Evaluating Healthcare Simulation Escape Rooms as an Educational Tool in Nursing Continuing Education

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Contributions

I, *Brennah Holley*, am the primary investigator and author of this Master of Science in Nursing thesis research study. I created, developed, and implemented the Healthcare Simulation Escape Room depicted in the thesis work. I identified and developed the research question, study purpose, and literature review. I contributed to the identification and development of the philosophical underpinning, conceptual framework, methodology, data analysis, data findings, and implications for nursing practice, research, and education.

Dr. Rochelle Einboden and Dr. Jane Tyerman are the thesis co-supervisors for this thesis research study. They played an integral role in the thesis development, including developing the identification of the philosophical underpinning, providing feedback on the written thesis work, and providing guidance when selecting an appropriate research paradigm, design, and methods. Furthermore, they are both editors of the thesis work.

Dr. Nicholas Mitsakakis is a thesis committee member for this research study. Dr. Mitsakakis supported the statistical analysis for this study. He reviewed the proposed statistical analysis plan and provided expert guidance regarding the analysis and interpretation of the results. He is an editor of the thesis work.

Dr. Megan Greenough is a thesis committee member for this thesis research study. She has contributed to the theoretical framework and provided feedback regarding the methods of this study. Dr. Greenough is an editor of the thesis work.

Victoria Cole is the Health Sciences Librarian at the University of Ottawa. Victoria contributed to the search strategy and helped find essential literature for this research.

Abstract

Background: Innovative educational strategies, such as healthcare simulation escape rooms (HSER), are increasingly used in nursing education to promote engagement and motivation in learning activities. **Purpose:** This study assessed whether participation in a HSER, in addition to a standard lecture, improves knowledge acquisition compared to a lecture alone. **Methods:** A two-arm randomized controlled trial compared pre- and post-test scores following a lecture (n = 51) and a lecture with a HSER (n = 44). An analysis of covariance (ANCOVA) was conducted to examine the differences in post-test scores, controlling for age, experience and pre-test scores. **Results:** Participants in both groups showed statistically significant improvements in post-test scores. The control group gained an average of 2.27 points, and the experimental group gained 2.29 points. However, there was no significant difference between groups after adjustment. **Conclusion:** HSERs did not yield greater short-term knowledge gains than a traditional lecture.

Keywords: *gamification, escape room, nursing education*

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Glossary of Terms

The terminology used in this proposal regarding simulation and serious games is consistent with the Society for Simulation in Healthcare (Lioce et al., 2024). Refer to the glossary of terms when required.

The Healthcare Simulation Dictionary is the source for all terms in the list below unless otherwise indicated. This resource is produced by The Society for Simulation in Healthcare (SSH) and endorsed by the International Nursing Association for Clinical Simulation and Learning (INACSL). (Lioce et al., 2024)

Debrief
A formal, collaborative, reflective process within the simulation learning activity.

Facilitator
An individual who is involved in the implementation and/or delivery of simulation activities. For example, faculty, educators, clinicians, etc.

Gamification
Approach for increasing learners' motivation and engagement by incorporating game design elements in educational environments.

Healthcare Simulation
A technique that uses a situation or environment created to allow persons to experience a representation of a real healthcare event for the purpose of practice, learning, evaluation, testing, or to gain understanding of systems or human actions: the applications of a simulator to training, assessment, research, or systems integration toward patient safety.

Healthcare Simulation Escape Room
"An interactive activity that incorporates traditional elements of escape rooms with health care related themes or content for the purpose of education, engagement and/or evaluation." (Anderson et al., 2021, p. 13)

Knowledge acquisition
The learner's measurable internalization of new conceptual and procedural knowledge resulting from participation in simulation-based experiences (Alharbi et al., 2024). (see *learning outcome*)

Learning Objective
Guides the debrief activity by supporting what content should be covered or avoided

Learning Outcome
A measurable change in knowledge, skills, and attitudes (KSAs) following the simulation experience

Prebrief
The process of providing participants with information before a simulation event to familiarize them with the simulation activity or environment, including center rules, timing, and the operation of simulation modalities, with the intent of preparing participants.

The purpose of the prebriefing is to set the stage for a scenario and assist participants in achieving the scenario's objectives.

Eds. Note: the terms Briefing, Orientation, Prebriefing, and Preparation are often used interchangeably.
Author's note: Definitions for prebrief and orientation have been combined for this proposal based on the editor's note to prevent confusion when discussing the 'prebriefing' in the context of nursing orientation.

Scenario
The scripts, stories, or algorithms created to instruct participants, including the simulators (human or robotic), on how to interact with the students.

Script
A written set of instructions providing a detailed plan of action for a simulation case; similar to a theatrical play script.

Serious Games
Serious games are simulations of real-world events or processes designed to solve a problem.

Simulation
A technique that creates a situation or environment to allow persons to experience a representation of a real event for the purpose of practice, learning, evaluation, testing, or gaining understanding of systems or human actions.

Simulation Activity
The entire set of actions and events from initiation to termination of an individual simulation event; in the learning setting, this is often considered to begin with the briefing (prebriefing) and end with the debriefing.

Chapter 1: Introduction

Reflexivity Statement

My approach to this proposal is rooted in my experience as a pediatric hematology/oncology nurse at the Children's Hospital of Eastern Ontario (CHEO). As I began my career 26 years ago, I did not receive onboarding training or orientation beyond my consolidation placement. As a novice nurse, I administered chemotherapy and blood products and provided central line care without supervision or guidance. After six months of working on the unit, I was deemed prepared to begin caring for the neuro-oncology population. The nurse educator provided me with journal articles to read without further follow-up. At that time, there was little continuing education provided to nurses on the unit. What was offered was unengaging and of poor quality. In contrast, my consolidation preceptor was an excellent educator and mentor. She sought out interesting learning opportunities, challenging me to do my best and to continue learning. Observing her as a student and later as a colleague, she engaged nurses on the unit in knowledge advancement in an unofficial capacity. The combination of these early experiences motivated me to model my preceptor's example by pursuing lifelong learning and fostering meaningful, interactive opportunities supporting my colleagues in their professional growth.

Throughout my career as a nurse on the inpatient and outpatient hematology/oncology units, I collaborated with colleagues to provide focused, engaging education sessions for staff. I first encountered gamification in nursing education in 2008 when a Jeopardy-style game was used to review chemotherapy medications. This experience further motivated me to develop innovative educational activities for nurses. When I was offered the opportunity to formally

assume the nurse educator role for the hematology/oncology program in 2017, I eagerly embraced the challenge.

I was the nurse educator in the specialties of hematology, oncology, and nephrology for eight years. My priority to deliver quality, engaging continuing education to nurses was met with enthusiasm by staff and leaders alike. In the spring of 2022, a nurse educator colleague from the Association of Pediatric Hematology/Oncology Nurses shared an idea for an escape room, inspiring me to create the first Healthcare Simulation Escape Room (HSER) at CHEO. My success in executing the HSER brought satisfaction and enjoyment to participants at all skill levels. This experience led to the creation of many serious games in departments throughout the hospital. They have been used in continuing education days and corporate nursing orientation for the last four years.

Evaluations of the experiences were overwhelmingly positive. Other nurse educators, who had either participated in an HSER or another type of serious game, were inspired to develop their own, leading to the creation of serious games across the hospital. However, assessments of these experiences mainly focused on engagement, satisfaction, and teamwork. I questioned whether nurses gained and retained knowledge from the experience. The leadership of the CHEO Simulation program started to doubt the value of incorporating escape rooms and serious games into training. At that time, I could not confidently assert that HSERs are effective teaching tools. I sought evidence to support the use of serious games for training and ongoing education.

The idea and plan for this research originated from a Registered Nurses' Association of Ontario Advanced Clinical Practice Fellowship in 2023. The original application to the CHEO Research Institute (CHEO RI) Research Ethics Board was submitted in 2023 during the

fellowship, under the mentorship of Dr. Rochelle Einboden and Dr. Jane Tyerman. With this thesis proposal, I hope to contribute to the body of evidence regarding the effectiveness of HSERs in continuing education for nurses.

Background

Lifelong learning is integral to nursing. It is a requirement by nursing colleges and governing bodies to maintain professional standards. Provincial regulatory colleges specify that nurses base their practice on current, evidence-based insights from nursing, allied science and the humanities. They encourage nurses to respond and adapt to their environment (British Columbia College of Nurses and Midwives, n.d.; College of Nurses of Ontario, 2025). This standard is a consistent requirement across nursing regulatory bodies in Canada. To ensure that nurses in Ontario are compliant with the standard, the College of Nurses of Ontario has a Quality Assurance program. The program requires nurses to reflect on their practice and develop a plan to address knowledge gaps (College of Nurses of Ontario, 2025).

Nurses regard continuing education not simply as a requirement by our governing colleges, but as an essential component of delivering safe, high-quality care. However, nursing education continues to struggle to provide learning experiences that truly resonate with and benefit a workforce with diverse clinical backgrounds and learning needs. Staffing shortages and budget constraints are additional factors that impact nurse participation in professional development programs (Seymour et al., 2023). Due to these complexities in the current healthcare system, nurse educators are challenged with engaging nurses in education that emphasizes lifelong learning and incorporates critical thinking and problem-solving skills into nursing care (Ward et al., 2024). High levels of engagement in learning contribute to improved

knowledge retention and application of skills (Daniel et al., 2021; Karima & Shinobu, 2022; Billner-Garcia & Spilker, 2024).

Traditional lecture-based approaches to learning, such as lectures, e-learning presentations and modules, are often passive teaching strategies that do not require the learner to participate in the activity (Bonn et al., 2023). In current nursing practice, clinical orientation and onboarding programs often combine didactic lectures with peer-supervised clinical practice buddy shifts, online learning modules, and structured competency checklists (Keller et al., 2020; Lee et al., 2021). While these approaches provide necessary exposure to institutional policies and patient safety standards, they are frequently criticized for being overwhelming, information-dense, and poorly tailored to individual learner needs (Theisen & Sandau, 2013).

Active engagement in education fosters a greater sense of responsibility in fulfilling ongoing learning requirements and delivering high-quality patient care (Ward et al., 2024). Hospitals have increasingly incorporated simulation-based orientation modules and e-learning platforms to supplement traditional onboarding, aiming to improve confidence, reduce transition stress, and enhance critical thinking (Spector et al., 2015). Despite these innovations, variability in the quality and structure of orientation programs persists, and new nurses often report gaps in applied clinical decision-making and interprofessional communication (Regan et al., 2021). These limitations underscore the need for evidence-based, interactive approaches that actively engage learners and directly link onboarding content to practice realities.

Simulation

In the last 25 years, simulation-based training has become a cornerstone of healthcare education, demonstrating effectiveness in improving clinical competence, patient safety, teamwork, and communication (McGaghie et al., 2011; Bienstock, 2022; Bienstock & Heuer,

2022; Curl et al., 2016; Lewis et al., 2019; Yeom & Park, 2024). Healthcare Simulation Standards of Best Practice for simulation design require (Watts et al., 2021):

1) Learning objectives to build upon foundational knowledge
2) Prebriefing that supports success in the simulation activity
3) Scenario that aligns with the learning objectives
4) Debriefing
5) Evaluation of the learner and the simulation

Although the standards of best practice were not explicitly designed for Healthcare Simulation Escape Rooms (HSERs), they may be used to optimize the design, maximizing participant learning.

Theoretical Framework

The use of theories, frameworks, and models can guide simulation development and study design, helping to address gaps in the literature and strengthen methodological rigour (Kopt et al., 2025). This is reinforced by the International Nursing Association for Clinical Simulation and Learning (INACSL), which encourages the use of a theoretical framework that is aligned with the purpose and learners when developing simulation-based learning experiences (INACSL, 2021).

Adults are self-directed learners who bring valuable prior experiences to the learning process. They want to understand the purpose of what they are learning and prefer content that is relevant to their personal or professional lives (New England School of Technology, n.d.). Adults learn best through hands-on, practical, and problem-centred approaches that connect directly to real-world challenges (Bonn et al., 2023). They are most motivated to learn when they

recognize a need for new knowledge or skills and when their motivation comes from within rather than external pressures (Stringfellow, 2021; New England Institute of Technology, n.d.).

Kolb's Experiential Learning Theory (ELT) integrates principles of adult learning. It was selected for this study for several reasons. First, the concept that learning is an ongoing cycle reflects the nature of continuing education in nursing. Nurses gain knowledge through caring for patients and clients, collaborating with a multidisciplinary team, and administering new therapies. These experiences influence how they interact and provide care later in their careers (Poore et al., 2014). Second, the idea that knowledge is central to human development resonates with me as an educator. This fosters curiosity and motivation to learn (Kolb, 1984). Finally, and importantly for this study, the ELT cycle mirrors the phases of simulation. Details on how ELT supports this study and can be applied to simulation best practices are discussed further in the theoretical framework section.

Evaluation

The Healthcare Simulation Standards of Best Practice™, developed by INACSL, require the evaluation of learning gained through simulation (INACSL, 2021). Kirkpatrick's four-level training evaluation model aligns with these standards. In particular, the second level of evaluation involves assessing knowledge using pre- and post-tests. The Kirkpatrick training evaluation model will be explained in more detail in Chapter 3.

Gamification

Since 2018, gamification has gained considerable attention as a strategy to enhance learner engagement and motivation by incorporating game design elements into educational settings (Yıldız et al., 2024; López-Belmonte et al., 2020; Coughlin et al., 2023; Dichev & Dicheva, 2022). In response to this new pedagogy, clinical nurse educators and curriculum

developers have embraced innovative teaching strategies to improve learner engagement in continuing education (Stringfellow, 2021). Gamification pedagogy is a new approach to continuing education that encourages active learning and enhances engagement, adhering to adult learning principles.

Healthcare Simulation Escape Room

HSERs combine principles of adult learning, gamification, and simulation, offering an innovative, interactive format that emphasizes problem-solving, collaboration, and active learner engagement (Guckian et al., 2020; Gomez-Urquiza et al., 2022). Although existing evidence supports the use of HSERs for improving teamwork and engagement, limited empirical research has specifically examined their impact on knowledge development, particularly in nursing education (Foltz-Ramos et al., 2021; Sahin Karaduman & Basak, 2024).

Anaphylaxis

Anaphylaxis is a rapid-onset, potentially fatal hypersensitivity reaction that requires immediate recognition and intervention to prevent morbidity and mortality (Dinakar & Chipps, 2012; Muraro et al., 2022). There is a risk of anaphylaxis from food contamination, unknown allergies, or medications that can trigger an anaphylactic reaction (TREKK, 2021). Prompt recognition and management of anaphylaxis are critically important across pediatric specialties. Despite clear clinical guidelines, evidence from pediatric tertiary care settings indicates ongoing challenges in the timely identification and management of anaphylaxis, including delays in administering intramuscular epinephrine, the first-line treatment (Cohen et al., 2018; Prendergast et al., 2020). These gaps are especially concerning in high-acuity pediatric environments, where clinical deterioration can occur rapidly, and early intervention is crucial. Therefore, targeted educational strategies are vital to improve clinician competence and confidence in recognizing

and managing anaphylaxis. Simulation-based education offers an experiential approach that supports knowledge acquisition, clinical decision-making, and skill retention in time-sensitive emergencies (Liu et al., 2025).

Purpose

To evaluate the effectiveness of HSERs in improving knowledge development among nurses during clinical orientation, in the context of recognition and management of anaphylaxis in a pediatric acute care hospital.

Research Question

Does participation in an HSER on anaphylaxis, in addition to a standard lecture, improve knowledge acquisition on assessment and management compared to a lecture alone?

Contribution to Advancement of Nursing Knowledge

Innovative strategies are needed to make professional development meaningful and sustainable. HSERs integrate adult learning principles, simulation, and gamification to encourage collaboration, problem-solving, and active participation. Research indicates improvements in engagement and teamwork. However, there is limited evidence on how these experiences affect knowledge acquisition. By comparing HSERs with lecture-based instruction in hospital orientation, this study seeks to determine whether this interactive approach can enhance learning outcomes and better prepare nurses to provide safe, evidence-informed care in today's complex healthcare environment.

Chapter 2: Literature Review

A literature review was conducted to evaluate existing research on HSERs during the summer of 2025. The review highlights the research question, aiding in shaping the methodology of this study.

Search Strategy

A literature review was performed using the databases CINAHL, Education Source, and Nursing and Allied Health Premium edition. These databases were accessed through the University of Ottawa's Health Sciences Library. Relevant citations from reference lists were included in the review. These databases were selected to ensure literature from health sciences and education was included in the results. In addition to the database searches, a manual search of reference lists and grey literature was conducted. Google Scholar was also used to access references that were not available through the University of Ottawa.

Keyword and related search terms included *gamif*, nurs*, escape room*, *serious games*, *continuing education, professional development, lifelong learning, ongoing education, simulation and simulation education*. Boolean operator terms "OR" and "AND" were used to improve the accuracy of the database searches.

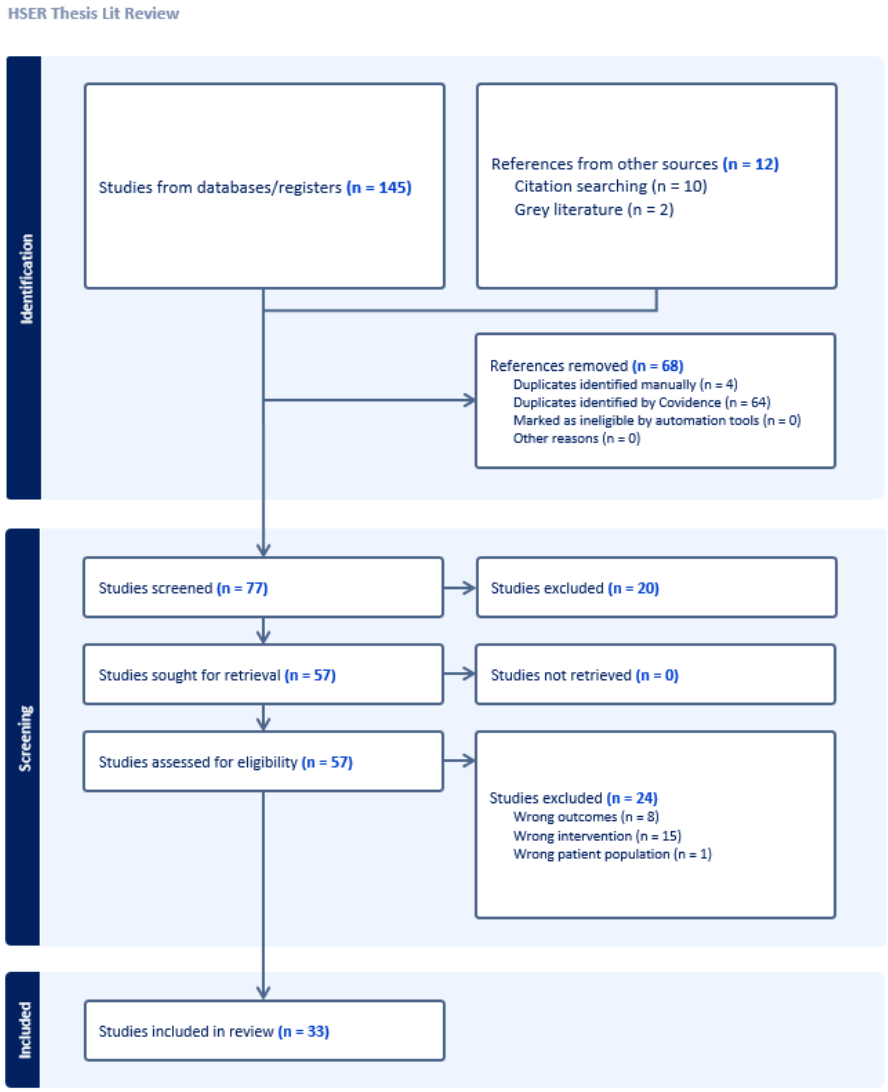
Sources include journal articles, conference papers, textbooks, book chapters, systematic reviews, and qualitative and quantitative studies published since 2018 in English. The rationale for selecting this date range was the nearly 220% increase in publications on gamification from 2018 to 2023 (Yildiz et al., 2024). All data sources were accessible online. Articles that did not mention gamification or a variation of "escape room" in the abstract were excluded. Resources

that did not involve nurses or nursing students, or did not assess knowledge in the abstract, were also excluded.

The search resulted in 145 publications. Duplicates were removed. Title, abstract and full-text screening were completed. 33 articles were selected for inclusion using the search strategy outlined in Figure 1.

Figure 1

Prisma Diagram



Publications that mention serious games, gamification, escape rooms and evaluation of knowledge were included in a full-text review. Among the articles reviewed, 19 addressed escape rooms in some capacity (Anderson et al., 2021; Anguas-Gracia et al., 2021; Arrue et al., 2025; Bright & Ulmen, 2023; Coughlin et al., 2023; Dacanay et al., 2021; Dinakar, 2012; Foltz-Ramos et al., 2025; Friedrich et al., 2019; Gomez-Urquiza et al., 2022; Guckian et al., 2020; Güngör et al., 2025; López-Belmonte et al., 2020; Özkan Şat et al., 2025; Rushdan et al., 2025; Seymour et al., 2023; Ward et al., 2024; Wynn, 2021; Yıldız et al., 2024). 14 evaluated the educational experience (Anguas-Gracia et al., 2021; Arrue et al., 2025; Bright & Ulmen, 2023; Coughlin et al., 2023; Dacanay et al., 2021; Foltz-Ramos et al., 2021; Friedrich et al., 2019; Gomez-Urquiza et al., 2022; Guckian et al., 2020; Lin et al., 2025; López-Belmonte et al., 2020; Seymour et al., 2023; Woolwine et al., 2019; Wynn, 2021). Only six investigated both the implementation of escape rooms and the measurement of knowledge outcomes (Arrue et al., 2025; Bright & Ulmen, 2023; Dacanay et al., 2021; Özkan Şat et al., 2025; Rushdan et al., 2025; Wynn, 2021). Only two of the 33 reviewed studies conducted a randomized controlled trial, evaluating knowledge acquisition following an HSER with very positive results (Arrue et al., 2025; Dacanay et al., 2021). The limited number of publications identified in the literature review underscores the need for further investigation into the role of HSERs in fostering knowledge development in nursing orientation and continuing education.

The systematic review published by Celik et al. (2025) supports these findings. It focuses on evaluating the level of evidence supporting the effect of game-based interventions on nursing students' knowledge. Studies included in this article assessed knowledge acquisition following various types of serious games using randomized controlled trials. Six articles were included in

their final analysis. Although the studies included did not evaluate HSERs, each demonstrated that gamification positively impacts knowledge levels.

Gamification

Gamification is a highly popular approach in nursing education. Activities such as using apps like ‘Kahoot’ and computer programs demonstrate improvements in knowledge levels (Moon & Kim, 2024; Celik et al., 2025). Tasks that involve manual skills enhance learning outcomes and support the retention of procedural knowledge (Ward, 2024). This is further supported by Woolwine et al. (2019), who conclude that gamifying learning experiences boosts motivation and increases engagement, resulting in better knowledge retention. Participants in research on online gamification in nursing education report that muscle memory, developed through practical, hands-on experience, was more effective than brain memory for retaining information (Lin et al., 2025).

Stringfellow (2021) emphasizes the significance of applying adult education principles. Key factors influencing learning include motivation, learners' prior experience, and the relevance of content to their professional context. Game-based instructional design frequently incorporates problem-based learning modelled on clinical scenarios, making it highly consistent with adult learning principles.

Much of the research examining the impact of gamification on the experience of learners does not specifically evaluate knowledge level or acquisition. However, studies conclude that participation in serious games results in high motivation and engagement, directly impacting knowledge levels following a learning activity (Woolwine et al., 2019; Anguas-Garcia et al., 2021; Kopt et al., 2025; Zapata et al., 2025). Studies that evaluated knowledge acquired following gamification using a pre/post-test method all showed statistically significant

improvement in test scores following a game activity (Billner-Garcia & Spilker, 2022; Moon & Kim, 2024; Othman et al., 2024). Of note, a study conducted by O'Neill et al. focusing on improving knowledge among nurses regarding catheter-associated urinary tract infections (CAUTI) using gamified education reports improvement in mean knowledge scores from a baseline of 67.87% to 86.15% eight weeks following the intervention, with statistical significance $p = 0.02$ (O'Neill et al., 2018). Similarly, a study examining the impact of gamified education activities on nursing students' engagement with regulatory requirements of nurses, conducted a pre-/posttest analysis demonstrating an improvement of 13% compared to the pretest scores for 635 matched participants (Zapata et al., 2025).

Kopt et al. (2025) conducted a mixed-methods study examining the perspectives, perceptions, and confidence of nurse educators and nursing students regarding gamification. Overall, the results indicate that both nurse educators and nursing students have a positive perception of the use of gamification in simulation education (Kopt et al., 2025). They found that older educators had more positive perceptions of gamification ($p = .022$) and higher confidence in facilitating gamification ($p = .048$). A positive correlation was found between perception and confidence and educational attainment ($p = .045$), with advanced degrees associated with higher levels of each factor. In keeping with these findings, correlations were observed among nurse educators with more teaching experience ($p < .001$) and those who had received training in this pedagogy ($p < .001$) (Kopt et al., 2025).

Healthcare Simulation Escape Room

HSERs integrate simulation and gamification to create collaborative problem-solving experiences that enhance learner engagement, teamwork, and real-time clinical decision-making (Guckian et al., 2020; Gomez-Urquiza et al., 2022). Research suggests HSERs are effective for

developing teamwork, communication, and learner satisfaction (Friedrich et al., 2019; Gomez-Urquiza et al., 2022; Coughlin et al., 2023). However, most existing studies are descriptive or exploratory, with limited empirical evaluation of their effectiveness in improving knowledge outcomes (Foltz-Ramos et al., 2021; Sahin Karaduman & Basak, 2024).

In a study focusing on prelicensure nursing students, Wynn (2021) examines the impact of an escape room simulation on knowledge acquisition regarding renal impairment using a pre/post-test method. Students attended a lecture on acute kidney injury the week before the escape room as preparation. Although this was a small sample size ($n = 24$), the results were positive overall. Five of the eight groups successfully solved the escape room within the allotted time frame of 30 minutes. The post-test mean was 86, an improvement from the pre-test mean of 73.5 (Wynn, 2021). The results include the perceptions of the participants regarding the experience, which highlighted the enjoyment of the activity and appreciation for applying knowledge gained in class. They observed that the experience was excellent for teamwork and overall, less stressful than a traditional simulation (Wynn, 2021).

Similarly, Özkan Sat et al. (2025) published findings from a randomized controlled trial supporting the use of escape rooms in nursing education. A three-arm randomized controlled trial compared knowledge and attitude outcomes regarding violence against women following role-play (simulation), a traditional lecture, and an escape room (Özkan Şat et al., 2025). Repeated measures ANOVA were used to compare groups over time. Between-group effect sizes were assessed using partial eta-squared (η^2). Within-group comparisons revealed no statistically significant changes in knowledge or attitude scores toward violence for any of the three groups ($p > .05$). However, post-test scores at the first week and first-month assessments showed that the simulation and escape room groups scored significantly higher than the control group ($p < .05$).

The between-group effect size was moderate ($F = .237$) at the first week follow-up and low ($F = .138$) at the first-month follow-up. These findings indicate that students in the role-play and escape room groups retained more knowledge over time than those in the control group. Interestingly, the escape room group showed a statistically significant increase in scores on the Scale for Nurses' and Midwives' Recognition of the Symptoms of Violence Against Women between the pre-test and post-tests one and two ($p < .05$). The difference between the post-tests at one week and one month was also significant, with a large effect size ($\eta^2 = .398$). These findings indicate that students in the escape room group continued to improve their ability to recognize the symptoms of violence over time (Ozkan et al., 2025).

Dacanay et al. (2021) published exciting results from their research evaluating the impact of sepsis HSER. The study offered an escape room educational activity to post-licensure nurses working in adult inpatient units, with the goal of improving recognition and management of sepsis and catheter-associated urinary tract infections (CAUTI). Significant improvements in patient outcomes were reported, particularly a reduction in CAUTI, six months after implementing the escape room, with CAUTI rates falling from an average of 1.83 to 0.33 per month. They also noted improvements in sepsis identification and in the performance of associated lab draws (Dacanay et al., 2021). The incidence of lactic acid blood sampling increased from 62% five months prior to escape room education to 77% three months post-implementation (Dacanay et al., 2021). The authors highlight the positive feedback staff provided about the impact the experience had on patient care. They also describe the enthusiasm and satisfaction of educators and facilitators throughout the development and implementation of the escape room.

HSERs can be delivered effectively in person and virtually (Colletto, 2023; Bright & Ulman, 2023). Bright and Ulman (2023) compared 83 nursing students' experiences of in-person and virtual escape rooms in a randomized controlled trial. After comparing the pre- and post-test scores within each group, they concluded that both modalities offer effective learning experiences. The virtual group's mean scores improved from 2.8 (pre-test) to 3.4 (post-test), demonstrating a significant positive impact ($P < .001$). The in-person group showed a similar improvement, with mean pre-test and post-test scores of 2.9 and 3.8, respectively. A two-sample *t*-test comparing the virtual and in-person groups found no significant difference between delivery methods ($t_{(79)} = 1.02$, $P = .30$). Feedback from both groups indicated that they found the activity engaging and fun. Participants commented that they felt the escape room encouraged critical thinking (Bright & Ulman, 2023).

Pedagogy Challenges

Despite the positive results found throughout this literature review on gamification and, more specifically, HSERs, there are implementation challenges. The findings of the study conducted by Kopt et al. (2025) highlight that nurse educator confidence is essential in the successful design and implementation of gamified education. Nurse educators with more years of teaching experience and training have higher levels of confidence. This highlights the need to provide training and support to nurse educators in this methodology (Kopt et al., 2025). Additional challenges identified are the lack of institutional support and policy limitations as significant barriers educators face in implementing gamification in simulation education (Kopt et al., 2025). There is also potential for resistance from faculty and students to gamification (Kopt et al., 2025).

Additional challenges to this pedagogical approach include limited opportunities for professional development to design, deliver, and evaluate gamified education (Kopt et al., 2025). There is also a lack of standardized assessment tools to accurately evaluate learning outcomes from gamified activities (Kopt et al., 2025). Enthusiasm among both nurse educators and learners can lead to overuse or inappropriate application of new learning methods, potentially reducing motivation to participate (Billner-Garcia & Spilker, 2024).

A factor to consider regarding virtual escape rooms is the initial cost of adopting new technology, which can be high (Woolwine et al., 2019). Nurse educators and simulation facilitators need training in the program used to produce a high-quality experience (Bright et al., 2025). Outdated technology and insufficient information technology support may also be barriers to the use of a virtual mode of gamified education (Kopt et al., 2025). Additional obstacles to smooth use of virtual escape rooms include unfamiliarity with the technology and understanding the program's functions (Colletto, 2023; Zapata et al., 2025).

Chapter 3: Theoretical Framework

Kolb's Experiential Learning Theory

This section provides an overview of ELT, exploring the foundations, principles, and applications to gamification and this study. ELT, first introduced by David Kolb in 1984, draws on the ideas of many pioneering thinkers. Kolb and Kolb (2017) identify William James, John Dewey, Kurt Lewin, Jean Piaget, Lev Vygotsky, Carl Jung, Mary Parker Follett, Carl Rogers, and Paulo Freire as key influences on the development of the theory. Combining principles of radical empiricism, constructivism, and experiential education with these scholars' insights, ELT provides a comprehensive framework for understanding and advancing experiential learning.

Examination of the formative philosophies Kolb used to develop ELT provides understanding and context to this theory. Kolb included the beliefs of philosopher William James in the development of ELT (Seel, 2012). James believed that learning revolves around how the world and thought are experienced (Kolb & Kolb, 2017). He proposed that the relationship between the body, the mind and experience is continuously evolving. Kolb incorporated this concept in the learning spiral of ELT (Kolb, 1984). John Dewey expanded on this, emphasizing the continuous cycle of learning and the relationship between reflection and learning (Kolb & Kolb, 2017).

Modelling the scientific process, Dewey, Piaget, and Lewin suggest that learning is the highest philosophical function of human adaptation (Kolb, 1984). They proposed that learning is not a linear process, nor is it limited to a single pathway such as cognition. Instead, it is a continuous cycle or spiral of ongoing experience and interpretation of information, leading to further adaptation of perceptions and beliefs. Learning results in change and new learning

throughout one's life (Kolb, 1984; Seel, 2012). Kurt Lewin argued that learning is most effective when individuals are active participants rather than passive recipients. His work on group dynamics and field theory laid the foundation for experiential learning, showing that active engagement fosters deeper reflection, more substantial ownership, and higher-quality outcomes (Lewin, 1951). These are important features of this theory as it applies to continuing education, particularly in nursing. As healthcare is constantly evolving, this requires nurses to commit to learning new skills, new protocols and new treatments throughout their career.

According to ELT, the transactional relationship between a person and the environment is symbolized in the dual meaning of the term ‘experience.’ For example, an individual may experience frustration or joy, and they may have 25 years of experience as a nurse. Kolb uses the term transactional intentionally, suggesting that it more accurately describes the fluidity of the concept between the objective conditions and the subjective experience. He elaborates, stating that “once they become related, both are essentially changed” (Kolb, 1984, p. 36).

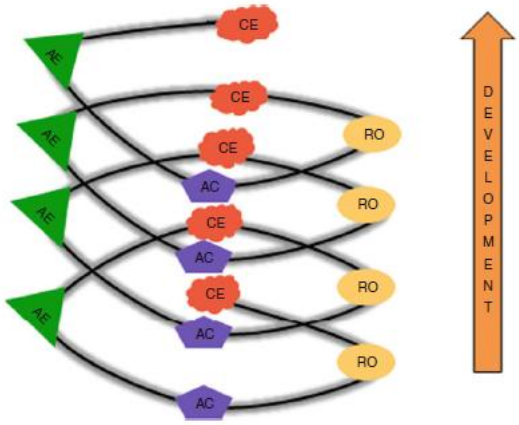
To better understand this theory, it is important to define learning. Rather than the passive relationship between a subject, educator, and learner, ELT places the subject matter at the center of the experience, with the learners and educators surrounding it. “For educators, the magic of experiential learning lies in the unique relationship that is created between the teacher, the learner, and the subject” (Kolb & Kolb, 2017, p. 16). As each individual has concrete experience with a subject, their perceptions change, creating a feedback mechanism for the other members in the group. This approach to education encourages different perceptions, challenges opinions, and supports varied learning styles. Learning can then be defined as the creation of knowledge through the transformation of experience (Kolb, 1984).

The Experiential Learning Theory spiral represents the most complete expression of learning, leading towards human development. The spiral has four elements that continue throughout an experience and beyond (Figure 1):

1. Concrete Experience (CE): The learner encounters either a new or familiar experience that sparks new ideas or questions.
2. Reflective Observation (RO): The learner intentionally reflects on the 'concrete experience' using existing knowledge.
3. Abstract Conceptualization (AC): Based on their experience, the learner draws conclusions, leading to a new or more profound understanding of concepts.
4. Active Experimentation (AE): The learner applies new knowledge in real-life situations (Kolb & Kolb, 2012; Ward, 2024).

Figure 2

Experiential Learning Spiral



(Kolb & Kolb, 2012)

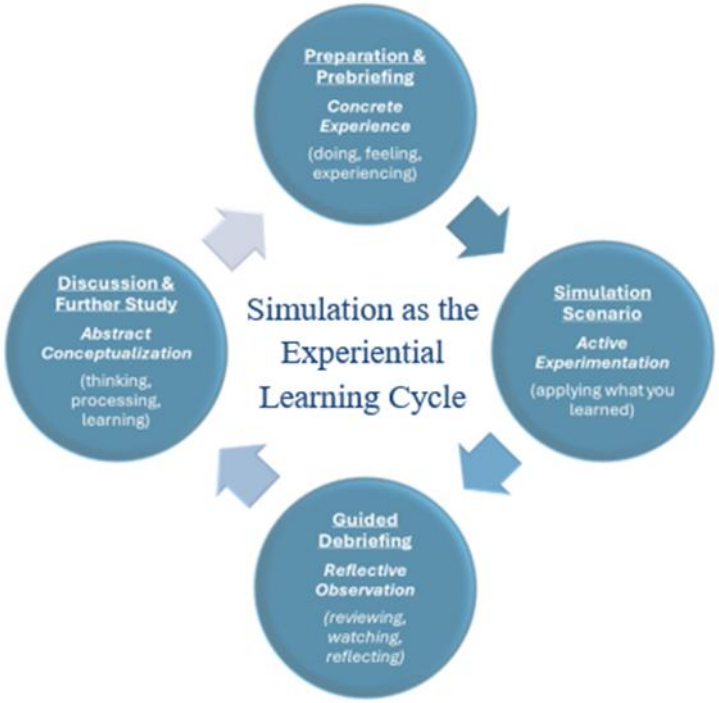
Application of Experiential Learning Theory to Healthcare Simulation Escape Rooms

ELT has been applied to training in various professions such as medicine, business, nursing, and psychology (Poore et al., 2014). Kolb and Kolb (2017) discuss the application of the theory in educational contexts in the guide they created for experiential educators in higher education. They highlight the role of the theory in simulation and problem-based learning, as well as innovative educational approaches. ELT can offer strategies for effective scenario development and the implementation of simulation experiences (Poore et al., 2014; Rossler & Kimble, 2016).

ELT's learning cycle supports the structure of HSERs by immersing learners in real-world clinical scenarios (concrete experience), promoting debriefing and discussion (reflective observation), enabling the application of theoretical knowledge (abstract conceptualization), and fostering the ability to apply learning to future situations (active experimentation). ELT provides a strong foundation for designing and evaluating simulation-based education, mainly when learning outcomes include critical thinking, knowledge acquisition, and decision-making (Figure 3).

Figure 3

Simulation and the Experiential Learning Cycle



(Kolb, 1984; Poore et al., 2014; Ward, 2024)

Kirkpatrick Model of Evaluation

The four-level Kirkpatrick Model of evaluation, developed by Dr. Don Kirkpatrick, provides a structured framework for evaluating training effectiveness across four levels: reaction, learning, behaviour, and results.

1. ***Reaction Level.*** The reaction level assesses participants' perceptions of the training, including satisfaction and perceived relevance. This level captures immediate responses and is typically measured through post-intervention surveys.
2. ***Learning Level***. The learning level assesses how well participants acquire the intended knowledge, skills, attitudes, confidence, and commitment. This learning is typically

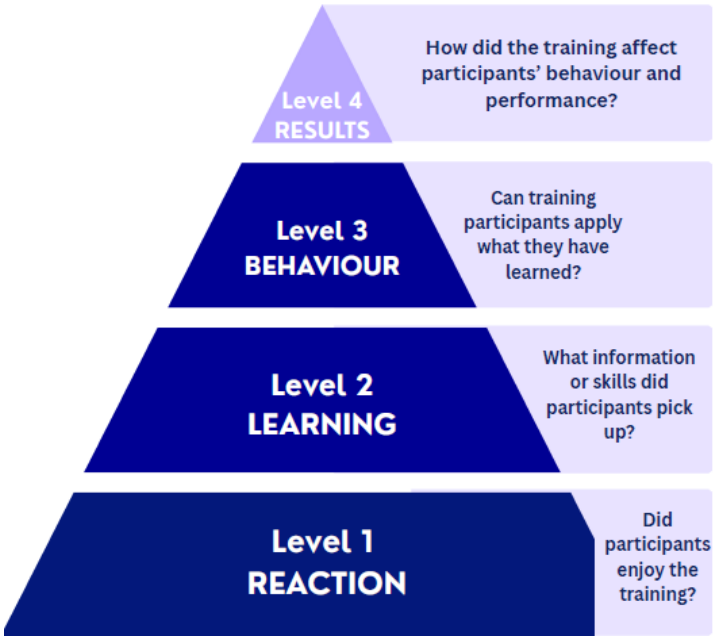
measured through objective methods such as written tests and skills assessments. In this study, evaluation tools include pre- and post-tests to demonstrate the learning gained from the educational activities. Successful completion of the HSER within the allotted time demonstrates that skills in recognizing and managing anaphylaxis have been learned. The debrief following the HSER further explores the participant's learning experience. The facilitator asks questions based on the learning objectives, encouraging the group to discuss their observations, reasoning behind their decisions, and actions.

3. ***Behaviour Level.*** The behaviour level assesses how learning translates into practice, concentrating on observable changes in workplace performance and professional conduct after the intervention. Data at this level may be gathered through self-report measures and multi-source feedback, including input from supervisors and peers.
4. ***Results Level.*** The results level evaluates the organizational impact of the training by measuring its contribution to specific outcomes. This level indicates the overall effectiveness of the training and is assessed using performance indicators such as retention or incident rates, often in partnership with organizational leadership (Kirkpatrick & Kirkpatrick, 2016).

This model is frequently used to assess the effectiveness of education and training in healthcare (Jeffney et al., 2025; Liu et al., 2025). An adaptation of this framework illustrates how each of the four levels applies in practice (Figure 4).

Figure 4

Kirkpatrick's 4-Levels of Training Evaluation in Education



(adapted from Kirkpatrick & Kirkpatrick, 2016)

The Healthcare Simulation Standards of Best Practice™ include 'evaluation of learning and performance' (INACSL, 2021). A valid, reliable tool should be used (INACSL, 2021). According to the standard, evaluating simulation-based experiences may involve assessing knowledge, skills, attitudes, and behaviours, aligning with the four levels of evaluation in Kirkpatrick's model, as shown in Figure 3 (Kirkpatrick & Kirkpatrick, 2016). Using this model as a framework, this study focuses on the second stage: learning. The methods Kirkpatrick recommends for evaluating learning guided the identification of pre- and post-tests as the appropriate tools to evaluate the research question. The development of the tests for this research is discussed further in the methods section. The successful completion of the HSER within the time restriction indicates skills learned in the recognition and management of anaphylaxis.

Additionally, Kirkpatrick's model provides a structure for analyzing the results of this study and offers insight into further evaluation of HSERs.

Chapter 4: Methods

Study Design

This study uses a two-arm randomized controlled trial design. This design was chosen to evaluate the effectiveness of adding an escape room activity to the learning session for nurses in a hospital-based orientation program. It adheres to the characteristics of a randomized controlled trial: 1) Manipulation - the HSER intervention; 2) Control – maintaining the control (Group A), allowing comparison to the experiment (Group B); and 3) Randomization – participants were randomly assigned, equalizing the groups (Polit & Beck, 2021). Kirkpatrick suggests that assessment of learning includes evaluation of knowledge and skills through discussion, simulation and knowledge testing (Kirkpatrick & Kirkpatrick, 2016). The study intervention consists of three activities: an interactive lecture on anaphylaxis (*discussion*), the HSER (*simulation*), and pre- and post-knowledge tests (*knowledge testing*) (Kirkpatrick & Kirkpatrick, 2016).

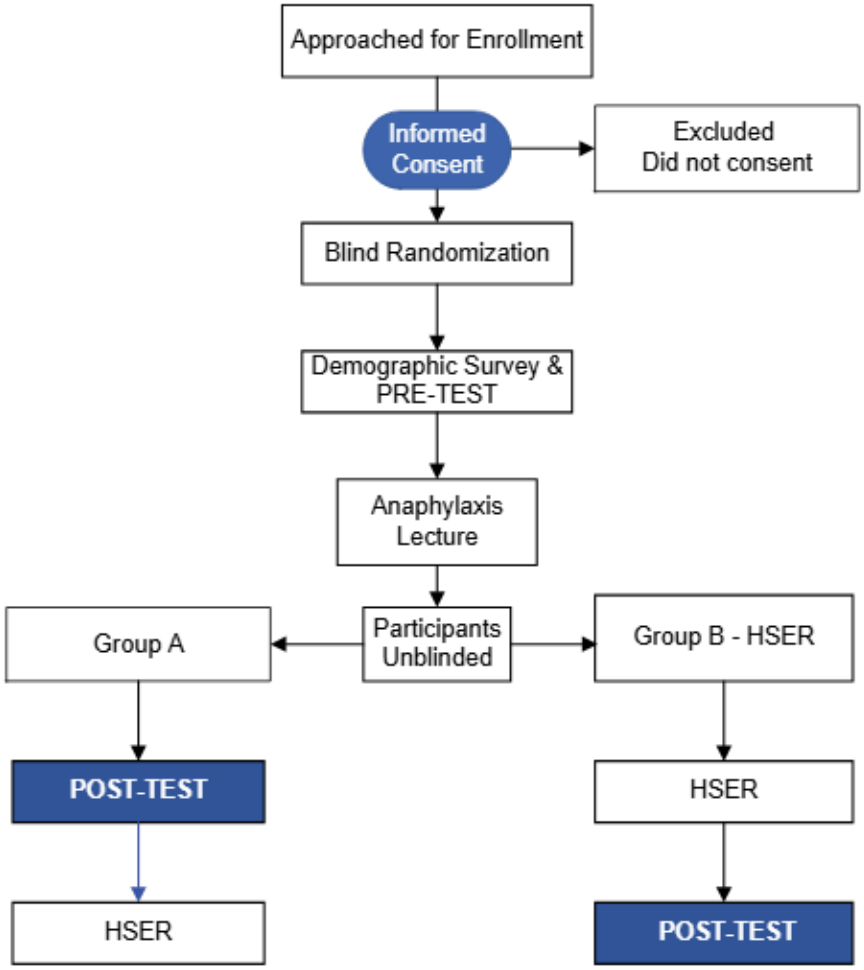
Anaphylaxis was selected as the focus of the HSER due to documented gaps in timely recognition and management in pediatric tertiary care, particularly delays in epinephrine administration (Cohen et al., 2018; Prendergast et al., 2020). Given the rapid progression and high risk of anaphylaxis, this topic is well-suited to simulation-based education to strengthen clinical decision-making in acute care settings. The case studies in the pre- and post-tests, as well as the scenario developed for the HSER, focus on the causes of anaphylaxis common across most units: amoxicillin, platelets, and intravenous immunoglobulin (IVIG). Penicillin and its derivatives, such as amoxicillin, are the most common cause of drug-induced anaphylaxis

(Ramsey & Staicu, 2022). Platelets were selected as the trigger for the post-test case study because allergic reactions are the most common transfusion-related adverse events associated with platelet administration (Khandelwal, Clarke & Goldman, 2021). IVIG, a plasma-derived blood product frequently used in pediatric care, can cause hypersensitivity reactions including anaphylaxis (Khandelwal, Clarke & Goldman, 2021). Given that pediatric nurses routinely administer antibiotics and blood products, prompt recognition and management of anaphylaxis are essential clinical competencies. Translating Emergency Knowledge for Kids (TREKK) promotes excellence in pediatric emergency care in Canada (TREKK, n.d.). TREKK recommendations and treatment algorithm for anaphylaxis are adhered to in the case studies in the pre- and post-tests, as well as in the HSER scenario (TREKK, 2021).

Nurses who agreed to participate were randomly assigned to either Group A (control) or Group B (experimental). All participants attended a lecture and a Healthcare Simulation Escape Room (HSER) on anaphylaxis as part of their orientation. The effect of the HSER on nurses' learning was assessed by delaying the post-test for the experimental group. Specifically, the post-test for Group A (control) will be administered directly after the nurses receive the lecture, while the post-test for Group B (experimental) will be completed after participants have attended the lecture and finished the HSER (see Figure 5). All events occur in one day.

Figure 5

Study Design



Consenting participants were asked to provide an email address to link their pre-test and post-test scores (see Data Collection and Management section). Following consent, participants were randomized equally to Group A or Group B (Fig. 5). Randomization was kept blind until after the anaphylaxis lecture, promoting equal participation by both groups in the lecture (Lim & In, 2019). A QR code was scanned to complete the demographic survey, pre-test, and post-test in SurveyMonkey. The intervention examined in this study evaluates the HSER as a holistic

educational strategy, rather than analyzing its discrete components. Accordingly, the purpose of the study was to assess the overall impact of the HSER on knowledge outcomes, rather than to determine the relative effectiveness of individual elements within the activity. All nurses enrolled in nursing orientation will receive the same training as those who choose to participate in the study.

Demographic data were collected from all participants using a SurveyMonkey questionnaire to describe the sample, contextualize the study within similar research, and assess the generalizability of the results. No inferences regarding participant demographic characteristics, such as potential associations between gender and post-test scores, will be made (Lewis et al., 2019). The survey will be conducted prior to the pre-test and will include questions about age, nursing specialty, and years of nursing experience. Participants may voluntarily self-identify their ancestry, gender, and disability status (Appendix A). Demographic data regarding physical disabilities, learning disabilities, and neurodivergence were collected, as these factors may influence learning and could potentially affect the effectiveness of the HSER in knowledge acquisition. All participants will complete the pre-test (Appendix B) before the lecture on anaphylaxis management. Following the presentation, the participants will be notified of their study group. As described above, the control group, Group A, will complete the post-test (Appendix C) following the anaphylaxis presentation. The experimental group, Group B, will complete the same post-test following the lecture and the HSER. The scores of the control group will be compared with those of the experimental group using appropriate statistical methods (see Statistical Analysis section).

Hypotheses

Null Hypothesis

There is no significant difference in knowledge acquisition between participants randomized to the HSER arm and those randomized to the traditional simulation arm.

Alternate Hypothesis

Participants randomized to the HSER arm have different knowledge acquisition compared to those in the traditional simulation arm.

Ethical Considerations

The study has received approval from the University of Ottawa (Appendix D) and CHEO Research Ethics Boards (Appendix E). Confidentiality has been maintained through de-identification and secure data storage. The primary researcher and all committee members completed the Tri-Council Policy Statement 2 (Appendix F). Annual renewal approval was obtained from the CHEO RI Research Ethics Board in January 2025 and January 2026.

Consent

I obtained informed consent in person, either directly or through a designated delegate, at least one day prior to the intervention (Appendix G). During orientation sessions held from February 2025 to January 2026 inclusive, I provided nurses with a verbal explanation of the research study and the HSER. Potential participants were given the opportunity to ask questions about the study both during the explanation and again on the day of the intervention. Two other nurse educators with experience teaching in nursing orientation were provided with the script for both the lecture and HSER. On the rare occasion that I was unable to be present to obtain consent or teach the content, they did so in my place.

Intervention

The HSER scenario mimics the progressive signs and symptoms of an anaphylactic reaction. The three phases are consistent with the standards for simulation-based education and Kolb's experiential learning theory, as shown in Figure 3 (INACSL, 2021; Kolb & Kolb, 2017).

1. The prebrief / concrete experience – participants receive guidance and instructions related to the escape room. During this phase, they are introduced to the simulation scenario and given a 10-minute time limit. This time restriction reflects the interval from the onset of the first symptom of anaphylaxis to the need for cardiopulmonary resuscitation if the condition remains untreated (TREKK, 2021).
2. The HSER / *active experimentation*– solving puzzles using the clues provided. Using skills learned in the earlier lecture.
3. Debriefing / *reflective observation* – discussion regarding their experience, what they learned and highlighting key teaching points. Please note, this is not a focus group. This is an essential phase of simulation education.

The key learning objectives focus on recognizing the signs and symptoms of anaphylaxis, identifying which systems are involved, selecting the appropriate emergency medication, and the correct formulation of epinephrine and the most appropriate administration site. This information is clearly outlined in the lesson plan (Appendix H).

Evaluation Tool

To assess the knowledge and skills gained from simulation, the pre-test/post-test approach is commonly employed (Sahin Karaduman & Basak, 2024). When no suitable tool exists for the subject matter, it is standard practice for the researcher to develop one (Curl et al.,

2016; Yeom & Park, 2024). The case studies utilized/ for the pre- and post-tests illustrate the signs and symptoms of anaphylaxis and adhere to the TREKK anaphylaxis management guidelines (TREKK, 2021). Two nurse educators, a clinical resource nurse, and a physician who are subject matter experts reviewed the tests. After incorporating their feedback, the tools were beta-tested with staff nurses in the inpatient hematology/oncology unit, focusing on both the functionality of the tests and the SurveyMonkey platform. Internal consistency was not emphasized, as Cronbach's alpha assumes unidimensionality and may be inappropriate for heterogeneous knowledge tests (Tavakol & Dennick, 2011).

The purpose of the pre- and post-tests is to evaluate participants' ability to accurately recognize and treat anaphylaxis. Each test consists of 10 multiple-choice questions, each with one correct answer, corresponding to the case study provided. The first question on each test slightly varies by case study, while the other nine questions remain the same. Only one question appears at a time. These questions are designed to build on each other, with later questions providing solutions to earlier ones. Participants cannot modify their responses after submission. The correct answers are coded as 1 and incorrect as 0, yielding a total score out of 10.

Originally, REDCap was selected as the survey platform. However, there were many issues. The platform crashed on two occasions for over an hour at the time of the pre-test, resulting in the inability to complete the test. The links for the pre- and post-tests were not sent promptly despite setting up the tests for timed delivery and troubleshooting. These concerns were discussed with the REDCap administrator at the CHEO Research Institute, but they ultimately could not be resolved. At that point, data collection transitioned to paper. This posed a new problem as the test was designed to provide one question at a time. There was potential for

participants to obtain the answers by reviewing the test before starting. Once this error was discovered, data collection was paused. A protocol deviation and protocol modification were filed. After SurveyMonkey was identified as the new platform, the study proceeded without further issues. The same survey structure, question format, and scoring approach were maintained when transitioning from REDCap to SurveyMonkey to ensure consistency in data collection.

Setting and Sample

The study took place at CHEO, a tertiary care pediatric hospital in Ottawa, Ontario. Orientation of nursing staff at this hospital is held 10 times each year, with a typical group size of 10-20 nurses. All new hires from February 2025 to January 2026 were invited to participate in the study. Those who consented were enrolled in the study during corporate nursing orientation. Orientation was selected for the predictable frequency and attendance during the year. The topic of anaphylaxis recognition and management is covered in the existing orientation content. In consultation with the Clinical Research Unit at the CHEO RI, the target sample size of 100 participants (50 control group/ 50 experimental group) was established to provide adequate statistical power to detect meaningful differences in knowledge acquisition between the intervention and control groups. This sample size provides sufficient power while accounting for potential missing or incomplete data (Polit & Beck, 2021).

Inclusion criteria

Participants must be Registered Nurses, able to consent, and proficient in English.

Exclusion criteria

Individuals who are unable to provide consent or are not registered nurses.

Duration of Participation

Participants will be required to take part for a maximum of 90 minutes, divided into two sections. Most of the time needed for participation is already included in the nursing orientation within the existing curriculum. This will include:

- Introduction of the study – 5 minutes
- Demographic survey – 5 minutes
- Pre-test – 10 minutes
- Lecture – total time 30 minutes
- Anaphylaxis HSER – 30 minutes
- Post-test – 10 minutes

Data

Collection and Security

Data was collected using a researcher-developed demographic survey, pre-test, and post-test. These tools were adapted as SurveyMonkey surveys to collect and store all study information. Data captured on data collection tools included direct and indirect identifiers. These include email addresses. The collection of email addresses is required for this study to link the results from the pre- and post-tests. Email addresses were de-identified and assigned a participant code. The email addresses are available on the Master list, accessible to my thesis supervisors and me. Identifying information is not used in data sets.

The administrative data, including the Master List and study notes, is password-protected and stored on a CHEO server with access limited to the research team. Study data and participant

emails are password-protected and stored on SurveyMonkey. These servers are located in Canada, the United States and Europe.

a) SurveyMonkey is a self-serve survey platform on which users can create, deploy and analyze surveys through an online interface.
b) SurveyMonkey encrypts all data at rest in data centers using AES 256-based encryption. Additionally, SurveyMonkey encrypts all data in motion using (i) RSA with 2048-bit key length-based certificates generated via a public Certificate Authority, for communications with entities outside SurveyMonkey's data centers, and (ii) RSA 256 certificates generated via an Internal Certificate Authority, for all the data within the data center.
c) After completion, the study data will be stored for the minimum data retention period of 7 years following the last date of publication.
d) The SurveyMonkey account is password-protected (SurveyMonkey, 2024).

Analysis Plan

Descriptive statistics are used to summarize the sample's demographic characteristics. Knowledge acquisition was assessed by comparing post-test scores between the two groups using analysis of covariance (ANCOVA), controlling for pre-test scores, age, and years of experience. Age was included as a covariate to account for potential demographic variability that may influence learning outcomes. In nursing populations, age is often associated with differences in professional experience and the development of clinical knowledge (Benner, 2010). Statistical control for age and years of clinical experience was selected to reduce error variance and improve the precision of estimated intervention effects (Polit, 2014). This approach allows for the evaluation of the intervention’s effectiveness while accounting for baseline differences in participants’ knowledge. IBM SPSS Version 29.0.2.0 is the software used to perform all

statistical calculations. The scripts of the analysis were extracted to ensure transparency and reproducibility.

Future Use

Data collected for this research may be used in future related research projects that are either an extension of the original project or in the same general area of research (secondary use of data). Researchers outside this specific study may request access to the coded data for new research purposes. This is stipulated in the informed consent; therefore, participants will not be asked to provide additional informed consent for the use of the coded data in future research.

Chapter 5: Results

Descriptive Statistics

Over 11 months, 108 nurses were invited to participate in the study. Most who declined did not offer a reason, nor was one pursued. 95 participants consented and completed the demographic survey and pre-test. 89 post-tests were completed. Sample sizes differed slightly between the pre- and post-test due to missing post-test data (Group A: n = 48; Group B: n = 41). The discrepancy in the number of completed pre- and post-tests resulted from confusion about when to administer the post-test on one occasion, which led to post-tests not being completed for the experimental group (n = 6).

Participant demographic and professional characteristics were similar across groups at baseline, as shown in Tables 1 and 2. 92.6% of participants identified as female, slightly higher than the reported national figure of 90% (Canadian Nurses Association, 2025). There is no evidence of a difference in gender distribution between Group 1 and Group 2. Most participants, 72.6%, were under 30 years old, which is significantly higher than the 33.8% of nurses in Ontario (College of Nurses of Ontario [CNO], 2025). The majority did not identify as having a disability (85.3%), 10.5% identified as having a disability, and 4.2% chose not to disclose. This is slightly lower than 12.4% of Ontario nurses with at least one disability reported by the CNO Workforce Census (CNO, 2024). The distribution of gender, age, disability status, and experience is comparable between groups. Participant ancestry is generally similar across both groups. While most identified as White or of European descent (66.3%), a variety of other ancestry groups were represented in the sample.

Table 1

Participant Demographic Characteristics by Group (N = 95)

Variable	Group A (*n* = 51)	Group B (*n* = 44)	Total (*N* = 95)
Age Group (years)			
20–29	38 (74.5%)	31 (70.5%)	69 (72.6%)
30–39	8 (15.7%)	11 (25.0%)	19 (20.0%)
40–49	2 (3.9%)	1 (2.3%)	3 (3.2%)
50–59	3 (5.9%)	1 (2.3%)	4 (4.2%)
Gender			
Female	48 (94.1%)	40 (90.9%)	88 (92.6%)
Male	2 (3.9%)	3 (6.8%)	5 (5.3%)
Non-binary	0 (0.0%)	1 (2.3%)	1 (1.1%)
Prefer not to say	1 (2.0%)	0 (0.0%)	1 (1.1%)
Disability Status			
Do not identify as having a disability	44 (86.3%)	37 (84.1%)	81 (85.3%)
Identify as having a disability	5 (9.8%)	5 (11.4%)	10 (10.5%)
Prefer not to say	2 (3.9%)	2 (4.5%)	4 (4.2%)
Years of Experience			
0–5	39 (76.5%)	34 (77.3%)	73 (76.8%)
6–10	8 (15.7%)	4 (9.1%)	12 (12.6%)
11–15	0 (0.0%)	3 (6.8%)	3 (3.2%)
16–20	3 (5.9%)	3 (6.8%)	6 (6.3%)
21–25	1 (2.0%)	0 (0.0%)	1 (1.1%)
Primary Area of Specialty			
Emergency	7 (13.7%)	6 (13.6%)	10 (10.5%)
Pediatric medicine	9 (17.6%)	9 (20.5%)	13 (13.7%)
Pediatric surgery	4 (7.8%)	4 (9.1%)	6 (6.3%)
Hematology/oncology	5 (9.8%)	2 (4.5%)	7 (7.4%)
Mental health	10 (19.6%)	4 (9.1%)	12 (12.6%)
Eating disorder program	3 (5.9%)	0 (0.0%)	3 (3.2%)
Neonatal ICU	8 (15.7%)	7 (15.9%)	10 (10.5%)
Pediatric ICU	10 (19.6%)	7 (15.9%)	10 (10.5%)
Ambulatory care	1 (2.0%)	0 (0.0%)	2 (2.1%)
Operating room	0 (0.0%)	1 (2.3%)	1 (1.1%)
Other	4 (7.8%)	12 (27.3%)	16 (16.8%)

Table 2

Participant Ancestry by Group (N = 95)

Ancestry	Group A (*n* = 51)	Group B (*n* = 44)	Total (*N* = 95)
Indigenous (First Nations, Métis, Inuit)	1 (2.0%)	0 (0.0%)	1 (1.1%)
Black	5 (9.8%)	3 (6.8%)	8 (8.4%)
Central Asian, North African/West African	1 (2.0%)	0 (0.0%)	1 (1.1%)
East Asian (Chinese, Japanese, Korean, Taiwanese)	1 (2.0%)	2 (4.5%)	3 (3.2%)
White / European descent	31 (60.8%)	32 (72.7%)	63 (66.3%)
Latin American descent	1 (2.0%)	2 (4.5%)	3 (3.2%)
Southeast Asian (Cambodian, Filipino, Indonesian, Thai, Vietnamese)	4 (7.8%)	0 (0.0%)	4 (4.2%)
South Asian (Bangladeshi, Indian, Indo-Caribbean, Pakistani, Sri Lankan)	0 (0.0%)	2 (4.5%)	2 (2.1%)
Middle Eastern (Arab, Persian, West Asian)	6 (11.8%)	1 (2.3%)	7 (7.4%)
Another ethnicity not listed	1 (2.0%)	1 (2.3%)	2 (2.1%)
Prefer not to say	0 (0.0%)	1 (2.3%)	1 (1.1%)

The groups began with similar baseline knowledge. The difference in pre-test means is very small (0.07), indicating that the groups were comparable before the intervention. The post-test scores for each group show significant improvement over the pre-test scores, demonstrating learning across all participants, as seen in Table 3. There is very little difference in the post-test scores between groups. Group A (Control) has a slightly higher post-test score mean than Group B (Experimental). This is examined further in the ANCOVA results.

Table 3

Descriptive statistics for pre- and post-test scores by group

Group	Pre-test M (SD)	Post-test M (SD)	Mean Change
A (*n* = 48)	5.71 (1.53)	7.98 (0.98)	+ 2.27
B (*n* = 41)	5.64 (1.16)	7.93 (0.91)	+ 2.29

Note: Mean change calculated as post-test mean minus pre-test mean. Sample sizes differed slightly between pre- and post-test due to missing post-test data.

A Univariate Analysis of Covariance

ANCOVA was performed using IBM SPSS Version 29.0.2.0 to compare post-test knowledge scores between groups while controlling for pre-test scores, age, and years of clinical experience. To ensure sufficient degrees of freedom and maintain the analysis's power, the age and years of experience categories were consolidated, reducing the number of variables. Age was reduced from four to three categories. Years of experience decreased from five to two categories. This serves to stabilize the parameter estimates (Polit, 2014). Group served as the independent variable, post-test score as the dependent variable, and pre-test score as a covariate. Age and years of experience were included as control variables to account for potential demographic

differences. Adjusted post-test score means were calculated at the mean value of the covariate, with estimated marginal means of 7.79 (*SE* = 0.16) for the control group and 7.76 (*SE* = 0.17) for the experimental group (Polit, 2014) (Table 4). The SPSS syntax for the ANCOVA is provided in Appendix I to facilitate reproducibility.

Levene's test of equality of error variances indicates that the assumption of homogeneity of variance was satisfied, $F(8, 80) = 0.43$, $p = .901$ (Polit, 2014). No clear evidence of deviation from normality was observed in the Q-Q plots or the Shapiro-Wilk test (Polit, 2014) (Appendix J). The results of the ANCOVA show that participants with high pre-test scores score higher on the post-test, $F(1, 83) = 13.98$, $p < .001$ and partial $\eta^2 = .144$, indicating a moderate to large effect (Polit, 2014). Age did not significantly predict post-test scores after controlling for other variables, with a small effect size, $F(2, 83) = 1.35$, $p = .265$, partial $\eta^2 = .031$. Additional experience had a negligible effect on the post-test, $F(1, 83) = 0.08$, $p = .778$, partial $\eta^2 = .001$. After accounting for pre-test scores, age, and experience, there was no statistically significant difference in post-test scores between groups, $F(1, 83) = 0.04$, $p = .840$, partial $\eta^2 = .00$, suggesting that the combination of a lecture and HSER had no effect on the post-test scores compared to the post-test after the lecture alone (Polit, 2014) (Table 4). These results support the null hypothesis that the HSER has no impact on knowledge acquisition.

Table 4

Adjusted Post-Test Scores and ANCOVA Results by Group (N = 89)

Group	Adjusted Mean (*SE*)	95% *CI* *[UL, LL]*	*F*(1, 83)	*p*	ηp²
Control	7.79 (0.16)	[7.48, 8.11]			
Experimental	7.76 (0.17)	[7.41, 8.10]			
Group Effect			0.04	.840	.000

Note: Values are estimated marginal means controlling for pre-test score (*M* = 5.63), age category, and years of experience. ηp² = partial eta squared.

Chapter 6: Discussion & Conclusion

In today's complex healthcare system, it is essential to engage nurses in education that emphasizes lifelong learning and integrates critical thinking and problem-solving into nursing care. Active engagement in educational activities is associated with better learning outcomes and fosters accountability for ongoing professional learning and high-quality patient care (Karimah & Shinobu, 2022; Ward et al., 2024). In response, clinical nurse educators and curriculum developers have embraced innovative teaching strategies to improve learner engagement in continuing education (Stringfellow, 2021). HSERs are gaining popularity in healthcare education, as evidenced by the increase in publications on escape rooms and gamification since 2018 (Yildiz et al., 2024). This expanding body of evidence supports HSERs as a tool to increase learner engagement and communication, while also identifying a gap in the literature on the impact of HSERs on learning outcomes (Foltz-Ramos et al., 2021).

This study used a randomized controlled trial to examine whether the addition of an HSER to a standard lecture led to greater knowledge acquisition than a lecture alone. Participants in both groups showed substantial improvement in knowledge, with an overall mean increase of 2.28 points. The average pre-test score was 63%, compared with an average post-test score of 88%. However, after controlling for pre-test scores, age, and nursing experience, there was no statistically significant difference in post-test scores between groups. Therefore, the addition of the HSER did not yield greater immediate knowledge acquisition than the lecture alone, supporting the null hypothesis.

These findings add an important perspective to the existing literature. Previous studies have reported improvements in knowledge following participation in gamified education and HSERs (Billner-Garcia & Spilker, 2022; Moon & Kim, 2024; Othman et al., 2024; Wynn, 2021).

However, pre- to post-test gains do not necessarily demonstrate that gamification itself is responsible for the change. For example, Wynn (2021) reported improved knowledge after an escape room, but participants received a lecture on the topic before completing the activity. Without a lecture-only comparison group, it is difficult to determine how much of the improvement was attributable to the escape room. The randomized controlled trial design used in the present study allowed the additional effect of the HSER to be examined and suggests that, although learning occurred, the HSER did not provide an additional measurable benefit for immediate knowledge acquisition.

The outcome used to evaluate learning may also have influenced these findings. The post-test primarily assessed immediate knowledge acquisition, whereas HSERs are experiential activities that involve applying knowledge through problem-solving, decision-making, teamwork, and hands-on participation. The literature suggests that these characteristics are among the primary strengths of HSERs (Guckian et al., 2020; Gomez-Urquiza et al., 2022). From the perspective of Kolb's Experiential Learning Theory, the HSER provided participants with an opportunity to apply information from the lecture in a simulated clinical situation. Participants were required to recognize anaphylaxis, determine the appropriate interventions, and follow the correct sequence of management. These elements of experiential learning may not have been fully captured by an immediate knowledge post-test.

This interpretation is also consistent with feedback from the HSER debriefings. Participants frequently highlighted the value of applying and reinforcing information presented during the lecture. In particular, participants noted that the HSER's linear structure underscored the importance of completing the appropriate steps in sequence when recognizing and managing anaphylaxis. All teams successfully completed the HSER within the ten-minute time limit,

demonstrating their ability to apply the required knowledge and skills in the simulated environment. The hands-on nature of the activity may therefore have contributed to reinforcing and consolidating learning, even though this was not reflected in higher immediate post-test scores. Similar benefits of hands-on and experiential learning have been reported by Ward et al. (2024) and Lin et al. (2025).

The timing of the post-test is another consideration when interpreting the findings. Knowledge was assessed immediately after the educational intervention, providing evidence of short-term knowledge acquisition but not of retention. Emerging evidence suggests that differences associated with experiential or gamified learning may become more apparent over time. Özkan Şat et al. (2025), for example, found no significant within-group changes in knowledge or attitudes immediately after an escape room, simulation, or traditional lecture. However, differences between groups emerged at later assessments, with participants in the simulation and escape room groups achieving higher scores than the control group at one week and one month. These findings suggest that the contribution of an HSER may be more apparent in knowledge consolidation and retention than in immediate information recall. Additional assessment points would be required to determine whether the experiential application provided by the HSER in the present study resulted in greater retention over time.

Kirkpatrick's evaluation framework offers another lens for interpreting the study findings. At Level 2, *Learning*, the substantial improvement in post-test scores across both groups indicates that participants acquired knowledge after the educational intervention (Kirkpatrick & Kirkpatrick, 2016). However, knowledge acquisition is only one aspect of learning. The HSER also required participants to demonstrate knowledge and skills in a

simulated clinical scenario. Evaluation at later time points could provide a more comprehensive assessment of whether this learning was retained and transferred to practice.

Extending evaluation to Level 3, Behaviour, could assess whether nurses apply anaphylaxis recognition and management principles appropriately in clinical practice. Chart audits conducted before and after the implementation of the HSER within nursing orientation could assess adherence to predetermined indicators for anaphylaxis recognition and management. At Level 4, Results, organizational safety reporting could be used to explore broader outcomes related to anaphylaxis recognition and management. Although these approaches would require careful consideration of other factors influencing clinical outcomes, they would provide a more comprehensive evaluation of whether learning associated with the educational intervention transfers beyond the simulated environment.

Limitations

The transition from REDCap to paper to SurveyMonkey significantly affected the data collection process and the study timeline. The project, originally planned for 12 months, was extended to 25 months. Due to the protocol deviation related to the survey platform, as discussed in the methods section, all data collected up to that point were destroyed without evaluation to prevent bias.

The sample size was limited to the number of staff enrolled in nursing orientation in a given year, as determined by CHEO's hiring processes. When the study commenced in 2024, each orientation session typically included at least 10 participants, often exceeding 20. Based on these figures, enrolment was projected to be completed within 10 months. However, in 2025, enrolment became more unpredictable, with attendance often falling below 10 participants. This

led to slower recruitment and greater uncertainty about the time required to reach the intended sample.

The timeline of the Master's program, along with challenges encountered with the data collection platform and participant recruitment, limited data collection to a single post-intervention time point. As a result, the study evaluated immediate knowledge acquisition but could not determine whether the HSER influenced knowledge retention or subsequent application of learning. Assessing knowledge and skill application at multiple intervals after the intervention would provide a more comprehensive evaluation of the impact of HSER participation and better align with the second and third levels of Kirkpatrick's evaluation framework.

The post-test itself represents an additional consideration. A knowledge-based assessment may not fully capture outcomes associated with an experiential learning activity, such as clinical decision-making, teamwork, sequencing of interventions, and application of knowledge. Future studies using multiple outcome measures may provide a more complete assessment of the educational effects of HSERs.

Implications for Nursing Education

The findings of this study have several implications for nursing education in both undergraduate and continuing education settings. Gamified learning activities, such as HSERs, can offer engaging opportunities for learners to participate actively, apply knowledge, and solve problems collaboratively. However, the findings do not support using an HSER solely to increase immediate knowledge acquisition when the same content has already been delivered through a lecture. Instead, HSERs may be better positioned as complementary educational

strategies that help learners reinforce and apply previously acquired knowledge. This distinction is important when educators consider the purpose of incorporating gamification into an educational program. The decision to use an HSER should be guided by the intended learning outcomes rather than by engagement or novelty alone. When the objective is knowledge acquisition, established teaching approaches may be sufficient. When objectives include application of knowledge, problem-solving, teamwork, decision-making, or experiential learning, an HSER may provide additional opportunities not available through didactic instruction alone. Combining gamified activities with other evidence-informed teaching strategies may therefore provide a more comprehensive approach to supporting learning.

The experiences of educators should also be considered when implementing gamified education. Developing and facilitating an HSER can give educators the opportunity to create innovative and enjoyable learning experiences. However, effective implementation requires knowledge of gamification, simulation design, facilitation, and evaluation. Kopt et al. (2025) found that nurse educators with more teaching experience and prior training in gamification reported greater confidence in using this pedagogy. Providing educators with appropriate training and access to established frameworks and simulation standards may therefore support the development of educational activities that are both engaging and pedagogically sound.

Implications for Nursing Leadership and Organizational Policy. Successful implementation of gamified education also requires organizational support. Nursing leaders can support educational innovation by providing educators with appropriate professional development, protected time, technological resources, and access to simulation expertise. Organizational policies and educational standards can further promote consistent practice by

encouraging the use of evidence-informed frameworks and established simulation standards in the development and evaluation of gamified learning activities.

Leadership support is particularly important because barriers to gamification may extend beyond the individual educator. Limited professional development, institutional support, and technology and information technology resources can affect an educator's ability to develop and implement these activities effectively (Kopt et al., 2025). Organizations considering investment in HSERs should therefore consider not only learner satisfaction and engagement but also the intended educational outcomes and the resources required for implementation. Where possible, evaluation should extend beyond participant satisfaction to assess learning, transfer to clinical practice, and relevant patient or system outcomes.

Future Research

Future research should continue to examine the role of gamification and HSERs in healthcare education using rigorous study designs, larger samples, and diverse clinical and educational settings. Although the present study did not identify an additional effect of the HSER on immediate knowledge acquisition, this does not exclude potential effects on other learning outcomes. Research examining knowledge retention, clinical decision-making, teamwork, skill performance, learner engagement, and application to clinical practice would provide a more comprehensive understanding of the educational contribution of HSERs.

Longitudinal research is particularly important. Including delayed assessments at multiple time points would help determine whether experiential application supports greater knowledge consolidation or retention than traditional teaching strategies. Future studies could also examine whether skills demonstrated during an HSER transfer to clinical practice and whether these

changes persist over time. Linking educational outcomes to clinical or organizational measures may help determine whether gamified education has an impact beyond the learning environment.

Further research is needed to examine HSER design, facilitation, and implementation. Variation in escape room structure, duration, difficulty, facilitation, debriefing, and integration with other educational strategies may contribute to differences in outcomes across studies. Developing and evaluating evidence-informed approaches to HSER design could improve consistency and enable more meaningful comparisons across studies. This work could also inform the development of training and resources for nurse educators, increasing their confidence and competence in using HSERs in nursing education.

Overall, the findings of this study suggest that the educational value of HSERs should not be determined by immediate knowledge acquisition. Although adding the HSER did not yield significantly higher post-test scores, it offered learners the opportunity to apply knowledge in an active, collaborative clinical scenario. Further research is needed to determine whether these experiential elements contribute to knowledge retention, skill development, or transfer of learning to clinical practice.

Conclusion

This study aimed to determine whether participation in a gamified learning activity led to improved knowledge outcomes compared with a traditional educational approach, while accounting for potential factors such as baseline knowledge, age, and years of clinical experience. Overall, participants showed improvements in knowledge from pre-test to post-test, indicating that learning occurred during the educational session. However, the ANCOVA model revealed no statistically significant difference in post-test scores between the experimental and control groups after adjusting for baseline knowledge, age, and years of experience. Baseline knowledge was the only significant predictor of post-test performance, suggesting that participants with higher initial knowledge were more likely to achieve higher scores after the educational activity. Age and years of experience did not significantly predict post-test knowledge, indicating that learning outcomes were similar across demographic groups within this sample.

This study contributes to the growing body of literature examining innovative educational strategies in nursing education and professional development. Although gamified learning approaches have gained popularity in healthcare education, empirical evidence evaluating their effectiveness in formal educational contexts remains limited (Sahin Karaduman & Basak, 2024). The current body of evidence includes very few direct comparisons of HSERs and traditional education methods, such as lectures, highlighting the importance of this study. By systematically evaluating a healthcare simulation escape room, this research provides evidence regarding the impact of such approaches on short-term knowledge acquisition among nurses. The findings suggest that while HSERs may support engagement and active participation, they do not

necessarily produce greater knowledge gains than more traditional educational approaches when measured immediately following the intervention. These findings contribute to a more nuanced understanding of the role of gamification in nursing education and underscore the importance of carefully evaluating innovative teaching strategies to ensure they meaningfully support learning outcomes in clinical practice.

In conclusion, this study contributes to the evolving understanding of innovative educational approaches in nursing orientation. While the HSER evaluated did not produce significantly greater knowledge gains compared with the traditional lecture, the findings highlight the importance of baseline knowledge and provide valuable insights into the implementation and evaluation of gamified learning activities in clinical education. Continued exploration of creative, evidence-informed educational strategies will remain essential as healthcare organizations seek effective ways to support nurses' learning and professional development upon entering clinical practice.

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Appendix A: Demographic Survey

DEMOGRAPHIC SURVEY

Instructions:
Thank you for agreeing to participate in this study!
You will begin by providing some demographic information. You will only have to complete this once. After finishing this portion of the survey, the knowledge assessment will begin. This will take approximately 15 minutes to complete.

Demographics

Email address (this will be used to link your responses): _____

1. Age – 20-29; 30-39; 40-49; 50-59; 60+

2. Years as a nurse – 0-5; 6-10; 11-15; 16-20; 21-25; >26

3. Primary area of specialty
    a. Emergency
    b. Pediatric medicine
    c. Pediatric surgery
    d. Hematology/oncology
    e. Mental health
    f. Eating disorder program
    g. Neonatal intensive care
    h. Pediatric intensive care
    i. Ambulatory care clinic
    j. Daycare surgery
    k. Recovery
    l. Operating Room
    m. Other – free text

4. If you are comfortable self-identifying, please check the closes option that describes your gender:
    a. Gender fluid/diverse
    b. Two-Spirit
    c. Non-Binary
    d. Man
    e. Woman
    f. prefer not to say
    g. Another gender identity not listed – open text box

5. If you are comfortable self-identifying, please check the options that best represent where your ancestry is from:
    a. Indigenous (First Nations, Metis, Inuk/Inuit)
    b. Indigenous person from outside of Canada
    c. Black
    d. Central Asian, North African/West African
    e. East Asian (Chinese, Japanese, Korean, Taiwanese)
    f. White or European Descent
    g. Latin American Descent
    h. Southeast Asian (Cambodian, Filipino, Indonesian, Thai, Vietnamese)
    i. South Asian (Bangladeshi, Indian, Indo-Carribean, Pakistani, Sri Lankan)
    j. Middle Eastern (Arab, Persian, West Asian)
    k. Another ethnicity not listed here – open text box
    l. prefer not to say

6. If you are comfortable self-identifying, please check the option below that applies to you:
    a. I do not identify as having a disability
    b. I identify as having a disability

Appendix B: Pre-Test

PRE-TEST

Grace is 15 years old and weighs 53 kg. She was admitted this morning for recurring sinusitis. IV Amoxicillin was started 20 minutes ago. When in the room to check the IV, you notice that Grace has a few hives on her neck. Grace and her parent/caregiver confirm that the hives are new. Upon further assessment, you discover hives covering Grace's neck and back. Grace complains of a sudden feeling of nausea.

Vital Signs taken now:

T – 37C po
HR – 145 bpm
RR – 24 bpm
BP – 95/45 mmHg
O2 sat – 96% RA

Instructions:

Consider the case study you just reviewed as you answer the questions.

Select the correct answer:

1. What is happening to Grace?
    a. These symptoms are common for a patient with sinusitis
    b. She is experiencing a sensitivity reaction to Amoxicillin
    c. She is having an anaphylactic reaction to Amoxicillin
    d. Grace is developing gastroenteritis
    e. Not sure

2. What does PALS stand for (think PALS sheet)?
    a. Pediatric Alert Lesson Sheet
    b. Prepare All Life Saving
    c. Pediatric Advanced Life Support
    d. Not sure

3. How many physiological system(s) must be involved to meet the definition of anaphylaxis?
    a. Anaphylaxis is only considered if someone has shortness of breath
    b. Any 2 systems are involved
    c. Gastrointestinal
    d. If a someone has respiratory involvement OR any 2 systems
    e. Not sure

4. What medication is FIRST line treatment for anaphylaxis?
    a. Acetaminophen
    b. Diphenhydramine

c. Epinephrine
d. Cetirizine
e. Not sure

5. How is cetirizine administered?

a. Oral
b. Suppository
c. Intravenous intermittent infusion
d. Subcutaneous injection
e. Not sure

6. How is epinephrine administered for anaphylaxis?

a. IV Direct
b. Subcutaneous injection
c. Continuous IV infusion
d. Intramuscular injection
e. Not sure

7. What location is **preferred** for administration of epinephrine for anaphylaxis?

a. deltoid
b. vastus lateralis
c. gluteal
d. abdominal
e. Not sure

8. Where did you **first** learn about identification and management of anaphylaxis?

a. Nursing school
b. CHEO nursing orientation
c. Prior work experience
d. Other

9. Where do you find the anaphylaxis kit at CHEO?

a. I get it from pharmacy
b. Patient specific in the medication cabinet
c. Under 'kits' in the medication cabinet
d. Not sure

10. Epinephrine for anaphylaxis can be given:

a. Without an order for an emergency
b. With a medication order from physician or nurse practitioner
c. Using the dose on the PALS sheet
d. Using the medical directive
e. Not sure

Appendix C: Post-Test

POST-TEST

Scott is a 4-year-old boy who was diagnosed with leukemia last week. His platelet count this morning is 7. You have ordered platelets from the Blood Bank. He has received 2 platelet transfusions before.

The prepared platelets have arrived on the unit. Before starting the platelet transfusion you assess Scott's vital signs:

T - 37.1C axilla
HR – 90 bpm
RR – 24 bpm
BP – 105/63 mmHg
O2 sat – 97% RA

Approximately 7 minutes after starting the infusion, Scott appears short of breath. You assess Scott. His skin is flushed but he is afebrile. The remaining vital signs are:

T- 36.9 axilla
HR – 155 bpm
RR – 32 bpm
BP – 94/46 mmHg
O2 sat – 93% RA

Instructions:
Consider the case study you just reviewed as you answer the questions.

Select the correct answer:

1. What is happening to Scott?
    a. Scott is demonstrating common symptoms of leukemia
    b. Scott is having a febrile reaction to the platelets
    c. Nothing, Scott is stable
    d. Scott is having an anaphylactic reaction to the platelets
    e. Not sure
2. What does PALS stand for (think PALS sheet)?
    a. Pediatric Alert Lesson Sheet
    b. Prepare All Life Saving
    c. Pediatric Advanced Life Support
    d. Not sure

3. How many physiological system(s) must be involved to meet the definition of anaphylaxis?
    a. Anaphylaxis is only considered if someone has shortness of breath
    b. Any 2 systems are involved
    c. Gastrointestinal
    d. If a someone has respiratory involvement OR any 2 systems

4. What medication is FIRST line treatment for anaphylaxis?
    a. Acetaminophen
    b. Diphenhydramine
    c. Epinephrine
    d. Cetirizine
    e. Not sure

5. How is cetirizine administered?
    a. Oral
    b. Suppository
    c. Intravenous intermittent infusion
    d. Subcutaneous injection
    e. Not sure

6. How is epinephrine administered for anaphylaxis?
    a. IV Direct
    b. Subcutaneous injection
    c. Continuous IV infusion
    d. Intramuscular injection
    e. Not sure

7. What location is preferred for administration of epinephrine for anaphylaxis?
    a. deltoid
    b. vastus lateralis
    c. gluteal
    d. abdominal
    e. Not sure

8. Where did you first learn about identification and management of anaphylaxis?
    a. Nursing school
    b. CHEO nursing orientation
    c. Prior work experience
    d. Other

9. Where do you find the anaphylaxis kit at CHEO?
    a. I get it from pharmacy
    b. Patient specific in the medication cabinet
    c. Under ‘kits’ in the medication cabinet

d. Not sure

10. Epinephrine for anaphylaxis can be given:
    a. Without an order for an emergency
    b. With a medication order from physician or nurse practitioner
    c. Using the dose on the PALS sheet
    d. Using the medical directive
    e. Not sure

Appendix D: University of Ottawa Research Ethics Board Approval

Université d'Ottawa
Bureau d'éthique et d'intégrité de la recherche

University of Ottawa
Office of Research Ethics and Integrity

H-11-25-12271 - OTH-12271 - Certificat d'approbation éthique / Certificate of Ethics Approval

(English message follows)

Cher/Chère Brennah Holley,

Veuillez trouver ci-joint le certificat d'approbation éthique pour le projet intitulé «Evaluating Healthcare Simulation Escape Rooms as an Educational Tool in Nursing Continuing Education».

Le certificat est valide jusqu'au : 15-01-2027

The date of the uOttawa ethics certificate was set according to the CHEO Ethics Committee.

Recherche financée : veuillez faire suivre une copie du certificat au Service de gestion de la recherche.

Si vous avez des questions, n'hésitez pas à communiquer avec le Bureau d'éthique à ethique@uottawa.ca ou en composant le 613-562-5387.

Vous pouvez voir votre demande en vous connectant à votre compte eReviews.

Cordialement,

Mathieu Laflamme
Responsable d'éthique en recherche

Ceci est une réponse automatisée, merci de ne pas répondre à ce courriel.

Dear Brennah Holley,

Please find attached the certificate of ethics approval for your research project titled "Evaluating Healthcare Simulation Escape Rooms as an Educational Tool in Nursing Continuing Education".

This certificate is valid until: 15-01-2027

The date of the uOttawa ethics certificate was set according to the CHEO Ethics Committee.

Funded research: A reminder that you must provide a copy of this certificate to Research Management Services.

If you have any questions, please contact the Ethics Office at ethics@uottawa.ca or by telephone at 613-562-5387.

You can view your project at any time by logging into eReviews.

Best regards,

Mathieu Laflamme
Protocol Officer

This is an automated message. Please do not reply directly to this email.

Attachement(s) / Attachment(s)

550, rue Cumberland, pièce 154 Ottawa (Ontario) K1N 6N5 Canada
550 Cumberland Street, Room 154 Ottawa, Ontario K1N 6N5 Canada

613-562-5387 • 613-562-5338 • ethique@uOttawa.ca / ethics@uOttawa.ca
www.recherche.uottawa.ca/deontologie | www.recherche.uottawa.ca/ethics

Appendix E: CHEO Research Institute Research Ethics Board Approval

CHEO REB
Letter of Approval

REB Protocol No: 23/113X
ROMEO File No: 20230379
Principal Investigator: Ms. Brennah Holley
Protocol Title: CHEOREB# 23/113X – Evaluating Healthcare Simulation Escape Rooms as an Educational Tool in Nursing Continuing Education

Protocol Status: Active

Approval Date: January 19, 2024
Approval Expiry Date: January 15, 2025

The CHEO REB has conducted a 72elegateed review and determined that the conditions of approval have been satisfied for the above-named study. Approval is valid for the period indicated above. This research study is to be conducted by the investigator noted above. Annual renewals or study closures must be completed before the expiry date noted above.
REB members involved in the study do not participate in the review, deliberations, or decision.

Documents Approved:

Document Name	Comments	Version Date
Other Document	Anaphylaxis HSER Template	2023/12/08
Protocol	Minimal Risk Protocol	2024/01/19
Other Document	letter of information – clean	2024/01/19
Consent Form	HSER Consent clean	2024/01/15
Other Document	Demographic Survey Clean	2024/01/15
Other Document	Anaphylaxis Lesson Plan	2023/12/07
Questionnaire/Survey	Post-test	2023/12/07
Questionnaire/Survey	Pre-test	2023/12/07

Any modifications made to the study must be reviewed and approved by the REB prior to implementation, except when necessary to eliminate immediate danger or hazard(s) to study participants or when the change(s) involves administrative aspects of the study. Investigators must promptly alert the REB of any changes that increase the risk to participants or affect the safety of participants, all unanticipated and harmful events that occur, and new information that significantly impact the conduct of the study.

The CHEO REB operates in compliance with, and is constituted in accordance with, the requirements of the Tri-Council Policy Statement: Ethical Conduct of Research Involving Humans (TCPS 2); the International Conference on Harmonization Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; and Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The CHEO REB is registered with the U.S. department of Health and Human Services (DHHS) Office for Human Research Protection (OHRP).

Appendix F: TCPS 2

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022

Certificate of Completion

This document certifies that

Brennah Holley

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000933168 **14 September, 2023**

Appendix G: Informed Consent Form

uOttawa

Informed Consent Form for Participation in a Research Study

Study Title: Evaluating Healthcare Simulation Escape Rooms as an Educational Tool in Nursing Continuing Education

Principal Investigator:
Brennah Holley RN, BScN, CPHON
Clinical Nurse Educator Hematology/Oncology/Nephrology
CHEO

INTRODUCTION

This consent form provides you with information to help you make an informed choice. Please read this document carefully and ask any questions you may have. All your questions should be answered to your satisfaction before you decide whether to participate in this research study.

You are being invited to join this study because you are a nurse participating in nursing orientation. All nurses within the orientation group will be invited to participate. Participation is completely voluntary, and regardless of your decision to participate, you will receive the same learning opportunities – the lecture and the Healthcare Simulation Escape Room.

Please take your time in making your decision.

Taking part in this study is voluntary. You have the option to not participate at all or you may choose to leave the study at any time. Your decision to participate or not in this study will not affect your employment at CHEO. You are free to withdraw from the study at any time by ending the survey or test. There will be no penalty to you.

A Healthcare Simulation Escape Room (HSER) is an interactive activity that has a goal. To get to the goal you will need to work with your colleagues to solve different types of puzzles using the clues provided. The HSER has been developed using adult learning principles and meets the best practice guidelines of simulation education.

WHY IS THIS STUDY BEING DONE?

The purpose of this research is to compare the effectiveness of a lecture alone versus a lecture in combination with a HSER on knowledge acquisition.

HOW MANY PEOPLE WILL TAKE PART IN THIS STUDY?

We expect to invite 100 people, registered in corporate nursing orientation at CHEO, to participate over a 12-month period. The results will be known in 2025.

WHAT WILL HAPPEN DURING THIS STUDY?

If you decide to participate then you will be "randomized," or assigned, into one of the groups described below. Randomization means that you are put into a group by chance (like flipping a coin). There is no way to predict which group you will be assigned to. You will have an equal chance of being placed in either group. Neither you, the study staff, nor the study doctors can choose what group you will be in.

You will be told which group you are in after the lecture.

If you choose to participate, you will be asked to complete the following tasks in addition to the curriculum of nursing orientation:

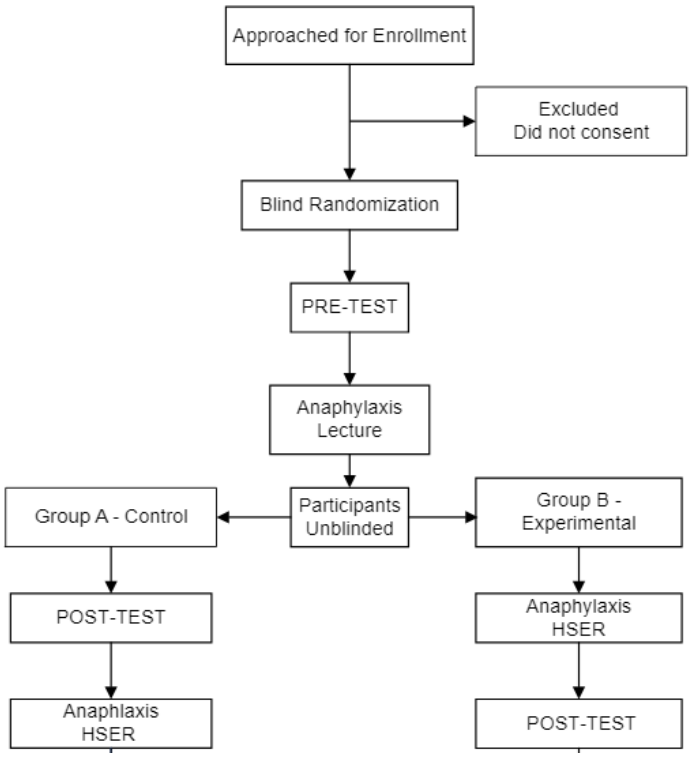
1. A short questionnaire collecting demographic information about you (5 minutes or less)
2. A short test before the lecture with 10 multiple choice questions based on a case (10 minutes)
3. A short test following the lecture OR the HSER with 10 multiple choice questions based on a **different** case (10 minutes)

If you decide to participate, you will be randomly assigned into one of two groups. Group A & B will do all the tasks as described above, but the second test will be taken in an altered sequence. It will be completed by Group A after the lecture and by Group B after the HSER. See the flow diagram on the next page a better understanding of the study.

All surveys and tests will be collected using SurveyMonkey, an online survey platform. Information will be kept strictly confidential.

HOW LONG WILL PARTICIPANTS BE IN THE STUDY?

Part of this study is integrated in the usual corporate nursing orientation time, but the extra time commitment required to participate in this study is approximately 25 minutes.



CAN PARTICIPANTS CHOOSE TO LEAVE THE STUDY?

You can choose to end your participation in this research (called withdrawal) at any time without having to provide a reason by not completing one of the tests or the survey. If you choose to withdraw from the study, you are encouraged to contact the research team.

You may withdraw your permission to use information that was collected about you for this study at any time by letting the research team know. However, this would also mean that you withdraw from the study.

WHAT ARE THE RISKS OR HARMS OF PARTICIPATING IN THIS STUDY?

The risks may be that you have feelings of anxiety during the escape room or during the debriefing that follows. Be assured that every effort will be made to minimize this risk such as ensuring the ability to withdraw from the study at any time, and all information remaining de-identified.

WHAT ARE THE BENEFITS OF PARTICIPATING IN THIS STUDY?

You may or may not directly benefit from the study. However, your input and perspective would be of tremendous value to the research team.

HOW WILL PARTICIPANT INFORMATION BE KEPT CONFIDENTIAL?

If you decide to participate in this study, the research team will only collect the information they need for this study.

Records identifying you at this center will be kept confidential and, to the extent permitted by the applicable laws, will not be disclosed or made publicly available, except as described in this consent document.

Authorized representatives of the following organizations may look at your original (identifiable) records to check that the information collected for the study is correct and follows proper laws and guidelines.

- The research ethics board who oversees the ethical conduct of this study
- This institution and affiliated sites, to oversee the conduct of research at this location

Information that is collected about you for the study (called study data) may also be sent to the organizations listed above. Your name, address, email, or other information that may directly identify you will not be used. The records received by these organizations may contain your email address.

This research study is collecting information on race and ethnicity as well as other characteristics of individuals to describe the study population. Specifically, data collection regarding the presence of disability is being collected to determine if this affects the efficacy of the HSER on knowledge acquisition. Unsubstantiated conclusions will not be drawn about any specific participant populations. Providing information on your race or ethnic origin is voluntary.

During the discussions, participants will be encouraged to refrain from using names. If names or other identifying information is shared during the discussion, it will not be included in the written records.

This study involves collecting questionnaire responses through SurveyMonkey, a company that uses servers both inside and outside of Canada. Any data that resides outside of Canadian borders may increase the risk of disclosure of information because the laws in those countries dealing with protection of information may not be as strict as in Canada. If the results of this study are published, your identity will remain confidential. It is expected that the information collected during this study will be used in analyses and will be published/ presented to the scientific community at meetings and in journals.

Even though the likelihood that someone may identify you from the study data is very small, it can never be completely eliminated. Study data will be retained for 7 years after the last publication.

Future research

Your coded study data may be used or shared with other researchers (inside and outside of Canada) for future studies. "Coded" means that directly identifying information (such as your name and date of birth) will be replaced by a randomly generated number, which will be applied to the study data. This may include storing the coded study data in controlled-access databases, for which access is limited to researcher(s) who submit a study plan and who sign an agreement to use the coded study data only for that research. Very limited coded study data may also be placed in an open access, publicly accessible database. The goal of sharing is to make more research possible. However, the code matching your study data with your name and other directly identifying study data will not be shared.

You will not be asked if you agree to take part in future research studies using your study data. You or your study doctor will not be told what type of research will be done. You will not be given reports or other information about any research that is done with your study data.

If you choose to participate, you will be asked to provide your email address for three reasons:

1. To indicate interest in the study and obtain the consent (which you have already done to receive this document)
2. The email address will be used to link the results from the pre and post-tests.

WHAT IS THE COST TO PARTICIPANTS?

Participation in this study will not involve any additional costs to you.

ARE STUDY PARTICIPANTS PAID TO BE IN THIS STUDY?

There is no compensation for participating in this study.

WHAT ARE THE RIGHTS OF PARTICIPANTS IN A RESEARCH STUDY?

You will be told, in a timely manner, about new information that may be relevant to your willingness to stay in this study.

You have the right to be informed of the results of this study once the entire study is complete. If you would like to be informed of the results of this study, please let the principal investigator know.

Your rights to privacy are legally protected by federal and provincial laws that require safeguards to ensure that your privacy is respected.

By signing this form you do not give up any of your legal rights against the researcher or involved institutions for compensation, nor does this form relieve the researcher of their legal and professional responsibilities.

WHOM DO PARTICIPANTS CONTACT FOR QUESTIONS?

If you have questions or concerns about taking part in this study, you can talk to Brennah Holley who is the primary researcher of this study.

If you have questions about your rights as a participant or about ethical issues related to this study, you can talk to someone who is not involved in the study at all. That person is:

CHEO Research Ethics Board	*613-737-7600 ext. 3272*
Name	Telephone

SIGNATURES

- All my questions have been answered,
- I understand the information within this informed consent form,
- I allow access to research records and related personal information as explained in this consent form,
- I do not give up any of my legal rights by signing this consent form,
- I agree to take part in this study.
- I agree that my data collected for this research may be used in future research within or beyond the general area of research of the current study.

Signature of Participant	PRINTED NAME	Date
Signature of Person Conducting the Consent Discussion	PRINTED NAME & ROLE	Date

Appendix H: Lesson Plan

Anaphylaxis Escape Room Lesson Plan

Location: sim lab

Physical Equipment / Props:

PALS sheet 32 kg	O2 set up
Epi kit	Suction
1L NS bag	Ambu bag
IV line	LOCKS: 2 3 digit locks – one with decimal point 1 3 letter lock 1 4 letter locks
BP monitor or Cardio resp monitor available but not attached	4 Lock boxes

PREBRIEF SCRIPT

Facilitator, ask the question: Has anyone participated in an escape room before? This is a healthcare simulation escape room. It works similarly to escape rooms that you have done before. You will find different kinds of locks and puzzles in the room.

This is a 'linear escape room.' That means that you need to solve one clue to get the information to solve the next clue.

For those of you who have not done an escape room before, don't worry. Members of your group need to work together to solve the clues. It is also helpful to think out loud!

You have 10 minutes to 'escape.' The goal is to unlock all the locks before time runs out. The clock will stop when you have saved your patient.

SCENARIO

Sally is 16 years old. She weighs 55 kg. Admitted for Kawasaki Disease. Currently receiving IVIG at step 2.

Last documented set of vital signs 5 minutes ago:

HSER EVALUATION

HR – 115
RR – 28
BP – 91/49
O2 sat – 95% RA
She is not your patient. You respond to mom ringing the bell.

SCENARIO TRANSITIONS /PATIENT PARAMETERS	**ESCAPE ROOM STEPS**
Give this info verbally 1. Sally is sitting up in bed complaining of sudden stomach cramps. Mom is concerned.	Do Vital Signs – Give Combo for number lock **HR155 – use as combo for lock** RR 28 BP 95/50 O2 sat 93%
Clue is printed inside box 1. Sally now has hives on neck and torso. She has an itchy throat. What do you do?	Stop infusion **STOP!** – combo for lock
2. What do you need? EPI	Word lock – **EPI** Opens box for PALS sheet & orders and next clue 'DOSE'
3. DOSE	**0.5** Need to white out different numbers and insert a decimal and extra decoys This will unlock box with epi kit & next instruction: 'ADMINISTER' If they go to thigh they win – Stop the time If they go to the arm – stop time and use as teaching moment

Debriefing introduction:

We are going to discuss the escape room together. If there is something you would like to share separately, please let me know before you leave, or email me and we can coordinate a time to talk privately.

Please remember that everything we talk about is confidential and stays within the group.

Debriefing points:

1. What are your initial thoughts about the escape room?

2. What are your impressions of how you were able to work together?

3. Did you encounter any challenges?

4. What did you learn during the escape room? Did you learn anything unexpected?

5. What is anaphylaxis?
   - Skin changes + respiratory +/- cardiovascular +/- GI symptoms
   - OR hypotension, bronchospasm or upper airway obstruction with exposure to allergen
   - Review Trekk algorithm 2018-12-10_Anaphylaxis_algorithm_v_1.1.pdf (trekk.ca)Review Trekk algorithm 2018-12-10_Anaphylaxis_algorithm_v_1.1.pdf (trekk.ca)

6. What do you need in the room to administer for potentially anaphylactic meds
   - NS rescue line
   - PALS
   - Epi kit
   - O2 & suction
   - Ambu bag

7. Why did you choose that epinephrine? 1:900 vs 1:10 000
   - Highlight use of each type

8. Where is the best place to administer epi? Thigh vs. arm – Thigh absorbs faster
   - Can you give epi more than once? Yes but if needed call SPOT if you have not yet done so.

Appendix I: SPSS Syntax for ANCOVA Analysis

```
UNIANOVA post_total BY Group age3 exp_cat WITH pre_total
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /EMMEANS=TABLES(Group) WITH(pre_total=MEAN)
  /PRINT ETASQ DESCRIPTIVE PARAMETER HOMOGENEITY
  /CRITERIA=ALPHA(.05)
  /DESIGN=Group age3 exp_cat pre_total.
```

APPENDIX J: Tests of Normality

Table 5

Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Standardized residual for post total	0.061	89	0.200	0.974	89	0.075

Figure 6

Q-Q plot