

## **Using the RETAIN Neonatal Resuscitation Game to Train and Assess Healthcare Professionals' Competence in an Observational Study Design**

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### **Abstract**

Each year, health care professionals around the world provide resuscitative care to over 13 million newborn infants at birth. While simulation-based education is recommended for health care professionals to train and assess their neonatal resuscitation competence, this approach is resource-draining and overall inaccessible. Therefore, most health care professionals are unable to maintain their clinical skills or knowledge. To address this barrier, we developed RETAIN, a simulation-based board game. RETAIN uses experiential game-based learning to teach neonatal resuscitation within an engaging educational environment. This case study describes the research plan we developed to evaluate the educational outcomes of playing the RETAIN board game. Our objectives were to evaluate the RETAIN board game for purposes of (a) training and (b) assessing neonatal resuscitation competence in a population of experienced neonatal health care professionals from a tertiary perinatal center. We measured short-term knowledge retention of the neonatal resuscitation algorithm using a pre-post-test observational study design. Furthermore, we examined the utility of RETAIN as a summative assessment tool

of neonatal resuscitation competence using an observational study design. Finally, we quantitatively and qualitatively measured health care professionals' opinions of RETAIN. This case study also discusses our experience conducting and troubleshooting clinical research in continuing health care education, including the importance of interdisciplinary decision-making, institutional partnerships, and conscientious recruitment of health care professional participants.

### **Learning Outcomes**

By the end of this case, students should be able to

- Summarize how to implement and measure the educational outcomes of a serious game for training and assessing health care professionals' clinical competence
- Implement strategies to effectively undertake clinical research with health care professional participants recruited from a busy intensive care hospital setting
- Anticipate and address the challenges they may encounter when generating their research design, particularly ethical considerations of evaluating competence at participants' place of work

### **Project Overview and Context**

Simulation-based education is the recommended method for health care professionals (HCPs) to train and demonstrate their clinical competence while maintaining patient safety (Soar et al., 2010). However, health care simulation is both financial- and human-capital intensive, requiring HCPs to dedicate a great deal of time to attend a simulation lab under the supervision of a trained instructor while using specialized equipment. These resource requirements pose a barrier toward frequent training opportunities (Miledler et al., 2014). Therefore, most HCPs do not adequately maintain their clinical skills or knowledge (Matterson et al., 2018).

This gap becomes especially dangerous during neonatal resuscitation, when HCPs must initiate cardiorespiratory interventions quickly and correctly to help newborn infants take their first breaths (Weiner, 2016). Alarming, up to 50% of infant mortality during resuscitation is caused by deficiencies in HCPs' competence (The Joint Commission, 2010). Therefore, a new approach is needed to prevent infant death and injury during delivery (The Joint Commission, 2010; Soar et al., 2010).

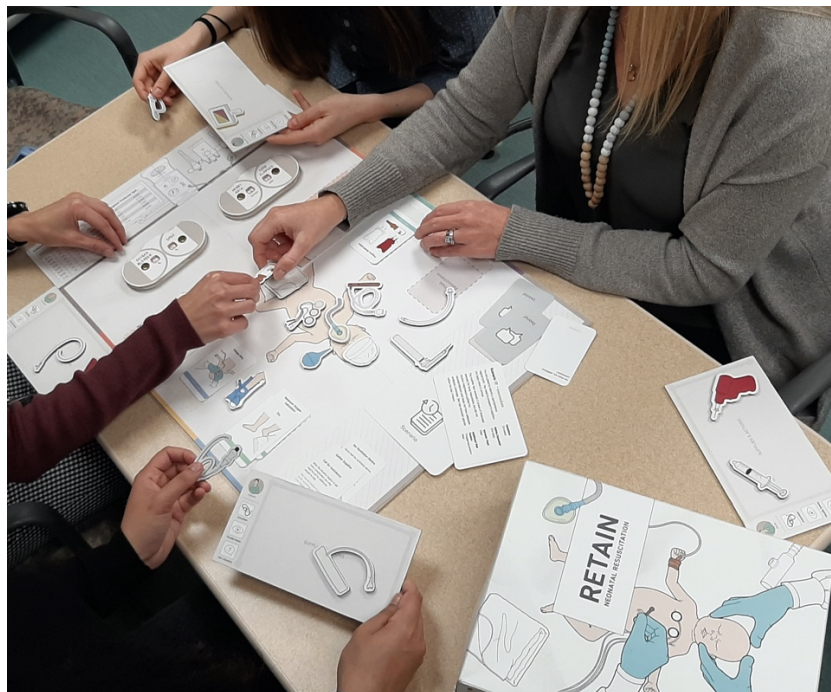
To address these issues, games may offer unique advantages as a pedagogical tool for health care education (Ghoman et al., 2019). Games which teach knowledge and skills are called serious games (Giunti et al., 2015). Serious games create an engaging environment to facilitate experiential learning (Ranchhod et al., 2014). Experiential learning, whereby learners consolidate their firsthand experiences into practical knowledge, skills, and strategies, is an important component of health care education (Koponen et al., 2012; Yardley et al., 2012). Learners engaged in experiential learning report improved understanding (Gosen & Washbush, 2004), performance (Perry et al., 1996), and enthusiasm (Dabbour, 1997) during training.

To improve access to simulation-based education while utilizing the advantages of game-based and experiential learning, we developed the serious game RETAIN (REsuscitation TrAINing for Healthcare Professionals). RETAIN is a simulation-based board game (**Figure 1**) for HCPs to practice their neonatal resuscitation knowledge while simultaneously training communication and teamwork. In the game, players take on the role of HCPs attending a delivery and use action cards, equipment pieces, and adjustable monitors to perform the correct steps of neonatal resuscitation as a collaborative team. A facilitator continuously updates the team with information from the game's case booklet, including the baby's visual appearance,

heart rate, and breathing. Players use this information to direct their decision-making by escalating or de-escalating care appropriately in response (Cutumisu et al., 2019).

**Figure 1.** *Health care professionals play the RETAIN board game as a collaborative team.*

*Players use role cards, action cards, and simulated equipment pieces to prepare and perform neonatal resuscitation interventions.*



Before using RETAIN during formal neonatal resuscitation education, we first needed to evaluate if it was indeed an effective method to train and assess HCPs. This case study describes the two studies we undertook to evaluate if playing the RETAIN board game improved educational outcomes in a population of experienced neonatal HCPs from a tertiary perinatal center. We first hypothesized that neonatal HCPs would improve their knowledge of the correct steps of neonatal resuscitation after playing the RETAIN board game. Next, we sought to understand if the RETAIN board game could be used to assess HCPs' knowledge of the correct steps of neonatal resuscitation. Furthermore, we measured HCPs' opinions about the RETAIN

board game (e.g., enjoyment while playing the game, motivation to play the game again, usefulness of the game for teaching).

### **Section Summary**

- Frequent simulation-based training and assessment is necessary for HCPs to maintain their neonatal resuscitation knowledge and skills, but it is not routinely offered due to resource constraints.
- We developed the simulation-based game RETAIN as an alternative approach to improve education opportunities for neonatal resuscitation providers.
- This case study describes our research plan to evaluate if RETAIN can be used to (a) improve and (b) assess HCPs' knowledge of the correct steps of neonatal resuscitation.

### **Research Design**

#### *Knowledge Retention*

Nina Swiderska and colleagues (2013) examined the serious game “Neonatology” designed to teach neonatal resuscitation knowledge to medical students. They used a post-test to evaluate the differences in learning outcomes between control and intervention groups (i.e., traditional curriculum vs. traditional curriculum plus 1 hr of game play; Swiderska et al., 2013). After playing the game, overall knowledge of neonatal resuscitation improved. Although all participants were novice learners with probably comparable knowledge, they did not assess participants' baseline knowledge. Consequently, the results should be interpreted cautiously (Swiderska et al., 2013). Therefore, to measure HCPs' knowledge retention after playing the RETAIN board game, we decided to use a pre-post-test observational study design. This was an

important consideration, as our participants were HCPs with a wide range of clinical experience (median = 7 and interquartile range = 2.6–11.5 years of neonatal experience). The pre-test was used to assess their incoming neonatal resuscitation knowledge. After the study, the change in knowledge was assessed with a post-test. Due to the range of neonatal experience in our HCP population, we decided that an intraparticipant improvement would be a more meaningful measure, rather than between-groups analysis.

Our study protocol began with each participant completing a written pre-test to assess their baseline knowledge of the neonatal resuscitation algorithm. The pre-test was an evidence-based, open-answer, written neonatal resuscitation scenario of an apneic 24-week premature infant. After reading the antenatal history, participants were prompted with the infant's heart rate, breathing, and visual appearance and instructed to explain the next steps to resuscitate and stabilize the infant. Participants received no feedback on their pre-test performance. Because we wanted to ensure that any improvement in their neonatal resuscitation knowledge during the study was solely from playing RETAIN, providing feedback on their performance would have confounded our results as it may have helped them learn. Overall, participants did not exhibit frustration or annoyance with the lack of feedback, as they were understanding of the parameters of the research study.

After a tutorial demonstrating how to play the board game, each participant played three scenarios of RETAIN, taking on the role of team leader during the simulated resuscitation. During each of the three evidence-based scenarios, the participant directed two standardized players (researchers) by verbally instructing them to use action cards and equipment pieces to perform the desired interventions. After playing RETAIN, participants completed a post-test

with the same scenario as the pre-test to assess their knowledge retention of the correct steps of neonatal resuscitation.

### *Summative Assessment*

The next step of our research plan was to evaluate if we could use players' performance on the RETAIN board game to assess their knowledge of neonatal resuscitation. Our study protocol began with having participants individually complete an open-answer written test of a neonatal resuscitation scenario (apneic 24-week premature infant). Again, participants received no feedback on their performance so as not to confound the results of our study. The written test was followed by having participants independently play one scenario of the RETAIN board game (apneic infant with fetal bradycardia).

Participants performed all the desired actions by themselves, so that their individual neonatal resuscitation competence could be assessed objectively. Participants gave informed written consent to have the game play sessions audio- and video-recorded, so that their neonatal resuscitation performance could be reviewed, coded, assessed, and compared with their pre-test performance.

To evaluate the RETAIN board game as a summative assessment tool, we compared the participants' performance using an open-answer written test as a traditional summative assessment method with the RETAIN board game.

### **Section Summary**

- To measure if RETAIN improved HCPs' knowledge retention of neonatal resuscitation, we used a pre-post-test observational study design to measure changes in their test scores after playing three scenarios of RETAIN.

- To evaluate if RETAIN could be used as a summative assessment tool, we compared HCPs' score on a traditional test to their score while playing the board game.

### **Research Practicalities**

Our research plan was developed by an interdisciplinary team of clinicians, educational psychologists, designers, and research scientists. The studies were performed at the Neonatal Intensive Care Unit at the Royal Alexandra Hospital (Edmonton, Canada), a tertiary perinatal care center, which admits over 350 infants with a birth weight of fewer than 1,500 g each year. Our participants were recruited from a population of experienced neonatal HCPs (including neonatal registered nurses, respiratory therapists, nurse practitioners, residents, fellows, and consultants) who regularly attend neonatal resuscitations. Our eligibility criteria stipulated that participants must have completed the Neonatal Resuscitation Program (NRP) provider course within 24-months prior to participating in the study. We decided on this timeframe as HCPs must complete the NRP course every 2 years to maintain their neonatal resuscitation provider certification status.

With the assistance of the research coordinators at the hospital, we recruited a total of 50 HCP participants across our two studies. HCPs were recruited from the unit based on if they were interested in participating in a research study, and if they had time to play. A strategy we used to recruit HCPs was to identify timeframes for which they generally were available. This included asking them to participate in our study just after they completed rounds, after shift change, or after they were done with their shift.

Throughout recruitment, we aimed to balance the different professions within the Neonatal Intensive Care Unit to ensure that our sample was representative of the resuscitation



team and to avoid overrepresentation of one group. We did this by collecting demographic information of our participants in a survey before we began our study. This information included their clinical position. Throughout recruitment, we continuously reviewed the number of participants we had within each clinical position, which then guided our recruitment strategy to end with a sample that was representative of the HCPs who typically go to deliveries on our unit (**Table 1**). On our unit, registered nurses and respiratory therapists are the main two groups of HCPs who go to resuscitations and are aided by doctors and neonatal nurse practitioners.

Furthermore, to minimize contamination between the two studies using the RETAIN board game (knowledge retention and summative assessment), we ensured that each HCP was only recruited to participate in one of the studies and was excluded from participating in the other.

**Table 1.** *Professional information from our study sample of neonatal health care professionals from a tertiary perinatal center.*

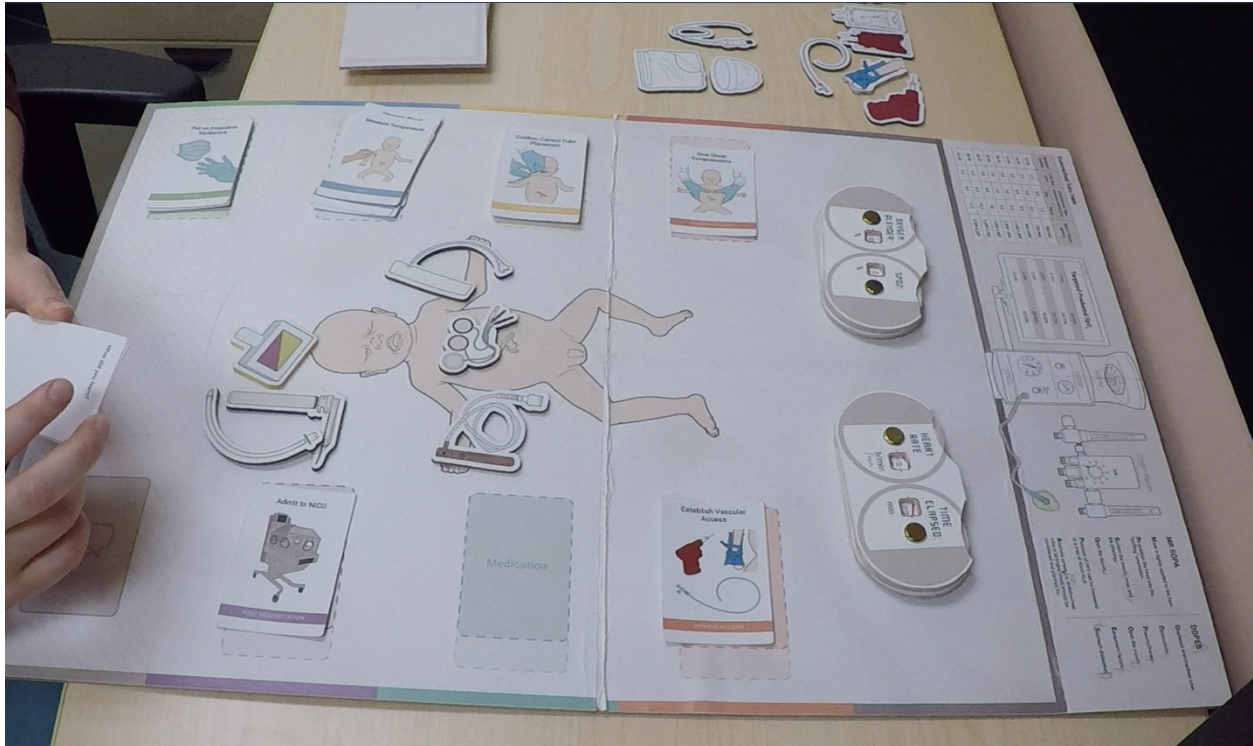
<b>Clinical position</b>	
Medical doctor	n=8
Registered nurse	n=21
Neonatal nurse practitioner	n=4
Respiratory therapist	n=17
Total	n=50

Approval for the studies was obtained by the Human Research Ethics Board at the University of Alberta, and written informed consent from HCPs was obtained prior to their

participation. As this was a simulation study with HCPs and we did not collect any patient information, we did not face major challenges with obtaining ethics approval. However, the most important issues we had to consider were to (a) make sure that HCPs' performance remained confidential and (b) their participation or performance would not be shared with their superiors or administrators.

We addressed these challenges by ensuring that participants were aware that their participation was voluntary, and their refusal to participate would not affect their professional standing. We also anonymized all the test papers using participant ID codes (e.g., 1001). As we did not need to collect any follow-up data, we did not need to create a master list. Therefore, there was no document created that linked participants' names with their ID code. The biggest challenge was to do our best to anonymize the audio- and video- recordings that were created to score the participants' performance while playing the board game (**Figure 2**). We did our best by setting up the video camera to capture only their hands and the board game to try to limit the amount of personal identifying information. Also, our data collector and data analyst did not work at the hospital and therefore were unlikely to be able to identify any of the HCPs based on their hands or voices.

**Figure 2.** Screenshot of a health care professional playing the RETAIN board game. In our video-recordings, only the participants' hands were captured in the frame, to keep personal identifying information confidential as best as possible.



In general, we did not give incentives within our population of HCPs, but we did thank participants for their time with a chocolate bar at the end of the study. However, this small token did not encourage recruitment. We also made a concerted effort to frame the research as a collective effort of our unit to better the care of our patients, rather than framing participation as HCPs doing a favor by participating in the principal investigator's research. We speculate that having a \$5 or \$10 coffee voucher, or professional development credit, may have increased participation.

## Section Summary

- Our studies were conducted within a neonatal intensive care unit that sees a high volume of high-risk deliveries and resuscitations in Western Canada.
- Inclusion criteria were defined based on clinical relevance (i.e., up-to-date neonatal resuscitation provider certification status).
- We obtained approval for our studies by our academic institution's Human Research Ethics Board prior to recruitment and written informed consent from all participants prior to their participation.

## Method in Action

### *Knowledge Retention*

To measure knowledge retention of the neonatal resuscitation algorithm after playing the RETAIN board game, we recruited 30 HCPs who were on service in the Neonatal Intensive Care Unit to participate in our pre-post-test study. We decided to use the same open-answer neonatal resuscitation scenario for both the pre-test and post-test. Using an open-answer scenario allowed us to measure HCPs' recall rather than recognition of the neonatal resuscitation algorithm, which is a more objective assessment of their knowledge. Using the same scenario meant that the changes in knowledge retention we measured were indeed from playing RETAIN and not caused by differences in scenario difficulty or differences in HCPs' incoming clinical experience. All HCPs underwent a 5-minute tutorial to learn how to play RETAIN. We observed that all the HCPs quickly and easily understood how to play the game (e.g., how to use their role card to gather their supplies and apply interventions using the action cards and equipment pieces). The

valuable feedback we received from HCPs has since been integrated into the rolling development of the latest version of the RETAIN board game.

### *Summative Assessment*

For the summative assessment study, we recruited 20 HCPs to complete the written pre-test and play one scenario of RETAIN. The study sessions took between 20 and 30 minutes each, for HCPs to complete the following: informed consent, demographic survey, written pre-test, one scenario of RETAIN, and a post-survey to assess their mind-set and overall board-game usage habits. From our experience, this was an appropriate amount of time to request from our participants, allowing them to balance participating in the study with their day-to-day clinical responsibilities and duties. We had initially planned for HCPs to be assessed while playing three scenarios of RETAIN; however, after our first participant, we quickly changed our study design to include only one scenario, to comply with a more appropriate time commitment.

As we had already observed that playing RETAIN improved HCPs' knowledge retention of the neonatal resuscitation algorithm, we wanted to make sure that this study represented a true objective summative assessment of HCPs' neonatal resuscitation competence. Therefore, no feedback was provided to participants before, during, or after playing the RETAIN game scenario. The researcher who facilitated the game scenario followed a script, which was limited to information about the infant's visual appearance, heart rate, oxygen saturation, and work of breathing. Participants could ask questions; however, the researcher only responded with information indicated in the script, or with "I do not have that information." Participants were provided no assistance.

If participants performed the steps of the neonatal resuscitation algorithm correctly, the scenario would proceed as planned. However, if participants performed incorrectly, the

researcher would respond with unchanged information about the infants' vitals. For example, at one point during the scenario, the simulated infant's heart rate was 40 beats per minute, and the next step of the algorithm indicated to proceed with chest compressions. If the participant played the "start chest compressions" card, the researcher would respond with, "The heart rate increases to 70 beats per minute." However, if the participant did not start chest compressions, the researcher would respond with, "The heart rate is still 40 beats per minute." After reviewing the literature on incorporating death during infant simulation (Corvetto & Taekman, 2013), we decided against using simulated death punitively during this study, as it was not a predefined learning objective of the summative assessment.

As all HCPs had completed NRP recertification within 24 months of the study, we scored participants' performance on the pre-test and on the RETAIN game using the NRP 2015 guidelines. This process was supervised by both an experienced neonatal nurse and a neonatologist, who provided valuable guidance, especially during interpretation of the open-answer test questions.

### **Section Summary**

- At many points throughout the course of these two studies, we had to make important decisions to optimize the quality of our research methodology in action.
- Although each study presented unique challenges, our consistent and well-defined methodological approach allowed us to overcome those obstacles while maintaining the integrity and validity of our research outcomes.
- Expert guidance from a research nurse and research clinician provided invaluable support throughout the process.

## **Practical Lessons Learned**

The goal of our research project was to measure the educational outcomes of playing the RETAIN board game. In our first study, we used a pre-post-test design to measure knowledge retention of the neonatal resuscitation algorithm in HCPs after playing three scenarios of RETAIN. We observed a 12% increase in overall knowledge retention of the steps of the neonatal resuscitation algorithm, with the largest improvement in the category of temperature management.

In our second study, we used an approach to assess HCPs' neonatal resuscitation competence by comparing their performance on a written open-answer summative assessment to their performance on one scenario of the RETAIN board game. We observed that HCPs demonstrated improved performance on the RETAIN board game, compared with the traditional written summative assessment. As simulation-based assessment is the optimal method to assesses competence beyond measuring cognitive knowledge on its own (Steadman & Huang, 2012), the RETAIN board game may have provided a more suitable environment for HCPs to demonstrate their mastery of the neonatal resuscitation algorithm, compared with the traditional written summative assessment.

Furthermore, the RETAIN board game elicited more information from HCPs on their knowledge of specific steps of the neonatal resuscitation which the written open-answer test did not. For example, most participants wrote down "MR. SOPA" on the open-answer test, which is an acronym for six ventilation corrective steps. While the acronym is easy to remember, often HCPs are unable to remember which step each letter represents. We had previously observed that when prompted to articulate each step of "MR. SOPA," 43% of HCPs on our unit answered incorrectly. Therefore, the test was unable to elicit HCPs' full understanding of what MR. SOPA

means. Whereas on the game, participants had to explicitly play the following cards: “1. Mask adjustment, Reposition of airway, 2. Continue PPV and reassess, 3. Suction mouth and nose, Open mouth, 4. Continue PPV and reassess, 5. Pressure increase, 6. Continue PPV and reassess, 7. Alternate airway, 8. Intubation preparation, 9. Continue PPV and reassess.”

With the help of a collaborator from the Department of Educational Psychology, we tested the data for normality and compared HCPs performance between the pre-test and the post-test using a repeated- measures analysis of variance (ANOVA) with a Greenhouse–Geisser correction. To compare HCPs’ performance between the written-test and on the RETAIN board game, we used Student’s t-test as the data consisted of continuous parametric variables. Statistical analyses were performed with SigmaPlot (Systat Software Inc., San Jose, CA, USA) and RStudio AGPL v3 Desktop Open Source Edition (RStudio Inc, Boston, MA, USA).

Therefore, in addition to its utility as a training tool to improve knowledge retention of the neonatal resuscitation algorithm, the RETAIN board game can also be utilized as an objective summative assessment of neonatal resuscitation competence. RETAIN as a summative assessment approach is more robust and representative of HCPs’ actual knowledge of neonatal resuscitation, in comparison with the traditional written test approach. While assessing HCPs using RETAIN may be more challenging in comparison with a simple written test and therefore limit its uptake, simulation-based assessment is recommended as the best way to evaluate HCPs’ clinical competence (Steadman & Huang, 2012). In the absence of a cost- analysis of RETAIN, we speculate that administering the board game would be a more accessible way to conduct simulation-based assessment in comparison with traditional simulation approaches (e.g., Objective Structured Clinical Examination [OSCE]). However, further studies are needed to see if RETAIN poses a feasible alternative.



Through our experience of validating the RETAIN neonatal resuscitation game, we identified practical lessons which may be useful when undertaking a clinical research project in health professional education:

- When studying a new topic in the scientific literature, such as serious games for training and assessing neonatal resuscitation, consult experts in other disciplines to develop effective and well- rounded research questions. By working with educators and neonatologists, we could address practical goals to validate our educational game, while simultaneously ensuring clinical relevance for neonatal HCPs.
- Partnering with research nurses and research clinicians working at a health care institution may help with obtaining access, approval, and resources; supporting recruitment; solving problems that arise during data collection; and communicating with professionals to optimize the research design.
- Conducting clinical research in a population of critical care HCPs requires simultaneously balancing the research goals with the priorities of participants. To improve cooperation and meaningful participation, recruit HCPs as partners in research. Rather than framing the relationship as researcher and subject, become a team to improve health care training, assessment, or delivery together for your unit.

### **Section Summary**

- We observed improved short-term neonatal resuscitation knowledge retention in HCPs after playing RETAIN, as well as a robust and objective summative assessment of neonatal resuscitation competence.

- We identified several strategies that were important to the success of our research project, such as being mindful of HCPs' time and other responsibilities outside the scope of the research, which may be useful to others pursuing similar clinical research.

## **Conclusion**

The successful completion of the first phase of our research project was aided by guidance from interdisciplinary experts, access to a population of neonatal HCP participants, and support from clinical research partners, to implement our methods into action. The next phase of our research project will aim to investigate the educational outcomes we observed in the context of collaborative team play, as a strategy to improve communication and teamwork while effectively training and assessing neonatal resuscitation knowledge and skills.

As described in this case study, developing strategies to conduct research in a critical care setting requires a thoughtful approach. The time of on-service HCPs is a valuable resource, and therefore researchers should be well-prepared before data collection begins. These steps include critically appraising the literature to identify the strengths and weaknesses of previously published studies in the field. This information, along with guidance from experienced interdisciplinary advisors (in our case, research clinicians and educational psychologists), will be helpful to develop a well thought-out and pragmatic methodology. Careful planning also includes anticipating and addressing potential problems (in our case, adapting our research design to the time constraints of on-service HCPs), ideally before they occur. Finally, research objectives should be explained to participants as an aim to eventually improve patient outcomes. Being mindful to work together as researchers and HCPs to achieve this common goal may help to develop more sustainable recruitment on the unit.

### **Classroom Discussion Questions**

1. A research team investigating serious games for neonatal health care would benefit from the inclusion of which other fields of study or disciplines (besides clinical and educational)? Explain your answer.
2. What are some practical considerations which must be considered when recruiting on-service health care providers as participants in your study? Explain how these considerations could affect or alter your research design or recruitment strategies.
3. Besides an open-answer written test, what other methods have your instructors used to assess your knowledge? How could you adapt those methods to be used to assess clinical competence?

### **Multiple-Choice Quiz Questions**

1. In comparison to multiple choice questions, open-answer questions elicit:
  - A) Recall of knowledge (CORRECT)
  - B) Recognition of knowledge
  - C) Reflection of knowledge
2. Experiential learning allows you to learn by:
  - A) Using your previous experiences to help you understand and contextualize the topic you are currently studying
  - B) Experiencing knowledge through a hands-on first-person experience (CORRECT)
  - C) Imagining a scenario where you will have to use what you are learning in a real-life experience.

3. To measure a change in participants' knowledge, your study design should include a:
  - A) Demographic survey to evaluate participants' years of experience with the subject matter being tested
  - B) Tutorial to evaluate participants' familiarity with the assessment method being used
  - C) Pre-test to evaluate participants' baseline knowledge (CORRECT)

### **Declaration of Conflicting Interests**

Simran Ghoman and Maria Cutumisu: No competing interests.

Georg M. Schmölzer has registered the RETAIN board game [Tech ID 2017083] and the RETAIN video game under Canadian copyright [Tech ID – 2017086]. Georg M. Schmölzer is a Co-owner of RETAIN Labs Medical Inc., Edmonton, Canada (<https://www.playretain.com>), which is distributing the game.

### **Contributor Biographies**

**Simran Ghoman**, BSc (Hons), convocated with high distinction with an honors Bachelor of Science degree from the University of Toronto. After driving an initiative to improve healthcare access and delivery for underserved pediatric cardiology patients in a global health setting, Simran matriculated as a Master of Science candidate in Pediatrics at the University of Alberta. Here she undertook a cutting-edge research program investigating gamification of neonatal resuscitation training and assessment. Combining her interdisciplinary perspective with a passion for improving pediatric patient safety, Simran's research may help improve access to effective and engaging training for neonatal resuscitation providers around the world.

**Maria Cutumisu**, PhD, is an Assistant Professor in the Department of Educational Psychology, Faculty of Education, at the University of Alberta, in the area of Measurement, Evaluation, and Data Science and an Adjunct Professor in the Department of Computing Science, Faculty of Science, University of Alberta. She graduated with an M.Sc. and a Ph.D. in Computing Science from the Department of Computing Science, University of Alberta, and she trained as a postdoctoral scholar at the Stanford Graduate School of Education. She uses psychophysiological techniques (e.g., eye-tracking and electrodermal activity measures) to provide a comprehensive

understanding of students' learning and memory processes. She is also interested in computational thinking and serious games.

**Georg M. Schmölzer**, MD, PhD, is the inaugural Heart and Stroke Foundation/University of Alberta Professor of Neonatal Resuscitation and the Director of the Center for the Studies on Asphyxia and Resuscitation (CSAR) in Edmonton, Canada. He also works as a neonatologist at the Royal Alexandra Hospital. Dr. Schmölzer obtained his MD, PhD and clinical training in Austria and Australia. In 2014, he completed a Banting Postdoctoral Fellowship at the University of Alberta. CSAR's research focuses to (i) understand physiological changes during fetal to neonatal transition, (ii) improve diagnoses, mitigate risk and improve survival and quality of life for newborns, (iii) use of emerging technologies during neonatal resuscitation, and (iv) examine how these physiological changes can be used to improve short- and long-term outcomes of newborn babies.

### **Further Reading**

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### **Web Resources**

RETAIN Neonatal Resuscitation: <https://www.retainlabsmedical.com/index.html>

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