total turnover cost of $38,000 to $61,100 per bedside nurse (Nursing Solutions, 2016). These significant costs make nursing retention a priority for hospitals.

Work-life balance is an essential component to retaining nurses (Rushton et al., 2015). Nurses are required to attend mandatory in-services after their twelve-hour shift, come in on their day off, and complete mandatory online modules. The critical care setting in this study only recently allowed nurses to complete online at home. Nurses were required to drive in from home to clock in and take online modules.

Challenges in professional development. The literature review produced only two studies that focused on the challenges in the professional development of critical care nurses. Despite high regard for their competence, critical care nurses have significant professional
development needs. Mandatory in-services have served as the gold standard of professional development because critical care nurses do not consistently attend formal in-services during their shifts or on their days off (Viljoen et al., 2017).

The unit productivity of patients does not permit significant on-shift education. Viljoen et al. (2017) found nursing attitudes towards mandatory in-services were influenced by poor communication of class logistics, too many professional development activities, time constraints, and financial implications. Family responsibilities and burnout prevent nurses from attending formal education. Child and eldercare have financial implications. Firm start and stop times for in-person training classes prevent rejuvenation of being away from the hospital. Effective communication of class days, times, and locations must be completed far in advance before work schedules are developed (Viljoen et al., 2017).

Higgins et al. (2017) examined the impact of the electronic health record on the frontline nurse in the hospital. Seventy-nine nurses were shadowed by nursing student observers to document nursing activities and durations across four units. The sample of nurses was similar across the units with a mean RN experience level of 5.6 years. The observers collected more than 900 hours of observations and documented 35,000 activities. Nurses reviewing and documenting in the electronic health record was the most common activity at 21% of a shift. As a comparison, patient assessment and interaction was 9% of a nurse’s shift. Interestingly, nurses’ perceptions of activities were not consistent with reality. The nurses perceived spending considerably more time in direct care activities (52%, p<.0001) than the actual 22% of their shift (Higgins et al., 2017). This study illustrates the changing landscape the electronic medical record
Intervention

The review of literature produced many articles pertaining to innovative educational techniques. Gamification, social media, smartphone applications, and spaced learning successfully enhanced learning. Themes surrounding innovative learning include learner-paced curriculum, interactive platforms that mimic with popular online entertainment, and instant results.

Gamification. Gamification is an innovative educational technique that is gaining popularity among nursing educators to improve learning, engagement, and satisfaction (Davidson & Candy, 2016; Day-Black, Merrill, Konzelman, Williams, & Hart, 2015). Gaming, as well as simulation, provides a safe learning environment where students feel safe to make mistakes. Seven articles explored the effect of gamification in the education of novice nurses. Common themes included high learner engagement, satisfaction, and knowledge retention.

“Gamification provides learners the ability to learn when they are ready, as opposed to when the educator is ready” (Brull et al., 2016, p. 372). Intrinsic rewards are met when learners earn points, badges, and level up. Participants can recognize when they are progressing through the content. Leaderboards create a fun, competitive atmosphere that promotes engagement. In the smartphone environment, educators need to capitalize on the limited attention span of our busy world (Brull et al., 2016).

Gamification is a rising modality in the education of college nursing students. Two studies successfully demonstrated the efficacy of gamification in nursing students. First-year
nursing students who participated in a knowledge competition had a statistically significant improvement in performance. The competition consisted of multiple-choice questions released weekly or biweekly during two rounds of play. The researchers found a significant increase in correct answers in round two (OR 1.8; 95% CI), which demonstrates improved retention of knowledge. Average daily users of the platform had an increase of 2.5 to more than 10 after the game manager sent a congratulatory email (Roche et al., 2018). This literature supports the power of recognition in engagement.

A quasi-experimental study in nursing orientation divided a 115-convenience sample of nurses into three groups with different educational interventions: didactic, online modules, and gamification. Thirty-four percent of the nurses were new graduates, and 66% possessed more than one year of experience. All three groups took the same pre- and post, multiple-choice exam involving wound management, falls, and pain management. Gamification orientation participants scored the highest and were statistically significant (p<.05) (Brull, Finlayson, Kostelec, MacDonald, Krenzischeck, 2017). Health care is slowly embracing gamification as an instructional technique; however, further research is needed to grow the pedagogy. Patient safety increases through gaming due to the removal of actual patients. Realism is achievable, and the topics are readily applicable to daily practice. Traditional didactic education rarely permits a comprehensive real-life situation that involves decision-making. The active learning of gaming maintains interest and appeals to multiple learning styles such as the visual, kinesthetic, social, solitary, and logical. Instead of providing students with the correct answers, the students take control of their learning and develop problem-solving skills.
In gaming, instant feedback allows students the opportunity to control the speed of their learning experience. Autonomy allows learners to work at a self-paced which meets their needs, not the instructor’s needs. Multiple studies support increased participant satisfaction due to the timely, immediate feedback with active learning (Roche, Wingo, Westfall, Azuero, Dempsey, & Willig, 2018; Davidson & Candy, 2016; Royse & Newton, 2007).

Despite the positive outcomes from gamification, the populations studied in the literature were primarily limited to nursing students and nursing orientees (Brull, Finlayson, Kostelec, MacDonald, Krenzischeck, 2017; Brull et al., 2017; Roche et al., 2018; White & Shellenbarger, 2018). Only one study evaluated gamification as a platform for the professional development of experienced nurses (Ferguson, Hickman, Philips, Newton, Inglis, Lam, & Bajorek, 2018). The omission is surprising due to the high responsibility, learning needs, and public expectations of nurses.

**Social media and smartphone applications.** Engagement is vital to learning. Learning stalls with boredom. Active learner-center education models increase engagement. Three studies focused on the use of social media to educate nurses. The results of the three articles concerning social media and applications were favorable outcomes (Witherspoon, Braunlin, & Kumar, 2016; Ying, 2014; Stephens & Gunther, 2016).

Social media has altered the way society communicates. The Institute of Medicine recommends the utilization of information technologies to improve the delivery of patient-centered care. Ying (2014) reported 94% of nurses indicated that they use social media with less than 1% reporting that they do not know how to use social media. “Social media can be a powerful tool to reach an intended audience quickly and globally” (Ying, 2014, p. 64).
Social media is becoming an established platform for information sharing among nurses. A study among 70 nursing students found “Twitter to be a convenient, cost-effective, and enjoyable means of intervention delivery” (Stephens & Gunther, 2016, p. 23). The subjects were randomly assigned to a control group and an experimental group with protected Twitter accounts. The vast majority of the experimental group rated Twitter favorably as an educational platform (88%) (Stephens & Gunther, 2016).

Witherspoon, Braunlin, and Kumar (2016) found a social media-based module to be a possible learning opportunity to overcome barriers to education in critical care nurses. Eight clinical vignettes were published with discussion strings per case with a mean of 8.3 posts. Over 100 nurses visited the social media pages during the active discussions (Witherspoon, Braunlin, & Kumar, 2016). Qstream’s similarity to social media warrants investigation to determine similar efficacy.

In a world of instant communication, smartphone applications are becoming a vital source of information for bedside nurses. These applications provide a point of care, quick reference to complex information. Educational opportunities via applications provide a novel approach for professional development specialists. Kang & Suh (2018) evaluated the knowledge for diabetes and hypertension among 3rd-year nursing students via an instructional/interactive application. Knowledge of hypertension ($t=4.41, p<.001$) and diabetes ($t=2.45, p<.009$) were significantly improved in the interactive application group (Kang & Suh, 2018).

**Spaced learning techniques.** Qstream utilizes spaced learning theory to present information. Ten studies demonstrated improved learning outcomes through spaced learning. Only two studies used the Qstream platform as their intervention. Spaced learning theory was
proven effective in college students, cognitively impaired patients, and medical residents. One single study validated the efficacy of Qstream for the professional development of critical care nurses (Ferguson, Hickman, Philips, Newton, Inglis, Lam, & Bajorek, 2018).

**College students.** Through frequent short exposure to content, short-term memories become long-term memories (Han et al., 2017). Repetition, of material in spaced intervals, is preferable to achieving long-term retention. The biochemical makeup of humans predisposes spaced learning to be an effective strategy (Smolen, Zhang, & Byrne, 2016). Kelley and Whatson (2013) demonstrated that spaced learning theory in a national Biology curriculum produced significantly higher scores in less time.

Kupper-Tetzel, Kapler, and Wiseheart (2014) examined the optimal retention strategy for 218 college students at York University. Should learning material be repeated at decreasing intervals, constant intervals, or increasing intervals between educational sessions? The material consisted of 28-word pairs with no apparent semantic association with each other. Learning sessions were provided at different time intervals to assess the group’s retention of information. Memory performance was assessed immediately, 24 hours, one week, or 35 days later. The optimal retention of information at 35 days was a decreasing time interval schedule (p=.001) (Kupper-Tetzel, Kapler, & Wiseheart, 2014). This study supports the use of spaced learning techniques to improve knowledge retention.

**Cognitively impaired.** Interestingly, even cognitively impaired patients found spaced retrieval techniques to be effective in memory retention (Han et al., 2017; Vance & Farr, 2007). Han et al. (2017) used an open-label, single-blind randomized, controlled design to evaluate the effects of spaced retrieval training on persons with mild cognitive impairment from Alzheimer’s...
disease or dementia. Fifty patients were randomized into two groups (spaced retrieval and usual care) and were given memory word tests to evaluate recall. The spaced retrieval group had more significant improvements in cognitive testing ($d = 0.49, p = 0.031$) than the usual care group (Han et al., 2017).

Repeatedly stimulating with timed spaces can initiate long-term memory coding to improve knowledge in persons with cognitive impairment (Han et al., 2017; Kelley & Whatson, 2013; Vance & Farr, 2007). Varying the repetition of material improves retention. The documented success of spaced learning techniques in the extreme population of persons with impaired neurologic function would suggest individuals with normal cognition would have even more successful learning outcomes. This research documenting success in the use of spaced learning techniques in individuals with altered cognition justifies evaluation in the average population.

**Medical residents/students.** Kerfoot and Baker (2012) used a randomized control design to examine the effect of online spaced education for medical residents. The same didactic information was presented to the entire group of 731 medical students. One cohort received the whole curriculum via email at a spaced interval following the educational presentation. The second cohort received half of the curriculum immediately following the didactic. Both groups took the same final test. The spaced interval group had improved knowledge retention as evidenced by higher test scores (Median scores baseline 53% vs. 93%). Seventy percent of enrollees (513/731) requested to participate in future SE games. Implications for practice demonstrated that spaced education with clinical scenarios and questions distributed weekly via email could improve students' retention (Kerfoot & Baker, 2012).
In a similar design, Matos et al. (2017) examined spaced education via email with a randomized, self-matched design among medical residents. The researchers divided students into two groups, with one provided reinforced material via email and the other without reinforced material. Both groups took the same test. The reinforced panel had a significantly lower risk of incorrect answers ($RR = 0.83$, $95\% CI$, $0.70\pm0.99$, $p = 0.04$) (Matos, Petri, Mukamal, & Vanka, 2017). The study supports Qstream for knowledge retention in the acute care setting.

Qstream has demonstrated effectiveness as a follow-up educational platform following a continuing medical education session. A randomized control study separated physicians into two groups, one with the Qstream module that sent questions to the participants to reinforce the content and one without. A follow-up behavior survey found the Qstream users reported a significantly more significant change in their global clinical behaviors because of the educational session ($p .013$ to <.001; $d=0.7$). The physicians reported favorably to using Qstream with 86% agreed or strongly agreed that the spaced education application enhanced the impact of the conference (Shaw, Long, Chopra, & Kerfoot, 2011). Throughout multiple study populations, spaced learning theories have proven to be a successful strategy for knowledge retention.

**Nursing.** One current Australian study has evaluated the efficacy of Qstream on the knowledge retention of acute care floor nurses relating to stroke screening. This quasi-experimental study evaluated pre and post-intervention knowledge of the nurses. The entire group took a Qstream module on atrial fibrillation and anticoagulation. The nurses’ knowledge was assessed before and after completion of the module over a period of six weeks. Forty nurses completed both knowledge assessments. A 54% mean improvement in knowledge was found.
with the most significant improvement relating to medication interactions and bleeding risk assessments. Post-intervention, the nurses were significantly more likely to use stroke screening tools (3% vs. 38%) and bleeding tools (3% vs. 35%) to assess stroke and bleeding risk, respectively \( (p<0.01) \) (Ferguson et al., 2018).

**Summary of educational platforms.** Spaced learning techniques have consistently demonstrated success in knowledge retention for nursing students, the cognitively impaired, and medical residents. A spaced learning platform has not been evaluated using the UTAUT framework. While recent studies of gamification in nursing education demonstrated benefit in novice nurses, a gap in the literature still exists inexperienced nurses (Brull et al., 2017; Roche et al., 2018; White & Shellenbarger, 2018). Further research is required to establish best practices in the gamification for the professional development of bedside critical care nurses. This study will fill gaps in the literature regarding the usefulness of Qstream across multi-generations of nurses.

**Comparison**

Generational differences in the acceptance of technology in nurses are the focus of this project.

**Generational differences.** Educational preferences have generational differences. As opposed to older generations of nurses who are content with traditional classroom presentations, millennials present challenges for educators to capture and retain their attention. By the time learners reach 21 years old, they have played 10,000 hours of video games (Brull & Finlayson, 2016, p. 373). Sitting in a classroom listening to lectures cannot compete with the stimulation of video games. Millennials prefer active learning modalities with immediate feedback (Monteney...
et al., 2013). Communication platforms that are the flexible and instant appeal to this subset of nurses (Diesing, 2016).

**Technostress.** Technostress is created when the user is unable to adapt and use the technology in a healthy manner. Tacy, Northam, and Wieck (2016) studied this phenomenon in nurse faculty. This study surveyed 1,161 faculty members with mean ages ranging from 61 to 51 years old. The advanced ages reflect an aging nursing faculty workforce. Tacy, Northam, and Wieck validated the Technology Acceptance Model with the addition of technostress. Technostress was inversely related to all model variables ($R^2 = .80, F(5, 1011) = 815.81, p < .000$). “Findings revealed that technostress undermines job satisfaction and technology use in nurse faculty” (Tacy, Northam, & Wieck, 2016, p. 21).

**Outcome**

The outcome will be a measurement called Qscores. The formula was created by the Qstream Company to communicate metrics to managers. Qscore performance benchmark “is an onboard metric used to rate the capabilities of an individual clinician or team by calculating engagement and performance scores into a single number. Managers can use Qscore to observe relative changes in performance” (Qstream, Inc., 2018). The literature review did not produce any studies that used a Qscores or even any quantitative assessment of engagement in learning.

**Time**

Two similar study designs evaluated the nurses with less than a week of exposure to the intervention. (Brull et al. 2017; Kang & Suh, 2018). Although gamification was an active education strategy, the short time to intervention measurement did not reflect short-term memory. Roche et al. (2018) used seven weeks, which demonstrates longer-term knowledge
acquisition. After evaluating these studies with similar methodologies, a three-month study period was determined to be the ideal timeframe.

**Theoretical Framework**

The Unified Theory of Acceptance and use of Technology (UTAUT) was created after a review of eight different models, which evaluated acceptance to use informational systems (Venkatesh et al., 2003). The UTAUT has significantly outperformed each of the eight individual models establishing a superior theory (Williams, Rana, & Dwivedi, 2015). The UTAUT “theory could explain 69% of the users’ intention to use technology whereas the previous models could explain up to 40% of intention” (Sharifian et al., 2014, p. 24).

The author reviewed 10 articles that used the UTAUT tool and theoretical framework to evaluate the technology. The methodology for all of the studies was survey based. Traditionally survey methodology is weak; however; over 400 articles have established the validity of this tool. UTAUT transcended disciplines, technologies, and was international. The UTAUT theoretical framework reliably predicts the usefulness of technology. The UTAUT has been applied to multiple studies evaluating mobile devices, adoption of social media, and the social influence in the workplace (Koivimaki, Ristola, & Kesti, 2008; Curtis et al., 2010; Eckhardt, Laumer, & Weitzel, 2009). No studies were found evaluated Qstream utilizing UTAUT. This paper will be the first publication, which focuses on the efficacy of Qstream as a professional development platform for nurses.

**Summary**

Several common themes of the literature were evident. The nursing shortage is multifactorial and pervasive. Nursing retention is a priority for nursing leaders. Workload and patient
acuity are rising. Quality initiatives and regulatory requirements have increased. Work-life balance is vital to preventing burnout among bedside critical care nurses. Current educational modalities do not appeal to all learners, do not provide immediate feedback, and are not customizable to individual learners’ abilities.

Generational differences exist in learning preferences. Gamification is a promising technology that is engaging and allows learners to customize their learning experiences. Social media has drastically altered our methods of communication and can be a powerful tool. A current systematic review examining the role of gamification in nursing education identifies a gap in the literature concerning “game mechanics and motivational factors used in education” (Brull, Finlayson, Kostelec, MacDonald, & Krenzischeck, 2017).

Healthcare disciplines prefer an online, gaming environment to learn. Nurses have a positive perception of online learning (X=3.86; SD=.48) (Karaman, 2011). Seventy percent of studied medical students requested to participate in future online, spaced learning games (513/731 enrollees) (Kerfoot et al., 2012). Gamification is more effective than traditional methods (didactic, online modules) in hospital nursing orientation (Brull et al., 2017).

Spaced learning is an effective strategy to improve memory. Spaced learning has documented success among medical residents, medical students, and physicians. Kerfoot and Baker found online spaced education to create higher scores among 1,470 physicians from 63 countries \((d = 0.43, p < 0.001)\) (Kerfoot & Baker, 2012). Similarly, Matos et al. (2017) had improved scores among medical interns who were exposed to spaced learning techniques \((RR = 0.83, 95\% CI, 0.70\pm0.99, p = 0.04)\) (Matos, Petri, Mukamal, & Vanka, 2017).
The extensive metric reporting of Qstream allows leaders to identify students with knowledge gaps. This identification allows educators to spend their time remediating students effectively in a targeted manner. Kerfoot et al. (2011) divided 2,648 medical students into two groups who received online practice question support. One group received no question repetition, and the other repeated the same question over more extended periods. The students that were struggling were identified with a 75% sensitivity, 77% specificity, and 41% predictive power. Spaced education process testing can identify poor performers to improve their knowledge retention (Kerfoot et al., 2011).

Weaknesses in the research methodologies were primarily survey-based studies. Survey studies may contain bias and are less generalizable to the general population. Many studies validated their outcomes by utilizing the UTAUT survey to validate the usefulness of the technology. The high volume of descriptive studies was another weakness in methodology. Descriptive studies explore a phenomenon but do not examine any correlation or causation. Nurses were not the population of focus in any of the studies.

The literature review found only one article that examined the effect of spaced learning on registered nurses. Qstream literature was minimal and was primarily limited to medical residents/students. This literature supports the need for a study that examines the effect of a spaced-learning theory educational platform as a professional development strategy for critical care nurses.

**Statement of the Problem**

Ongoing professional educational needs for critical care nurses in the modern critical care environment are at an all-time high. Patient acuity and technology have significantly increased,
while resources for critical care has decreased (Nates et al., 2016). Research continually changes protocols and best practices. The emergent nature of critical care nursing requires immediate interventions with no room for error. Nursing professional development specialists are struggling to maintain competency for hundreds of novice nurses. Recommendations for competency assessment methods from national professional organizations are vague (Martin & LaVigne, 2016). Online modules, didactic presentations, and skills fairs involve passive learning without individualizing content (Boctor, 2012). Professional development activities are poorly attended, costly, and have uncertain outcomes (Viljoen, Coetzee, & Heyns, 2017).

The ultimate impact of the massive educational need of critical nurses is poor patient outcomes (Harkanen, Ahonen, Kervinen, Turunen, & Vehvilainen-Julkunen, 2015). Nurses will not be successful, and turnover will ensue, compounding the nursing shortage. Patients and hospitals will be affected by poor patient care due to poorly prepared nurses. This proposed study will examine the efficacy of an innovative educational platform for the professional development of critical care nurses. This project will also evaluate any impact of new technology implementation on different generations of bedside nurses.

The critical care units in this research study suffer from nursing dissatisfaction due to excessive mandatory education. Compulsory education was from accreditory bodies, quality initiatives related to problem-prone areas, and professional development specialists’ preferences. The education expenses to pay for the excessive mandatory education for the 175 nurses in 2017 was not available to provide pre-data. The new critical leadership team has established the goal to reduce mandatory didactic classes by 50% in 2018. One-third of the current critical care nurses in our study unit has less than two years of experience. This lack of experience creates a
practice gap that may lead to patient safety events. Many of these nurses are from the millennial generation who value immediate feedback (Diesing, 2016). Saved educational funds create opportunities for active on-shift learning through bedside drilling and simulation experiences.

**Purpose of the Project**

The goal of this quantitative, retrospective, comparative project was to evaluate the efficacy of a brief, online, spaced learning, education platform (Qstream) as an option for the professional development of critical care nurses. This project specifically identified if the age of the nurse affected the engagement and competency scores of the module. A complex clinical environment with rapidly changing clinical guidelines and increased technology has created a need for ongoing professional development needs for critical care nurses. Didactic in-person presentations and skills fairs have vast financial implications, passive learning without individual feedback, and effect work-life balance which can influence retention (Boctor, 2012; Curran, 2014; Martin & LaVigne, 2016; Opperman, Liebig, Bowling, Johnson, & Harper, 2016).

Attitudes are responsible for critical care nurses’ low attendance rates at educational presentations (Viljoen, Coetzee, & Heyns, 2017). Millennial nurses’ demand technologically advanced learning with instant feedback and preferred online learning (Montenery et al., 2013; Karaman, 2011).

The research question was, “Does age of the critical care nurse affect the Qscores in a gamification platform?” The learning module of study will address the identification of possible organ donor patients in the intensive care unit. Compliance for calling organ procurement agencies before patient death is historically a challenge for Critical Care Units. Various educational methods have been used over the past ten years in this hospital to improve timely
calls. The educational methods utilized at the study hospital have consisted of online modules, trigger cards, in-services, rounding, job aids, super users, and checklists. The long-established gap in practice relating to early notification calls to the organ procurement agency makes an ideal situation to study the efficacy of Qstream. The PICOT formatted question was as follows:

P: Bedside Critical Care nurses in an acute care hospital in the southeastern region of the United States

I: Qstream educational platform: Qstream uses a gaming modality that sends multiple-choice questions to a phone application. Clear rationales are provided for missed answers. Qstream customizes the educational experience by retiring questions if the content is answered correctly twice. Time spent on answering the questions averages less than five minutes a day (Qstream Healthcare Solutions, 2017).

C: Age of the nurses grouped by generations

O: Qscores: Scoring system generated by the Qstream platform. Qscores are automatically calculated by using correct answers (proficiency) and speed to answer the questions (engagement).

T: Three months from the launch of the module

Spaced learning theory has been established as an effective strategy for converting short-term memories into long-term knowledge (Han et al., 2017; Smolen, Zhang, & Byrne, 2016; Tulenko, 2013). Qstream has demonstrated effectiveness and perception of value in the education of medical residents (Kerfoot & Baker, 2012; Matos, Petri, Mukamal, & Vanka, 2017; Steelman, 2014). New technology has a learning curve and may be challenging to generations of nurses who were not raised with computers and technology.
Potential short-term outcomes that may occur for this project include improved work-life balance for bedside critical care nurses due to the reduction of mandatory education classes. Educational costs may decrease, which will improve hospital expenditures. Keeping nurses at the bedside may improve hospital quality improvement metrics such as patient falls. Nursing engagement may improve due to the instant rewards gamification provides.

The potential long-term outcomes will affect nurses, patients, and the community at large. The nursing outcomes impacted could be improved work-life balance from a reduction in mandatory education. Improved work-life balance could improve the retention of bedside nurses. Patient outcomes would include timely recognition of patients who are eligible as ventilated referrals. Improving the early trigger recognition process and allows the organ procurement agency to approach the family promptly. Timely communication maximizes the chances of the family consenting to donate. Society is experiencing severe organ shortages. Any successful initiative to improve organ donation will save lives.

**Significance of the Project**

The American public expects nurses to provide safe and competent patient care. The national nursing shortage, increased demands, and increases in technology keep experienced nurses from staying at the bedside. Critical care nurses are exposed to changes in practice, increased responsibility, and frequent exposure to pain and death on a daily basis (Galletta et al., 2016). The changes in technology, evidence practice guidelines, and improved quality improvement data have all contributed to the need for critical care nurses’ ongoing professional development. This project has benefits for patients, critical care nurses, organizations, nursing leadership, and society.
Patients will benefit from the implementation of Qstream by improving the competence and knowledge base of the bedside nursing staff. Improving dissemination of the rapid influx of new information will transform bedside care to be compliant with evidence-based guidelines. Evidence-based guidelines are paramount to patient safety.

This project will benefit critical care nurses by improving work-life balance, burnout, and improved knowledge retention. Due to the increase in charting via electronic medical records, nurses have less time for professional development (Higgins et al., 2017). An innovative, short professional development platform such as Qstream provides nurses with more time to spend with bedside nursing care. As much as 70% of knowledge is lost 30 days after an educational event. Qstream allows for customized progression through the module. Instead of all nurses taking a three-hour class, Qstream content adjusts to nursing competence. This customization maximizes learning and reduces technostress. Qstream provides bedside nurses with the opportunity for lifelong learning and professional development.

Nursing leaders will benefit from Qstream as a professional development platform by the reduction of mandatory classes, decreased staff burnout, and the provision of educational metrics. The reduction of mandatory classes will reduce the financial burden, scheduling challenges, and improve staff morale. Managers have more budget funding to spend on hands-on skills, simulation, and communication training.

Qstream allows nurses to stay at the bedside to monitor critically ill patients and reduce nursing burnout. Patient responsibilities require off-shift time to complete educational requirements that can lead to burnout. “Burnout is a serious problem for critical care unit workers because they are exposed to chronic psychosocial stressors, including high

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responsibility, advanced technology and high patient acuity” (Galletta, Portoghese, Mereu, & Contu, 2016, p. 59).

Qstream provides automatic weekly reports to nursing leaders that illustrate staff engagement, competency, and knowledge gaps of the staff. With one click, the nursing leader can send a message to the staff to motivate participation. Qstream allows the nursing leader to assess not only the unit’s learning needs but also individual performers. Improved retention of knowledge of the nurses facilitates more knowledgeable and competent nurses. Organizations will benefit from Qstream by improving the competence of nurses, thus improving patient outcomes, reducing expenditures from education expenses, and improved retention of nurses by reducing burnout. Qstream may reduce medical errors by allowing focused bedside time to focus on medication administration, not extended mandatory education modules. Competent and rested nurses will improve patient quality outcomes such as a reduction in serious safety events/never events, recognition of patient deterioration, and patient satisfaction. An educational platform that allows staff to complete a large percentage of education during paid working time has tremendous economic benefits. Improved retention of nurses leads to a stable workforce that significantly reduces turnover costs.

Nursing competence and expertise will affect society at large through nursing retention by reducing the burnout of critical care nurses. The significant shortage of registered nurses should be a national priority (Galletta et al., 2016). Qstream can allow nurses to stay at the bedside to monitor critically ill patients and reduce nursing burnout. Patient responsibilities require off-shift time to complete educational requirements that can lead to burnout. “Burnout is a serious problem for critical care unit workers because they are exposed to chronic psychosocial
stressors, including high responsibility, advanced technology, and high patient acuity” (Galletta, Portoghese, Mereu, & Contu, 2016, p. 59).

The goal of the author was to evaluate an innovative educational platform that provides instant feedback in less than five minutes per nursing shift. The impact on different generations of nurses will provide insight into future introductions to technology. Considerations for technology implementation may be necessary to meet the needs of all generations of nurses. The project will validate the success of a social media experience for the professional development of critical care nurses.

**Nature, Scope, and Limitations of the Project**

The nature of the project examined the efficacy of a Qstream as an educational platform for multi-generations of critical care nurses. The Qstream program was successfully implemented in this study facility as an educational tool for critical care nurses in January of 2018. The reduction in mandatory classes and staff’s positive reactions to the modality has led to a leadership decision to spread the use of Qstream outside of critical care to the entire hospital. A Qstream subscription has been added to the 2019 hospital budget. Please reference Appendix D as documentation that Qstream is a current hospital initiative that is independent of this doctoral project.

Qstream is a web-based program where participants answer multiple-choice questions in less than five minutes per day, three to four days a week. If an item is missed, a rationale is provided, and the question will be resent in a different format. Questions will be created by the critical care clinical nurse specialist, clinical nurse leader, and the organ procurement outreach specialist to address critical clinical concerns for organ donation in critical care. Questions will
be multiple choice or choose all that apply. Once an item is answered correctly twice, the question is retired. A clear rationale will be provided regardless of the accuracy of the answer. Questions will be supplemented with pictures, videos, and links as appropriate. Organ donation is the topic of focus for this intervention.

This program utilizes spaced learning theory to incorporate short-term memories into long-term memories through short periods of repetition over days (Qstream Healthcare Solutions, 2017). The research design was a cross-sectional, quantitative, retrospective; the non-experimental project is to evaluate the efficacy of a brief, online, spaced learning, education platform (Qstream) an option for the professional development of critical care nurses. Generational differences were examined to find any relationship between Qscores and age of the critical care nurses.

The data collection involved retrospective data. Bedside nurses’ demographical data was already collected by nursing administration to input their demographics into a database for Magnet Designation Application. Two nursing leaders in the hospital have access to the database of demographic information. Qscores data (engagement and proficiency) will be collected at the end of the organ donation module. Employee information will not be identified to anyone except the primary researcher.

There was no formal instrumentation for this project. The data gathered included:

- Demographic information of the registered nurses (generational grouping, presence of more than two years in critical care nursing, gender, education level, presence of critical care nursing certification, and clinical ladder level). Data analysis for the demographics will include descriptive statistics to describe each
variable with frequency, minimum, maximum, central tendency and dispersion, percentages, mean, median, and standard deviation.

- Qscores for the organ donation module, which reflects engagement and volume of correct answers of the participants. The Qscores will be analyzed across the four generational groups using the one-way between groups ANOVA statistical method. If the data is abnormally distributed, a Kruskal-Wallis approach will be used instead of the one-way between groups ANOVA method.

Data were managed through a password-protected computer in a locked office in the study hospital. In addition to a locked office, the critical care units are locked and monitored by security. Data will be permanently deleted from the computer and all papers shredded after five years at the conclusion of the study.

Scope

The target population is critical care nurses working in the United States. My accessible population was a convenience sample of 118 nurses working as a bedside nurse in critical care units at the study hospital in the southeastern region of the United States. The inclusion criteria included all registered nurses working bedside in intensive care units. There were no exclusions relating to years of experience, educational level, age, gender, certifications, work status, or primary unit. Nurses working in rapid response were excluded from this study. The study hospital is the flagship hospital of a five-hospital system in a rural location close that serves residents across three states. The hospital has 455 beds with a level two-trauma center designation.
Despite being a community hospital, this setting is unique. Due to the remote location, patient acuity is may be high, yet the volume of the patients requiring these high acuity treatments is low. This unpredictable nature creates a challenging environment to keep staff competent with a high acuity/low volume technology.

The period of the project data collection began in October 2018. Data analysis happened after doctoral proposal and Institutional Review Board approvals. Limitations on resources to purchase Qstream and the lack of accessibility to nurses outside of the study’s critical care units were the reasons for the selection of nonprobability techniques.

The intervention of Qstream was mandatory for bedside critical care nurses working at the study hospital. Therefore, a recruitment strategy is not necessary. Total population sampling allows the study of an entire population of registered nurses working at the study facility’s critical care unit. Advantages of total population sampling include deep insights into the phenomena and the ability to make analytic generalizations about the study population. Disadvantages of total population sampling are institutional mores may be pervasive and less generalizable to other workplaces (Laerd, 2012).

Feasibility of the Project

The costs of this project were minimal in the context of a large healthcare organization. The Director of Critical Care purchased 500 seats in the Qstream platform for $15,000. The Clinical Nurse Specialist (project researcher) and Clinical Nurse Leader spent three hours developing and assigning the module. The positions are salaried, and this work was consistent with their daily responsibilities. The critical care nursing leadership team (all-salaried) spend 30 minutes every week for three months following up with staff who are inactive with their module.
questions. The staff was encouraged to answer questions during their shift. It was acceptable for staff to answer questions at home; however; they were not compensated. In comparison with the salary costs related to a didactic class, the Qstream program was very reasonable.

The author had obtained written permission from the manager of the Critical Care Units to use this setting for a research study (See Appendix B) and to utilize nursing demographics that were already collected by the study hospital’s nursing leadership (See Appendix C). Resources for this study were minimal. The Qstream seats described above cost $15,000. All Qstream questions are delivered to existing work email addresses. Staff may download the application onto their smartphones as desired. Content experts with knowledge of adult learning principles were a valuable resource to develop reliable questions with robust rationales. The resources relating to time are described above. More time is required for the development of the module than after the implementation.

Limitations

The success of a new educational platform will be strongly influenced by the strength of the questions. If the items are too challenging or too easy, the success using the technology may be impacted. The topic selection of organ donation being controversial may have negatively influenced engagement due to possible positive or negative past experiences. Personal beliefs regarding organ donation could have affected eagerness to participate in the module.

This project was limited to Critical Care nurses who may affect the usefulness of the findings to be applied to other nursing populations. Intensive care nurses while caring for the sickest patients have set ratios, and their patient assignment will not exceed one to three patients. Medical-surgical floor nurses may have six patients with frequent discharges and admissions.
Emergency room and operating room nurses all have different work patterns, which may not reflect critical care nurses.

**Delimitations**

The project’s population was limited to critical care nurses for resource allocations. The critical care director budgeted for Qstream and advocated for its use. This education platform has benefits for the practice of most healthcare workers, including rehabilitation therapists, physicians, patient care technicians, pharmacy staff, and respiratory therapists. This study was limited to critical care nurses due to the cost of the program and a lack of educator administrators to create questions.

The study hospital is part of a five-hospital system. This project did not examine the efficacy of Qstream across other hospitals or outpatient settings. The study hospital is a large flagship hospital with the most acute patients and sophisticated equipment that is requiring ongoing professional development support.

**Theoretical Framework**

The UTAUT is a theoretical framework that assesses the ability of a user to accept new technology. It answers the question “what are the user’s attitudes towards accepting a new information technology?” The theory consists of four main concepts: performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh, Morris, Davis, & Davis, 2003). These four “constructs are, in turn, moderated by gender, age, experience, and voluntariness of use” (Williams, Rana, & Dwivedi, 2015, p. 443). UTAUT is the ideal framework for this study because the efficacy of new technology is dependent on the acceptance of the nurses to use the technology.
Performance expectancy is the “degree to which an individual believes that using the system will help him or her to attain gains in job performance” (Venkatesh et al., 2003, p. 447). Performance expectancy for nurses was found to be the strongest predictor of nursing’s use of technology (Sharifian, Askarian, Nematolahi, & Farhadi, 2014, p. 28). Effort expectancy is “the degree of ease associated with the use of the system” (Venkatesh et al., 2003, p. 450).

Age of the user influences the acceptance of technology and is the primary focus of this study. Effort expectancy moderates the influence on behavior intention by gender, age, and experience (Venkatesh et al., 2003, p. 450). Social influence is “the degree to which an individual perceives that important others believe her or she should use the new system” (Venkatesh et al., 2003, p. 451). Social influence was the most reliable direct predictor of electronic patient record usage in nurses (Maillet, Mathieu, & Sicotte, 2015, p. 36). Facilitating conditions are “the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system” (Venkatesh et al., 2003, p. 453).

The framework of this project addressed the social influences of peers in the acceptance of new technology. The UTAUT framework provided an ideal structure for this study’s design. The inclusion of behavioral, societal, and performance expectations was essential for the successful launch of new technology. Age, gender, experience, and voluntariness of use are all independent variables that influence technology acceptance (Williams et al., 2015).

The UTAUT theory focuses on the end users’ perception of whether or not the technology increases their productivity. Ease of use of technology underpins the degree of improved work effectiveness. If a new technology is challenging to learn, the perception of usefulness will decrease. (Maillet et al., 2015). If an informational system is not perceived as

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useful, the nurses will not benefit from the system, and waste will occur. The comprehensive, adaptable, and reliable nature of the UTAUT provides the ideal framework for this study.

**Definitions of Terms**

*Competencies*: Mechanisms that support health professionals in providing high quality, safe care (Opperman et al., 2016)

*Engagement*: A metric provided by Qstream that reflect the amount of participation in the program (Qstream, 2017).

*Gamification*: An educational approach to motivating students through video game design elements. The introduction of gaming elements outside of the game setting (Brull & Finlayon, 2016).

*Professional Development*: All onsite, ongoing hospital education that allows bedside critical care nurses to perform the evidence-based practice. Professional development includes competency of equipment, new protocols, in-services, and annual competencies as required by accrediting bodies and centers of excellence standards (Opperman et al., 2016).

*Qscores*: Qscore is a metric that combines the frequency of usage with a number of correct questions. Qscores are automatically calculated by the Qstream program and are used for leaderboard competitions (Qstream, 2017).

*Qstream*: An online, brief (less than 5 minutes per day), educational platform based on spaced learning theory. Questions are customized to the learner's history of correct questions. The education is created by a local content expert educator and may include clinical scenarios, videos, and website links (Qstream, 2017)
**Proficiency**: A metric provided by Qstream that is based on the number of correct answers and improvement (Qstream, 2017).

**Skills Fairs**: An educational technique consisting of multiple skills stations with posters. Education through exposure to information and occasionally demonstration.

**Summary**

This proposed project made a meaningful contribution to knowledge in nursing by establishing the efficacy of an online, brief, spaced-learning model (Qstream) as an educational platform for critical care nurses. According to the widely validated UTAUT theory, the age of the user affects their ability to adopt new technology (Venkatesh, 2016). This project examined if there is a generational impact on the adoption of gamification technology for the professional development of practicing critical care nurses. Are generational considerations important for new technology adoption among critical care nurses?

Conclusion of this project provided valuable information regarding the ability to close the gap on the challenges of maintaining competent and proficient nurses. As outlined in previous sections, the current practice environment has both internal and external factors that affect the successful preparation of nurses. The literature echoes the gap in available platforms by which to achieve the high performance required by our trusted profession.
SECTION II: METHODS

The purpose of this quantitative, non-experimental, and retrospective project was to examine if generational implications are associated with the implementation of a new educational platform (Qstream) among critical care nurses. The Qstream platform is designed to maximize knowledge retention through spaced learning techniques. Through frequent short exposure to content, short-term memories become long-term memories (Han et al., 2017). Repetition of material, in spaced intervals, is preferable to achieving long-term retention.

Critical care units nationwide are experiencing a high turnover of nurses. The constant change in the competency level of bedside staff causes strain on nursing leaders (Galletta, 2016). Orientation often takes priority over the professional development of the existing staff, leaving the needs of the experienced staff unmet. The dynamic critical care environment is in a constant state of change due to evolving technology and sicker patients. This complicated situation creates significant challenges to educate of bedside nurses in the acute care setting (Witherspoon, Braunlin, & Kumar, 2016).

Innovative solutions are necessary to meet the educational competencies of bedside critical care nurses. Fiscal responsibility, retention of nurses, and platform customization are priorities for new learning modalities in the current critical care environment. Qstream meets these requirements and warrants evaluation as a professional development strategy for critical care nurses.

This project is the second study to date that has focused on the efficacy of Qstream as a professional development strategy for critical care nurses. Too often in the professional development of nurses, a mass effect provides an education bolus. The information presented is
too much, too fast without individualization to the current knowledge of the learner. Current critical care nursing professional development modalities lack knowledge retention strategies (Martin & LaVigne, 2016).

The theoretical framework chosen to guide this study is UTAUT. The UTAUT reliably predicts the usefulness of technology. The framework design of this project addresses the social influences of peers in the acceptance of new technology. The UTAUT framework provides an ideal structure for this study’s design. The inclusion of behavioral, societal, and performance expectations is essential for the successful launch of new technology. Age, gender, experience, and voluntariness of use are all independent variables that influence technology acceptance (Williams et al., 2015). If an informational system is not perceived as useful, the nurses will not benefit from the system, and waste will occur. The comprehensive, adaptable, and reliable nature of the UTAUT provides the ideal framework for this study.

The UTAUT model underpins the necessity for new technology to be accepted by the users. In order for technology to be perceived as useful, the user must feel the system provides benefits and it easy to use. The age of the user is identified in the UTAUT literature as a direct influence on technology acceptance and has not been evaluated in nurses (Venkatesh, 2013). By studying how different generations of critical care nurses interact and utilize the Qstream platform, this researcher hopes to justify the efficacy of the platform as an educational strategy for nurses. This project design will evaluate the extent of integration to establish Qstream as a professional development platform for critical care nurses. Section II will outline the project design, sample, and setting, and describe the educational intervention. Data collection method, analysis, management, and ethical considerations will also be explored.
**Project Design**

This project is quantitative in nature and will examine the impact of new technology on different generations of critical care nurses. The project has a non-experimental and cross-sectional design that will retrospectively compare Qscores among generational groups of critical care nurses. The Qstream platform was introduced at the study facility in February 2018 as a required educational tool with content completion mandatory. Theses previously determined factors drive the non-experimental, retrospective design. The intervention was completed by the staff nurses before the study design was proposed.

The entire populations of bedside critical care nurses at the study unit were required by the administration to complete the module. The demographic data has been collected for a national Magnet designation survey in February 2018. The cross-sectional design approach will be supported by the Qscore data, which will be collected at one point in time. The point of data collection will be after 95% completion of the Qstream module to accommodate a 5% drop-out rate.

The Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead synthesized 1,267 articles, which referenced the UTAUT (Venkatesh, Thong, & Xu, 2016). This systematic review is the top of the research hierarchy pyramid and creates guidelines to shape future research (NOVA, 2017). The UTAUT identifies essential themes relating to the acceptance of new technology, which includes the age of the individual as a significant factor in the acceptance of new technology. The widely studied theory justifies the choice to examine the effect of age nurse on the competency and engagement with Qstream technology.
Educational Intervention

Qstream is a gaming based platform that provides interactive learning in less than five minutes a couple of times a week. Only one other study has examined the usage of Qstream as a professional development strategy for registered nurses. Qstream is portable, motivates learners, and provides extensive analytics to create personalized data for nursing leaders.

Platform

Qstream questions are available through employee email or on a smartphone application. The portability of the application allows nurses to complete their education at their convenience. Local hospital experts create module questions and formatting. The participants learn by taking questions in a gaming format, which does not require prior knowledge of the subject matter. The modules consist of multiple choice, fill in the blank, or choose all that apply question formats.

Questions that support situational awareness through clinical decision-making are encouraged by the Qstream Company. Short videos, internet links, and pictures supplement the questions. Clear rationales are provided if the question is missed and repetition is deployed according to the platform’s computer-generated schedule over a couple of weeks. This strategy utilizes the spaced learning theory which has established that repetition at longer intervals converts short term memories into long term memories (Kupper-Tetzel C., Kapler, I.. & Wiseheart, M., 2014). The recommended module length is between 12 and 18 questions. Using the recommended spacing of questions, most modules are completed within three months. Not only do the individuals learn through participation, but global deficits in thinking can also be identified. A question that recreates safety event can safely be rectified and evaluated to decide how pervasive the issue has become.
Motivation

Regulatory requirements for education creates a mundane environment for learning. Qstream addresses engagement through leaderboards and module completion recognition. To motivate learners, unit teams compete against each other. Each of the four units has a separate leaderboard to provide local incentives and peer pressure. Nursing leaders have a dashboard that identifies staff who are excelling, not engaged, and have not started the program. An automatic system in Qstream allows the leader to send an email to an individual or a group to recognize high proficiency or to encourage improvement. White and Shellenbarger (2018) found digital badges to be “visible indicators of accomplishment and skill” (p.78).

Learning Analytics

Analytics provided to the nursing leaders include both team-based and individual. Team statistics include progress, activity, and proficiency. Individual metrics include the number of questions, question attempts, and overall Qstream difficulty are readily available. The initial level of correct answers, the current level of correct answers, and improvement trend lines for both teams and individuals are provided in a bar graph. The nursing leader can view the team’s proficiency comparison by topic.

Proficiency comparison is a data-driven real needs assessment for the unit’s educational needs. Finally, the team has a proficiency heat map, which visually identifies which question were missed across multiple teams. The heat map allows educators to examine if a question was improperly worded or to identify a team knowledge area of weakness.
Summary

Bedside nurses have substantial professional development needs, yet little support to attend classes. Nurse professional development specialists struggle to meet individuals’ learning needs due to the lack of resources and volume of nurses. Qstream automates the knowledge assessment process and provides nursing leaders with individualized learning needs and progress.

Individual analytics are available to nursing leaders at any point. Leaders can quickly check individuals who are struggling at the bedside and evaluate their clinical decision-making in Qstream. Qscores determine the leaderboard rankings. Often, a Qstream topic becomes a point of discussion among the nursing staff, which brings awareness to a topic.

Instrumentation

There will be no formal instrumentation tool for this project. Demographics will be collected retrospectively from the hospital’s Magnet application. Written consent has been provided by the hospital to access this data. Qscores are computer-generated metrics, which are calculated by proficiency (number of correct questions) and engagement (frequency of participation). This project will be comparing the final Qscores at the completion of the module to examine if any generational differences in registered nurses are noted.

Sample and Setting

The target population is critical care nurses working in the United States. The accessible population was a total population sample of nurses working as a bedside nurse in critical care units in the study hospital in the Southeastern United States. The inclusion criteria include all registered nurses working in the four critical care units. There will be no exclusions relating to
years of experience, educational level, age, gender, certifications, work status, or primary unit. Including these nurses creates a more diverse population that may be more generalizable to the population at large. Experience level is not included in the exclusion criteria because the Qscore is influenced equally by engagement as well as correct answers.

Critical care trained nurses working as the mobile rapid response team will be excluded as their practice environment is not consistent with the target population. Nurses, who are on extended leave greater than two weeks, will also be excluded from the study. The data will be collected across the four critical care units and will include approximately 175 nurses.

Total purposive sampling is used when an entire population of individuals shares the same unique criteria. For this study, the sample is all registered nurses practicing bedside in the adult critical care units in the sample hospital in April 2018. Advantages of total population samples is an elimination of biased sample selection associated with random sampling and deeper insights into a population (Laerd Dissertation, 2018). Participation in Qstream for professional development is mandatory per administration. Overall, this population consists of nurses who are new to the career. According to the director of critical care nursing, 53% of the staff have less than five years of nursing experience, and 28% have less than 2 years of experience (Mendez, B, 2018).

The hospital setting is a 455-bed hospital with a level two-trauma center. This medical center is the flagship hospital of a five-facility system in a rural location close that serves residents of a tri-state area, although the critical care units are based in a rural setting, as a flagship hospital, it receives similar critically ill patients to urban settings as measured by the APACHE score. The Acute Physiological Assessment and Chronic Health Evaluation
(APACHE) II scoring system estimate the acuity of critical care patients. The APACHE score is validated and is often used in research studies. The APACHE range is formed 0-71, with 71 being the highest acuity of patients. The average APACHE scoring for the study critical care unit for the second quarter of 2018 was 62. The APACHE metric designates the critical care units at the study hospital to be as high acuity. The higher acuity environment equates to more sophisticated technologies requiring extensive training to maintain competencies.

Approximately 3,600 patients a year are admitted to the four critical care units.

Data Collection

Data collection will begin following Institutional Review Board (IRB) approval from American Sentinel University (ASU) and the study hospital. Consent was obtained from hospital nursing administration to conduct the project on their campus (Addendum B). Consent was also obtained from nursing administration to utilize the nurses’ demographics that were already collected by the study hospital’s professional development committee (Addendum C).

Module Development

The topic of the Qstream module of focus is Organ Donation in Critical Care. Some of the topics included in this module include early identification of potential organ donor patients, triggers to call the organ procurement agency and examples of patients who have potential to be donation after cardiac death donors. The Organ Donation module featured in this project was created by a critical care Clinical Nurse Leader, Clinical Nurse Specialist (primary investigator), and the hospital liaison for the organ procurement agency. The Clinical Nurse Leader and the Clinical Nurse Specialist attended an interactive webinar on Qstream question development, programming, and administration. The organ procurement liaison served as a content expert for
the question development. Nurses were able to access the program via their work email or download the application from their personal smartphones.

**Module Administration**

The Qstream module of focus will be the second required module for the critical care staff. All login information and use of the program has been established and therefore, familiar to the participants. The module is programmed to use the program’s default spaced learning settings, which spreads the questions out over approximately three months. The participants received an email stating that the module was ready to begin in April of 2018. Leaderboards were generated by the Qstream program instantly to communicate staff progress. The published scores were Qscores. The leaderboards were available for viewing immediately on the application and posted weekly on the huddle boards. Those participants who did not participate in a timely manner (two weeks) were encouraged by nursing leadership via email and in person.

**Data Analysis Plan**

All data will be inputted by the primary investigator into an Excel Codebook. Demographic data of age, gender, the highest level of education, more than two years in critical care, presence of Critical Care Nursing Certification (CCRN), and clinical ladder level will be collected from an existing database. The demographic database was established by nursing leaders at the study hospital and updated with every new hire. The validity of data is confirmed by the staff nurses on a yearly basis. Those demographics, which are categorical variables, will be evaluated utilizing descriptive statistics, including frequencies and proportions. SPSS Version 24 will be used for data analysis. Only nurses who have completed the modules entirely and are not missing any demographic data will be included in the data analysis. Once all of the
variables are collected, the participants’ identifying information (names) will be de-identified as “Participant 1,” “Participant 2,” etc.

Qscores will be imported from the Qstream program and linked to the appropriate participant. A Qscore is a metric that combines the frequency of usage with a number of correct questions. Qscores are automatically calculated by the Qstream program and are used for leaderboard competitions (Qstream, 2017). Categories of age will be divided as the following groups by birth year:

- Baby Boomers 1946-1964
- Generation X 1965-1976
- Millennials 1977-1995

Descriptive statistics, including minimum, maximum, and standard deviation will be used to evaluate Qscores of each generational grouping of nurses. The central tendency will be analyzed using the mean, median, and mode within those groups. Range and standard deviation will be established to identify how well a measure of central tendency represents the average value in the data. Normality with kurtosis and skewness will describe the data.

This project’s research question investigates if the age of the learner affects the Qscore (proficiency/engagement). The subject variables for this study will be Qscores of the participants from the organ donation module. The dependent variable will be the age of the nurses. The hypothesis is as follows

- Ho: There is no difference in variance between the age of nurses and Qscores
- Ha: There is a difference in variance between the age of nurses and Qscores
In order to answer this question, the data was be analyzed with inferential statistics. The a priori power analysis for ANOVA demonstrated a participation rate of 16 nurses would have a minimum power of 0.80 as acceptable. This participation rate is acceptable because, at this level, there should be less than 20% chance of committing a Type II error. Statistical analysis will be defined as a p-value ≤ .05.

If the data is normally distributed, a one-way between-groups analysis of variance (ANOVA) with planned comparisons will be conducted to explore the impact of age on Qscores (engagement and competency) scores for the organ donation module in Qstream. ANOVA "compares the variance between the different groups with the variability (believed to be due to the independent variable) within each of the groups (believed to be due to chance)" (Pallant, 2016, p. 255). This statistical method was chosen to establish if a variance exists in one of the above age groups. An F ratio will be calculated to determine if there is more variance between groups than within each individual group.

Homogeneity of variances will be assessed using the Levene’s test to determine whether the variance in scores is the same for each of the three groups. If the significant value for the Levene’s test is higher than .05, then homogeneity of variance will not be violated. The ANOVA analysis will be used to determine if a significant difference somewhere along the mean scores of the Qscore variables exists for the three generational groups. Any statistical significance of differences between each pair of groups will be examined. A significant F ratio indicates that the null hypothesis can be rejected, meaning the population means are not different. If a statistically significant difference is discovered, post-hoc tests will be examined to
evaluate mean difference significance (p<.05) to determine which group has different Qscores. The effect size will be calculated if appropriate.

If the data is abnormally distributed, a non-parametric test Kruskal-Wallis will be used to analyze the data. The Kruskal-Wallis test is an appropriate “non-parametric alternative to a one-way between groups’ analysis of variance” (Pallant, 2016, p. 236). This method allows for the comparison of scores on some continuous variable (Qscores) for three or more different groups. If the significance level is less than .05, the researcher can conclude that there is a statistically significant difference in Qscores across the three generational groups. The mean Qscore rank for the three generational groups will be analyzed to determine the overall ranking that corresponds to the group with the highest scores (Pallant, 2016).

If a statistically significant difference in Qscores is found, post-hoc tests will be utilized to determine which group if different from one another. A Mann-Whitney U test will be used to analyze each pair of groups. To control for Type 1 errors, a Bonferroni adjustment to the alpha values will be applied (Pallant, 2016).

**Data Management Plan**

**Roles and Responsibilities**

All research data collected as part of this project is owned by the study hospital (North Carolina State, n.d.). The Principal Investigator of this project will take responsibility for the collection, management, and sharing of the research data. Day-to-day quality assessment will be the responsibility of the Critical care director, who in turn is overseen by the Chief Nurse Executive of the hospital.

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The hospital’s research committee will have primary responsibility for data when the original personnel is no longer present. In the event, the primary investigator leaves the organization, the hospital’s nursing research committee will designate a qualified person to oversee the data (North Carolina State, n.d.). The process to transfer data management responsibilities will be a brief orientation and establishment of password access.

**Data Standards**

The data that will be collected include nursing demographics and Qscores. The demographics will be extracted from existing databases from the study hospital. A Healthstream database contains nursing demographic information. The Qstream program contains the Qscores. These two databases are web-based and password protected. A minimal number of hospital employees (less than five) have access to these databases. The associated data types will be captured using Excel software and analyzed using SPSS data analytics tool. Research data will be stored using excel file formats. Related files in different formats will be linked by file naming conventions, e.g., Qstream Codebook V1. Data will conform to best practices and standards from the hospital research committee (North Carolina State, n.d.).

**Access, Sharing, and Privacy**

The principal investigator for the project and the study institution will hold the intellectual property rights for the research data they generate. The primary investigator has been trained in human subjects’ protection (Addendum E). In case of an emergency, the Director of Critical Care will be trained as project staff. This trained project staffer will be operating under the IRB approval for the project will have access to the confidential, individually identifiable data. All data will be aggregated or anonymized for publication (North Carolina State, n.d.).
The principal investigator will request expedited IRB review compliant with procedures established by the American Sentinel campus IRB. The study hospital’s IRB review will also be obtained prior to any data collection. Research activities envisioned present no more than minimal risk to human subjects (North Carolina State, n.d.).

**Data Storage and Preservation**

The data files from this study will be managed, processed, and stored in a secure environment (e.g., lockable computer systems with passwords, firewall system in place, power surge protection, virus/malicious intruder protection) and by controlling access to digital files with encryption and/or password protection. De-identified files will be deposited with the study hospital whose security policy has been written according to best practices. The data will be processed and managed in a secure non-networked environment using virtual desktop technology. After analysis, all study data will be removed and permanently deleted from the Excel program and stored on a flash drive. Information on the desktop will be securely destroyed with commercial software applications designed to altogether remove all data (North Carolina State, n.d.). The flash drive will be locked in the researcher’s office for five years. Five years after the completion of the study, all study related files will be permanently deleted from the flash drive, and the flash drive will be reformatted.

**Ethical Considerations**

This retrospective cross-sectional study has no identifiable risk to participants and will be conducted in an ethical fashion. This project does not report on primary research. All data analyzed will be collected as part of routine professional development activities for critical care nurses at the study site and was not influenced by this project. The Qstream intervention would
have been required of the nurses regardless of the research study. The research study did not influence participation in the intervention (Addendum D). Anonymity and confidentiality of results will be protected. The researcher will remove all individually identifiable data. The primary investigator has recently completed Research Ethics and Compliance Training (See Appendix E).

This project will not pose any identifiable risk to participants. Institutional Review Board (IRB) approval will be sought from American Sentinel University prior to beginning any data collection. Once the data has been transcribed into the Excel Codebook, all participant names will be de-identified by the researcher. All study data will be removed and permanently deleted from the Excel program and stored on a flash drive. The flash drive will be locked in the researcher’s office for five years. After five years, all study related files will be permanently deleted, and the flash drive will be reformatted.

**Internal and External Validity**

Internal validity is vital to report what was actually studied (Laerd Dissertation, 2012). A risk to this projects’ internal validity is variations in curriculum development. A more or less dynamic or creative question writer could significantly influence participants’ competency and engagement scores. One critical care clinical nurse specialist (primary investigator) will edit all of the organ donation modules for the study.

External validity is the degree of generalization from a study’s findings to the general population (Trochim, 2006). This retrospective, non-experimental, research design is less rigorous, therefore has lower external validity. The study’s convenience sample design from one hospital’s intensive care units lowers the external validity. Extending the study to include more
sites would be more powerful but cost prohibitive at this time. Replication studies with similar results improve external validity.

Summary

The design, instrument, data collection method, and analysis plan were explicitly chosen to align with the project purpose and goals. The chosen educational intervention support the UTAUT theoretical framework concerning variables that influence the acceptance of new technology. The researcher ensured the privacy and confidentiality of participants and their demographic data.
SECTION III: RESULTS AND DISCUSSION OF FINDINGS

Introduction

The ever-changing landscape of healthcare has presented many challenges to maintaining the competency of bedside nurses (Galletta et al., 2016). Healthcare bedside practices are growing in complexity due to the aging population, nursing shortage, and opportunities for nurses to leave the bedside for advanced practice roles. Technology has grown exponentially with sophisticated modalities that keep patient organs perfused while allowing the body to heal (Higgins et al., 2017). The drive for high-quality care initiatives demands perfection. Hospital-acquired healthcare infections, falls, and failure to rescue data are transparent and are a reflection of nursing quality (Opperman et al., 2016).

Establishing and maintaining nursing competency is an ongoing challenge for nursing and hospital administration. Regulatory agencies require multiple annual online modules for accreditation. Specialty programs provide recognition and organizational endorsement; however, require periodic knowledge validation. Best practice literature continuously evolves, and protocols are continually changing (Galletta et al., 2016). Professional development specialists are deemed with the task of ensuring quality nursing care with minimal resources. Didactic classes and skills fairs are expensive and resource heavy.

Retaining nurses is a priority for hospitals as the cost of turnover or temporary employees can have a catastrophic effect on organizational finances. Work-life balance for nursing is key to retention. Requiring nurses to come in on their days off to attend mandatory educational sessions affects nurses’ resiliency affects retention rates (Vilijoen, Coetzee, & Heyns, 2017).
This study examined the efficacy of an innovative, brief, gaming application on the professional development of critical care nurses. The educational platform Qstream is based on spaced learning theory, which facilitates short-term memories to be converted to long term through short exposure at timed intervals. Qstream has demonstrated effectiveness in improving the learning of medical residents, nursing students, and cognitively impaired patients (Gyorki et al., 2013; Han et al., 2017, Matos et al., 2017). Only one study to date has studied the effectiveness of Qstream in practicing nurses. This study found improved knowledge acquisition of the nurses, which translated into improved outcomes for patients in heart failure (Ferguson et al., 2018).

This project specifically identified if the age of the nurse affected the engagement and competency scores of the module. The literature review found generational differences in learning preferences exist and can influence the effectiveness of educational interventions (Montenery et al., 2013). This study examined if generational technostress affected the competency and engagement scores of this gaming platform (Roche et al., 2018). The final section of this paper will examine the outcomes and explain how this new knowledge influences the nursing profession.

Summary of Methods and Procedures

This retrospective, qualitative research project evaluated if any generational differences in the sample of nurses existed regarding the Qscore metric. The Qscore metric is a reflection of the competency (correct answers) and engagement (speed to answer) that is delivered automatically to the platform’s site administrator. Hospital administrative permission, IRB approval from American Sentinel University, and the study hospital IRB were all obtained.
Employee demographics that had been previously obtained for a Magnet application and were collected from a database. A Qstream module to encourage the early notification of the local organ procurement agency had been developed by the unit’s Clinical Nurse Leader and Clinical Nurse Specialist and administered to all bedside critical care nurses six months prior to the study.

The Qscore report data was analyzed with the demographic data to discover any trends. Any subject with missing data was eliminated. Statistical analysis was performed for descriptive data, including frequencies and averages in SPSS version 25. The advanced statistical analysis sought to find a relationship between Qscores and the age of the participants. All data was kept on a password-protected computer in a locked office.

**Summary of Sample and Setting Characteristics**

The setting was a 48-bed critical care unit in a 400-bed hospital in a five-hospital system. Due to the tristate rural location and regionalization responsibility, the hospital has a high acuity patient population. The sample group was bedside critical care nurses working in the study facility. The module was required by leadership, and therefore, had high participation.

One hundred and eighteen nurses participated in the study. The mean age was 38.4, with a range from 24 to 64 (\(M=38.4, SD=10.7\)). Age was non-normally distributed, with a positive skewness of .694 (SE=.223) and negative kurtosis of -.547 (SE=.442). The median age was 35.5 years.

The sample population consisted of 85% females, and 15% males, which is consistent with the predominant female profession of nursing. Eighty-two percent of the participants had more than two years of nursing experience. The majority of the nurses had a Bachelor degree (75%), followed by an Associate degree (15%), and a Master’s degree (9%). Twenty-eight
percent of the sample population was certified in critical care nursing. Almost all of the sample was employed in a full-time status (89%).

In addition to other demographic information, the database also included a professional development stratification level known as a clinical ladder. Clinical ladder status provides an opportunity for professional development, which reflects enhanced clinical knowledge and performance. Due to the elective nature, the ladder level also indicates the engagement and drive of the nurse to improve. All nurses progress from a level one to a level two after they successfully complete critical care orientation. The majority of the sample of nurses were RN 2 (73%). The highest level of RN 4 was 15% of the sample. Novice level RN 1’s and RN 3 were respectively, each 6 % of the nurses in the study. Thirty-three percent of the nurses in the study held a Certified Critical Care Nurse status.

The mean Qscore for the module was 1325 ($SD=187$). The median score was 1356 ($IQR\:208$) with the minimum 442 and the maximum score being 1622. The data were analyzed with 95% confidence that the real mean of the stress scores falls between 1291 and 1359. The original mean ($M=1325$) and the newly trimmed mean (1340) are similar, indicating that extreme values did not affect the mean scoring. Total Qscores was non-normally distributed, with a negative skewness of -1.84 ($SE=.223$) and positive kurtosis of 6.25 ($SE=.442$). The Kolmogorov-Smirnov test for Qscores indicates the data does not follow a normal distribution, $D (118) =.104$, $p=.003$. 

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Table 1

*Descriptive Statistics Qscores*

<table>
<thead>
<tr>
<th>Generation</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millennials</td>
<td>71</td>
<td>1340</td>
<td>135</td>
<td>16</td>
</tr>
<tr>
<td>Gen X</td>
<td>33</td>
<td>1306</td>
<td>229</td>
<td>40</td>
</tr>
<tr>
<td>Baby Boomer</td>
<td>14</td>
<td>1292</td>
<td>291</td>
<td>78</td>
</tr>
<tr>
<td>Total</td>
<td>118</td>
<td>1325</td>
<td>187</td>
<td>17</td>
</tr>
</tbody>
</table>

Homogeneity of variances was assessed using the Levene’s test to determine whether the variance in scores is the same for each of the three groups. Levene’s test for equality of variances was significant ($F = 4, 2.48, p=.048$); therefore, homogeneity of variance was not violated. The ANOVA analysis was the appropriate statistical method to determine if a significant difference somewhere along the mean scores of the Qscore variables exists for the three generational groups.

A one-way between-groups analysis of variance was conducted to explore the impact of age on participants on Qscores (a measure of engagement/competency). Participants were divided into three groups: (Baby Boomers: 1946-1964, Generation X: 1965-1976, and Millennials: 1977-1995). There was not a statistically significant difference at the $p<.05$ level in Qscores for the three age groups: $F (2, 115) =.621, p=.539$. The actual difference between the
mean scores of the groups was quite small. The effect size, calculated using eta squared, was 0.011.

Table 2

ANOVA Analysis of Qscores

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>43760</td>
<td>2</td>
<td>21880</td>
<td>.62</td>
<td>.539</td>
</tr>
<tr>
<td>Within Groups</td>
<td>4049693</td>
<td>115</td>
<td>35215</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4093453</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Electronic copy available at: https://ssrn.com/abstract=3404348
Major Findings

The significant finding for this project was Qstream competency, and engagement were not affected by the age of the nurse. Qstream should be considered as an educational option for nursing professional development specialist with the age of the nurse not being a consideration. The age of the bedside nurse was a mean of 38.4 years and a median of 35.5 years.

The highest frequency of the age of the nurses was the Millennial nurses (n=48) who were born 1983-1995. The high frequency of millennial nurses is reflective of the lack of experience at the bedside, which increases the need for education and frequent competency assessments. The results of the age demographic regarding the high number of Millennial nurses are valuable to nursing leaders when allocating hospital resources for professional development,
orientation, and preceptor training. Less experienced nurses will need more professional development support to create a highly reliable organization that optimizes patient outcomes.

The average participant gain in competency was 24% improvement from the first time the question was presented to the second time. This educational gain was achieved with minimal costs—only 4 hours of professional development time from the Clinical Nurse Specialist and Clinical Nurse Leader to develop and administer the module. An hour didactic class for the same information would have cost conservatively $4,200 (118 multiplied by $35/hour). Interestingly, the call volume from the critical care units to the organ procurement agency tripled in the month following the education.

Figure 2. Proficiency Scores from Learning Module

Qstream should be considered a worthwhile professional development option for bedside nurses. The ease of use, gaming technology, and reduction of seat time would positively affect nursing education as supported by other studies (Brull et al., 2017) (Furguson et al., 2018). The
instant analytical outcome data associated with the Qstream platform provides needs assessment from learning of both individuals and from a unit perspective. Progression of learning and participation analytics is readily available to both educators and nursing leaders. Instant prompts are available to the site administrator and nursing leaders to send a message of encouragement for both high achievers and those with low participation.

The Unified Theory of Technology Acceptance identifies that the age of the user modifies their acceptance of new technology (Williams, Rana, & Dwivedi, 2015). In the case of Q-stream, age was not statistically significant to the success of Qstream. A limitation of the study was the mandatory status of the assignment. The nurses were required to start to use the technology, and therefore, their acceptance may have been partially related to the mandate. However, the progression through the program was at their own pace. The mandatory usage by nursing administration would influence starting to use the program but would not motivate the users to answer questions quickly and accurately.

**Implications for Nursing Practice**

The gap in the literature concerning Qstream and bedside nurses is pronounced with only one study published to date (Furguson et al., 2018). The implications of this study indicated that the age of the user does not affect the engagement and competency scores in Qstream. Nursing leaders should care about the impact a gaming professional development strategy can have on bedside staff. This approach has implications on staff satisfaction scores; reduce budgetary expenditures for education, improved retention of knowledge, and ultimately the quality of care. These positive implications are categorized into financial, nursing retention, and improved learning metrics.
Financial Implications

Professional development activities to maintain the competency of bedside nurses are expensive (Ferguson et al., 2018). The study hospital has more than 30 different online/skills fairs competencies that are required for regulatory agencies. With the average nurse making approximately $35/hour for 118 nurses, a two-hour didactic class would cost $8,400 for the nurses’ time to attend. An addition Master’s prepared nurse would spend two hours presenting the content. Didactic classes often involve passive learning with no individualized learning analytics. The Qstream professional development platform subscription costs $15,000 for 500 seats yearly. Due to the minimal time to participate, (less than 5 minutes three times a week), participants are not compensated for their time. In order to avoid labor laws, participants are only required to participate on shift. The minimum time commitment makes Qstream learning a very feasible approach, even on a busy shift. Additional participation at home adds to the convenience of the platform but is optional. In healthcare’s harsh financial environment, implications for using Qstream throughout the hospital across multiple disciplines would be substantial. The money saved in less effective education time could be reinvested into staff positions at the bedside, which would improve patient care.
Table 3

*Qstream Cost Savings for Education in Critical Care*

<table>
<thead>
<tr>
<th>Cost Component</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employee class time cost avoidance</td>
<td>$56,150</td>
</tr>
<tr>
<td>Educator class time cost avoidance</td>
<td>$5,750</td>
</tr>
<tr>
<td>Annual subscription for Qstream</td>
<td>-$15,000</td>
</tr>
<tr>
<td><strong>Total cost savings</strong></td>
<td><strong>$46,900</strong></td>
</tr>
</tbody>
</table>

**Nursing Retention**

The nursing shortage is extensive with the retention of experienced nurses a priority for all hospitals across the nation (American Nurses Association, 2018). Work-life balance improves resiliency and impacts retention. Staff is often required to attend mandatory educational sessions on their days off or after working 12-hour shifts. Coming to work on their day off (often on a different shift) does not promote rest from a physically and mentally challenging profession. Bedside nurses are primarily young women who often have responsibilities for young children. A lack of affordable childcare makes attending extra educational sessions challenging and expensive (Hedrick & Winters, 2017).

Nursing leaders are evaluated on their metrics concerning nurse turnover and work-life balance satisfaction scores. Replacing nurses is expensive, and gaps in staffing may affect patient outcomes. The Qstream platform significantly reduced off shift necessary education time for bedside critical care nurses at the study hospital. The literature review has identified the reduction of mandatory education during off shifts will improve nursing burnout and satisfaction scores. This study unit’s nursing retention rate at the conclusion of the study was 91% with zero...
use of agency staff. For comparison, in 2017, 10% of the bedside nurses were temporary agency workers (B.Mendez, personal communication, March 11, 2019). While nursing retention rates are multi-factorial, the improved work-life balance from a decrease in mandatory education supports this positive outcome documented in the literature (Galletta et al., 2016).

**Improved Learning Metrics**

Over 70% of knowledge is lost a month after a didactic class is taken. Qstream improves retention of knowledge through the utilization of spaced learning theory. Spaced learning theory (short, repetitive exposure to information) has been proven to demonstrate improved knowledge retention in medical residents, nursing students, and even cognitively impaired patients (Gyorki et al., 2013) (Han et al., 2017) (Matos et al., 2017). This study had success in learning improvements similar to the literature review related to spaced learning techniques.

In this study, Qstream has successfully demonstrated learning outcomes comparable to online modules or didactic classes through metrics calculating a greater than 20% improvement from the first time the question is answered to the second. Due to the fact that Qstream is “open book,” other learners may have researched the correct answer for the first question. Researching is acceptable because it enhances learning. However, the metrics may underrepresent the actual percentage of knowledge acquisition (Qstream, 2017).

The Qstream platform provides multiple instant learning metric report to both educators and managers. The learning analytics allow educators to have an automatic needs assessment to evaluate areas of success and weakness of their staff. Specific teaching modifications can be made based on the learning metrics to optimize outcomes. For example, a situational clinical question can be used to evaluate how pervasive a clinical reasoning error has spread throughout
the staff. Poorly written questions can be identified and changed. Staff who are struggling can be automatically identified and remediated. The staff who are succeeding can be sent an encouraging email with one click from the nursing leaders (Qstream, 2017).

**Society at large**

Society at large will benefit from the use of Qstream as a professional development strategy for critical care nurses by improving nursing competency, bedside nurse retention, and decreasing healthcare expenditures. The competency needs for bedside nurses have grown exponentially due to improved technology and higher acuity patients. Qstream has demonstrated significantly improved knowledge retention. The improved work-life balance will assist in nursing retention, which will keep experienced nurses at the bedside to maximize patient health outcomes. The United States has the most expensive healthcare system in the world (Galletta et al., 2016). Any reduction in financial expenditures will improve the cost of healthcare. Reducing the cost of healthcare will remove barriers to accessing care before a condition becomes too advanced, requiring critical care.

**Conclusion**

The Qstream educational platform has many positive implications for the professional development of nurses. Despite the Unified Theory of Technology Acceptance inclusion of age as a mediating factor in technology’s acceptance, the age of the nurse in this study did not significantly change their Qscores (engagement/competency). Qstream for professional development is appropriate for all ages of nurses and has positive financial, retention, and knowledge acquisition implications for nursing and hospital administration.
Recommendations

Due to the minimal body of research concerning the role of Qstream in the professional development of critical care nurses, there a number of recommendations for future research. This study found that the age of the nurses did not affect their Qscores (competency/engagement analytics). The nurses demonstrated a significant knowledge improvement (24%). Costs for education decreased significantly, as previously discussed. Feedback to learners was immediate. Future research opportunities are indicated for the study hospital’s local leadership, the nursing profession as a whole, and the society at large.

Local hospital leadership

The study hospital has expanded the use of Qstream to the housewide nursing population based on the positive learning and financial outcomes of the implementation in the critical care department. Recommendations for research include a UTAUT survey to formally validate the acceptance of new technology, financial versus knowledge retention outcomes, and evaluation of serious safety events after a specific Qstream module of focus. Expansion of Qstream has also grown to other medical professions, including the Intensivist physician team. The sharing of questions can provide an interdisciplinary educational rollout for a quality improvement project. Future literature could include individual analysis of Qstream across multiple disciplines, to evaluate if Qstream is better suited to nurses as opposed to physicians or pharmacists. The outcomes support the literature finding on an online gaming environment to be preferable for health disciplines (Karaman, 2011).
Nursing profession

Nates et al. (2016) describe the current state of the bedside nurse to have rising patient acuity with fewer resources. Maximizing the nurses’ time to learn will improve patient outcomes and improve work-life balance (Harkanaen et al., 2015). Improving work-life balance will decrease nursing turnover and financial costs (Galletta et al., 2016).

The nursing profession has educational needs that could be addressed by a gaming platform. This study adds to the knowledge concerning the effectiveness of gamification in the education of nurses (Brull et al., 2017). Gamification has demonstrated to be more effective than traditional methods of education (Furguson et al., 2018). The nursing profession as a whole could evaluate the application of Qstream educational platform across multiple settings. Qstream may be a useful educational tool for nursing students, graduate advanced practice nursing students, professional development for established nurses, or even as patient education tools.

The body of evidence concerning the use of Qstream is low, which provides an ideal opportunity for research. The adoption of technology in education modernizes nursing practice to stay current with other industries. Smartphone with social media experiences is an effective way to educate nurses (Witherspoon, Braulin, & Kumar, 2016) (Ying, 2014) (Stephens & Gunter, 2016).

Nursing schools

Nursing schools could quickly evaluate the effectiveness of Qstream on test scores with one cohort using the application and one not. Surveys could be provided to establish if students find Qstream to be a helpful technology to assist their learning. Simulations could have a
Qstream attached to refresh retention after an experience. Students who are struggling could be easily identified and remediated prior to formal testing through the platform analytics previously described in this paper.

Funding for nursing education policies could be refreshed by an innovative platform that improves outcomes while decreasing costs. Nursing and graduate schools could improve their board passing rates by starting review questions early and throughout their programs. Qstream provides analytics that can be utilized for process improvement and research studies for students.

**Professional development of practicing nurses**

This study could be replicated and expanded using the UTAUT survey to establish Qstream as an acceptable technology by nurses. UTAUT has been repeatedly verified to be an accurate measurement of predicted use (Venkatesh et al., 2003). Certification rates of nurses are an essential metric for Magnet designation. Qstream modules could be created with review questions to improve both knowledge and confidence. Self-efficacy studies could be performed with the transition to practice nursing populations to determine if Qstream held any benefit. Quality initiatives could utilize Qstream for root causes that involve a knowledge deficit. Situational questions could improve nurses’ clinical reasoning skills, which may lead to a decrease in serious safety events.

**Society at large**

Society has become more technologically well informed with 77% of the population now using smartphones as of 2018. In 2011, the number of people using smartphones was only 35% (Pew Research, n.d.). Patient education has not evolved to meet society’s love of instant
feedback. Improved patient education through the Qstream platform, could lead to a decrease in readmissions, quality of life, and healthcare expenditures.

The effectiveness of patient education modules on measurable outcomes is ideal research ideas. (Ferguson, et al., 2018). Diabetes, heart failure, and hypertension patients all need considerable education to be successful. Bariatric programs can focus on healthy eating and exercise outcomes. Research opportunities can evaluate the effectiveness of Qstream on specific outcomes such as weight, labs that monitor chronic diseases, etc.

The analytics from Qstream relating to patient education will satisfy accrediting organizations to maximize payments for service. Increasing revenue will improve the bottom line of healthcare organizations and ultimately improve access to populations. Rural patient populations would have equal access to healthcare education than those living in more populated regions. Written patient education materials are quickly outdated, costly to print, and fill the landfills.

Qstream modules could easily be tailored to the rapidly changing guidelines and best practices. The gaming aspect improves the experience and motivation to encourage participation. Qstream is active learning where written information is static and does not document individual competence. Using Qstream would provide practitioners with learner success information to determine if a patient has a knowledge deficit or a compliance issue to stay healthy.

**Conclusion**

In conclusion, there is a multitude of recommendations for future research that would influence the study hospital’s local leadership, the nursing profession as a whole, and the society
at large. There is a potential to improve society’s overall health through an interactive experience in active learning. With a significant amount of society using social media, the static patient medical literature is no longer valid (Pew Research, n.d.). Qstream is a professional development platform that has demonstrated an increase in competency for practicing bedside nurses. The gaming aspect with a social media experience creates an engaging environment for learning. This project has established that Qstream is a powerful learning modality across different generations of critical care nurses.
References


https://www.nursingworld.org/practice-policy/workforce/


Han, J., Byun, H., Ko, J., Kim, K., Hong, J., Kim, T., & Kim, K. (2017, June 6). Efficacy of the ubiquitous spaced retrieval-based memory advancement and rehabilitation training (USMART) program among patients with mild cognitive impairment: a randomized controlled crossover trial. Alzheimer’s Research & Therapy, 46-52.


Appendix A

The United Theory of Acceptance and Use of Technology (UTAUT)

(Venkatesh et al., 2003, p. 447)
Appendix B

Facility Permission to Complete Project

November 2, 2017

Nicole,

This letter serves as formal acknowledgement and acceptance of your DNP project on spaced learning methodology for critical care nursing (QStream). We are excited to get started and appreciate your expertise and inspiration.

Best Regards,
Nicole Ryder

[Signature]

ICU Manager
Winchester Medical Center
Appendix C

Facility Permission To Use Retrospective Demographic Data

ValleyHealth
Healthier, together.

September 9, 2018

Winchester Medical Center
1840 Amherst Street
Winchester, VA 22601

To whom it may concern:

This letter serves as documentation of permission to access nursing demographic data and Qstream scores/data. The data has already been collected for our hospital Magnet database. We appreciate the opportunity to participate in your research project and are eager to see the findings.

Sincerely,

Nicole Ryder
Clinical Manager of Critical Care
Appendix D

September 21, 2018

To whom it may concern,

I have been asked to confirm elements of Qstream and its use within the critical care department at Winchester Medical Center. The Qstream platform was acquired and successfully implemented as an educational tool for critical care in January of 2018. Multiple modules have been deployed including an organ donation module. The 2017 return on investment of the platform has resulted in an expansion of the Qstream subscription for house-wide deployment for 2019 budget planning. Nicole Gendron-Trainer has assisted with question development and implementation. Her work as a DNP student, although very interesting and possibly beneficial to the overall understanding the use of new technology, does not impact the use of Qstream within critical care or Winchester Medical Center as a whole.

Best Regards,

Nicole Ryder
Critical Care Manager
Winchester Medical Center
1840 Amherst Street
Winchester VA 22601
Appendix E

Research Ethics and Compliance Training

This is to certify that:

Nicole Gendron-Trainer

Has completed the following CITI Program course:

CITI Good Clinical Practice (Curriculum Group)
CITI Good Clinical Practice Course 1 - GCP (Course Learner Group)
Stage

Under requirements set by:

American Sentinel University

Verify at: www.citiprogram.org/verify/?wd91b8062-8335-415b-a5c8-4ff1fd1bc779bf-25436430
You completed the mandatory elements of this course on 04-Dec-2017 with a final reported average score of 91%.

This is the date and score recorded in the Completion Report sent to your institution.

- You may review any of the course content and retake quizzes, including those for supplemental optional modules, but your reported quiz scores and dates will not change.
- You do not receive any extra credit for this course if you retake quizzes or complete additional quizzes on supplemental materials.
- In some cases, completion of additional modules may be required for eligibility for CEU credits.
- Additional completions and new quiz scores may transfer to other CITI Program courses, if you register for courses that include those modules. You must login using the same account, and the other institution must allow transfer credit.

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Please check "Action" column for either of the two following options:
# Appendix F

## Excel Codebook

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Appendix G

IRB Approval American Sentinel University

December 20, 2018

Nicole Gendron-Trainer
DNP Student
American Sentinel University

Re: The Efficacy of a Gamification Platform on the Professional Development of Different

Dear Ms. Gendron-Trainer,

On December 20, the Institutional Review Board (IRB) of American Sentinel University has approved the above-referenced submission. The contingencies have been addressed and the IRB approves the protocol. Work on this project may begin. This approval is for a period of one year from the dates of this letter and will require continuation approval if the research extends beyond one year. If you make changes to the protocol during the period of this approval, you must submit a revised protocol to the American Sentinel University IRB for approval before implementing the changes.

If you have any questions regarding the IRB’s decision, please contact me through irb@americansentinel.edu.

Sincerely,

[Signature]

Elaine Foster PhD, MSN, RN
Chair
American Sentinel University IRB

C. Dr. Cleveland
Appendix H

IRB Approval Valley Health

January 3, 2019

Nicole Gendron-Trainer, RN, MSN, CNS-BC, CCRN-K, CHSE
Winchester Medical Center
1840 Amherst Street
Winchester, VA 22602

RE: The Efficacy of a Gamification Platform on the Professional Development of Different Generations of Critical Care Nurses

Dear Nicole:

The Institutional Review Board of the Valley Health/Winchester Medical has approved your Modification to Approved Research Form.

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<th>Expiration date for this study is: 01/03/20</th>
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The IRB policies require that a report be submitted at the closure of this study. The following information regarding the patients you enroll in the study must be included in the report: total number of patients enrolled, completing and dropped from the study, reasons for patients dropped from the study, any adverse events experienced by patients enrolled in the study, and any perceived benefits derived by patients enrolled in the study.

This approval is valid for 1 year. Should an extension be required, an annual report will need to be submitted along with other required IRB documentation.

The IRB is organized and operated by Policies and Procedures as set forth in the Federal Register. This is to certify that the following Institutional Review Board/Ethics Committee is in compliance with Good Clinical Practice Guidelines as defined by the U.S. Food and Drug Administration under the Code of Federal Regulations (21 CFR Parts 50 and 56; 45 CFR Part 46) and International Conference on Harmonisation (ICH) Guidelines (Section E6), RB600035173, expiration date July 11, 2021, and FWA00015109, expiration date July 7, 2022.

Sincerely,

Jeffrey Sklett, M.D.
IRB Chairperson
Valley Health/Winchester Medical Center IRB