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Infection Control of the Anesthesia Workspace – Double Glove Technique

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Abstract

Current infection control practice has proven to be inadequate and pathogen transfer from anesthesia provider to patient is well established in literature, especially pertaining to contamination during direct laryngoscopy (DL), which exposes both surface and patient to disease, viruses, and bacteria. The purpose of this study was to evaluate the acquisition of confidence and perceived knowledge of proper handling of potential contaminants during induction and DL utilizing video simulation among junior level (second year) nurse anesthesia trainees (NAT-2s) enrolled at NorthShore University HealthSystem (NSUHS). Eighteen NAT-2s were evaluated using single group, pre-test post-test design, both before and immediately after video simulation, on the steps of induction and endotracheal intubation using double glove technique. A paired samples *t* test was conducted to compare pre- and post-tests for confidence and perceived knowledge. The results demonstrated a significant increase in both outcomes. There was a statistically significant difference between pre ($M = 3.1$; $SD = 0.75$) and post ($M = 4.4$; $SD = 0.41$) mean scores on confidence with *t* test statistics showing $t(df = 17) = -7.41$, $p < 0.001$. Additionally, there was a statistically significant difference between pre ($M = 0.0$; $SD = 0.00$) and post ($M = 0.6$; $SD = 0.50$) mean scores on perceived knowledge with *t* test statistics value of $t(df = 17) = -5.17$, $p < 0.001$. Demographic variables had no significant effect on the scores of confidence or perceived knowledge. This pilot study provides preliminary evidence to support that video simulation education demonstrating the proper handling of contaminants may reduce patient harm, and improve provider compliance of infection control standards if presented during nurse anesthesia curriculum to junior level NATs.

Keywords: Nurse Anesthesia Trainee, simulation, infection control, anesthesia workspace

Infection Control of the Anesthesia Workspace

Introduction

Background and Significance

Safe infection control practices are of paramount importance in the operating room (OR). Increasing resistance of organisms, surface contamination, and nosocomial infections are but a few of the concerns that may cause harm to patients in the OR. Current infection control practice has proven to be inadequate and pathogen transfer from anesthesia provider to patient is well established in literature (Biddle et al., 2016; Machan, Monaghan, McDonough, & Hogan, 2013). Anesthesia-related bacterial transmission is a "root cause of 30-day postoperative infections affecting as many as 16% of patients undergoing surgery" (Loftus, Kof, & Birnbach, 2015). Furthermore, the consequences of such harm may result in profound expense as well as burden patient outcomes (Machan, 2012).

Direct laryngoscopy (DL) exposes both surface and patient to contaminants, disease, viruses, and bacteria. Lack of knowledge, education, and training of the NAT on infection control may lead to infectious complications affecting anesthesia care outcomes. This intensifies the need to eliminate human error, noncompliance, and inadequate disinfection as a vector in potentially devastating disease transmission. This study examined NAT-2s knowledge of proper handling of potential contaminants during induction and DL. This quantitative data collection methodology utilizes both an educational simulation video demonstrating the double glove technique during induction and DL, in addition to pre- and post-survey methodology. The purpose is to increase awareness, confidence, and knowledge of infection control standards in the anesthesia work environment.

Research Problem

Anesthesia providers frequently have contact with infectious fluids and blood, and as student learners, the researchers experienced a need for education regarding contamination of the anesthesia workspace. Microbes inevitably infiltrate the anesthesia workspace and despite adherence to standard practice, "no perfect decontamination procedure exists" (Machan et al., 2013). Oral contamination as a result of DL can be found on multiple areas of the anesthesia machine, patient's intravenous access ports, the anesthesia drug cart, and the provider's stethoscope (Biddle et al., 2016). The most frequently contaminated sites include the "reservoir bag, breathing circuit pressure valve (APL valve), distal Y-piece of the breathing circuit, the vaporizer control dial, the intravenous flow control, the ventilator controls, the intravenous stopcocks, and the drug cart surface and drawers where drugs and equipment are stored" (Biddle et al., 2016). In seeking best practice that effectively decreases the spread of microbe transfer, especially with respect to oral inoculum, double gloving technique employed during laryngoscopy and intubation, with immediate removal of outer set post-intubation, was determined to drastically reduces contamination of the anesthesia workspace (Birnbach et al., 2015).

Purpose Statement

The purpose of this study was to examine the NAT-2's confidence level and knowledge of proper handling of potential contaminants during induction and DL utilizing video and survey methodology. Using best practice, the double glove laryngoscopy technique, and video simulation, this study investigated whether there was an increased acquisition of confidence and perceived knowledge pertaining to infection control standards of the anesthesia work environment.

Research Question

- Among NSUHS NAT-2s, does the implementation of video simulation education training demonstrating the double glove laryngoscopy technique increase confidence and perceived knowledge regarding proper handling of potential contaminants during induction and endotracheal intubation?

The research question was designed to evaluate awareness and understanding of infection control at the level of the anesthesia provider, specifically the NAT-2. The short-term goal was to increase the NAT's confidence and knowledge in proper handling of potential contaminants during induction and DL. The ultimate impact of this intervention will be an overall improved delivery of anesthesia care by utilizing safe and effective infection control standards. Subsequent impact will be improved patient outcomes, decreased spread of potentially harmful pathogens, and decreased incidence of nosocomial infection.

Theoretical Framework

The theoretical framework applicable to this study was Kolb's Experiential Learning Theory. Experiential Learning combines four cyclical stages of learning: experience, perception, cognition, and behavior (Kolb, 2014). The experience for this study was an in-service demonstration via video simulation education. The perception, or observation, described the learner's ability to reflect on the video demonstration. The third stage was cognition, or the think stage, in which the NAT conceptualized learned information, as demonstrated by survey. Our goal was that these steps translated into the fourth stage, where the learner demonstrates this behavior in the clinical setting. The goal is based on the premise that demonstration of aseptic technique facilitates and improves the quality of learning and ascertaining of skill (McNett, 2012).

Literature Review

A thorough review of literature was performed using MEDLINE/PubMed and CINAHL databases to identify studies examining implications of infection control and the anesthesia environment. The search terms *nurse anesthesia trainee*, *anesthesia, workspace, contamination, vectors, microbes, pathogens, health care associated infection, and infection control* were combined, yielding 81 articles, 11 of which are included in this study. The literature review included randomized controlled trials, observational studies, and cross-sectional studies.

Double Glove Technique

Birnbach et al. (2015) performed a study evaluating anesthesia providers under simulation. It was determined that anesthesia providers are indeed vectors in the spread of pathogens and the operating room is a reservoir for resistant microbes (Birnbach et al., 2015). Furthermore, according to Birnbach et al. (2015), hand hygiene is not practiced consistently or regularly by anesthesia providers, despite having frequent contact with upper airway secretions and blood. Out of 22 simulations, Birnbach et al. (2015) conducted 11 single gloved technique intubations and 11 double-gloved technique intubations. The differences in the technique simulations were statistically significant, with a dramatic reduction reported in the contaminated sites of the double-gloved technique versus single gloved technique, 5.0 +/- 0.7 compared to 20.3 +/- 1.4, respectively, $p < 0.001$ (Birnbach et al., 2015). Double gloving during laryngoscopy and intubation, with immediate removal of outer set post-intubation, dramatically reduces contamination of the anesthesia workspace (Birnbach et al., 2015).

Biddle et al. (2016) examined the anesthesia provider's role in pathogen dispersion through three mechanisms: simulated induction to demonstrate the passage from oral to anesthesia environment, double gloving as a means to reduce provider contamination to

environment, and the effectiveness of between case decontamination. Group 1 (single gloved group) contaminated 16 sites compared to group 2 (double gloved group) who contaminated 7.6 sites. Sites most frequently contaminated by group 1, but not group 2 were: medication vials, ventilator controls, gas flow dials, and anesthesia cart drawers ($p < 0.05$) (Biddle et al., 2016). Additionally, post-induction contamination continued at a rapid rate in group 1, but not in group 2. With respect to between case disinfection, Biddle et al. (2016) determined that cleaning was an ineffective means of contaminant removal. This study further confirms the benefits of double gloving technique and the importance of maintaining the integrity of a clean environment to avoid risk to patients.

Anesthesia Providers and Equipment as Vectors in the Spread of Infection

Rowlands et al. (2014) performed video observation of anesthesia provider hand hygiene in order to map the transmission of bacteria from provider and surface to patient. Compliance was least observed during induction and emergence, as these times represent critical moments for the anesthesia provider; however, this is when there is the most provider contact with patient bodily fluids. Rowlands et al. (2014) found correlation between hand hygiene and the rate of bacterial contamination of the anesthesia work area.

Maslyk, Nafziger, Burns, and Bowers (2002) sought to quantify the microbial growth that occurred after full day's use of the anesthesia machine in the operating room. Maslyk et al. (2002) used the Wilcoxon signed rank test to determine colony-forming units (CFUs) present before and after equipment use. Even though the resulting *P* value did not demonstrate a significant decrease in CFUs before and after use, the results did indicate important findings. The collected samples revealed that several pathogenic organisms with the potential for threat to providers and patients survive on the anesthesia machine (Maslyk et al., 2002). Additionally,

this study demonstrated how easily these pathogenic organisms can be transferred between and around different departments within the hospital (Maslyk et al., 2002).

Loftus et al. (2011) examined the origin of intraoperative bacterial transmission and evaluated environmental decontamination practices as a mode to decrease transmission in the operating room. The primary measurement evaluated the incidence of intraoperative pathogen transmission from anesthesia provider to patient environment or intravenous (IV) stopcock (Loftus et al., 2011). The secondary measurements were "bacterial speciation of transmission events, provider variability in hand contamination, horizontal transmission, and the adequacy of anesthesia environment decontamination practices" (Loftus et al., 2011). It was determined that 66% of anesthesia provider's hands were infiltrated with at least one of the following microbes: *Acinetobacter*, *Pseudomonas*, *Brevundimonas*, *Enterobacter*, and *Moraxella* (Loftus et al., 2011). One hundred sixty-four cases (82 case pairs) were studied and intraoperative bacterial transmission was transmitted to the IV stopcock set in 11.5% of cases, 47% of which were of provider origin (Loftus et al., 2011). Additionally, intraoperative pathogen transfer to the anesthesia environment was identified in 89% of cases, 12% of which were determined to be provider origin (Loftus et al., 2011). This study demonstrated that provider hand contamination is an important source of intraoperative contamination to patient environment and IV stopcock set.

Loftus et al. (2015) conducted a study to determine the transmission of commonly found gram-negative bacteria in the anesthesia work area environment (AWE). The secondary objective was to determine correlations between transmission events and 30-day postoperative heath care-associated infections (HCAIs) (Loftus et al., 2015). The five most frequently encountered bacteria (*Acinetobacter*, *Pseudomonas*, *Brevundimonas*, *Enterobacter*, and

Moraxella) were responsible for 81% of possible transmission events (Loftus et al., 2015). Reservoirs implicated as a source for between-case transmission events associated with HCAIs were patient/provider hands and contaminated environmental surfaces (Loftus et al., 2015). Loftus et al. (2015) determined that between-case, and within case AWE gram-negative transmission, occurs often and is linked to postoperative infections. This evidence intensifies the need for conscientious providers, adequate hand hygiene, and properly disinfected surfaces.

Blood Contamination of Anesthesia Equipment

Perry and Monaghan (2001) evaluated the presence of visible and occult blood on various anesthesia and monitoring equipment in 28 operating rooms of two separate healthcare facilities. They determined that 32% of the equipment used during 342 observations contained occult blood, a "direct violation of the Occupational Safety and Health Administration Blood-borne Pathogen Standard and the infection control guidelines of the American Association of Nurse Anesthetists" (Perry & Monaghan, 2001). These findings further prompted the undertaking of a project to improve infection control practices and compliance.

Hall (1994) conducted a randomized study to determine the degree of blood contamination on both anesthesia and monitoring equipment in the operating room. Nineteen surfaces on anesthesia machines, anesthesia carts, and monitors that are touched or handled frequently by anesthesia personnel were identified and sampled. Sites with the highest prevalence of contamination were monitor cables (82%), drawer handles (64%), and oximeter probes (59%) (Hall, 1994). This study confirms the prevalence of blood contamination on the surfaces of anesthesia equipment and monitoring equipment.

Machan (2012) performed a review of literature to evaluate current practice methods of infection control and laryngoscopy. Machan's (2012) review found that current processes are

ineffective and may cause harm to the patient, and possibly even provider, especially with respect to blood borne pathogens (i.e., Hepatitis B) known to survive for a prolonged amount of time on surfaces such as laryngoscope blades and handles.

Intervention to Improve Infection Control Compliance

Clark, Taenzer, Charette, and Whitty (2014) conducted a randomized study to determine the effect of a prescribed training intervention on intraoperative anesthetic environment contamination. The intervention included the following: education, a "clean hands only" placard placed on the anesthesia equipment cart as a reminder that only clean items be placed on it, the designated working area was the surface of the anesthesia machine, and contaminated sites required decontamination wipes intraoperatively (Clark et al., 2014). The baseline cases reached a contamination threshold level of 46% compared to 12% of the intervention cases (Clark et al., 2014). Clark et al. (2014) demonstrated that a simply designed intervention, in addition to a hygienic anesthesia environment, can considerably affect the quantity of contamination in the anesthesia space over the progression of a case.

Baillie, Sultan, Graveling, Forrest, and Lafong (2007) performed two cross-sectional studies to examine the pathogen contamination of anesthesia machines before and after implementation of between case disinfection. Before the intervention, the proportion of positive pathogenic cultures were alarmingly high, despite following professional guidelines for cleaning anesthetic equipment (Baillie et al., 2007). This demonstrated convincing evidence that the route for bacterial transmission to patients occurs indirectly via contaminated anesthetic equipment. Potentially pathogenic bacteria such as *Staphylococcus aureus* and gram-negative bacilli were found in 18% of cultures (95% CI 9.4–26.5%) pre-intervention and only 6% of cultures (95% CI 1.0–12%; $p = 0.03$) six weeks post-intervention (Baillie et al., 2007). This study demonstrates

that potentially pathogenic bacteria are present on anesthesia machines, and that a simple intervention can drastically reduce the pathogenic colonization of the anesthesia work area.

In conclusion, this literature review examines the role of anesthesia providers in the spread of potentially catastrophic pathogens, and identifies induction and DL as vulnerable intervals and as a source of major contamination of the anesthesia workspace. It also highlights that interventions, such as double glove technique and education, can considerably decrease the extent of contamination of the anesthesia workspace. In turn, this exemplifies that a conscientious and educated provider can ultimately improve the quality and safety of the anesthesia experience.

Deficiencies in Past Studies

Despite statistically significant studies demonstrating provider contamination of the anesthesia work environment, there were limited recommendations on best practices to decrease workspace contamination. Many of the studies conducted utilized simulation rather than actual OR behavior, which may limit usability of results. There was limited evidence showing actual pathogenicity of anesthesia provider contamination, or tracking sources of infection to the anesthesia provider. Last, with respect to NATs, there was limited, if any research demonstrating provider compliance or lack of education in infection control precesses (see Table 1).

Methods

Research Design

A single group, pre-test post-test design evaluated confidence and perceived knowledge before and immediately after video simulation education in the NAT. Specific video education steps included induction and endotracheal intubation using double glove technique (see

Appendix C). This technique was determined to be the best practice to decrease contamination of the anesthesia workspace. The educational video simulation was scripted and validated by an expert panel of NSUHS, School of Nurse Anesthesia faculty: Pamela Schwartz DNP, CRNA; Karen Kapanke DNP, CRNA; Julia Feczko DNP, CRNA; Susan Krawczyk DNP, CRNA; and, Bernadette Roche EdD, CRNA. This research project was completed in four phases: (1) development of an educational video simulation and script, (2) development of confidence and perceived knowledge assessment tools, (3) evaluation of intervention (video simulation) via pre-confidence and post-confidence assessment tool (CAT), and (4) evaluation of intervention (video simulation) via pre-knowledge and post-knowledge assessment tool (KAT).

This study was a non-experimental design, and thus had an intervention group only, no control. Methodology and quantitative analysis fit this research question, as the statistical data was fixed and measurable. Quantitative research requires statistical analysis and measurement through evaluation of numerical information (Polit & Beck, 2017). Qualitative analysis may be used to assess NAT perspective on infection control in the anesthesia workspace; however, it would be difficult for this research project as it is more dynamic, open ended, and difficult to interpret or measure.

Participants and Sampling

This study utilized a convenience sampling approach. The intervention group was a homogenous sample of junior level NATs enrolled at NSUHS, after the start of their 20-month clinical rotations (N=18). The participants' demographic information was ascertained via questionnaire (see Appendix D). This information enabled the researchers to identify characteristics of the sample. The demographic information questionnaire included: years of critical care experience, level of education, gender, age, and ethnicity. Using a homogenous

sample of NATs enhanced the interpretability of the results. According to Polit and Beck (2017), a key benefit to this type of sampling is that it eliminates variability of the confounding variable. Additionally, a homogenous sample is easy to analyze, which, in turn, facilitates consistent, precise, and reliable data (Polit & Beck, 2017).

Recruitment Procedure

Recruitment of participants occurred via email to all second year NATs by the project's Committee Chair and NSUHS Program Director, School of Nurse Anesthesia, Pamela Schwartz, DNP, CRNA. A participation invitation and introduction to the project as well as an information sheet detailed this research project and subjects' rights (see Appendices A &B). The participation in this 45-minute seminar was voluntary and survey methodology was completely confidential; pre- and post-tests participation provided implied consent, therefore, formal consent was not obtained. There was no monetary or compensatory incentive for participation. The voluntary participants were provided with a brief introduction to the researchers and study just prior to administration of the demographic survey, CAT pre-test, and KAT pre-test. Surveys were distributed and collected confidentially and anonymously in envelopes with labeled numbers only. Video education and simulation was then played via recorded PowerPoint presentation and CAT and KAT post-tests were administered to all participants and collected.

Video Simulation of Induction and Endotracheal Intubation

The intervention in this study was a video outlining the step by step instructions of induction and intubation using double glove technique. After a review of literature, the researchers determined that the double glove technique was a best practice technique aimed at decreasing vector contamination of the anesthesia workspace. The steps for induction and oral endotracheal intubation using double glove technique were adapted from Jaffe, Schmiesing, and

Golianu (2014) (see Appendix C). The video was then recorded in an available operating room at NSUHS in Evanston, Illinois, and embedded in a short educational video via PowerPoint presentation. The steps of induction and intubation followed an expert validated and approved outline. The objective of utilizing a video was to increase awareness, confidence, and knowledge of infection control standards in the anesthesia work environment using the double glove technique.

Instruments

Confidence and perceived knowledge were measured in this study. CAT and KAT were developed to assess these two outcomes, along with the NAT-2's understanding of the steps required for general anesthesia induction and intubation. The pre- and post-tests were reviewed and validated by the expert faculty panel for clarity, relevance, simplicity, and consistency. CAT and KAT additionally required Institutional Review Board (IRB) approval. Both assessment tools contained close-ended, identical questions, and format and were given to NAT-2s before and after the video education to determine if confidence and knowledge improved as a result of the intervention.

Confidence Assessment Tool

The CAT assessed the NAT's confidence level related to the double glove technique during induction and intubation, and the potential implications of contamination (see Appendix E). The CAT test format utilized a Likert rating scale that ranged from one (very uncomfortable) to five (very comfortable).

Knowledge Assessment Tool

The KAT tool requested the NAT to numerically arrange 12 steps, from induction to completion of intubation, using the double glove technique (see Appendix F).

Data Collection

After receiving both NSUHS and DePaul University IRB exempt status approval, data collection was held on Saturday, March 11, 2018 at NSUHS's Frank Auditorium in Evanston, Illinois (see Appendices G1 & G2). A convenience sample of NAT-2's (N = 18) voluntarily participated in the 45-minute seminar. A demographic survey (years of critical care experience, education level, gender, age, ethnicity) was administered and collected followed by the CAT and KAT pre-tests. After completion, the participants viewed the video simulation intervention on induction and intubation using double glove technique. Last, they were given the CAT and KAT post-tests. All results were compared to determine if there was any statistically significant differences in confidence and knowledge, pre- to post-test, after the intervention.

Data Analysis

The results of the pre- and post-tests were evaluated using statistical analysis, specifically the International Business Machines (IBM) Statistical Package for Social Science (SPSS) software version 24 (IBM, 2017). The null hypothesis was: there is no difference in the comfort level and knowledge of NATs in the areas of induction and intubation related to infection control with double glove technique at pre- and post-tests. In order to test the null hypothesis, a paired-samples *t* test was conducted to compare pre- and post-tests for confidence and perceived knowledge. Paired samples *t* test is a parametric statistical test used when analyzing differences in a pair of observations (Polit & Beck, 2017). Assumptions include: independent observations, the data must be continuous, follow normal distribution, and cannot contain outliers (Polit & Beck, 2017). All the assumptions of *t* test have been checked prior to data analysis and investigators verified that these assumptions were met.

The adapted CAT questionnaire had a Cronbach's alpha of 0.62 for the pre-test, which was considered inadequate for reliability; however, the post-test had a Cronbach's alpha of 0.89, indicating excellent reliability or high internal consistency. The KAT pre- and post-tests had a Kuder-Richardson Formula 20 (KR-20) value of 0.65 and 0.64, respectively. Thus, the KAT was a reliable instrument to measure the knowledge of participants on infection control of the anesthesia workspace.

Human Subjects Protection and Ethical Considerations

In addition to review and approval by NSUHS and DePaul University IRBs, the researchers obtained human subjects training via Collaborative Institutional Training Initiative (CITI) and Financial Conflict of Interest (FCOI) to ensure that there was little to no human risk involved in participation. Furthermore, employing survey research is considered minimal risk to the participant and ethical vigilance was taken with respect to research design and survey questions (Polit & Beck, 2017).

The recruitment email and information sheet outlined these human subject's standards, including explanation and purpose of the study, voluntary and confidential participation that may be withdrawn at any time, and contact information of investigators and research services. In order to maintain anonymity and confidentiality standards, the demographic survey, pre-test, and post-test contained no identifiable information and were all distributed in numbered manila envelopes. The results were then collected, sorted, and securely stored in a locked cabinet until data analysis.

Results

A single intervention group composed of 18 second year NSUHS NATs (N = 18) participated in this study. There were two males and 16 females (see Figure 1). The majority of

the participants were 26 to 30 years of age (44.4%), followed by 31 to 35 years of age (33.3%), 20 to 25 years of age (11.1%), and 36 and older (11.1%) (see Figure 2). Most of the participants had Bachelor's degree educations (88.9%) compared to Master's degree education (11.1%) (see Figure 3). Years of critical care experience ranged from one to two years (27.8%), three to five years (38.9%), six to eight years (22.2%), and greater than eight years (11.1%) (see Figure 4). All participants identified their ethnicity with 72.2% being white, 16.7% Asian or Pacific Islander, 5.6% black, and 5.6% mixed (see Figure 5).

The intervention group was evaluated using pre-test post-test design, both before and immediately after video simulation, on ordering the steps of induction and endotracheal intubation using double glove technique. A paired samples *t* test was conducted to compare pre- and post-tests for confidence and perceived knowledge mean scores. The results demonstrated an increase in both outcomes during post-test. There was a statistically significant difference between pre-confidence (M = 3.1, SD = 0.75) and post-confidence ($M = 4.4$, $SD = 0.41$) mean scores with *t* test statistics showing $t(df = 17) = -7.41$, $p < 0.001$. Additionally, there was a statistically significant difference in the pre-perceived knowledge (M = 0.0, SD = 0.00) and post-perceived knowledge ($M = 0.6$, $SD = 0.50$) mean scores with *t* test statistics showing $t(df = 17) = -5.17$, $p < 0.001$.

Discussion

Pathogen transfer between anesthesia provider and workspace to patient is well-established in literature and there is no best practice currently recommended to deter this phenomenon (Biddle et al., 2016). This technique was selected as a best practice by the researchers because of statistically significant evidence presented in both Biddle et al. (2016) and Birnbach et al. (2015). The researchers also considered the vulnerability of the anesthesia

workspace to contamination during induction and intubation and that hand hygiene is not consistently practiced by anesthesia providers (Biddle et al., 2016; Birnbach et al., 2015; Munoz-Price et al., 2013).

This study evaluated the efficacy of video simulation education of NAT-2s on their confidence and perceived knowledge pertaining to infection control of the anesthesia workspace using double glove technique. The results were statistically significant, with *P* values less than 0.001 for both confidence and perceived knowledge, suggesting that education of the NAT is a powerful tool. The mean between pre- and post-confidence increased from 3.1 to 4.4, and between pre- and post-perceived knowledge, increased from 0.0 to 0.6. These were expected results, especially pertaining to the pre-test knowledge assessment of the ordering of steps of induction and intubation using double glove technique. While no NAT ordered the steps correctly in the pre-test, 61% of NATs ordered the steps correctly in the post-test, demonstrating effective educational intervention.

Gender, level of education, and ethnicity demonstrated significant homogeneity in the sample, making those variables exempt from drawing comparisons. Age and years of critical care experience, while not homogenous, had no statically significant effect in the pre- or post-tests in confidence or knowledge assessment. Thus, the demographic variables of this sample had no statistically significant effect on the scores of confidence or perceived knowledge of technique.

While there has never been a study of this nature performed on the nurse anesthesia trainee, the evidence and results do corroborate with studies by Clark et al. (2014) and Baillie et al. (2007) in which an education intervention on intraoperative anesthesia environment contamination can significantly decrease the quantity of contamination. Thus, education of

NAT-2s via video simulation is a quantifiable tool as demonstrated by the statistical significance of our data. The hope is that this education, paired with increased confidence and knowledge, translates into decreased contamination in the OR.

Limitations

As a result of the target population at NSUHS consisting of only 19 enrolled students, this study had limited eligibility for enrollment. This study had a small sample size, which limits the generalization of study findings. Another limitation is the homogeneity of the sample. While this can enhance the interpretability of the results by eliminating variability of potential confounding variables, it may result in problems like lack of variability. This lack of variability is not reflective of the overall population of interest, causing increased variance and external or reduced validity issues (Polit & Beck, 2017). Future studies should be aimed for a larger sample size that best represents the overall target population of NATs.

Future Recommendations

This pilot study provided preliminary evidence to support that video simulation education demonstrating the proper handling of contaminants may reduce patient harm, and improve provider compliance of infection control standards if presented during nurse anesthesia curriculum to junior level NATs. Further research should be conducted on a larger scale to truly determine if intervention at the novice level promotes better adherence to infection control standards at the expert level and if education can be linked to better long term compliance and outcomes. Research should also examine actual OR behavior, before and after an educational intervention, to quantify if education translates into actual practice. Longitudinal studies that examine the effect of video education as the training tool for NATs on the actual incidence of infection acquired in the OR are warranted. Additionally, studies should be undertaken to

determine that the outer glove of the double glove technique can provide the proper barrier to contain oral pathogens from contaminating the anesthesia workspace and therefore, reduce patient harm.

Conclusion

Lack of knowledge, education, and training of the NAT on infection control may lead to infectious complications affecting anesthesia care outcomes. This intensifies the need to decrease human error, increase compliance, and education of proper infection control prevention and disinfection of the anesthesia workspace.

The goal of this research study was to increase awareness, confidence, and knowledge of infection control standards in the anesthesia work environment. Increasing the knowledge and perceived confidence on infection control has the potential to eliminate anesthesia providers as vectors in potentially devastating transmission of diseases. Thereby making education of NAT-2s via video simulation an effective educational tool that can be utilized as one of the interventions to curb OR-related acquired infections.

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Rowlands, J., Yeager, M., Beach, M., Patel, H., Huysman, B., & Loftus, R. (2014). Video observation to map hand contact and bacterial transmission in operating rooms. *American Journal of Infection Control, 42*(7), 698-701. doi: http://dx.doi.org/10.1016/j.ajic.2014.02.021

Table 1. Evidence-Based Table on Infection Control in the Anesthesia Workspace

Author and Year	Study Objectives	Methods (Design, Sample Size, Setting, Human Subjects Issues)	Study Variables or Constructs Measured or Variables Controlled for by Researchers	Instrument/s Used to Measure the Construct/s	Statistics Used for Data Analysis	Study Findings	Conclusion
Birnbach et al. (2015)	Determine whether two glove technique reduces spread of pathogens to the anesthesia environment during endotracheal intubation.	Double blind, controlled, randomized trial; Sample size: 41 anesthesiology residents; Setting: simulated operating room; study was exempted by University of Miami Miller School of Medicine IRB	22 simulation sessions, 11 with intubating resident wearing single pair of gloves, 11 with intubating resident wearing double gloves with outer pair removed immediately after intubation.	Lips and inside of mannequin mouth were coated with fluorescent marking gel as surrogate pathogen; 40 sites were evaluated after simulation using ultraviolet light and were assigned a score.	Fisher exact test Poisson regression SAS 9.3	Statistically significant lower risk of rate of contamination of anesthesia workspace by double gloved anesthesia residents compared to single gloved residents (n=40), 5.0 ± 0.7 versus 20.3 ± 1.4, P<0.001	Double glove technique during laryngoscopy and intubation with immediate removal after dramatically reduces contamination of the intraoperative environment
Rowlands et al. (2014)	To evaluate the hand hygiene (HH) compliance of anesthesia providers	Observational study; IRB approved and informed, written consent obtained Key words: "Hand hygiene" "Health care-associated infection" "Equipment contamination"	Phase 1: randomly selected operating rooms scheduled for general anesthesia, providers were blinded to observational end points, hand contact between provider and 90 different objects was quantified	Phase 2: 20 most frequently touched objects from Phase 1 were targeted and analyzed for pathogen culture via five additional surgical cases		Anesthesia providers have low rate of HH compliance, 2.9% mean; inverse correlation established between HH during induction and emergence, 3.2% and 4.2%, respectively; anesthesia work environment (AWE) contamination at induction and emergence is 103 and 147 CFU, respectively	Correlation exists between HH compliance rates and bacterial contamination of the AWE
Biddle et. al (2016)	Quantify surrogate pathogen contamination from simulated patient mouth to anesthesia work space during induction; test hypothesis that double gloving	Observational study, convenience sample of 20 anesthesia providers to perform simulated induction of general endotracheal anesthesia; IRB approved	10 providers to each single gloved group (Group 1) or double gloved group (Group 2), each performed standard induction	Surrogate pathogen dye is tracked form oral cavity to work station, standard decontamination is performed and residual dye quantified	Regression analysis Parametric statistics 2 sample *t* test Fisher exact test	Statistically significant difference in contamination between groups 1 and 2; Group 1: mean contamination 16.0 (SEM=0.89), Group 2: mean contamination 7.6 (SEM=0.85), P<.001; after induction, Group 1 continued high rate on	Double glove technique was associated with less contamination of work space compared to single gloved group; between case disinfection was ineffective in removal of

	technique would reduce contamination sites; examine effectiveness of decontamination between anesthesia cases	Key words: "Handwashing" "Anestheisa workstation" "Contamination" "Medical simulation"				new site contamination compared to Group 2	contaminant, posing risk to patients
Machan (2012)	To determine infection control practices associated with disposable laryngoscope blades	Literature review Key words: "Disposable laryngoscope blade" "Laryngoscope" "Laryngoscope blade" "Reusable laryngoscope blade"	Disposable laryngoscope blade, single use laryngoscope blade, reusable laryngoscope blade, laryngoscopy	CINAHL, Medline, PubMed, and Cochrane library		Microbes inevitably infiltrate the anesthesia workspace and despite adherence to standard practice, there is no decontamination routine that can be deemed as perfect	Current disinfection processes are ineffective and may cause harm to the patient, especially blood borne pathogens known to survive for a prolonged amount of time on surface (i.e., laryngoscope blades and handles)
Perry and Monaghan (2001)	To determine presence of visible and occult blood on various anesthesia and monitoring equipment that are labeled as ready for use	IRB approval (although no humans or animals were used in this study) Key words: "Anesthesia" "Anesthesia equipment" "Contamination decontamination" "Occult blood"	28 operative suites were used and a total of 336 samples taken from various equipment: ventilator control knobs and switches, flow meter knobs, volatile agent dials, ECG leads, pulse oximeter probes, blood pressure cuffs	Visual inspection for the presence of blood was made Sample swabs taken from anesthesia equipment were tested for occult blood using a 3-stage phenolphthalein blood indicator test		32.7% of the equipment used during 342 observations contained blood contamination; 6 had visible blood; 33% of 19 surfaces examined using phenolphthalein blood indicator testing were positive for blood	Anesthesia equipment is not in compliance with OSHA standards or the infection control guidelines set forth by the AANA Finding further prompt the necessity of improving infection control practices and compliance Recommendations include redesigning equipment and use of disposable equipment
Baillie, Sultan, Graveling,	To identify whether viable pathogenic	2 cross-sectional studies of bacterial contamination on	Proportion of cultures containing viable pathogenic bacteria	Observation and bacterial culture	Chi- square test, with significance taken as $p < 0.05$.	Potentially pathogenic bacteria such as Staphylococcus aureus	This study demonstrated that potentially

Forrest, and Lafong (2007)	bacteria are present on anesthetic equipment during normal operating conditions, and whether a simple and practical change to departmental policy would reduce the overall burden of pathogenic bacteria on anesthetic equipment.	anesthetic machines before and after a simple intervention (each machine should be wiped once with a detergent wipe between cases) Key words: "Anesthesiologists" "Bacterial diseases" "Organisms" "Pathogenic bacteria" "Anti-infective agents"	pre-and post-intervention.	counts, gram +/- staining	Confidence intervals for proportions were calculated by normal approximation to the binomial distribution.	and gram-negative bacilli were found in 14⁄78 cultures (18%; 95% CI 9.4–26.5%) from the initial study. No multidrug-resistant bacteria were identified. Six weeks after the intervention, Staphylococcus aureus and gram-negative bacilli were present in 5⁄77 cultures (6%; 95% CI 1.0–12%; p = 0.03). The species of bacteria found did not vary between the two samples	pathogenic bacteria are present on anesthetic machines, and that a simple and easy intervention can significantly reduce the colonization of anesthetic equipment with pathogens.
Maslyk, Nafziger, Burns and Bowers (2002)	To determine the amount of microbial growth that develops on the anesthesia machine after a full day's use in the operating room.	Randomized study Key words: "Anesthesia machines" "Bacteriology" "Colony-forming units (CFUs)" "Infection control" "Microbes"	Quantification and identification of microbes present on selected anesthesia machines	Gram +/- staining to identify microbial types, quantification of colony forming units	The Wilcoxon signed rank test examines the direction of change in pretest-posttest measures. Effect size can be measured using Cohen's *d* statistics using the Mean scores and *SD* from paired *t* test (pre-and post-test design)	The Wilcoxon signed rank test was used to evaluate the change in colony-forming units (CFUs) before and after use of equipment. The resulting P value of 0.12 indicated that the observed CFU increase was not statistically significant at the .05 level.	Although the statistical results did not demonstrate an increase of 50% growth or more in CFUs during the day, samples revealed that many organisms survived on the anesthesia machines before and after use.
Loftus et. al (2010)	Primary objective: the incidence of anesthesia provider origin of intraoperative bacterial transmission to the patient environment or IV stopcock set. The secondary outcomes were bacterial speciation of	Prospective observational study	Bacterial transmission to the patient IV stopcock set and the anesthesia environment (adjustable pressure-limiting valve and agent dial)	Bacterial organisms recovered from provider hands, the anesthesia work area, or patient (IV stopcock sets) were presumptively identified by colony morphology, Gram stain, and simple rapid tests.	The primary outcome of provider-origin bacterial transmission was considered binary and evaluated by univariate logistic regression analysis and results reported as odds ratios. The Wilcoxon rank-sum (Mann–Whitney) test was used to compare hand contamination of providers (CFU) by case 1 versus case 2. Comparisons of hand contamination (CFU) by trainee level were made using the Bonferroni analysis of	Overall, 66% of provider hands were contaminated with 1 or more major pathogens (MRSA, VRE, methicillin-sensitive Staphylococcal aureus, *Enterococcus*, and Enterobacteriaceae). The overall mean number of total CFUs found on the hands of providers was 1045 (95% CI: 210 to 2000). Attending anesthesiologists had significantly less overall hand contamination than	The contaminated hands of anesthesia providers serve as a significant source of patient environmental and stopcock set contamination in the operating room.

	transmission events, provider variability in hand contamination, horizontal transmission, and the adequacy of anesthesia environment decontamination practices				variance. All other outcomes were considered continuous, and we report the mean, SD, and 95% confidence intervals (CI). Univariate logistic regression analysis was used to examine the dependence of provider, patient, and environmental transmission on multiple covariates: primary provider type (CRNA, resident physician, or attending physician), the duration and type of surgery, the preoperative and discharge patient location (intensive care unit [ICU], inpatient ward, or same day), urgency of surgery (emergent, urgent, or elective), the ASA status, patient age, and patient gender. An [alpha] of <0.05 was considered statistically significant. All analyses were conducted using Stata 9.0 software (College Station, Texas).	did both residents and CRNAs (attending mean 655, 95% CI: 150 to 1150; resident mean 1201, 95% CI: 250 to 2000; CRNA mean 1014, 95% CI: 200 to 2000) (mean difference attending vs. resident physician -545, $P <$ 0.001; mean difference attending vs. CRNA -358, $P = 0.021$). There was no difference between residents and CRNAs in terms of total hand contamination (mean difference -186, P = NS). The magnitude of contamination (number of CFUs) found on provider hands before case 1 was higher than that before the start of case 2 (case 1 mean 1224, 95% CI: 1000 to 2000; case 2 mean 883, 95% CI: 900 to 2000) ($P < 0.001$).	
Hall (1994)	To determine the extent of blood contamination of anesthesia equipment and monitoring equipment in clinical use in operating rooms.	Randomized study including 22 OR's	Nineteen definable surfaces on anesthesia machines, anesthesia carts, and monitors that are touched or handled frequently by anesthesia personnel were identified: the anesthesia machine table, flowmeter knobs, vaporizer controls, fresh gas flow button, pop-off knob, anesthesia ventilator controls,	The study employed a catalytic-test method to detect blood contamination of anesthesia equipment.	The three-stage phenolphthalein blood indicator test, a catalytic test, employs hydrogen peroxide as the oxidant and phenolphthalein as the indicator. Results (yes/no) were analyzed using $x^2$with significance established at the 0.05 level.	There were significant differences of blood contamination among the types of surfaces tested (blood-positive versus blood-negative surfaces: x^2 (18df) =74.095;P<0.001) .Sites with the highest prevalence of contamination were monitor cables (82%), drawer handles (64%), and oximeter probes (59%).	This study documents the prevalence of blood contamination on the surfaces of anesthesia equipment and monitoring equipment. Whether this blood contamination represents an infection risk was not determined.

			the suction control, anesthesia machine drawer handles, general monitor controls, respiratory gas monitor controls, noninvasive blood pressure (NIBP) monitor controls, pulse oximeter monitor controls, neuromuscular blockade monitor controls, monitor cables (electrocardiogram, NIBP, pulse oximeter, nerve stimulator), pulse oximeter probe, NIBP cuff inside surface, telephone handset and keypad, the anesthesia cart table, and anesthesia cart drawer handles.			Horizontal surfaces were not more frequently contaminated than other surfaces (horizontal versus non- horizontal surfaces:x^2 (1 df) =0.039;P<0.90)	
Clark, Taenzer, Charette, and Whitty (2014)	Objective: To determine the effect on anesthetic environment contamination between procedure start and finish before and after intervention	Randomized study and survey Keywords: "Surgical site infection" "Contamination" "Anesthesia environment"	54 current practice first morning cases with minimum expected case durations of 2 hours and general anesthesia as the planned technique. Five sites within the anesthesia environment were cultured for CPSS counts (adjustable pressure limiting valve, oxygen control knob, anesthetic agent control dial, drawer pulls to the	Collected samples were applied to blood agar plates and incubated for 48 hours prior to bacterial colony counting.	Asymptotic Wilcoxon rank-sum tests (computing exact conditional *P* values and quartiles) for unpaired samples were used to analyze changes between baseline and intervention and generate confidence intervals for assumption of non-equality. Statistical results are shown as the change in location shift with confidence intervals and the corresponding *P* value.	There were 25 of 54 baseline cases (46%) and 6 of 51 intervention cases (12%) that had at least 1 site ≥100 colonies per surface area sampled (CPSS) ($P < .001$). There were 35 of 239 baseline sites (15%) versus 8 of 245 intervention sites (3%) that had ≥100 CPSS ($P < .001$). The magnitude and significance of the results were not different whether or not omitted sites were included. CPSS were different by the rank-sum test between	A small, structured intervention along with attention to a clean anesthesia environment can dramatically affect the amount of contamination in the anesthesia environment over the course of a case.

			first and second drawers in the anesthesia equipment cart, which were separate from the anesthesia machine). Samples were collected pre and post intervention.			baseline and intervention (difference in location was 6; 95% confidence interval, 3-8; $P < .001$).	
Loftus et. al (2015)	Primary objective: characterize the transmission dynamics of frequently encountered gram-negative bacteria in the anesthesia work area environment (AWE). Secondary objective: examine links between these transmission events and 30-day postoperative heath care-associated infections (HCAIs).	Randomized study **Evaluation of Gram-Negative Transmission Dynamics (Primary Objective)** Design: A systematic analysis of gram-negative isolates were classified according to colony morphology, gram stain, and simple rapid tests. Cases were then reviewed for evidence of possible gram-negative transmission defined by the presence of a gram-negative isolate in 2 or more reservoir sites across the case pair. Sample size: 274 case pairs (548 cases)	Gram-negative isolates obtained from the AWE (patient nasopharynx and axilla, anesthesia provider hands, and the adjustable pressure-limiting valve and agent dial of the anesthesia machine)	Intraoperative bacterial transmission events by class of pathogen, temporal association, and phenotypic analysis (analytical profile indexing). The top 5 frequently encountered genera were subjected to antibiotic disk diffusion sensitivity to identify epidemiologically related transmission events.	Complete multivariable logistic regression analysis and binomial tests of proportion were then used to examine the relative contributions of reservoirs of origin and within- and between-case modes of transmission, respectively, to epidemiologically related transmission events. Analyses were conducted with and without the inclusion of duplicate transmission events of the same genera occurring in a given study unit (first and second case of the day in each operating room observed) to examine the potential effect of statistical dependency. Transmitted isolates were compared by pulsed-field gel electrophoresis to disease-causing bacteria for 30-day postoperative HCAIs.	Contaminated provider hands were less likely to serve as the reservoir of origin for transmission events (all isolates, odds ratio 0.12, 95% confidence interval 0.03–0.50, $P = 0.004$; without duplicates, odds ratio 0.05, 95% confidence interval 0.01–0.49, $P = 0.010$) than contaminated patient or environmental surfaces. This difference remained significant with or without inclusion of the significant interaction term for the analysis including all isolates. There were differences in modes of transmission for the analysis involving all isolates ($P = 0.004$), but this difference did not remain statistically significant in the analysis	Between- and within-case AWE gram-negative bacterial transmission occurs frequently and is linked by pulsed-field gel electrophoresis to 30-day postoperative infections. Provider hands are less likely than contaminated environmental or patient skin surfaces to serve as the reservoir of origin for transmission events.

	Evaluation for Microbiological Links Between Gram-Negative Transmission Events and 30-Day Postoperative Infections (Secondary Objective): The objective was to examine the primary reservoir of origin and mode of transmission for all epidemiologically related transmission events involving frequently encountered gram-negative pathogens in the AWE.		excluding duplicate transmission events (P = 0.096). Approximately 7% (54/767) and 5% (41/767) of all isolates implicated in an epidemiologically related intraoperative bacterial transmission sequence were involved in between- and within-case modes of transmission, respectively (binomial test of between- and within-case transmission event proportions, P = 0.178). After exclusion of duplicates, approximately 6% (47/748) and 4% (28/748) of isolates were involved in between- and within-case modes of transmission, respectively (binomial test of between- and within-case transmission event proportions, P = 0.036).

Figure 1. Gender of study participants

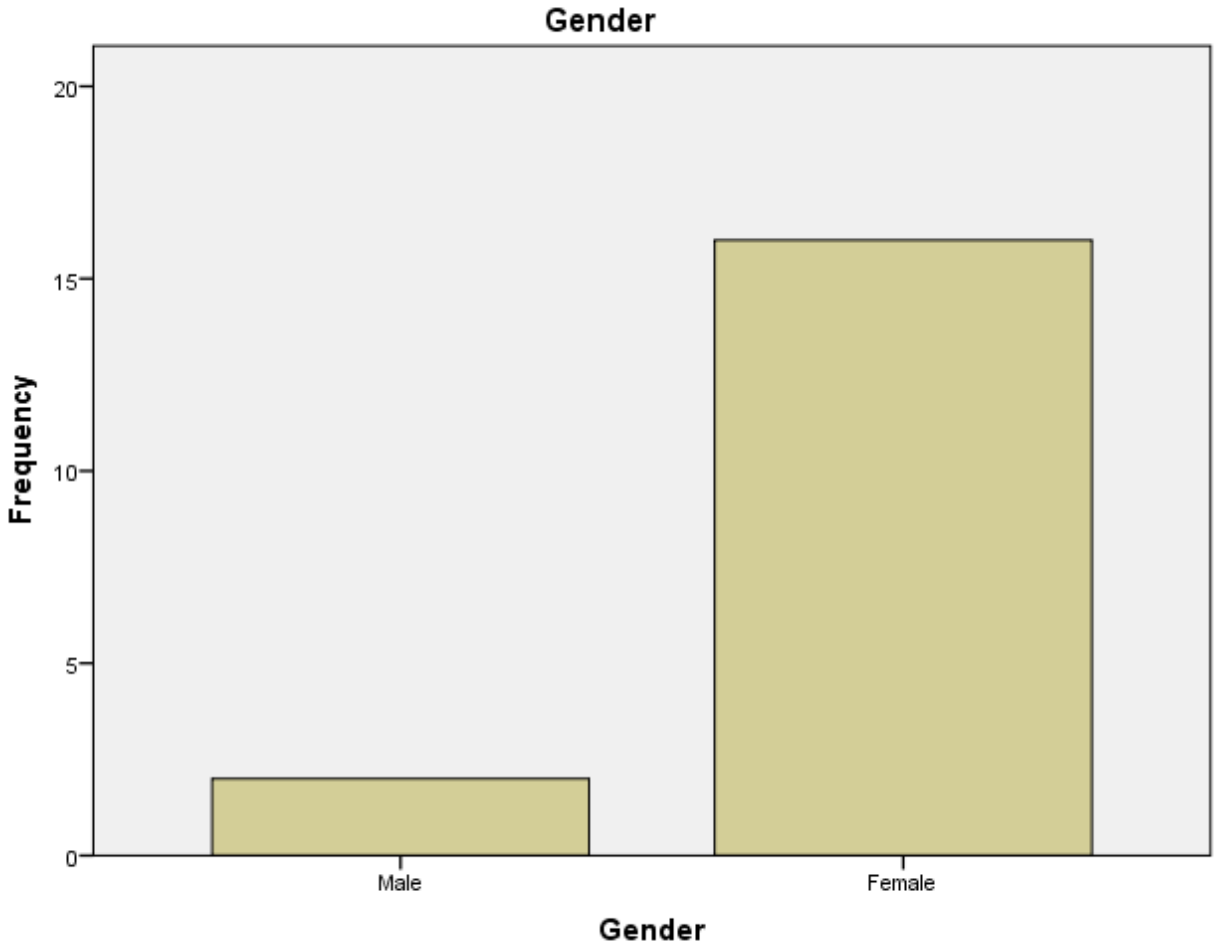


Figure 2. Age of study participants

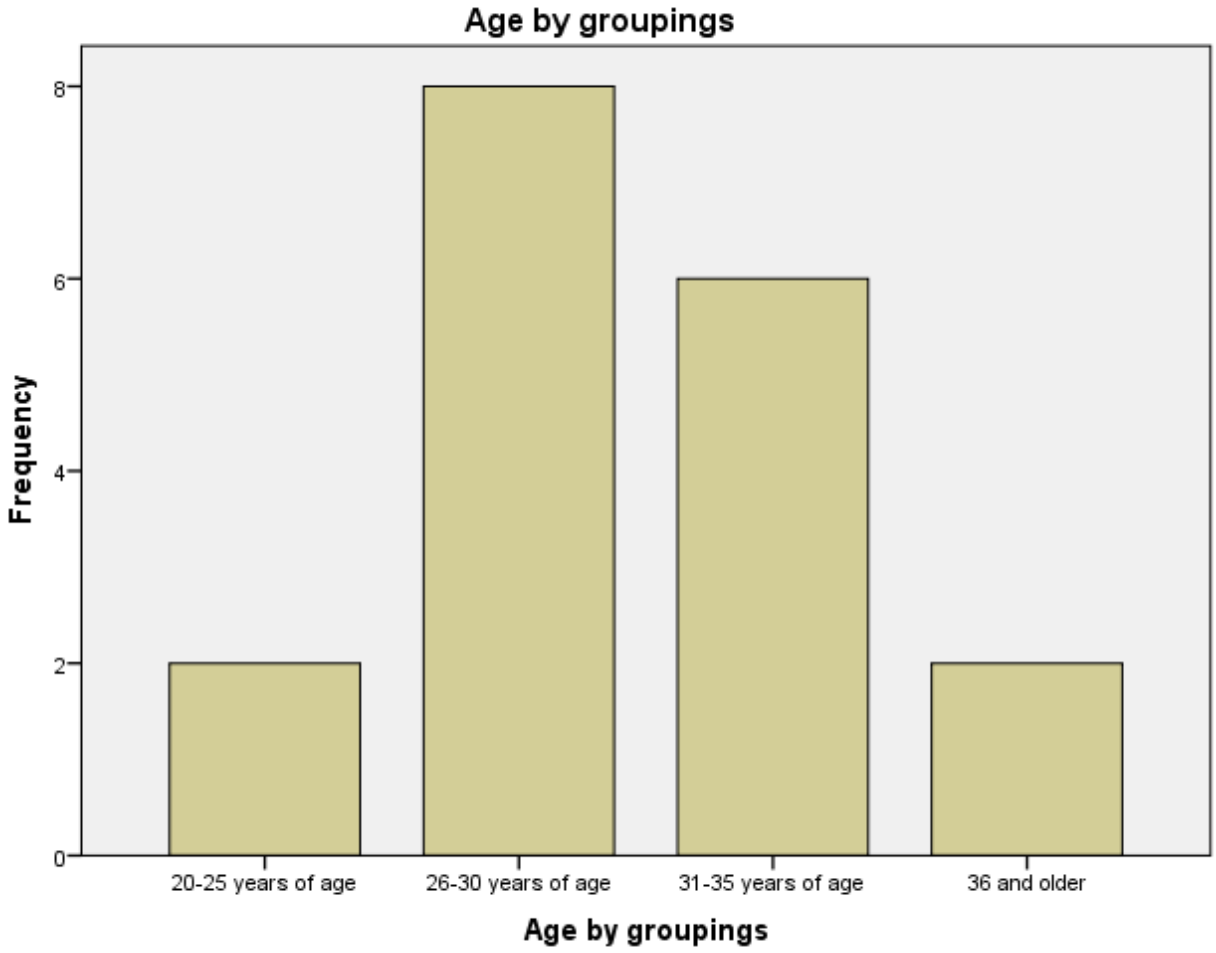


Figure 3. Level of education of study participants

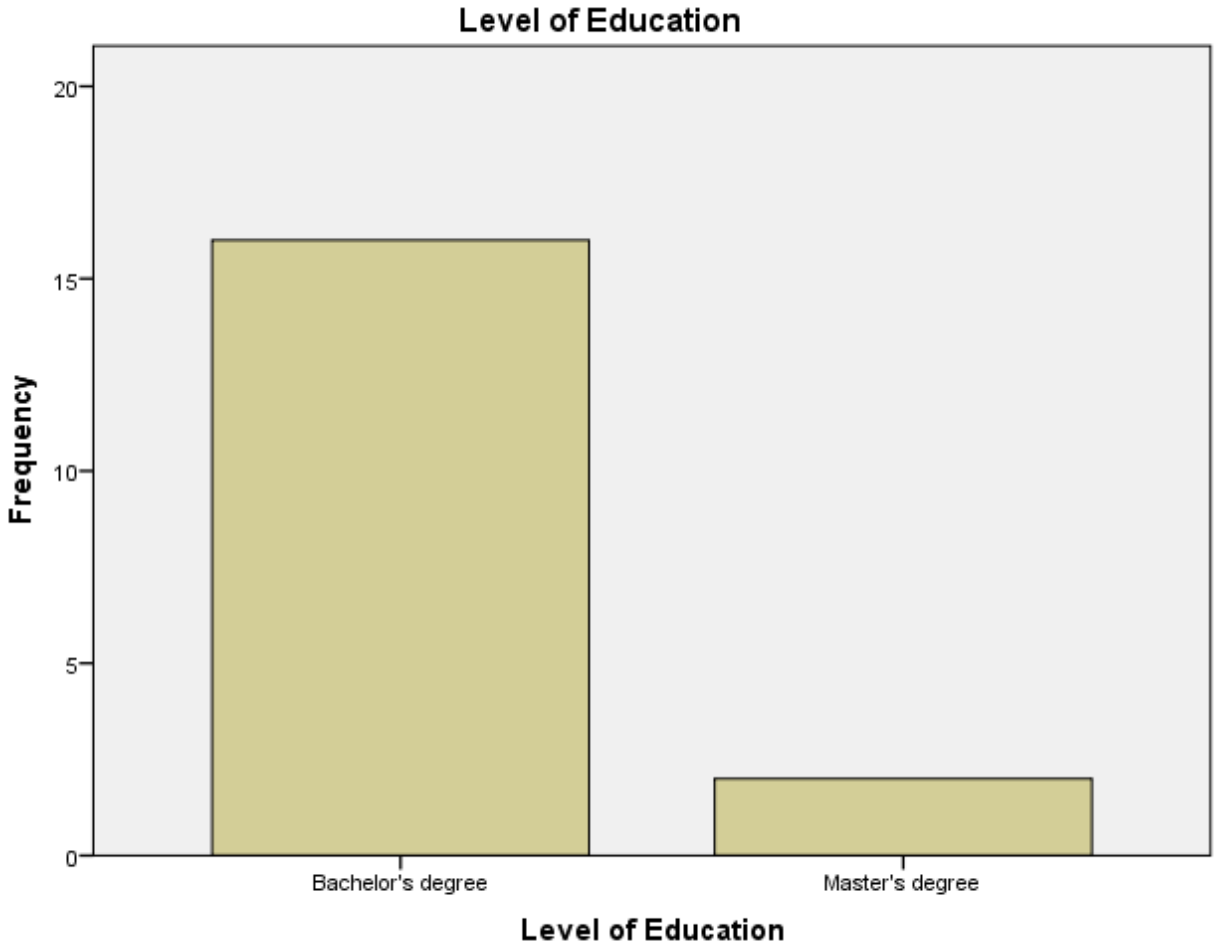


Figure 4. Years of critical care experience of study participants

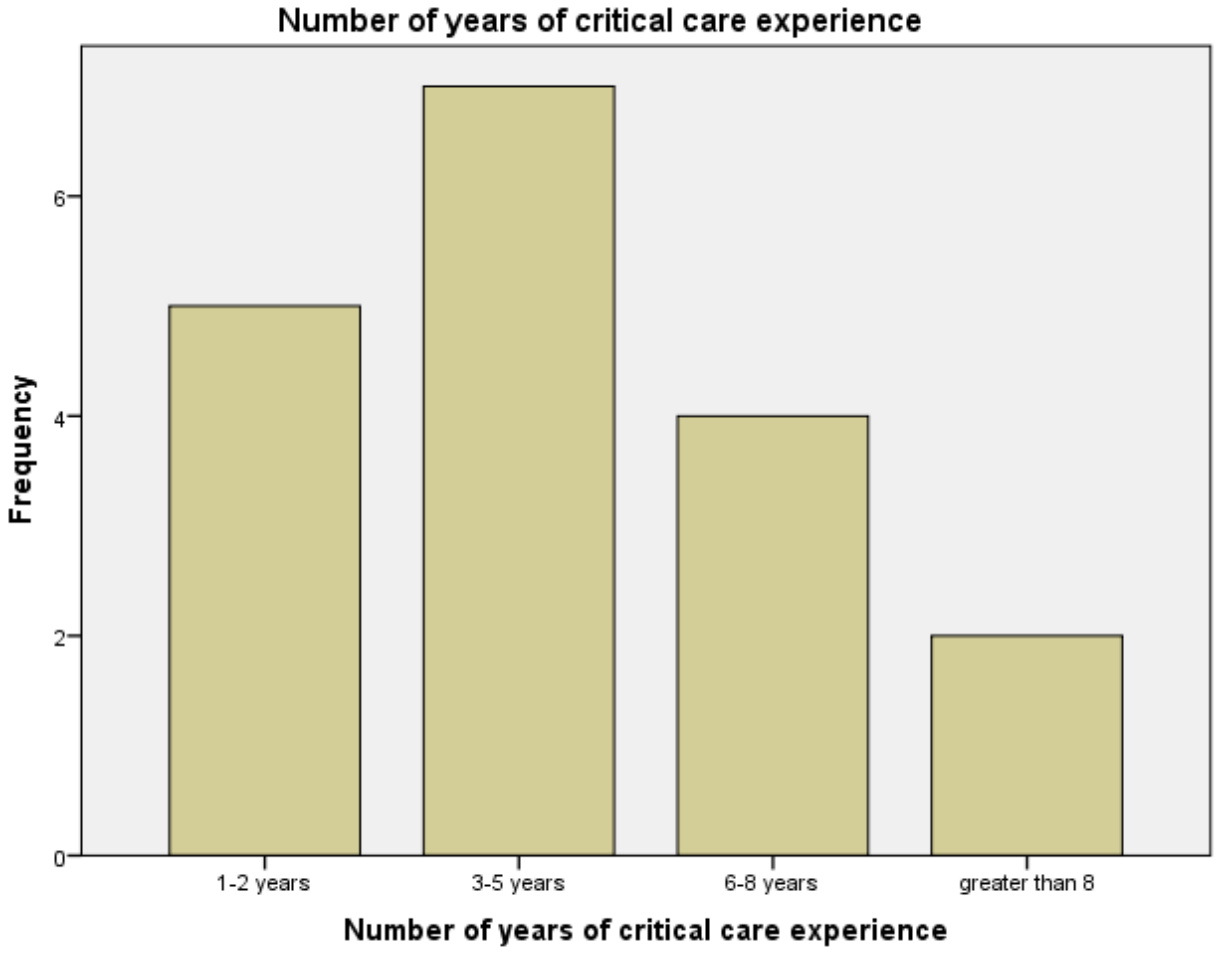
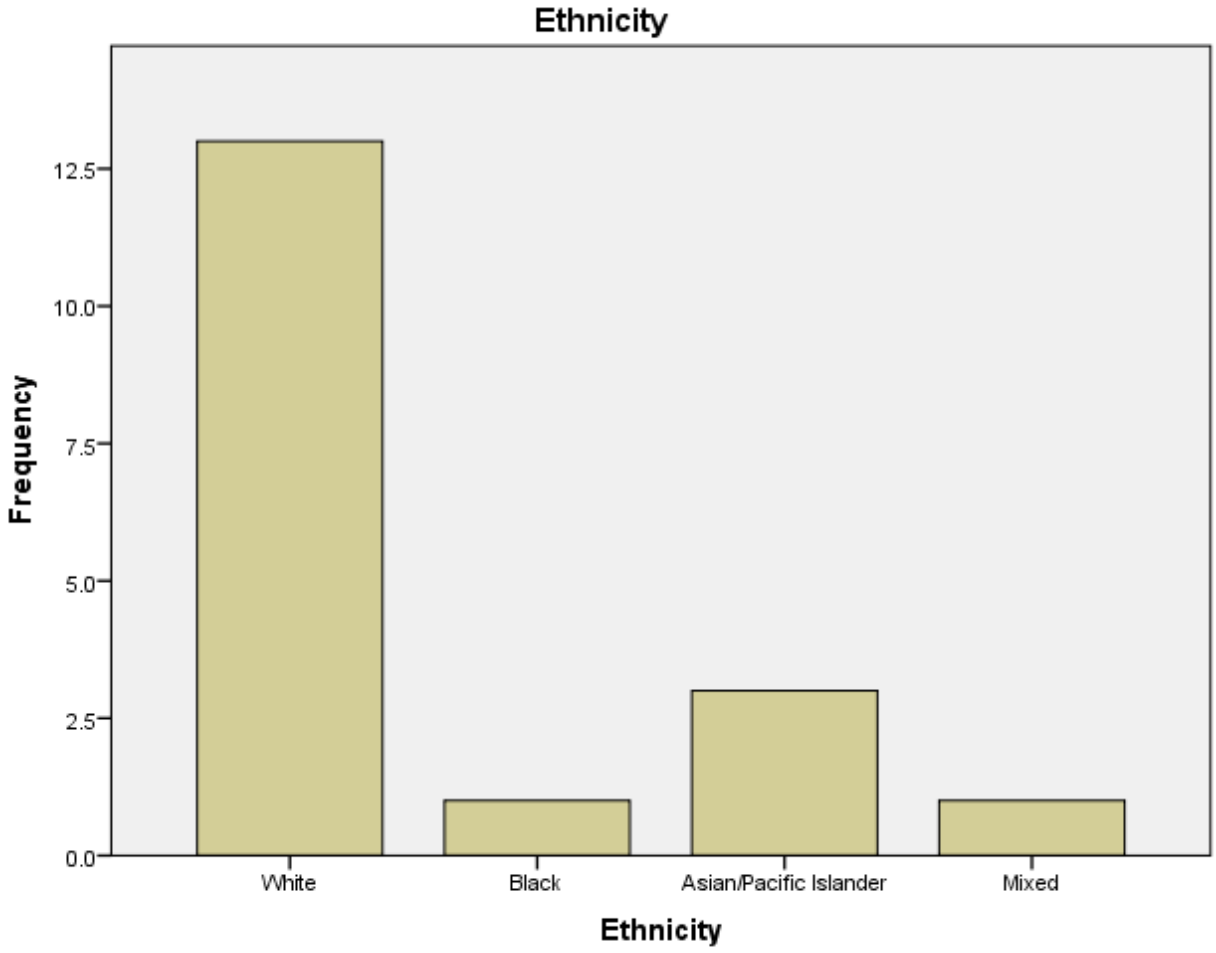


Figure 5. Ethnicity of study participants



Appendix A

Recruitment Email

Hello Nurse Anesthesia Trainees (NATs),

Tomorrow you may choose to participate in a forty-five-minute seminar focused on infection control of the anesthesia workspace employing the double glove technique utilizing a video-based simulation presented as part of our DNP project. The goal of the seminar and surveys is to determine if an educational video-based simulation will improve your knowledge and confidence related to infection control practices during the induction sequence of anesthesia. Your participation in the research study is both voluntary and confidential. If you choose not to participate at any time during the seminar, you are not obligated to stay and may exit the room; however, once you have submitted a survey, we will be unable to remove your responses from the data, as it is anonymous, so we will not know which responses you provided. Attached you will find an information sheet for participation in the research study. Please review the information sheet prior to your participation. We thank you in advance for your participation.

Sincerely,

Megan Callow, BSN, RN and Debra Farida, MSN, RN

Appendix B

Information Sheet

INFORMATION SHEET FOR PARTICIPATION IN RESEARCH STUDY
VIDEO-BASED SIMULATION TO IMPROVE KNOWLEDGE AND CONFIDENCE OF INFECTION CONTROL PRACTICES DURING INDUCTION OF ANESTHESIA IN NURSE ANESTHESIA TRAINEES

Principal Investigator: Megan Callow, BSN, RN; Debra Farida, MSN, RN

Institution: DePaul University, USA

Collaborators: NorthShore University HealthSystem School of Nurse Anesthesia: Pamela Schwartz, DNP, CRNA

We are conducting a research study to examine perceived knowledge and confidence in the second year nurse anesthesia trainee regarding proper handling of potential contaminants during induction and intubation via video simulation. We are asking you to be in the research because you are enrolled in the NorthShore University HealthSystem School of Nurse Anesthesia and are in your second year of training. If you agree to be in this study, you will be asked to watch a fifteen-minute educational video-based simulation on the potential hazardous contaminates in the operating room (OR), anesthesia providers' role in infectious transmission, and contamination reduction techniques. You will also be asked to complete five surveys: one demographic, two prior to watching the instructional video, and two after the instructional video. The demographic survey will collect some personal information about you such as gender, age, ethnicity, education level, and the number of years of intensive care unit experience. If there is a question you do not want to answer, you may skip it. The pre and post surveys, will include questions about your perceived knowledge and confidence in relation to infection control practices and reduction techniques during induction and intubation. Each of the five surveys will take approximately 5 minutes to complete.

Your participation is voluntary, which means you can choose not to participate. The submission of a survey will assume the form of voluntary agreement to participate in the study. There will be no negative consequences if you decide not to participate or change your mind later after you begin the study. You can withdraw your participation at any time prior to submitting your survey. If you change your mind later while answering the survey, you may simply exit the survey. Once you submit your responses, we will be unable to remove your data later from the study because all data is anonymous and we will not know which data belongs to you. Your decision whether or not to be in the research will not affect any grade, evaluation, or status within DePaul University or the NorthShore University HealthSystem School of Nurse Anesthesia.

If you have questions, concerns, or complaints about the study, or you want to get additional information please contact Megan Callow at megan_callow@yahoo.com or Debra Farida at debfarida@gmail.com.

If you have questions about your rights as a research subject you may contact Susan Loess-Perez, DePaul University's Director of Research Compliance, in the Office of Research Services at 312-362-7593 or by email at sloesspe@depaul.edu. You may also contact DePaul's Office of Research
Services if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.

You may keep (or print) this form for your records.

Appendix C

Outline for Instructional Video: Sequence of Induction and Intubation with Double Glove Technique for the second year Nurse Anesthesia Trainee

Video Content
Teaching Objectives At the completion of this video, the NAT-2 will be able to: • Describe how to perform induction and intubation using the double glove technique.
• Describe at what points during induction and intubation does contamination of the anesthesia workplace with patient secretions occur.
• Identify the most commonly contaminated areas of the anesthesia workspace.
• Understand the implications for contamination of the anesthesia workspace during induction and intubation.
Specific Steps for Induction and Intubation using the Double Glove Technique 1. Attach standard and patient specific monitors; assess vital signs for induction readiness. 2. Put on protective eye wear. 3. Perform hand hygiene. 4. Don 2 pairs of gloves; restrict touch to only the wrist opening of the gloves. 5. Induce the patient and insert the endotracheal tube. 6. Place handle and blade on a blue surgical towel. 7. Use left thumb and index finger to pinch right outer glove at the wrist, peel glove way and turn inside out. 8. Slide fingers of right hand between the left outer and inner gloves, roll outer glove down the hand and fold into the right outer glove. 9. Discard both outer gloves. 10. Inflate endotracheal tube cuff to minimal occlusive pressure, connect circuit, and hand ventilate. 11. Assess for successful endotracheal tube placement and secure endotracheal tube. 12. Remove remaining gloves (as previously described) and discard; perform hand hygiene.

Appendix D

Demographic Survey Questionnaire

Your participation is voluntary and anonymous. This survey should take approximately 3 minutes. Please mark a X in the box that best pertains to your demographics.

1. Prior to anesthesia school, how many years of critical care nursing experience did you have?	☐ 1-2 years ☐ 3-5 years ☐ 6-8 years ☐ >8 years
2. Prior to anesthesia school, what was your highest level of educational?	☐ 1 Associate's degree ☐ 2 Bachelor's degree ☐ 3 Master's degree ☐ 4 Doctorate – DNP/PhD
3. Gender	☐ Male ☐ Female
4. Age	☐ 20-25 ☐ 26-30 ☐ 31-35 ☐ 35 & Older
5. Ethnicity (optional)	☐ White ☐ African American ☐ Hispanic or Latino ☐ Asian/Pacific Islander ☐ Native American or American Indian ☐ Other

Appendix E

Confidence Assessment Tool

Instructions: Please complete the following survey regarding the level of confidence in the areas of recognition and ability to perform tasks related to management of induction and intubation with double glove technique. Your participation is voluntary and anonymous. This survey should take approximately 5 minutes. The information from the survey will be used to evaluate confidence pertaining to task and infection control management related to induction and intubation using the double glove technique.

Rate your level of confidence in the following areas related to double glove technique during intubation and potential for contamination:					
	VERY UNCOMFORTABLE (1)	SOMEWHAT UNCOMFORTABLE (2)	NEUTRAL (3)	SOMEWHAT COMFORTABLE (2)	VERY COMFORTABLE (1)
1. How confident do you feel *listing* the steps to induction and intubation with double glove technique?	1	2	3	4	5
2. How confident are you in your understanding of the implications of a contaminated workspace?	1	2	3	4	5
3. How confident do you feel in *performing* the steps identified during induction and intubation with double glove technique?	1	2	3	4	5
4. How confident do you feel *recognizing* the potential for contamination during induction and intubation?	1	2	3	4	5
5. How confident do you feel *listing* common areas of the anesthesia workspace that are contaminated during induction and intubation?	1	2	3	4	5

Appendix F

Perceived Knowledge Assessment Tool

Instructions: Please list the steps of general anesthesia induction and intubation with double glove technique in the correct sequential order. Starting with step 1, write the correct number of each step in the column to the right. Your participation is voluntary and anonymous. This survey should take approximately 5 minutes. The information from the survey will be used to evaluate knowledge related to induction and intubation using the double glove technique.

Steps for Oral Endotracheal Intubation Using Double Glove Technique	**Step Number**
A. Inflate endotracheal tube cuff, connect circuit, and hand ventilate.	10
B. Perform hand hygiene.	3
C. Slide fingers of right hand between the left outer and inner gloves, roll left outer glove down the hand and fold into the right outer glove.	8
D. Induce the patient and insert the endotracheal tube.	5
E. Attach standard and patient specific monitors; assess vital signs for induction readiness.	1
F. Discard both outer gloves.	9
G. Assess for successful endotracheal tube placement and secure endotracheal tube.	11
H. Don 2 pairs of gloves, restrict touch to only the wrist opening of the gloves.	4
I. Use left thumb and index finger to pinch right outer glove at the wrist; peel glove away and turn inside out.	7
J. Put on protective eye wear.	2
K. Remove remaining gloves (as previously described) and discard; perform hand hygiene.	12
L. Place handle and blade on a blue surgical towel.	6

Appendix G1

NorthShore University HealthSystem IRB Approval

NorthShore
University HealthSystem

Research Institute

1001 University Place
Evanston, Illinois 60201
www.northshore.org

Phone (224) 364-7100
Fax (847) 570-8011

January 18, 2018

Megan Callow, BSN, RN
Department of School of Nurse Anesthesia
2650 Ridge Ave.
Evanston, IL 60201

Re: EH18-071: Callow, Megan BSN, RN: Infection Control of the Anesthesia Workplace-Double Glove Technique. *Protocol Version 1, Dated 11/13/17*

Dear Ms. Callow:

The above-referenced project was reviewed in the Research Institute and by a member of the Third Friday Institutional Review Board (IRB) of NorthShore University HealthSystem. This project was approved on the date of this letter and has IRB approval through **1/17/2020**.

The project was reviewed in accordance with the Code of Federal Regulations (45 CFR 46 - as revised). The NorthShore University HealthSystem Institutional Review Board has an approved assurance of compliance with OHRP which covers this activity (Federal Wide Assurance: FWA00003000). This project conforms to the requirements for exemption from the Code of Regulations and does not require a Consent form because research will involve the use of educational tests and anonymous surveys [45 CFR 46.101(2)].

Your request for a waiver of written documentation consent has been granted since the study poses no more than minimal risk, the waiver does not adversely affect the rights and welfare of subjects, and the research could not practicably be conducted without the waiver.

According to institutional policy, your project must be reviewed **every two years**. A Progress Report Form (RI-5.0) will be **due** in the Research Institute **no later than 45 days prior** to the above expiration date. **Changes in the experimental protocol must not occur without prior approval of the IRB.** Unanticipated problems must be reported to the IRB. If this project is terminated before its next Review, please submit a Termination Report Form (RI-5.1) to the Research Institute.

Sincerely yours,

Sara Levin, MSN, RN-BC
Chairperson, Institutional Review Board

/lk

cc: Mary Keegan, R.N.
Robert Stanton, J.D.
Pamela Schwartz, R.N.

Appendix G2

DePaul University IRB Approval

DEPAUL
UNIVERSITY

Office of Research Services
Institutional Review Board
1 East Jackson Boulevard
Chicago, Illinois 60604-2201
312-362-7593
Fax: 312-362-7574

Research Involving Human Subjects

NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

To: Megan Callow, BSN, Graduate Student, Nursing

Date: January 12, 2018 **(Revised 1/19/2018)**

Re: Research Protocol # MC112717NUR
"Infection Control of the Anesthesia Workspace-Double Glove Technique"

Please review the following important information about the review of your proposed research activity.

Review Details
This submission is an initial submission.

Your research project meets the criteria for Exempt review under 45 CFR 46.101 under the following category:

> *(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:*
> *(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.*

Approval Details
Your research was originally reviewed on December 12, 2017 and revisions were requested. The revisions you submitted on January 8, 2018 were reviewed and approved on January 12, 2018.

> **Number of approved participants:** 19 Total
> ***You should not exceed this total number of subjects without prospectively submitting an amendment to the IRB requesting an increase in subject number.***
>
> **Funding Source:** 1) None.
>
> **Approved Performance sites:** 1) DePaul University; 2) NorthShore University HealthSystem.

Reminders
- Under DePaul's current institutional policy governing human research, research projects that meet the criteria for an exemption determination may receive administrative review by the Office of Research Services Research Protections staff. Once projects are determined to be exempt, the researcher is free

to begin the work and is not required to submit an annual update (continuing review). As your project has been determined to be exempt, your primary obligation moving forward is to resubmit your research materials for review and classification/approval when making changes to the research, but before the changes are implemented in the research. **All changes to the research must be reviewed and approved by the IRB or Office of Research Services staff.** Changes requiring approval include, but are not limited to, changes in the design or focus of the research project, revisions to the information sheet for participants, addition of new measures or instruments, increasing the subject number, and any change to the research that might alter the exemption status (either add additional exemption categories or make the research no longer eligible for an exemption determination).

- **Once the project is complete, you should submit a final closure report to the IRB.**

The Office of Research Services would like to thank you for your efforts and cooperation and wishes you the best of luck on your research. If you have any questions, please contact me by telephone at (312) 362-6168 or via email at jbloom8@depaul.edu.

For the Board,

Jessica Bloom, MPH
Research Protections Coordinator
Office of Research Services

Cc: Debra Farida, MSN, RN, Co-Investigator, Nursing
Pamela Schwartz, DNP, Faculty, Nursing