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Residual Neuromuscular Blockade in the Post Anesthesia Care Unit: An Educational Initiative

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Table of Contents

Copyright Acknowledgement Statement.....	2
Abstract.....	5
Introduction.....	7
Significance of the Problem.....	7
Clinical Question.....	11
Focus Areas.....	11
Relevance To Military Nursing.....	12
Organizing Framework.....	13
Project Design.....	15
General Approach.....	15
Setting.....	15
Procedural Steps.....	15
HIPAA Concerns.....	17
Project Results.....	18
Analysis.....	18
Organizational Impact/Implications to Practice & Policy.....	18
Future Directions for Research and Practice.....	18
Conclusion.....	19
References.....	20
Appendices.....	23
Appendix A.....	23

Appendix B.....27

Appendix C.....28

Appendix D.....29

CITI Certificates.....31

Figure 1.....34

Figure 2.....35

Figure 3.....36

USU (VPR) Form 3202N.....37

MTF IRB/PI Letter of Determination.....38

PAO Clearance for archiving final reports to “USU Archives”.....39

DNP Project Completion Verification Form.....40

Abstract

Phase II Site

Navy Medical Center (NMC) Portsmouth

Project Title

Residual neuromuscular blockade (RNMB) in the Post Anesthesia Care Unit: An Educational Initiative

Authors

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Background or Problem/Issue

The nationwide occurrence of RNMB is approximated to be 30% (Esteves, et al., 2013). Although currently not tracked, this equates to a rate of roughly 3,000 cases at NMC Portsmouth annually. There is no formal education for recognition and treatment of RNMB for PACU nurses, which can lead to delayed or inaccurate diagnosis. The nurse or corpsman are may be the initial PACU staff to identify RNMB.

Clinical Question or Purpose

At NMC Portsmouth, does an educational video for PACU nurses and corpsmen increase awareness, recognition, and management of RNMB?

Project Design

The design of this project is a quality improvement project using Lippitt's change theory. PACU nurses and corpsmen at NMCP were provided a 10-question pre-assessment, including demographic information. A 17-minute educational video was shown to participants. At the conclusion of the video the same 10-question test was administered with two additional

questions using a Likert scale evaluating overall confidence in recognizing and managing RNMB.

Data Analysis

The Wilcoxon Signed Rank test found significance when overall pre- and post-assessment scores were compared, $p < 0.001$, and showed an increase in post-assessment of 44%. Post video Likert scale: 87.5% strongly agreed or agreed to an increase in ability to recognize RNMB. 81% strongly agreed or agreed to an increase in ability to assess and treat RNMB in the future.

Organizational Impact/Implications for Practice

Currently, there is no information on RNMB in NMC Portsmouth PACU orientation, in SWANK, or in Elsevier Clinical Skills. The educational video fills a gap in military nursing and support staff caring for patients in the PACU. The anticipated global impact is to increase knowledge, recognition, and management of RNMB in Navy MTF's and DoD-wide, leading to decreased costs, decreased morbidity and mortality, improved nurse and corpsman training and readiness, and improved patient safety.

Introduction

Neuromuscular blocking agents (NMBAs) are commonly used during general anesthesia. These agents prevent the neuromuscular sympathetic response to laryngoscopy, intubation, surgical incision. Neuromuscular blocking agents also blunt neuromuscular protective reflexes such as coughing, gagging, or blinking, and cause paralysis of skeletal muscles (Claudis, Garvey, & Viby-Mogensen, 2009). One potential side effect of NMBA's is residual neuromuscular blockage, or paralysis that persists or recurs after skeletal muscle relaxation is no longer clinically indicated. The incidence of residual curarization is approximated at 30%, and may result in respiratory insufficiency leading to morbidity and mortality (Esteves, et al., 2013). Although currently not tracked, this could potentially equate to an annual rate of 3,000 of the 10,000 surgical cases at NMC Portsmouth.

Signs and symptoms of RNMB may not be apparent until after the patient has been transferred to the PACU. Thus, PACU staff are ideally positioned to identify patients at risk of respiratory compromise from RNMB. Currently, there is no formal educational program at Naval Medical Center Portsmouth to ensure PACU staff can recognize and manage residual neuromuscular blockade. This gross lack of knowledge can lead to delayed recognition and management of this potentially fatal complication.

Significance of the Problem

Neuromuscular blocking agents are considered an essential aspect of a balanced anesthetic treatment plan, used to decrease laryngeal trauma during intubation and sympathetic nervous system responses (Claudis, Garvey, & Viby-Mogensen, 2009). Necessary paralysis of

muscle movement is routine practice for the duration of multiple types of surgical procedures, including high-risk surgeries, such as neurovascular or cardiovascular. Although commonly given as part of balanced anesthesia, use of NMBAs have a wide range of duration of actions (Barash, Cullen, & Stoelting, 2013). A potential side effect is RNMB, also known as residual curarization. Residual neuromuscular blockade is when the patient experiences muscular paralysis after leaving the operating room (Claudis, Garvey, & Viby-Mogensen, 2009).

A normal functioning neuron sends signals from the brain to the muscles with the aid of the neurotransmitter acetylcholine. Neuromuscular blocking agents work in to prevent acetylcholine from attaching to receptors and stopping the neurotransmitter response. By affecting the transmission of acetylcholine, normal muscular movement is prevented (Butterworth, Mackey, & Wasnick, 2013). Currently, several methods are used to aid the anesthesia provider to determine the percentage of acetylcholine receptors blocked by NMBAs. Train-of-four (TOF), a commonly used qualitative measurement, uses peripheral nerve stimulation by placing small electrodes on the forearm to produce muscle movement of the thumb via stimulation of the adductor pollicis muscle. As the number of twitches fade, the patient has a higher number of receptors blocked and a ratio is created. When stimulated, the anesthesia provider observes the number of times the thumb twitches, zero to four times, which is then correlated to the percentage of blocked receptors (Butterworth, Mackey, & Wasnick, 2013). Train-of-four is a subjective assessment of how many times the thumbs moves, and may change between providers.

Residual neuromuscular blockade is defined at a TOF <0.9 (Murphy et al, 2013).

Residual neuromuscular blockade may lead to hypoxemia from the inability to move respiratory

muscles and places the patient at increased risk for adverse events, such as aspiration, obstruction of the airway, and reintubation (Esteves, et al., 2013). According to Esteves, et al., (2013), in a meta-analysis of over three thousand patients who received intermediate-acting NMBA, 41.3% experienced RNMB with a TOF <0.9. Murphy, Szokol, Marymont, Greenberg, Avram, & Vender (2013) completed a study finding 40% of patients receiving an intermediate-acting NMBA had a TOF <0.9, with patients experiencing muscle weakness more often in the group with a TOF <0.9 than with a TOF >0.9.

Patients who received muscle relaxants may show multiples signs and symptoms of muscle paralysis in the PACU. Within 15 minutes of arriving to the PACU, the most common subjectively pronounced signs and symptoms are: generalized weakness, difficulty opening eyes for five seconds, and blurry vision with difficulty tracking and talking (Plummer-Roberts, Trost, Collins, & Hewer, 2016). These signs and symptoms correlate with the sensitivity of the ocular and pharyngeal muscles to RNMB (Plummer-Roberts et al., 2016). Numerous studies have shown an association between RNMB and critical adverse outcomes. These adverse outcomes can occur up to 15 minutes after the patients' arrival to PACU, including hypoxia, hypoxemia, and respiratory failure (Plummer-Roberts et al., 2016).

Subjective signs and symptoms of RNMB may be confused with other postoperative complications. Among the most common reasons for delayed anesthetic recovery are residual drug effects, increased duration and type of anesthesia, and potentiation by other medications (Frost, 2014). Extremes of age, genetic variation, body habitus, comorbidities, obstructive sleep apnea, and hepatic or renal failure also increase the likelihood of a delayed recovery. Alone, hypoxia is often interpreted as a common occurrence postoperatively, especially in the elderly or

patients with respiratory comorbidities. Additional differentials include sensitivity to narcotics, slow metabolism of anesthetic gases based on slowed respiratory rate, and decreased hepatic and renal function (Frost, 2014). Other medications which contribute to hypoxia include benzodiazepines, scopolamine, atropine, and phenothiazines; all of which are commonly used in anesthesia. Metabolic abnormalities that contribute to hypoxia, hypercarbia, and a slow recovery include hyponatremia, hypercalcemia, and hypomagnesemia. Alterations in glucose levels, thyrotoxicosis, adrenal insufficiency, hepatic encephalopathy, uremia, and porphyria also slow recovery. An intraoperative neurologic event such as a cerebrovascular accident, increased intracranial pressure, seizures, or a central nervous system (CNS) infection are also important considerations. Hypothermia and sepsis are included in the differentials (Frost, 2014).

With any of the previous complications, treatment with supplemental oxygen may be beneficial, delaying adequate treatment can lead to progression and possible further deterioration. A full review of the patient's history and anesthetic history should be the initial reaction to this occurrence. Assessment of anesthetic method, fluids administered, intraoperative hemodynamics and temperature should be evaluated (Frost, 2014). Neuromuscular blocking drug use, type, amount, TOF status, and reversal status are important factors to consider in the algorithm. Narcotic or benzodiazepine overdose is treated with appropriate antagonist medications. Laboratory analysis to include a blood gas and complete blood count may provide valuable information and aid treatment. Additionally, a 12-lead electrocardiogram may prove helpful in excluding a cardiac source. Although RNMB can be easily misdiagnosed, treatment of symptoms, exclusion of other causes, and an appropriate chart review will identify occurrence and aid in proper treatment.

According to a landmark study completed from 1948 to 1952, patient deaths during the induction of anesthesia without the use of a paralytic agent was one in 15,500 and with the use of a paralytic agent the death rate was one in 2000. The study also found that there was a six-fold increase in deaths when a paralytic agent was used without any other factors changing. The study states more information is required to prove the direct correlation of use of paralytic agents, but these initial numbers almost 70 years ago show complications from the administration of muscular blocking agents is not a new concept in anesthesia (Beecher & Todd, 1954).

Clinical Question

At NMC Portsmouth, does an educational video for PACU nurses and corpsmen increase awareness, recognition, and management of RNMB?

Focus Areas

The first focus area is to develop an educational module to increase the PACU staff ability to recognize and manage RNMB in recovering patients. Our preliminary intentions include a pre-and post-assessment of PACU staff knowledge of RNMB, causes, signs, symptoms, and interventions in a ten-question format. The assessment form will include basic information, including education level, associate degree in nursing or bachelor degree in nursing, years of experience in PACU, and if the staff has prior knowledge or education of RNMB. The educational portion of the project includes a video. The video will be a useful, effective, user-friendly, technologically appropriate educational video and knowledge assessment.

The second focus area includes a total of 20 PACU registered staff to participate in the pre-and post-assessment and educational video. As part of this focus area we intend to start the

process of investigating occurrence at our facility. Based on the difficulty in diagnosing RNMB definitively, and our facilities lack of acceleromyography, this will be challenging. We aim to start by meeting with our risk manager for the operating room and PACU to brainstorm ideas on how to capture this data. Data collection will be purely subjective, based on a diagnosis of exclusion. Due to an identified current lack of PACU nurses' knowledge, much of this task will be adequately performed after the educational video and post-assessment. Once we have identified a way to track occurrence, we can better lay the groundwork for future projects aimed at RNMB interventions and management.

The third focus area sustainment. We will to add the training to the PACU departmental orientation and the semi-annual PACU course at NMC Portsmouth. By including the training in the orientation, this will capture all incoming staff in a manner that is already in place. Additionally, we hope to implant this training in a global outreach aimed at PACU nurses MTF wide by SWANK or Elsevier Clinical Skills. Dissemination of the information will be challenging, but may occur through communication with specialty leaders.

Relevance to Military Nursing

In 2014 the U.S. Navy's medical budget was \$9.6 billion with a total of 2.81 million beneficiaries (MHS, 2015). The MHS reports an average weekly inpatient admission rate of 20,000 patients, of which 75% are of purchased care. Purchased care costs are substantially higher than Military Treatment Facility (MTF) costs (2015). Patients who experience RNMB may have to reintubated and can experience longer hospital stays (Claudis, Garvey, & Viby-Mogensen, 2009; Graham, McCoy, & Schultz, 2015). Rujirojindakul, et al (2012) found the use of neuromuscular blocking agents as an independent risk factor for reintubation in the post

anesthesia care unit (PACU) [Figure 3]. Over 45 percent of patients who required reintubation in the PACU received neuromuscular blocking agents during surgery (Rugirojindakul, et al, 2012). Patients requiring reintubation and a longer hospital stay require additional resources to provide medical care for the adverse event, including cardiac or respiratory arrest, prolonged respiratory support, brain death, and death (Chinachoit, Waraporn Chau-in, Suraseranivongse, Kitsampanwong, & Kongrit, 2005). Critical respiratory events in the post-operative period are detrimental, not only to the patient, but to the profession of nursing and the military. Graham, McCoy, and Schultz state patients who experience in-hospital cardiac arrest will be admitted to the intensive care unit and experience frequent rehospitalizations and an additional \$19,000 in costs in the first year after arrest (2015).

Organizing Framework

The change theory that will guide the project at NMC Portsmouth is Lippit's Model of Change [Figure 1]. This model uses seven steps: from diagnosing the problem to gradually terminating the helping relationship when the change becomes part of the organizational culture (Kritsonis, 2004-2005). The NMC Portsmouth group aims to incorporate training about RNMB into the PACU staff orientation, which overtime will become part of the standard educational materials and thus an element of the organizational culture.

The first step is to diagnose the problem. The group established a knowledge deficit among PACU staff regarding the recognition of RNMB. Even more fundamental than recognizing residual blockade, there is a knowledge deficit in understanding of how paralytic agents used intraoperatively exert their effect. The second step is to assess the motivation and capacity for change; our group has secured the PACU Clinical Nurse Specialist along with

several other parties in the PACU and anesthesia leadership to assist in our project. The third and fourth elements are to assess the resources and motivations of the change agent and choose the change objects. Our group will create a video to be incorporated into the standard PACU orientation so that all new staff to the unit will be exposed to this information. The fifth step is that the role of the change agents should be clearly understood by all parties with set expectations. Here the roles are the student nurse anesthetist (SRNA) as educators and the PACU staff as students who will be assessed with pre-and post-assessments. The sixth step is to maintain the change utilizing communication, feedback and group coordination. Since there is buy-in from the PACU leadership, the group expects to receive feedback from these stakeholders and adjust accordingly. Lastly, the seventh step is to gradually terminate the helping relationship as the change becomes part of the organizational culture. The goal is for the instructional materials to last far longer than the time this group is in training at NMCP and for this to be a continual component of the PACU staff orientation.

These seven steps will work well for an educational model so that the original change agents may be gone, but the effect will become part of the organization. The creators of the model, Lippit, Watson, and Westley, state that the changes are more likely to be rooted the more the behavior is regarded as normal (Kritsonis, 2004-2005). For our group, normal would be that it becomes a standard element for all new nurses to the unit, and over time through staff turnover, all PACU nurses will have exposure to the material. See Appendix C for positive and negative forces affecting change.

Accompanying Lippit's model as an overarching organizational model, is the Theory of Planned Behavior from Ajzen. To achieve change within a group, several elements need to be

evaluated. Specifically, the relationship between beliefs and attitudes of people involved in the change are addressed by the theory (Ajzen, 1991). Each person has a subjective view regarding new behavior producing a certain outcome – for this DNP project, PACU staff recognition of RNMB and an understanding of the paralytic agents and reversals will be used. The theory of planned behavior incorporates attitude, opinion, and expectation. The combination of these three elements form perceived benefits. For the change to be accepted there needs to be a favorable attitude towards the behavior, a subjective norm that the group believes in the change, and a feeling of control over the change. When perceived behavioral control and positive attitudes towards the behavior exist, the formation of behavioral intent occurs. When a sufficient degree of control over the behavior is achieved with positive norms regarding change, people are expected to carry out the intentions, identifying RNMB, when presented with the opportunity (Ajzen, 2002).

Project Design

General Approach

This project is intended to both investigate PACU staff proposed knowledge gaps in regards to RNMB and to provide education in an effort to bridge those gaps. Armed with greater knowledge, PACU staff should possess the ability to recognize and manage these events providing better outcomes for MTF beneficiaries.

Setting

The setting of this project is at NMC Portsmouth, located in Portsmouth, Virginia. NMC Portsmouth is the oldest operating Naval Hospital, providing care to military and their dependents since 1830. NMC Portsmouth provides health care to the largest concentrations of

U.S. military in the world (Naval Medical Center Portsmouth, 2017). Over 10,000 surgeries are performed annually, with a potential for 30% of the surgical patients to experience RNMB.

There will be two-10 question multiple choice assessments. The first assessment will be administered prior to any teaching, discussion, or videos between PACU staff and SRNA's. The second will be administered after PACU staff has watched the educational video. After completion of the post-assessment, scores of the pre-and post-assessment will be analyzed and compared.

Procedural Steps

After completing a literature search, the articles chosen for inclusion were within 15 years old, and retrieved from only four sources (Appendix A). Although mostly correlational and retrospective, the body of evidence revealed consistent themes. The articles chosen assist in clarifying the exact problem, extent, and current quantitative measurement procedures for RNMB. Studies chosen ranged from level two to level three evidence with the largest number being of correlational design. Articles fell into three thematic categories: defining and quantifying the incidence of RNMB, comparing tools (subjective versus objective) across populations, and measuring effectiveness of the tool.

The first thematic category of defining the incidence of RNMB included three studies. One study intended to prove RNMB based on pulmonary function test (PFT) parameters (Heier, Caldwell, Feiner, Liu, Ward, & Wright, 2010). Pulmonary function test measurements were decreased when the AMG was less than 0.9. The RECITE study was a lengthy, multicenter, Canadian investigation into the incidence of RNMB (Fortier, et. al., 2015). This prospective observational study alluded to the commonality of RNMB in patients arriving in the PACU and

recommended improving standards of monitoring. The third study examined RNMB in a large group of morbidly obese patients undergoing bariatric surgery (Frank, Cajina, Cozacov, & Abels, 2013). This observational study again reiterated the risks of RNMB and recommended practice improvement. Each of these studies defined RNMB as an AMG measurement of <0.9 with respiratory depression.

The next thematic category of comparing subjective versus objective measurements included three studies. The highest level of evidence found was a systematic review which summed up the themes of nine studies focusing on comparing objective AMG to subjective TOF (Brull & Murphy, 2010). This review concluded that AMG can detect smaller levels of RNMB and prompt intervention early, therefore preventing respiratory sequelae. The next study included a randomized control trial (RCT) of patients undergoing elective surgery and requiring NMBA's (Murphy, et. al., 2008). Investigators concluded that less patients with RNMB (defined as AMG <0.8) were introduced to the PACU when monitored with AMG versus TOF. Further, the incidence of negative respiratory events was far less in the group monitored with AMG. The last study in the category included a RCT that controlled for the type of surgery and NMBA used, and measured AMG versus TOF upon transfer to the PACU (Gätke, Viby-Mogensen, Rosenstock, Jensen, & Skovgaard, 2002). Researchers concluded that although use of AMG does not prevent occurrence of RNMB, benefits of use are still superior to subjective TOF measurement.

The third thematic category of measuring tool effectiveness included two studies. The first study in this category was observational and attempted to seek comparisons between TOF and AMG measurements, therefore establishing the greater sensitivity of AMG in detecting

RNMB (Capron, Fortier, Racine, & Donati, 2006). Researchers concluded that the threshold for identifying RNMB was significantly lower in the AMG measured patients. The last study was an RCT that compared AMG to multiple types of subjective measurements (Samet, Capron, Alla, Meistelman, & Fuchs-Buder, 2005). The study concluded that even a single AMG measurement more sensitively indicated RNMB than any of the subjective measurements.

To start the educational aspect of the project, the group will evaluate the current knowledge level of PACU staff. The next phase will be to provide the PACU staff the short, five to ten-minute videos. Following the implementation of this training, PACU staff will take a post-assessment to evaluate knowledge. This data will be compared to the initial pre-assessment results to examine efficacy of information dissemination and retention.

HIPPA Concerns

This DNP project has minimal HIPPA concerns. The project will not be collecting personally identifiable information from any patients. Computers used for staff data collection are common access control (CAC) enabled and located in a secure office at NMC Portsmouth. There will be no personally identifiable information released at the end of the data collection period.

Project Results

Our project yielded an increase in post-assessment scores of 44%. PACU staff reported an increased perceived ability to diagnose and manage RNMB.

Analysis of the Results

The Wilcoxon Signed Rank test found significance when overall pre- and post-assessment scores were compared, $p < 0.001$, and showed an increase in post-assessment of 44%.

Post video Likert scale: 87.5% strongly agreed or agreed to an increase in ability to recognize RNMB. 81% strongly agreed or agreed to an increase in ability to assess and treat RNMB in the future [Figure 2].

Organizational Impact/Implications to Practice & Policy

Then value based care concept focusses on improved patient satisfaction, decreased cost of care, and enhanced patient outcomes. This project proved potential improvements in each of these areas. The premise of these enhancements is that increased knowledge will lead to decreased incidence of cases. Decreased cases results in a significant cost savings and enhanced patient outcomes.

Future Directions for Research and Practice

There are still significant gaps in the research of RNMB. Since a 30% occurrence among existing research is quite high, future high level research is warranted. Post-operative nausea and vomiting and enhanced recovery after surgery initiatives have received the focus of attention for anesthesia change in recent years. Although there is significant research aimed at proving the subjectivity and ineffectiveness of the train of four monitor for verifying recovery of neuromuscular blockade, there has been little effort to change practices. Surprisingly, we found no evidence of a program for educating the end-users of neuromuscular blocking drugs. Providing education to the staff most likely to encounter the event is paramount to effective management. The educational video established for our project was created in a platform to allow for continued dissemination. An integrated system such as Swank or Elsevier Clinical Skills could allow a modality for continued widespread MTF dissemination. Based on our

results, this educational tool has the potential to augment new PACU staff orientation or to serve as a stand-alone periodic evaluation.

Conclusion

This project proves that RNMB education to PACU staff in MTFs is warranted. Dissemination of this educational initiative throughout military medicine has the potential to improve patient quality outcomes, therefore should be considered. The incidence and cost of RNMB is high. We received favorable comments from participants and recommendations to share our video. We would like to thank the NMCP PACU staff for participation, NMCP CRNA and MDA staff mentors, LCDR Lauren Suszan (senior mentor), CDR Reginald Middlebrooks (mentor), Andrea McGlynn (biostatistician), CDR Kenneth Wofford, LT Melinda Mathis, LCDR Michael Rucker, and CDR Ryan Nations for their contributions.

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Appendix A: Evidence Table

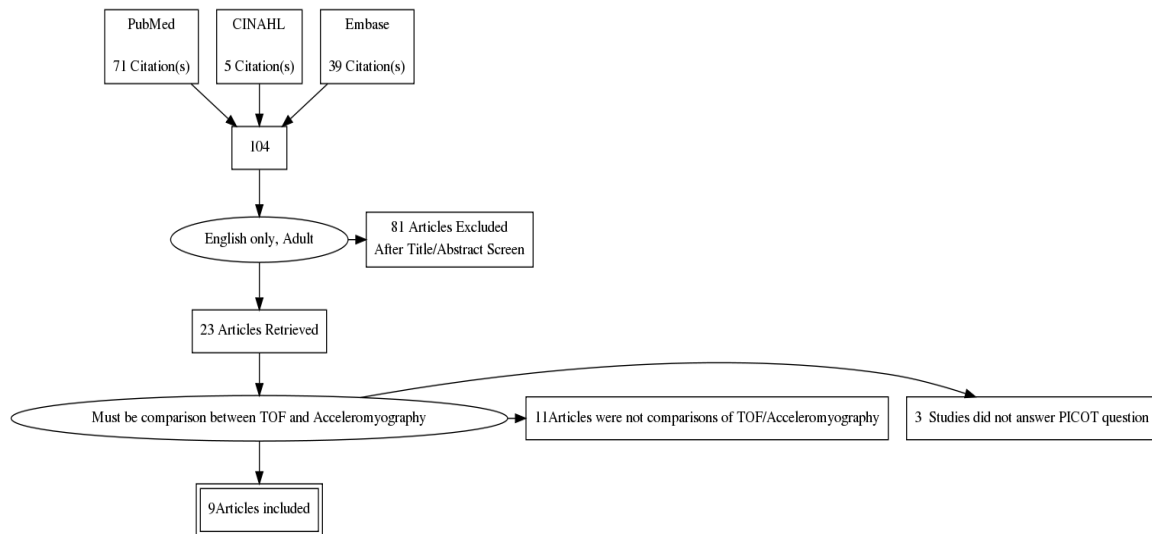
Title	Author(s)	Year	Journal	Purpose	Keywords	# of subject	Inclusion Criteria	Exclusion criteria	Design	Independent/Subject Variables	Dependent variables/measurements collected	Findings	Level of Evidence	Quality
Comparison of acceleromyography and kinemyography monitoring methods during recovery period of neuromuscular block	Ezer, F.; Bezen, O.; Saracoglu, A.; Ozata, A. S.; Sengul, T.	2014	European Journal of Anaesthesiology	To compare kinemyography with acceleromyography for the recovery parameters of NM block.	neuromuscular blockade, rocuronium, midazolam, curare, propofol, monitoring, neuromuscular blocking, anaesthesiology, human, patient, parameters, arm, artifact, mortality, informed consent, morbidity, ethics, implantable cardioverter defibrillator, endotracheal	46	ASA status I - II patients aged 19-65, scheduled for elective surgery under general anaesthesia	ASA status >2, age <19 or >65, surgery other than elective and using other than general anesthesia. The patients in whom additional use of NM blockers or reversal agents and in whom data acquisition was artefactual were excluded.	Observational	Patients undergoing elective surgery with general anesthesia.	AMG versus KMG readings	AMG and KMG are interchangeable for the recovery parameters of NM block. In addition to AMG, KMG can also be safely used to determine PORC.	III	Moderate
The RECITE study: A Canadian prospective, multicenter study of the incidence and severity of residual neuromuscular blockade	Fortier, L. P.; McKeen, D.; Turner, K.; De Médicis, É.; Warriner, B.; Jones, P. M.; Chaput, A.; Pouliot, J. F.; Galameau, A.	2015	Anesthesia and Analgesia	To investigate the incidence and severity of residual NMB as measured by TOF acceleromyography of <0.9 in the immediate postoperative period. Compares those incidences with occurrence of postoperative respiratory events.	neostigmine, rocuronium, suxamethonium, abdominal surgery, acceleromyography, adult, Canada, conversion to open surgery, endotracheal intubation, extubation, female, human, incidence, laparoscopic surgery, major clinical study, myography, neuromuscular blocking, neuromuscular function, neuromuscular monitoring, paralysis, postanesthesia care, opioids	302	Adult patients undergoing open or laparoscopic abdominal surgery expected to last <4 hours, ASA physical status I-III, and scheduled for general anesthesia with at least 1 dose of a nondepolarizing neuromuscular blocking agent for endotracheal intubation or maintenance of neuromuscular relaxation	quantitative monitoring of neuromuscular transmission (e.g., mechanomyography, electromyography) was permitted. All other qualitative (visual and tactile) monitoring measures were allowed. Participants were excluded if their medical condition, surgical procedure, or positioning would interfere with the operation, calibration, or accuracy of the TOF-Watch.	Prospective, blinded, observational	Patients undergoing open or laparoscopic abdominal surgery and receiving at least one dose of NMBD	TOF by acceleromyography at time of extubation and upon arrival at PACU	Residual paralysis is common at tracheal extubation and PACU arrival, despite qualitative neuromuscular monitoring and the use of neostigmine. More effective detection and management of NMB is needed to reduce the risks associated with residual NMB.	III	High
Postoperative residual curarization in the morbidly obese	Frank, L.; Cajina, C.; Cozacov, Y.; Abels, I.	2013	Anesthesia and Analgesia	To study the incidence of PORC upon extubation of morbidly obese patients (BMI>30) having bariatric surgery.	neuromuscular blocking agent, vecuronium, anesthesia, society, human, neuromuscular blocking, extubation, patient, monitoring, surgery, obesity, bariatric surgery, high risk population, neuromuscular function, control group, surgical	115	BMI >30, bariatric surgery	BMI <30, surgery other than bariatric	Retrospective (control) and prospective observational	Morbidly obese patients having bariatric surgery	Incidence of TOF with acceleromyography of <0.9	The clinical implications of continual quantitative monitoring of neuromuscular block at the adductor pollicis vs other locations during surgery of high BMI patients are important to provision of care.	III	Low

Title	Author(s)	Year	Journal	Purpose	Keywords	# of subject	Inclusion Criteria	Exclusion criteria	Design	Independent/Subject Variables	Dependent variables/measurements collected	Findings	Level of Eviden	Quality
Comparison of acceleromyography and kinemyography monitoring methods during recovery period of neuromuscular block	Ezer, F.; Bezen, O.; Saracoglu, A.; Ozata, A. S.; Sengul, T.	2014	European Journal of Anaesthesiology	To compare kinemyography with acceleromyography for the recovery parameters of NM block.	neuromuscular blockade, rocuronium, midazolam, curare, propofol, monitoring, neuromuscular blocking, anesthesiology, human, patient, parameters, arm, artifact, mortality, informed consent, morbidity, ethics, implantable cardioverter defibrillator, endotracheal	46	ASA status I - II patients aged 19-65, scheduled for elective surgery under general anaesthesia	ASA status >2, age <19 or >65, surgery other than elective and using other than general anesthesia. The patients in whom additional use of NM blockers or reversal agents and in whom data acquisition was artefactual were excluded.	Observational	Patients undergoing elective surgery with general anesthesia.	AMG versus KMG readings	AMG and KMG are interchangeable for the recovery parameters of NM block. In addition to AMG, KMG can also be safely used to determine PORC.	III	Moderate
The RECITE study: A Canadian prospective, multicenter study of the incidence and severity of residual neuromuscular blockade	Fortier, L. P.; McKeen, D.; Turner, K.; De Médicis, É.; Warnier, B.; Jones, P. M.; Chaput, A.; Pouliot, J. F.; Galameau, A.	2015	Anesthesia and Analgesia	To investigate the incidence and severity of residual NMB as measured by TOF acceleromyography of <0.9 in the immediate postoperative period. Compares those incidences with occurrence of postoperative respiratory events.	neostigmine, rocuronium, suxamethonium, abdominal surgery, acceleromyography, adult, Canada, conversion to open surgery, endotracheal intubation, extubation, female, human, incidence, laparoscopic surgery, major clinical study, myography, neuromuscular blocking, neuromuscular function, neuromuscular monitoring, paralysis, postanesthesia care, curare,	302	Adult patients undergoing open or laparoscopic abdominal surgery expected to last <4 hours, ASA physical status I-III, and scheduled for general anesthesia with at least 1 dose of a nondepolarizing neuromuscular blocking agent for endotracheal intubation or maintenance of neuromuscular relaxation	quantitative monitoring of neuromuscular transmission (e.g., mechanomyography, electromyography) was permitted. All other qualitative (visual and tactile) monitoring measures were allowed. Participants were excluded if their medical condition, surgical procedure, or positioning would interfere with the operation, calibration, or accuracy of the TOF-Watch.	Prospective, blinded, observational	Patients undergoing open or laparoscopic abdominal surgery and receiving at least one dose of NMBD	TOF by acceleromyography at time of extubation and upon arrival at PACU	Residual paralysis is common at tracheal extubation and PACU arrival, despite qualitative neuromuscular monitoring and the use of neostigmine. More effective detection and management of NMB is needed to reduce the risks associated with residual NMB.	III	High
Postoperative residual curarization in the morbidity obese	Frank, L.; Cajina, C.; Cozakov, Y.; Abels, I.	2013	Anesthesia and Analgesia	To study the incidence of PORC upon extubation of morbidly obese patients (BMI>30) having bariatric surgery.	neuromuscular blocking agent, vecuronium, anesthesia, society, human, neuromuscular blocking, extubation, patient, monitoring, surgery, obesity, bariatric surgery, high risk population, neuromuscular function, control group, surgical	115	BMI >30, bariatric surgery	BMI <30, surgery other than bariatric	Retrospective (control) and prospective observational	Morbidly obese patients having bariatric surgery	Incidence of TOF with acceleromyography of <0.9	The clinical implications of continual quantitative monitoring of neuromuscular block at the adductor pollicis vs other locations during surgery of high BMI patients are important to provision of care.	III	Low

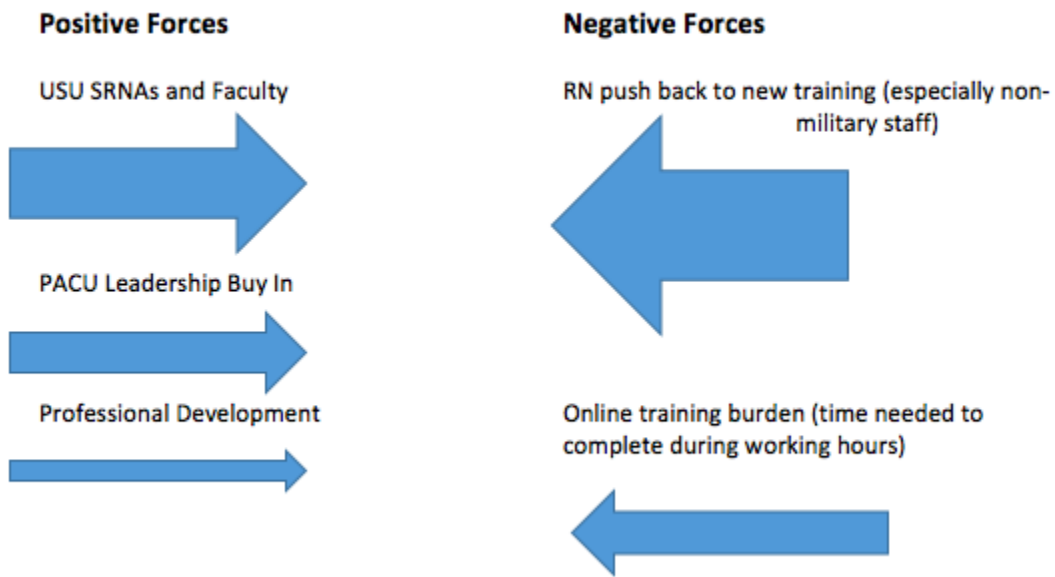
<p>Postoperative muscle paralysis after rocuronium: Less residual block when acceleromyography is used</p>	<p>Gätke, M. R., Viby-Mogensen, J., Rosenstock, C., Jensen, F. S., Skovgaard, L. T.</p>	<p>2002</p>	<p>Acta Anaesthesiologica Scandinavica</p>	<p>To establish the incidence and degree of postoperative residual block following the use of rocuronium in patients not monitored with a nerve stimulator, and to compare it with results obtained in patients monitored using acceleromyography (AMG).</p>	<p>diazepam, fentanyl, neostigmine, nitrous oxide, propofol, rocuronium, triazolam, adult aged, anesthetic recovery, article, clinical trial, controlled clinical trial, controlled study, double blind procedure, extubation, female, human, major clinical study, male, myography, nerve stimulation, neuromuscular blocking, operation</p>	<p>120</p>	<p>18-70 y/o, eye, ear, or gynecologic surgery requiring muscle relaxation</p>	<p>Renal/hepatic disease, neuromuscular disorders, on medications that may interfere with neuromuscular transmission, weight deviation of 20% from ideal body weight</p>	<p>Prospective, randomised and double-blind study</p>	<p>Adult patients undergoing eye, ear, or gynecologic surgery and receiving muscle relaxants and receipt of repeat doses of NMBD's based on TOF with AMG versus provider intuition (no monitoring)</p>	<p>Incidence of TOF <0.8 (residual block) immediately post extubation/Mann-Whitney test, CI, Fisher's exact, P-values</p>	<p>Clinical evaluation of recovery of neuromuscular function does not exclude significant residual paralysis following the intermediate-acting muscle relaxant rocuronium, but the problem of residual block can be minimized by use of AMG.</p>	<p>II High</p>
<p>Relationship between normalized adductor pollicis train-of-four ratio and manifestations of residual neuromuscular block: a study using acceleromyography during near steady-state concentrations of mivacurium</p>	<p>Heier, T., Caldwell, J. E., Feiner, J. R., Liu, L., Ward, T., Wright, P. M.</p>	<p>2010</p>	<p>Anesthesiology</p>	<p>To study the relationship between normalized acceleromyographic TOF ratio, lung volumes, and clinical signs of residual neuromuscular block.</p>	<p>Recovery Period, Deglutition/drug effects/physiology, *Electromyography, Female, Functional Residual Capacity, Hand Strength/physiology, Humans, *Isoquinolines, Jaw/physiology, Male, Movement/drug effects, Muscle, Skeletal/drug effects/physiology, *Neuromuscular Blockade, *Neuromuscular Nondepolarizing Agents, Residual</p>	<p>12</p>	<p>18-35 y/o, with normal airway exam</p>	<p>Women who were pregnant or currently breast feeding and individuals with body mass index greater than 25, history of smoking, medications known to interfere with neuromuscular-blocking drugs, family or personal history of problems related to anesthesia, acid reflux, or current upper-airway infection</p>	<p>Correlational</p>	<p>TOF with acceleromyographically</p>	<p>Pulmonary function tests (VC, FRC)</p>	<p>Lung vital capacity decreased linearly with decreasing TOF ratio. Responses to clinical tests of muscle function varied to a large extent among individuals at comparable TOF ratios. None of the volunteers had significant clinical effects of neuromuscular block at normalized acceleromyographic TOF ratio greater than 0.90.</p>	<p>III Moderate</p>
<p>Residual neuromuscular block: lessons unlearned. Part II: methods to reduce the risk of residual weakness</p>	<p>Brull, S. J.; Murphy</p>	<p>2010</p>	<p>Anesthesia and Analgesia</p>	<p>To examine optimal neuromuscular management strategies that can be used by clinicians to reduce the risk of residual paralysis in the early postoperative period.</p>	<p>Humans, Monitoring, Physiologic/instrumentation, Muscle Contraction/drug effects, Muscle Weakness/chemically induced/diagnosis/prevention and control, Neuromuscular Blockade *adverse effects/methods, Neuromuscular Depolarizing Agents/ *adverse effects/antagonists & inhibitors, Postoperative</p>	<p>1350 (systematic review)</p>	<p>Adult patients undergoing anesthesia</p>		<p>Systematic Review</p>		<p>tactile) neuromuscular monitoring is used (train-of-four [TOF], double-burst, or tetanic stimulation patterns), clinicians often are unable to detect fade when TOF ratios are between 0.6 and 1.0. Furthermore, the effect of qualitative monitoring on postoperative residual paralysis remains controversial. In contrast, there is strong evidence that acceleromyography (quantitative) monitoring improves detection of small degrees (TOF ratios >0.6) of residual blockade.</p>	<p>II High</p>	

<p>Intraoperative Acceleromyographic Monitoring Reduces the Risk of Residual Neuromuscular Blockade and Adverse Respiratory Events in the Postanesthesia Care Unit</p>	<p>Murphy, G.S., Szokol, J.W., Marymont, J.H., Greenberg, S.B., Avram, M.J., Vender, J.S., & Nisman, B.A.</p>	<p>2008</p>	<p>Anesthesiology</p>	<p>To determine the incidence and degree of residual neuromuscular blockade in patients randomized to conventional qualitative train-of-four (TOF) monitoring or quantitative acceleromyographic monitoring.</p>	<p>Accelerometry, Adverse Drug Event--Prevention and Control, Intraoperative Care, Monitoring, Physiologic, Postoperative Care, Accelerometry--Methods, Chi Square Test, Comorbidity, Confidence Intervals, Demography, Descriptive Statistics, Equipment and Supplies, Fisher's Exact Test, Mann-Whitney U Test, Monitoring, Physiologic--Methods, Spearman's Rank Correlation Coefficient, T-Tests, Two-Tailed</p>	<p>185</p>	<p>Age younger than 18 or older than 70 yr, expected duration of the surgical procedure less than 60 min, ASA status IV or V, weight greater than 30% above ideal body weight, presence of an underlying neuromuscular disease, use of drugs known to interfere with neuromuscular transmission, and preoperative chronic renal insufficiency (serum creatinine > 1.6 mg/dl) or hepatic dysfunction</p>	<p>presenting for elective surgical procedures requiring maintenance of neuromuscular blockade were eligible for enrollment</p>	<p>Randomized</p>	<p>Patients undergoing elective surgery requiring maintenance of neuromuscular blockade</p>	<p>Fade of TOF compared to acceleromyography >0.8</p> <p>A lower frequency of residual neuromuscular blockade in the PACU (TOF ratio < 0.9) was observed in the acceleromyography group (4.5%) compared with the conventional TOF group (30.0%; P < 0.0001). During transport to the PACU, fewer acceleromyography patients developed arterial oxygen saturation values, measured by pulse oximetry, of less than 90% (0%) or airway obstruction (0%) compared with TOF patients (21.1% and 11.1%, respectively; P < 0.002). The incidence, severity, and duration of hypoxic events during the first 30 min of PACU admission were less in the acceleromyography group</p>	<p>III</p>	<p>High</p>
<p>Tactile fade detection with hand or wrist stimulation using train-of-four, double-burst stimulation, 50-Hertz tetanus, 100-Hertz tetanus, and acceleromyography</p>	<p>Capron, F.; Fortier, L. P.; Racine, S.; Donati, F.</p>	<p>2006</p>	<p>Anesthesia and Analgesia</p>	<p>To establish the threshold at which visual assessment of differences in TOF stimulation becomes undetectable to observers compared to quantitative measurement with acceleromyography.</p>	<p>Adult Aged, Anesthesia, Local/Methods, Electric Stimulation/Methods, Electromyography/Methods, Female, Hand/Physiology, Humans, Male, Middle Aged, Touch/Physiology, Wrist/Physiology</p>	<p>32</p>	<p>Exclusion criteria included neuromuscular, hepatic, or renal disease, suspected difficult tracheal intubation, body mass index >32 kg/m², pregnancy, being on medication that influences neuromuscular function, or a history of allergic reaction to drugs used in the study.</p>	<p>Thirty-two adult patients, ASA physical status I-III, scheduled for elective surgical procedures under general anesthesia with tracheal intubation</p>	<p>Observational</p>	<p>Patients undergoing elective surgery requiring maintenance of neuromuscular blockade</p>	<p>Fade of TOF threshold for visual observation and differentiation compared to acceleromyography.</p> <p>The mean mechanomyographic TOF ratio when acceleromyographic TOF ratio first exceeded 1.0 was 0.89 ± 0.06. This threshold did not depend on the site of stimulation but was more variable with stimulation at the wrist (Fig. 4). The tactile TOF fade became undetectable at a mean mechanomyographic TOF ratio of 0.31 ± 0.15. The corresponding threshold was significantly higher for DBS fade (0.76 ± 0.11).</p>	<p>III</p>	<p>High</p>
<p>Single acceleromyographic train-of-four, 100-Hertz tetanus or double-burst stimulation: which test performs better to detect residual paralysis?</p>	<p>Samet, A.; Capron, F.; Alla, F.; Mestelman, C.; Fuchs-Buder, T.</p>	<p>2005</p>	<p>Anesthesiology</p>	<p>To determine which test performs better to detect residual paralysis. Single acceleromyographic train-of-four, 100-Hertz tetanus or double-burst stimulation.</p>	<p>Adult, Aged, Anesthesia, Calibration, Electric Stimulation, Female, Humans, Male, Middle Aged, Muscle, Skeletal/Drug Effects/Physiology, Myography/Methods, Neuromuscular Blockade, Paralysis/Chemically Induced/ Diagnosis, Physical Stimulation</p>	<p>85</p>	<p>neuromuscular, hepatic, or renal disease, abnormal airway anatomy (Mallampati score 3 and 4), deviation from ideal body mass >25%, pregnancy, medication that influences neuromuscular blockade, or a history of allergic reaction to drugs used in the study.</p>	<p>elective surgical procedures under general anesthesia with tracheal intubation</p>	<p>Randomized</p>	<p>elective surgical procedures under general anesthesia with tracheal intubation.</p>	<p>Acceleromyography compared to 100-Hertz and double-burst stimulation</p> <p>acceleromyographic TOF performs better than both subjective tests investigated, i.e., DBS and 100 Hz, 5-s tetanus, but it does not reliably detect lesser degrees of RP. In the second part of the current study a new approach for the management of low degrees of RP is proposed, i.e., acceleromyography-based prediction of the time interval until complete recovery from neuromuscular blockade. This concept may further improve the clinical value of the acceleromyographic</p>	<p>II</p>	<p>High</p>

Appendix B: Literature Review



Appendix C: Variables



Appendix D: Pre and Post- Test Questionnaire

1. How does Acetylcholine depolarize the muscle cell?
 - a. Opens the Calcium gated channels
 - b. Opens the Sodium gated channels
 - c. Closes the Calcium gated channels
 - d. Closes the Sodium gated channels

2. What is one type (or mechanism of action) of neuromuscular blocking drugs?
 - a. Calcium blocker
 - b. Hyperpolarization
 - c. Non-depolarizing
 - d. Repolarizing

3. What is the only definitive method to diagnose residual neuromuscular blockade?
 - a. Based on signs/symptoms
 - b. Chemistry panel
 - c. Train of four monitor
 - d. Acceleromyography

4. What is one use of paralyzing agents?
 - a. Comfort for the patient
 - b. Decrease pain from surgery
 - c. Facilitate intubation
 - d. Only used for intubation

5. What neurotransmitter causes muscle cell depolarization?
 - a. Norepinephrine
 - b. Acetylcholine
 - c. Calcium
 - d. Potassium

6. What is the name of the space between the axon terminal and post synaptic membrane?
 - a. Synaptic cleft
 - b. Neuromuscular junction
 - c. Exocytosis
 - d. Voltage gated channel

7. Succinylcholine can be reversed by:
 - a. No medication reversal exists
 - b. Glycopyrrolate & edrophonium
 - c. Neostigmine & glycopyrrolate
 - d. Suggamadex

8. Non-depolarizing neuromuscular blockers can be reversed by:
 - a. Ephedrine
 - b. Glycopyrrolate & neostigmine
 - c. No reversal exists
 - d. Neostigmine & atropine

9. What is the first action you should take if residual neuromuscular blockade is suspected?
 - a. Place an O2 mask
 - b. Give ephedrine 5mg IV
 - c. Call for help
 - d. Give glycopyrrolate 0.2mg IV

10. In the absence of a definitive diagnostic tool for residual neuromuscular blockade, how is the diagnosis made?
 - a. Diagnosis of exclusion
 - b. Train of four monitor
 - c. Signs/symptoms
 - d. Can only be made by the anesthesia provider

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)**COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT****

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

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- **Curriculum Group:** OUSD P&R Human Research
- **Course Learner Group:** Biomedical Investigators and Research Study Team
- **Stage:** Stage 1 - Biomedical Investigators

- **Report ID:** 20625671
- **Report Date:** 31-Aug-2016
- **Current Score**:** 100

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
History and Ethics of Human Subjects Research (ID: 498)	31-Aug-2016	7/7 (100%)
Informed Consent (ID: 3)	31-Aug-2016	5/5 (100%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	31-Aug-2016	4/4 (100%)
Records-Based Research (ID: 5)	31-Aug-2016	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	31-Aug-2016	5/5 (100%)
Genetic Research in Human Populations (ID: 6)	31-Aug-2016	5/5 (100%)
Vulnerable Subjects - Research Involving Children (ID: 9)	31-Aug-2016	3/3 (100%)
Vulnerable Subjects - Research Involving Pregnant Women, Human Fetuses, and Neonates (ID: 10)	31-Aug-2016	3/3 (100%)
FDA-Regulated Research (ID: 12)	31-Aug-2016	5/5 (100%)
Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 912)	31-Aug-2016	No Quiz
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	31-Aug-2016	5/5 (100%)
Avoiding Group Harms - U.S. Research Perspectives (ID: 14080)	28-Aug-2016	3/3 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	31-Aug-2016	5/5 (100%)
Recognizing and Reporting Unanticipated Problems Involving Risks to Subjects or Others in Biomedical Research (ID: 14777)	28-Aug-2016	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	28-Aug-2016	5/5 (100%)
Module for Non-DoD Personnel Conducting Research Involving Human Subjects Supported by the DoD (ID: 16769)	31-Aug-2016	No Quiz

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COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

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- **Phone:** 6198499524

- **Curriculum Group:** OUSD P&R Human Research
- **Course Learner Group:** Biomedical Investigators and Research Study Team
- **Stage:** Stage 1 - Biomedical Investigators

- **Report ID:** 20622993
- **Completion Date:** 28-Aug-2016
- **Expiration Date:** 28-Aug-2019
- **Minimum Passing:** 80
- **Reported Score*:** 87

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Avoiding Group Harms - U.S. Research Perspectives (ID: 14080)	27-Aug-2016	3/3 (100%)
Recognizing and Reporting Unanticipated Problems Involving Risks to Subjects or Others in Biomedical Research (ID: 14777)	27-Aug-2016	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	27-Aug-2016	4/5 (80%)
Module for Non-DoD Personnel Conducting Research Involving Human Subjects Supported by the DoD (ID: 16769)	27-Aug-2016	No Quiz
History and Ethics of Human Subjects Research (ID: 498)	27-Aug-2016	7/7 (100%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	27-Aug-2016	4/5 (80%)
Informed Consent (ID: 3)	27-Aug-2016	4/5 (80%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	27-Aug-2016	4/4 (100%)
Records-Based Research (ID: 5)	27-Aug-2016	3/3 (100%)
Genetic Research in Human Populations (ID: 6)	27-Aug-2016	4/5 (80%)
Vulnerable Subjects - Research Involving Children (ID: 9)	28-Aug-2016	3/3 (100%)
Vulnerable Subjects - Research Involving Pregnant Women, Human Fetuses, and Neonates (ID: 10)	28-Aug-2016	3/3 (100%)
FDA-Regulated Research (ID: 12)	28-Aug-2016	4/5 (80%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	28-Aug-2016	4/5 (80%)
Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 912)	28-Aug-2016	No Quiz
Stem Cell Research Oversight (Part II) (ID: 14584)	28-Aug-2016	3/5 (60%)

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COMPLETION REPORT - PART 2 OF 2

COURSEWORK TRANSCRIPT**

** NOTE: Scores on this [Transcript Report](#) reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Brandi Alford (ID: 5733771)
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- **Phone:** 202-805-2003

- **Curriculum Group:** OUSD P&R Human Research
- **Course Learner Group:** Biomedical Investigators and Research Study Team
- **Stage:** Stage 1 - Biomedical Investigators

- **Report ID:** 20590502
- **Report Date:** 26-Aug-2016
- **Current Score**:** 81

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
History and Ethics of Human Subjects Research (ID: 498)	26-Aug-2016	7/7 (100%)
Informed Consent (ID: 3)	26-Aug-2016	3/5 (60%)
Social and Behavioral Research (SBR) for Biomedical Researchers (ID: 4)	26-Aug-2016	4/4 (100%)
Records-Based Research (ID: 5)	26-Aug-2016	2/3 (67%)
Genetic Research in Human Populations (ID: 6)	26-Aug-2016	3/5 (60%)
Vulnerable Subjects - Research Involving Children (ID: 9)	26-Aug-2016	3/3 (100%)
Vulnerable Subjects - Research Involving Pregnant Women, Human Fetuses, and Neonates (ID: 10)	26-Aug-2016	3/3 (100%)
FDA-Regulated Research (ID: 12)	26-Aug-2016	3/5 (60%)
Office of the Under Secretary of Defense (Personnel and Readiness) (ID: 912)	26-Aug-2016	No Quiz
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	26-Aug-2016	3/5 (60%)
Avoiding Group Harms - U.S. Research Perspectives (ID: 14080)	24-Aug-2016	3/3 (100%)
Cultural Competence in Research (ID: 15166)	26-Aug-2016	4/5 (80%)
Basic Institutional Review Board (IRB) Regulations and Review Process (ID: 2)	26-Aug-2016	5/5 (100%)
Recognizing and Reporting Unanticipated Problems Involving Risks to Subjects or Others in Biomedical Research (ID: 14777)	26-Aug-2016	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	26-Aug-2016	3/5 (60%)
Module for Non-DoD Personnel Conducting Research Involving Human Subjects Supported by the DoD (ID: 16769)	26-Aug-2016	No Quiz

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Figure 1: Lippitt's Model

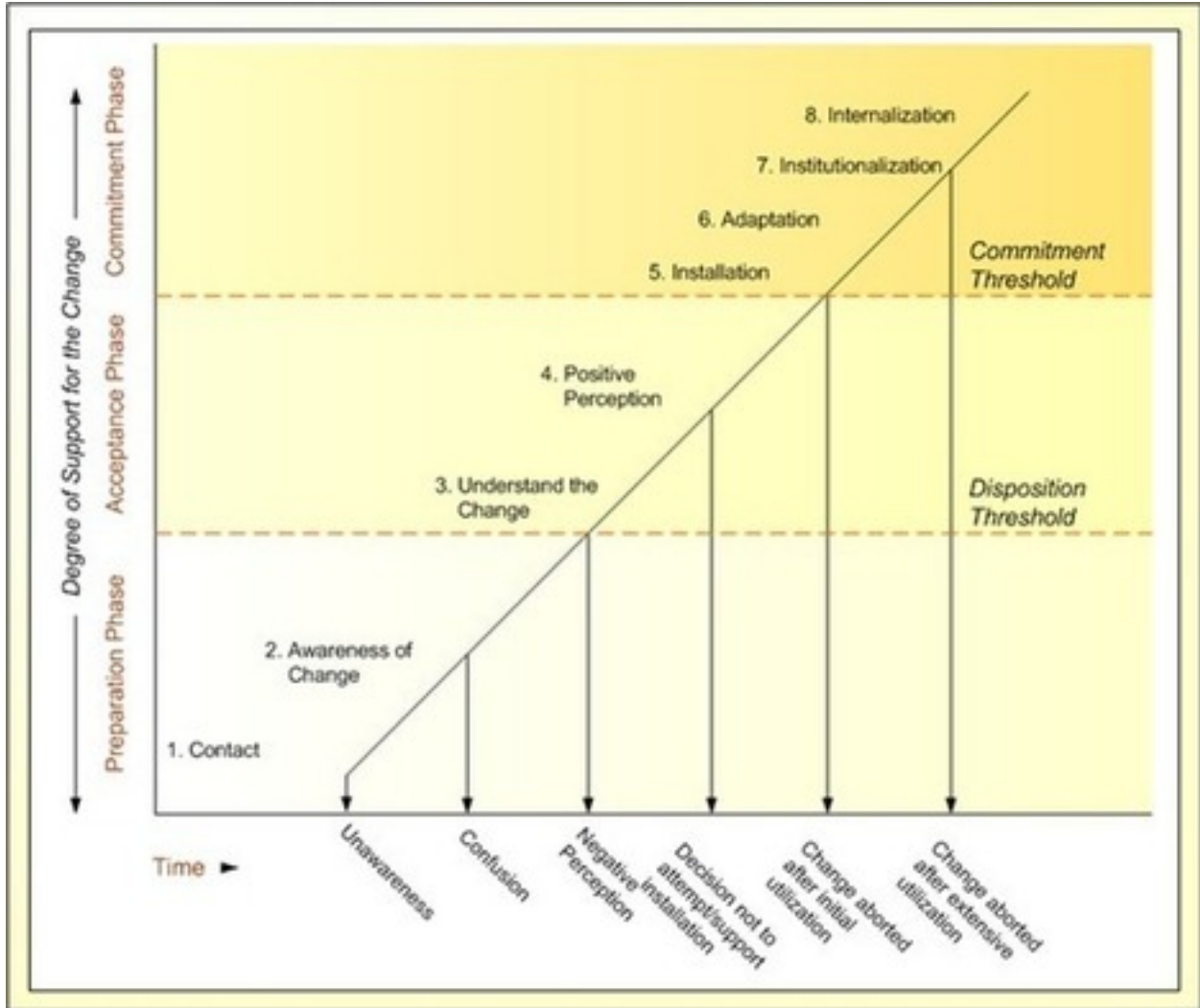


Figure 2: Pre and Post Test Results

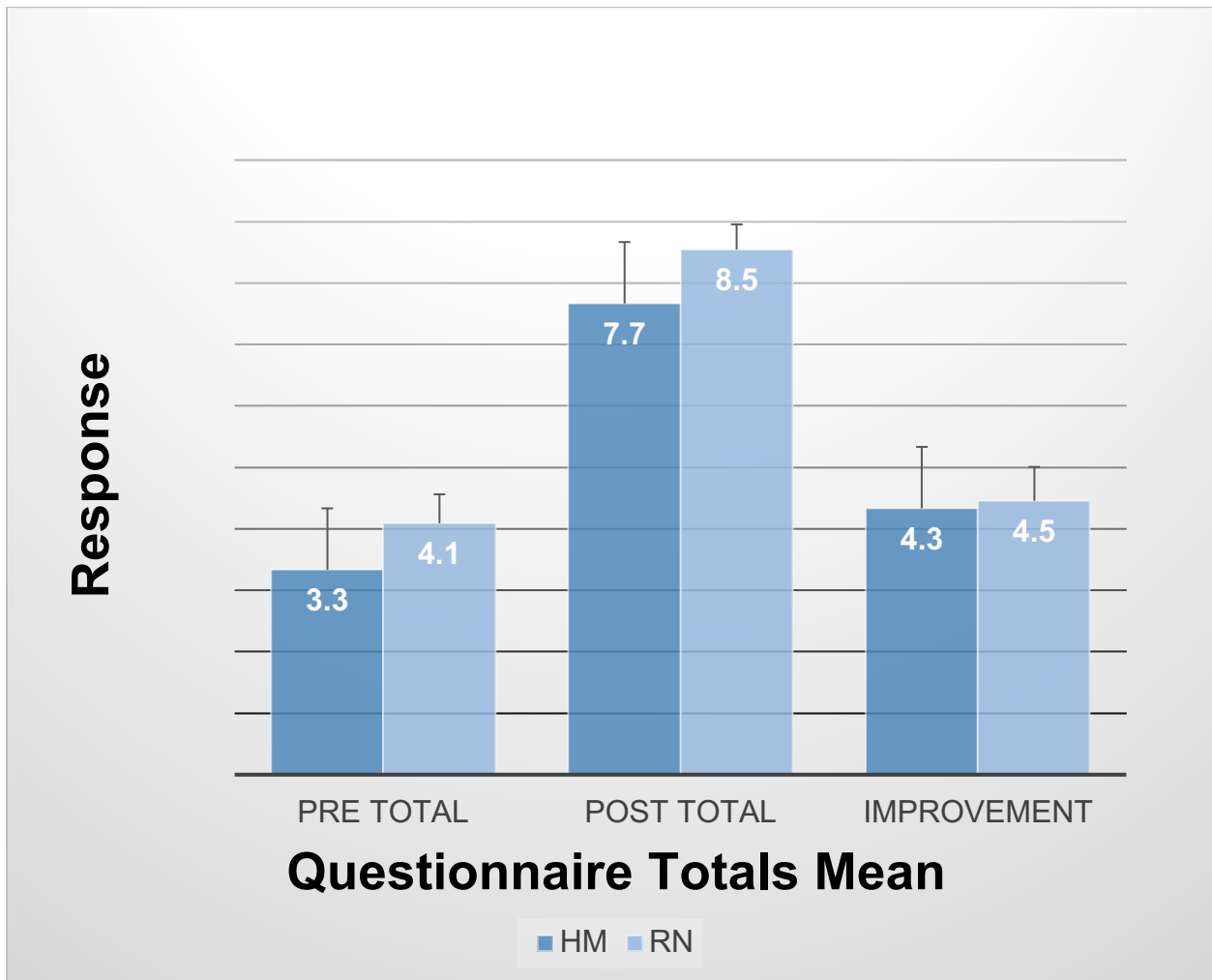
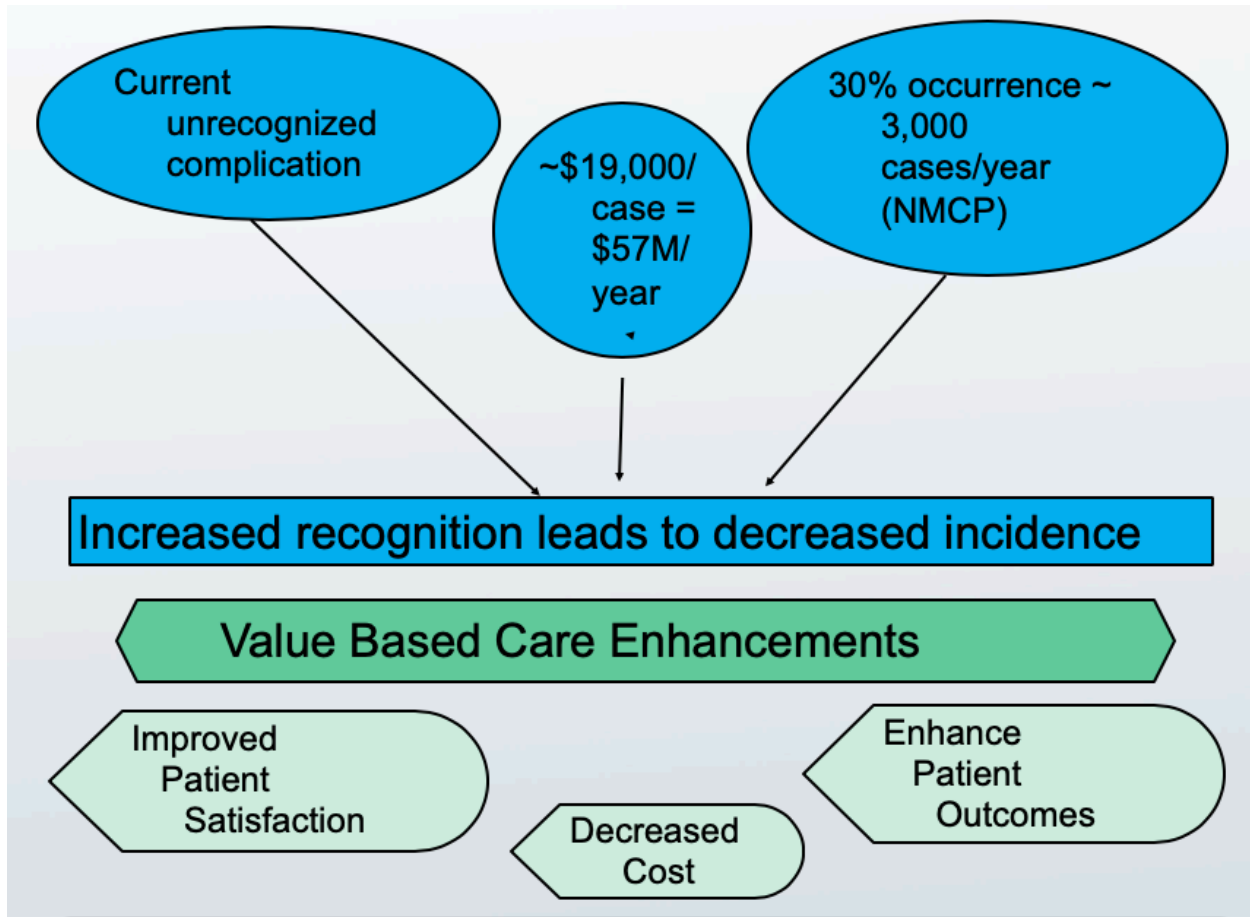


Figure 3: Value Based Care Enhancements



USU Form 3202N

**USUHS FORM 3202N
DANIEL K. INOUE GRADUATE SCHOOL OF NURSING
EVIDENCE-BASED PRACTICE/PERFORMANCE IMPROVEMENT PROPOSAL**

VPR Date Stamp

Project Number: GSN-61-10258 (VPR will assign)
Project Title: Residual Neuromuscular Blockade Educational Project for PACU Nurses

SECTION A: STUDENT POC INFORMATION	
1. Name (Last, First, MI): Rockwell, Alisen, W	Student E-mail: alisen.rockwell@usuhs.edu
2. Home Address: [REDACTED]	
SECTION B: COMMITTEE CHAIR / SENIOR MENTOR INFORMATION	
3. Name (Last, First, MI): Suszan, Lauren	
4. Telephone: 757-953-3198 Fax: _____	E-mail: lauren.suszan@usuhs.edu
5. USUHS Building/ Room No.: BLDG 2, floor 3	
SECTION C: PROJECT INFORMATION	
6. Attach the Abstract for the proposal, including the following sections: Site Location of the Project, Title, Authors, Background or Problem/Issue, Clinical Question/Purpose, Project Design, Anticipated Organizational Impact/Implications for Practice and also include the Proposed Timeline. Single space the abstract and use Times New Roman font, size 12.	
7. Is this proposal related to an active research project of the Chair/Senior Mentor identified in Section B? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, complete below; if no, proceed to Part 8. Project Number: _____ Project Title: _____ Project Start Date: _____ Project End Date: _____	
8. Anticipated period of performance: Project Start Date: 11/1/2017 Project End Date: 5/15/2019	
9. Performance Site(s): NMC Portsmouth	
10. Does this project involve any classified information? (Contact the USUHS Security Office for guidance) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
11. Do you have a funding source for this project? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> NA If yes, specify the funding agency and the amount provided: _____	
SECTION D: SIGNATURES	
The following signatures attest to the validity of the above information:	
[REDACTED]	[REDACTED]
Student (Project Point of Contact for the Group) (Signature and Date)	Chair/Senior Mentor (Signature and Date)
[REDACTED]	[REDACTED]
Chair/Program Director (Signature and Date)	Chair/Program Director (Signature and Date)
[REDACTED]	[REDACTED]
DNP Project Director or PhD Director (Signature and Date)	Associate Dean for Academic Affairs, GSN (Signature and Date)
[REDACTED]	[REDACTED]
Associate Dean for Research, GSN (Signature and Date)	Dean, DK1 Graduate School of Nursing (Signature and Date)
In light of the above signatures, the project is approved.	
[REDACTED]	Date
USUHS Vice President for Research	30 Nov 2018

MTF IRB/PI Letter of Determination

Clinical Investigation Department, Naval Medical Center Portsmouth

620 John Paul Jones Circle, Portsmouth, VA 23708 (757) 953-5939 Fax (757) 953-5298, DSN 377-5939



20 March 2018

Thomas S. Rieg, PhD
Research Director

From: Head, Clinical Investigation Department
To: LT Alisen Rockwell, NC, USN

Kersten N. Wheeler, MS
Deputy Director
Division Head,
Research Subjects Protection

SUBJ: LETTER OF WAIVER OF IRB REVIEW FOR PROGRAM
EVALUATION/QUALITY IMPROVEMENT PROJECT

June G. Brockman, BA
Division Head,
Research Resources


1. Your project titled, "NMCP.2018.0057: Residual Neuromuscular Blockade Educational Project for Post Anesthesia Care Unit Nurses" does not require IRB review. Navy policy states that these types of program evaluation projects are exempt from IRB review.

Joanna E. Fishback, DVM
Major, VC, USA
Division Head,
Laboratory Animal Medicine

2. Projects that do not require IRB approval are not eligible for Clinical Investigation Department travel funds.

3. You will still need to obtain publication approval for the project which is required for all works presented or published outside of NMCP.

4. I remain available and may be reached at (757)953-5939.


T. S. RIEG

"FIRST AND FINEST IN RESEARCH SUPPORT"

PAO Clearance for archiving final reports to “USU Archives”

<p>Department Head Recommendation: <input checked="" type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: CDR Longwell Date: 08APR19</p>		<p>Director Recommendation: <input checked="" type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: CDR Cardoso Date: 05APR19</p>	
<p>Public Affairs Recommendation: <input checked="" type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: HC Johnson CIV Date: 08APR19</p>		<p>CID Recommendation: <input checked="" type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: June Brockman Date: 05APR19</p>	
<p>Attending Veterinarian Recommendation: <input type="checkbox"/> N/A <input type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: Date:</p>		<p>OPSEC Security Recommendation: <input checked="" type="checkbox"/> Approve <input type="checkbox"/> Approve with comment <input type="checkbox"/> Return to author for revision, discussion <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: Name/Signature: LT Jackson Date: 08APR19</p>	
<p>NME Recommendation: <input type="checkbox"/> N/A <input type="checkbox"/> Approve <input type="checkbox"/> Approve w/ comment <input type="checkbox"/> Return to author for revision <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward to BUMED Comments: Name/Signature: Date:</p>	<p>BUMED Recommendation: <input type="checkbox"/> Approve <input type="checkbox"/> Approve w/ comment <input type="checkbox"/> Return to author for revision <input type="checkbox"/> Disapprove <input type="checkbox"/> Not required Comments: Name/Signature: Date:</p>	<p>Command Action: <input type="checkbox"/> Approve <input checked="" type="checkbox"/> Approve w/ comment <input type="checkbox"/> Return to author for revision <input type="checkbox"/> Disapprove <input type="checkbox"/> Forward for higher level review Comments: After completion of edits by Longwell and Cardoso Name/Signature: June Brockman by direction Date: 05APR19</p>	

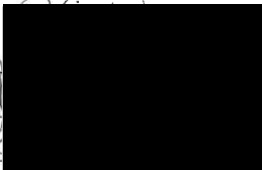
DNP Project Completion Verification



Appendix G: Daniel K. Inouye Graduate School of Nursing
DNP Project Completion Verification Form

**DOCTOR OF NURSING PRACTICE PROJECT
Completion Verification Form**

The DNP Project titled: Residual Neuromuscular Blockade in the Post Anesthesia Care Unit: An Educational Initiative was completed at Navy Medical Center Portsmouth by the following student(s):

<i>(type student name)</i>		<i>(date)</i>
Brandi Alford, MSN, LCDR, USN		4/4/19
Alisen Rockwell, BSN, LT, USN		04 April 2019
Jonathan McGowen, BSN, LT, USN		04 APR 2019

The DNP Practice Project Team verifies that the following components of the DNP project, accomplished by the above students, is of sufficient rigor and demonstrates doctoral level scholarship to meet the requirements for USUHS GSN graduation:

- Presentation of DNP project to the leadership/stakeholders at the Phase II Site,
- Abstract/Impact Statement (*Appendix F*), and
- DNP Project written report.

Verified by:

<i>(type name)</i>	<i>(signature)</i>	<i>(date)</i>	
Lauren Suszan, DNP, LCDR, USN		04 APR 2019	Senior Mentor
Reginal Middlebrooks, DNP, CDR, USN		04 APR 2019	Team Mentor
Michael Rucker, DNP, LCDR, USN	M	04 APR 2019	Team Mentor

For RNA Students only - add the following additional signature for final verification of project completion:

Kennett Radford, DNP, CDR, USN RNA Project Director <i>(type name)</i>	 <i>(Signature)</i>	04Apr2019 <i>(Date)</i>
---	--	----------------------------