Anesthesia Workstations as Intensive Care Ventilators During a COVID-19 Surge

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Abstract

SARS-CoV-2 is an extremely transmittable virus that causes coronavirus disease 2019 (COVID-19). In the last 20 years, COVID-19 is the third coronavirus pandemic to occur. The SARS virus of 2002, while highly virulent, was not rapidly transmitted and thus did not create a significant strain on healthcare infrastructure. In early 2009, Influenza A (H1N1) like COVID-19 transmitted rapidly throughout the world and increased hospitalizations at an exponential rate but was still treatable with available medical resources. The surge created by COVID-19, however, resulted in an increase in hospitalizations that created such a strain on hospital infrastructure, it became necessary to implement alternative patient care solutions to treat the surge of critically ill patients. As COVID-19 spread, patients showed rapid decline with many requiring respiratory support via mechanical ventilation. This rise in intensive care ventilator use, outstripped available resources and generated an imminent need for unconventional solutions. Anesthesia workstations were rapidly identified as a viable alternative to address the demand for mechanical ventilation devices created by COVID-19. The use of anesthesia workstations within the intensive care environment however, resulted in a knowledge gap for critical care nurses who had no prior exposure to the equipment. Thus, creation of an evidence based online continuing education module in collaboration with Echelon, AdventHealth University's (AHU) professional education division will help decrease critical care nurse knowledge gap regarding the use of anesthesia machines as intensive care ventilators. With a secondary aim of constructing an SRNA guidance protocol that clarifies and improves the CE module development at AHU.

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Introduction

The coronavirus (COVID-19) has spread throughout the world, causing an unexpected healthcare demand. Between 5%-16% of COVID-19 patients showed rapid deterioration leading to the need for mechanical ventilation, placing them in the hospital's intensive care unit (ICU) (Litton et al., 2020; Mason & Friese, 2020). As COVID-19 spread, the demand for mechanical ventilators became greater. As a result, healthcare facilities lacked essential equipment needed to perform safe and effective care, including mechanical ventilation (Litton et al., 2020; Mason & Friese, 2020). The immediate availability of anesthesia workstations in hospital operating rooms (OR) creates a viable solution to the insufficiency of intensive care ventilators.

Significance & Background of Clinical Problem

The recent emergence of the COVID-19 virus has led to the largest, most significant global pandemic since the spread of the H1N1 flu virus in 1918. In a 20-month period, approximately 193.2 million cases were identified, and over 4.1 million people died (World Health Organization, 2021; Worldometers, 2021). In the United States, the overall national death rate has increased by an unprecedented 16% from 2019 to 2020, which experts have primarily attributed to COVID-19 (CDC, 2021). As of March 2021, the COVID-19 virus had undergone multiple mutations and the United States experienced three epidemic waves with more predicted (Cacciapaglia, Cot, and Sannino, 2021). The Delta variant of the COVID-19 virus was considered highly transmissible and resulted in the flooding of healthcare systems and oxygen supply shortages (Bernal et. al., 2021). In addition, the heightened transmissibility and the presence of multiple pandemic waves created a critical shortage of mechanical ventilators (Dhanani et al, 2020).

There are a variety of outcomes related to the clinical course of the COVID-19 patient. The most common initial signs and symptoms are fever, sore throat, dry cough, and dyspnea (Bolay et al, 2020; Gulati et al., 2020). These preliminary clinical manifestations can progress to rapid deterioration of the respiratory system and the necessity of ventilatory support (Bolay et al., 2020; Botta et al., 2020; Gulati et al., 2020; MacMillan, 2020; Roberts 2020). Patients suffering from this disease can stay on the ventilator for as little as a few hours to a few months (Botta et al. 2020, MacMillan, 2020; Roberts 2020). However, most patients diagnosed with the coronavirus that need more respiratory support will require approximately 4 to 10 days of mechanical ventilation (Botta et al., 2020; MacMillan, 2020; Roberts, 2020).

While mechanical ventilation has been the treatment of last resort since the pandemic began, 5 to 16% of patients with COVID-19 have required admission into an intensive care unit (ICU), necessitating mechanical ventilation (Grasselli et al., 2020; Kambhampati et al., 2020; Litton et al. 2020). In Lombardy, Italy, 88.5% of the patients hospitalized, were placed on intensive care ventilators (Wunsch, 2020). Additionally, 59% of hospitalized patients in the United Kingdom required invasive mechanical ventilation (Wunsch, 2020). In hospitals across the United States, the focus has been to obtain adequate resources to provide safe and effective care to COVID-19 patients (Kobokovich, 2020; Wells et al., 2020).

While the United States has a supply of 98,015 ventilators, only 69,660 are available for use (Kobokovich, 2020; Well et al., 2020). An additional 45,341 machines may be needed should future surges occur (Kobokovich, 2020; Wells et al., 2020). Additionally, the state of Florida has a total of 5,140 ventilators (Florida Department of Health, 2011). However, the limitations of ventilators in Florida have led to the donations of ventilators via private institutions to lessen the exponential demand in local hospitals (Florida Department of Health, 2020).

AdventHealth, a local hospital in Florida, implemented extreme changes based on the rapid growth in COVID-19 cases in the Central Florida division. Specifically, elective surgical cases were canceled, in-person visitation suspended, and the reallocation of ancillary teams to assist the COVID-19 clinical team (AdventHealth, 2021). Cessation of elective surgical cases, however, created an availability of anesthesia workstations for use in the event of intensive care ventilator shortage.

Anesthesia workstations are a viable solution to a possible future ventilator shortage (Ariza et al., 2020; Jaber et al., 2020; Monti et al., 2020). As the use of anesthesia workstations as alternative devices has been approved by the Food and Drug Administration (FDA), the American Society of Anesthesiologists (ASA), and anesthesia workstation manufactures (Dosch, 2020; Draeger, 2020;GE Healthcare, 2020). Anesthesia ventilators can also provide respiratory support equivalent to that of the intensive care ventilator for COVID-19 patients (Jaber et al., 2020; Fullick & Oliver, 2020; Greig et al., 2020). Research supports anesthesia workstations as a safe and effective option for ventilatory support. However, education and collaboration between healthcare disciplines are needed for effective use (Goul-Cheron et al., 2020; Mouli et al., 2020). Traditionally, anesthesia machines are solely located in ORs and operated by anesthesia professionals (Draeger, 2020; GE Healthcare, 2020). Although, the implementation of anesthesia workstations as intensive care ventilators is feasible, their use does create a knowledge gap for all bedside healthcare personnel (Goul-Cheron et al., 2020; Mouli et al., 2020).

CRNA's are uniquely qualified to educate critical care nurse regarding the use of the anesthesia workstation. During nurse anesthesia programs, students are provided with in-depth education regarding the anesthesia workstation, how to perform comprehensive equipment

checks, as well as how to appropriately identify and act when faced with equipment related malfunctions (COA, 2019). In addition, CRNA's are registered nurses, who have a minimum of one-year critical care experience. This background provides unique insight into the needs and knowledge gaps of critical care nurses, which must be addressed for safe patient care (COA, 2020). Thus, an educational module for critical care nurses, presented by AHU, regarding the use of the anesthesia workstation as an alternative device for mechanical ventilation was created. The use of an online format will provide needed education at minimal cost with greater accessibility to critical care nurses. This module was submitted for approval for CE credits by the American Nurses Credentialing Center (ANCC), to decrease the knowledge gap of critical care nurses and allows safe and effective care to COVID-19 patients. The development of this module was used secondarily to improve AHU's educational module creation success through the concurrent development of a SRNA guidance protocol.

PICOT Evidence Review Questions

Two questions, posed in PICO format, have assisted in the systematic review of the literature. In COVID-19 positive patients requiring ventilatory management (P), how does the use of alternative devices as intensive care ventilators (I) affect safe and effective care during a COVID-19 surge (O)? The second question addresses the clinical innovation: At AdventHealth University (P), does the implementation of the find, organize, clarify, understand, select, plan, do, check, and act (FOCUS-PDCA) cycle during the development of a continuing educational module for ANCC and AANA credit regarding the use of anesthesia workstations as intensive care ventilators (I) result in the development of a SRNA guidance protocol that strengthens facilitators and address barriers related to SRNA developed continuing education modules (O)?

Search Strategies

The search strategy included databases, governmental agencies, professional practice organizations, and reference lists: CDC, CINAHL, Google Scholar, and PubMed. Key Search Terms and MESH combinations included: *COVID-19, COVID surge, COVID 19 Pandemic, Ventilator Management, Alternative Devices, Education, Anesthesia Machine, Anesthesia AND Mechanical ventilators, ventilation, Ventilators, Coronavirus, Health care safety, anesthesia, critical care, ICU, Intensive Care Unit, and mechanical ventilators.* Inclusion criteria included COVID-19, anesthesia workstations, intensive care ventilators, online education, and ventilator components. A total of 889 articles were initially retrieved. 562 articles were excluded if the titles were not related to alternative methods for mechanical ventilation, COVID-19 disease, the need for mechanical ventilation, or the need for education related to the use of anesthesia ventilators. Similarly, article abstracts were reviewed for the same content resulting in 270 being eliminated. Finally, the remaining articles were read and the final 14 did meet criteria. No search limiters were used.

GRADE Criteria

The literature was evaluated using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) criteria. For the supporting body of evidence, the overall GRADE level initially was low-2. The GRADE achieved was due to most of the research deriving from studies, such as observational, qualitative, and case studies. It was then graded down because of the limitations, such as imprecision due to small sample size, methodological flaws such as short duration of research, and no human testing. This resulted in a decrease in GRADE level of very low-1.

The body of evidence, however, had a large magnitude of effect which increased the overall GRADE level to low-2. The overall evidence supports the use of anesthesia machines as safe and effective alternative devices for ventilation of the COVID-19 patient. An additional increase in GRADE level to moderate -3 was determine due to all possible confounders increasing confidence in the estimated effect. The observational studies only showed the use of anesthesia machine with the patients' diagnosed with COVID-19, however, exposure to other respiratory diagnoses may also show positives outcomes. Based on the quality of evidence available, a recommendation can be made to use anesthesia machines as means of respiratory support in the COVID-19 patient.

Literature Review and Synthesis of Evidence

Anesthesia workstations as an alternative method for mechanical ventilation seems promising (Fullick & Oliver, 2020; Gouel-Cheron et al.; Greig et al., 2020). However, there are unique safety as well as functionality concerns that should be considered when using the anesthesia workstation as opposed to an intensive care ventilator. These concerns encompass the anesthesia workstation's unique structural components, machine functionality, electrical considerations, the need for performance checks and specific monitoring requirements. A thorough understanding of these issues is required for safe operation, resulting in the need for education to decrease the uninitiated critical care nurse's knowledge gap associated with the anesthesia workstations as intensive care ventilators (ASA/APSF, 2020; Drager, 2020; Fullick & Oliver, 2020; GE Healthcare, 2020; Gouel-Cheron et al., 2020).

Location

The location of the anesthesia workstation may impact the machine functionality as a setting that will ensure adequate high-pressure oxygenation and medical air, the capability to

generate negative pressure, and sufficient electrical power is required (Peter et al; 2020; Fullick and Oliver, 2020). Depending on the hospital facility, and the decision to use anesthesia gas versus intravenous sedation, the availability of a scavenging system should also be considered (Herzog-Niescery et al., 2017; Herzog-Niescery et al., 2018; Farrell et al., 2018). While the use of anesthesia gases requires the presence of a scavenging system, if not in use, machines may be used purely for ventilation without it. In this scenario, however, COVID-19 patients would require negative pressure rooms to prevent the transmissibility of the infectious diseases (Healthwise, 2020; Mittel et al., 2020). Of concern are circumstances when negative pressure rooms are unavailable, in which case, the conversion of a clean room to a negative pressure room can be achieved by using a negative pressure HEPA filtration system (Clean Room International, 2020; Healthwise, 2020; Mittel et al., 2020).

Scavenger System

When repurposing the anesthesia machine as an intensive care ventilator, it is prudent to ensure the presence of an adequate scavenging system (Drager, 2020; Pham et al, 2021). The scavenging system of an anesthesia machine stores waste gasses from the breathing circuit and discards them by means of a waste anesthesia gas suction (WAGS) connection. In the intensive care unit, however, the WAGS connection is rarely seen (Drager, 2020; GE Healthcare, 2020; Pham et al, 2021). This creates a problem as clinically significant amounts of positive end-expiratory pressure (PEEP) may be given to the patient (Drager, 2020; GE Healthcare, 2020). Medical vacuum systems, however, are available and while inferior to WAGS connection, the medical vacuum system will allow for the anesthesia workstation to perform safely (Ehrenwerth et al., 2013) (ASA/APSF, 2020; Pham et al, 2021).

Expired Carbon Dioxide Absorbent

The anesthesia workstation and the ICU ventilator manage expired CO2 differently. Intensive care ventilators are open circuit breathing systems that release CO2 into the environment (Ehrenwerth et al. 2013; Feldman et al., 2020). The anesthesia workstation, however, is a closed-circuit system that manages the buildup of exhaled CO2 via a CO2 absorbent (Ehrenwerth et al. 2013; Feldman et al., 2020). The CO2 absorbent creates a reaction with soda lime to help eliminate rebreathing of CO2 while using a closed-circuit system (Ehrenwerth et al. 2013; Feldman et al., 2020). The absorbent, however, will become exhausted and need replacement (Mittel et al., 2020; Torres et al., 2020). If the inspired CO2 becomes greater than 5 mmHg, the absorbent should be replaced to prevent re-breathing of excessive CO2 (Drager, 2020; Loeb & London, 2021). Depletion is also indicated when the CO2 absorbent color changes to purple (Drager, 2020; Loeb & London, 2021). Another issue arises when the absorbent is exposed to high Fresh Gas Flow (FGF), which may lead to excessive drying and a reduction in CO2 absorbent life (Loeb & London, 2021).

Humidification

Another issue with functionality is that of humidification. Intensive care ventilators are different from anesthesia machines since they deliver fresh gas from a compressed air source and immediately discharge all exhaled gases into the environment without recirculation (Braz et al., 2017; De Oliveira et al., 2017; Loeb & London, 2021). Since compressed gases have no humidity; the addition of humidification and active warming may be necessary (Braz et al., 2017; De Oliveira et al., 2017; Dixson, 2001). The inclusion of heat and moisture exchange filters (HMEF) may also be employed to ensure adequate airway humidification by passively retaining heat and moisture expired by the patient (Canelli et al., 2020; Torres et al., 2020).

The anesthesia workstation also uses a compressed air source; however, it recycles the patient's humidified exhalation and uses it for inspiration (Braz et al., 2017; De Oliveira et al., 2017; Dijkman et al., 2021). In addition, the reaction between the exhaled CO2 and the CO2 absorbent causes heat release that further humidifies inspired gases (Hirabayashi et al., 2008). This process, however, may result in excessive buildup of humidification in the breathing circuit during long-term use (Dosch, 2020; Fullick and Oliver, 2020). Long-term ventilation while using low FGF further exacerbates this issue causing extensive water vapor and condensation in the circuit (Dosch, 2020; Fullick and Oliver, 2020). Thus, it is vital to monitor moisture levels while using the anesthesia workstation as excessive condensation can lead to breath stacking and complete obstruction of the breathing circuit (Haina, 2020). To minimize condensation issues, the FGF in the anesthesia machine should be set to equal minute ventilation to prevent humidity build-up (Canelli et al., 2020; Torres et al., 2020). Hourly assessments of the breathing circuit and HMEF are also recommended to help prevent complications with humidification (Canelli et al., 2020; Torres et al., 2020).

Accidental Delivery of Vaporizers

Vaporizers are structural components of the anesthesia workstation that deliver inhaled anesthetics to patients through the breathing circuit to maintain an anesthetized state (Drager, 2020; Ehrenwerth et al. 2013; GE Healthcare, 2020. Inhaled anesthetics, however, are not recommended for long-term use, unless a unique situation occurs in which intravenous (IV) sedation is not available (Drager, 2020; GE Healthcare, 2020). Small amounts of inhalation agents are also known to trigger malignant hyperthermia, a life-threatening reaction to certain anesthetic agents (Drager, 2020; GE Healthcare, 2020). It is, therefore, advised that all vaporizers and nitrous oxide gas are disconnected from the anesthesia workstation and the

anesthesia ventilator flushed to prevent the presence of residual amounts of anesthetic agents in the breathing system (Drager, 2020; GE Healthcare, 2020). Intensive care ventilators do not contain vaporizers thus making these issues a unique concern to the anesthesia workstation (Drager, 2020; GE Healthcare, 2020).

Low Oxygen Supply

Oxygen is used by some anesthesia workstation models to drive ventilator bellows. This may be problematic if a particular healthcare facility reaches a low supply of available oxygen as the functionality of the anesthesia ventilator may be compromised. However, there are ways to reserve oxygen supply (ASA/APSF, 2020; Ford & Foale, 2020). Anesthesia workstation bellows can be altered to use air instead of oxygen to create pressure and flow to ventilate the patient (ASA/APSF, 2020; Ford & Foale, 2020). In addition, the critical care nurse can reduce the FGF delivered to the patient in 500 milliliters/minute increments. Critical care nurses should be vigilant while implementing reductions in FGF, however, as the accumulation of humidity and possible hypoxia may result (ASA/APSF, 2020). More recent models may be electrically powered or piston-driven which do not use oxygen to create pressure and flow thus eliminating a significant amount of oxygen consumption (ASA/APSF, 2020; Ford & Foale, 2020).

Potential Electrical Shutdown

Inadvertent shut down is an electrical consideration of the anesthesia workstation, therefore, a temporary backup battery is included within the machine (Panchamia et al., 2020; Loeb & London, 2021). This backup battery is inadequate to support ICU use, requiring the anesthesia workstation to be plugged into a red emergency electrical outlet to support dependable long-term function. Total loss of power, however, has been seen when providing ventilation for COVID-19 patients, when the machine continues to function using power from the backup

battery (Drager, 2020; Panchamia et al., 2020; Loeb & London, 2021). It is essential then that the low power alarm on the anesthesia workstation be turned on, visible and audible to prevent an inadvertent shutdown (Drager, 2020; Panchamia et al., 2020; Loeb & London, 2021).

Monitoring and Maintenance of Machines

To work optimally, anesthesia machine components also require monitoring and maintenance to prevent machine functionality issues. Specifically, the anesthesia machine's breathing circuit has the potential to be compressed, given that it does not have a support device to lift it off the bed (Loeb & London, 2021; Notz et al., 2020). Kinking of the anesthesia machine breathing circuit can cause the cessation of ventilation, leading to critical complications. Thus, an assessment of the breathing circuit should be done hourly, to identify any kinking or build-up of excessive condensation to prevent impeded ventilation (Fullick & Oliver, 2020; Loeb & London, 2021). Another area of concern is the potential for the development of an obstruction within the HME filter. Obstruction usually results from condensation build-up within the filter and presents as increased peak airway pressures and reduced tidal volumes. Thus, peak airway pressure and returned tidal volume should be monitored for changes every hour to prevent airway filter obstructions (Fullick & Oliver, 2020; Loeb & London, 2021; Mellema, 2015).

Another final concern is the potential for the development of leaks around the endotracheal tube cuff and the anesthesia circuit. When present, these leaks result in the environmental spread of respiratory droplets and aerosolized viral particles within the environment (Loeb & London, 2021; Mellema, 2015). To identify these issues, the critical care nurse should ensure that the peak plateau pressure (Pplat) is less than 30 cm H_2O every four hours and after every change in PEEP or tidal volume (Loeb & London, 2021; Panchamia et al., 2020). If there is an imbalance between inspiratory and expiratory volume measurement, a

startup test for the anesthesia machine needs to be completed (Loeb & London, 2021; Warner, 2021).

Performance Checks and Alternative Means of Ventilation

To prevent machine functionality issues such as deviation from selected ventilation settings and monitor dysfunction, routine machine checks should be completed per protocol (ASA/APSF, 2020; Loeb & London, 2021). The ASA and manufacturers of anesthetic machines recommend doing a daily pre-use check before utilizing the unit (ASA/APSF, 2020; Drager, 2020; GE Healthcare; Loeb & London, 2021). However, for more prolonged usage, most manufacturers recommend doing this procedure every three days (ASA/APSF, 2020; Loeb & London, 2021). Thus, critical care nurses should anticipate that every 24 to 72 hours, an anesthetic machine performance check will be necessary (Drager, 2020; GE Healthcare, 2020; Panchamia et al., 2020; Loeb & London, 2021). It is necessary during the performance check, that the machine be turned off, re-started, and evaluated, therefore an alternative means of ventilation during this process will be required (ASA/APSF, 2020; Loeb & London, 2021).

Patient Monitoring During Long-term Ventilation

Anesthesia workstation long-term ventilation creates additional essential monitoring requirements for the critical care nurse, which are essential for patient safety (Baker, 2019; Canelli et al., 2020; Peters et al., 2020). When ventilation is initiated, airway parameters such as tidal volume, plateau pressure, and minute ventilation should be recorded to establish a baseline. This baseline will aid in monitoring for airway parameter changes and optimize patient care (Loeb & London, 2021; Panchamia et al., 2020; Warner, 2021). After initiation of anesthesia workstation use, the following parameters should be monitored hourly: respiratory rate, inspired

oxygen concentration, inspiratory pressure, expired and inspired carbon dioxide, tidal volume, as well as low oxygen alarms (Loeb & London, 2021).

Knowledge Gap

The use of anesthesia workstations as alternative devices within the ICU setting has created a knowledge gap for critical care nurses (Goul-Cheron et al., 2020; Mouli et al., 2020). Critical care nurses must be educated on how to use the anesthesia workstation, related safety concerns, additional monitoring requirements, as well as monitoring/maintenance of the anesthesia workstation (Loeb & London, 2021; Panchamia et al., 2020; Warner, 2021). Collaboration and education between anesthesia professionals and bedside personnel is necessary to decrease this gap (Goul-Cheron et al.; Mouli et al., 2020). Educational material, however, should be easily accessible and convenient for busy critical care nurses. Online education is a flexible and cost-effective method to transition evidence-based research to practice in the clinical setting (Dunleavy et al., 2019). The utilization of an online continuing education module is a viable form of education given that online and traditional education provide similar results in improving knowledge (Tudor Car et al., 2019). Therefore, the purpose of this scholarly project was to create a CE module for critical care nurses that will address the identified knowledge gap in a convenient and accessible format (Dunleavy et al., 2019; Gouel-Cheron et al., 2020).

Methodology

Project Aims

The primary aim of this scholarly project was to address knowledge gaps via creation, in collaboration with Echelon, AdventHealth University's (AHU) professional education division, of an evidence-based online continuing education module regarding the use of the anesthesia workstations as intensive care ventilators for the critical care nurse. The secondary aim was the

construction of an SRNA guidance protocol that clarifies and improves the continuing education (CE) module development at AHU. The objectives are as follows:

1. Develop an evidence-based one-hour online module, with a pre/posttest, developed and delivered through the AHU Echelon platform, concerning evidence-based use of the anesthesia workstations as an alternative device for ventilatory support by June 2022.
2. Apply for CE credit approval through the American Nurses Credentialing Center (ANCC) and American Association of Nurse Anesthesiology (AANA) by June 2022.
3. Complete a guidance protocol that clarifies process, optimizes AHU facilitators, and reduces barriers for Student Registered Nurse Anesthetists (SRNAs) development of accredited CE modules in collaboration with Echelon by April 2023.

Quality Improvement Framework as Methodology

The FOCUS-PDCA cycle is a model originally developed by the Hospital Corporation of America to guide process improvement in healthcare. Its use, however, had expanded to continuous improvement in education (Abu-Shaheen, 2020; Gerard & Arnold, 1996; Redick, 1991; Saxena et al, 2004). This cycle promotes the exposure of barriers and optimization of facilitators to progressively improve process iteratively over time (Abu-Shaheen, 2020; Alshahani &Alsulaibaikh, 2015; Redick, 1991; Saxena et al, 2004). Multiple iterations do take time to complete, however. Therefore, this scholarly project will address the FOCUS portion of the FOCUS-PDCA cycle and include a recommendation for future DNAP cohorts to complete the PDCA portion.

The FOCUS-PDCA is an acronym that has nine steps: find, organize, clarify, understand, select, plan, do, check, and act (Abu-Shaheen, 2020; Alshahani &Alsulaibaikh, 2015; Ramsey, 2002; Redick, 1991; Saxena et al, 2004; Zimnicki, 2015). Find is the process of discovering the

issue, which was addressed when the knowledge gap for critical care nurses regarding the use of the anesthesia workstation was first identified. Organizing is the coordination of a team that comprehends the problem and was accomplished via the formulation of the scholarly project committee. Clarification is the process of identifying relevant research, understanding is the development of a clear problem, and selecting is the identification of a strategy that will improve the problem. These steps were achieved via a synthesis of the identified literature and key player interviews. With the FOCUS portion complete, the plan portion of the PDCA cycle was accomplished via the identification of a clear opportunity for the improvement of the critical care nurses' knowledge base as well as the CE module development process. Thus, this scholarly project will plan and develop both the needed CE module and an SRNA guidance protocol for CE module development to minimize barriers and optimize facilitators. Due to the extensive time requirements for the implementation of the CE module and the guidance protocol as well as the analysis of the results and the identification of what was learned, the do, check, and act portions of the cycle will need to be implemented by a future scholarly project team.

Planning and Procedures

An interview with the key players was performed to identify common ideas along with facilitators and barriers to implementing the project. The key players involved in the interview included Lori Polizzi (Echelon Director), Stephanie Johnson (RN, BSN), and Sasha Perez-Loor (AdventHealth Executive Director). Based on the outcomes of the interview, various facilitators, and barriers to implementing the project were identified. Implementation will be guided by the FOCUS PDCA cycle and will include CE module creation and the concurrent development of a CE module development protocol. The creation of the CE module development protocol

resulted in minimizing barriers and optimizing facilitators to sustain the viability of CE module creation as a scholarly project option. This scholarly project does not require funding.

Timeline

Initial documents were prepared by November 2021. By April 2023, the evidence-based one-hour online module, with a pre/post-test, was completed. An application for CE credit approval through the ANCC will then be submitted by April 2023. In April 2023, there was mcompletion of a guidance protocol that clarifies process, optimizes AHU facilitators, and reduces barriers for student generated CE modules in collaboration with Echelon. Dissemination via a PowerPoint presentation and poster was completed in April 2023.

Results

Results and Findings

The results of this scholarly project led to the development of a CE module accredited by ANCC and AANA. Upon submitting the accreditation application, the process of approval took approximately one month. In addition, this scholarly project led to the development of a guidance protocol for SRNAs. The guidance protocol clarified the process for SRNA developed accredited CE modules that optimized AHU facilitators and reduced barriers via the PDCA-FOCUS cycle. This protocol was created throughout the implementation of our scholarly project.

Discussion & Implications

Applicability to Practice

This project aimed to investigate the feasibility of using anesthesia workstations as ICU ventilators during any pandemic or epidemic that necessitate respiratory support. To be specific, COVID-19 is a novel coronavirus causing a global pandemic, resulting in many people requiring

hospitalization (Litton et al., 2020; Mason & Friese, 2020). In some places, the hospital did not have enough capacity to care for all the patients. This project involves a feasibility study to determine whether anesthesia workstations can be used as ICU ventilators in patients with COVID-19. The study will include a review of the literature and a survey of anesthesia providers. The benefits of this project include the potential to increase the number of ICU ventilators available during a surge in COVID-19 patients.

A significant number of publications support the need for alternative ventilatory management devices to address the high likelihood of ventilator shortages created by COVID-19 surges (Institute for Health Metrics and Evaluation, 2020). Using alternative devices, such as anesthesia workstations as ventilatory treatment, will alleviate some of the demand (Fullick & Oliver, 2020; Gouel-Cheron et al.; Greig et al., 2020). This approval does not come without limitations and safety concerns. Education must be provided by experts in the use of these devices to bridge the gap in knowledge that exists with critical care nurse professionals who will be responsible for patient care (Gouel-Cheron et al., 2020).

Discussion

The results support the need for education of the anesthesia workstations as alternative ICU ventilators to implement its safe and effective use. Thus, it is vital that the healthcare provider operating the anesthesia workstation, gain knowledge and understanding of the features and functionality of the anesthesia workstation as it relates to the ICU ventilators. However, to create a seamless implementation of these alternative devices, proactive preparedness of the healthcare team should be considered. The active preparation of the healthcare team through education about the implementation of the anesthesia workstation in the

intensive care setting will aid in a smooth process to alternative means for respiratory support in the patient care setting.

The FOCUS portion of the cycle was completed by synthesis of prior scholarly projects that were geared towards CE module feasibility studies. With the FOCUS portion completed, the plan portion of the PDCA cycle was accomplished via the identification of a clear opportunity for the improvement of the critical care nurses' knowledge base as well as the CE module development process. This scholarly project planned and developed both the needed CE module and an SRNA guidance protocol for CE module development to decrease barriers and optimize facilitators. As a result of the extensive time required to implement the CE module and the guidance protocol; the do, check, and act portions of the cycle will need to be implemented by a future scholarly project team.

Contribution to Professional Growth

Although the implementation of this scholarly project could potentially increase the number of ventilators available during a surge in COVID-19 patients; there are challenges that may arise during the process. These challenges can be mitigated with execution of protocols/procedures and superusers in the use of the anesthesia workstation in the ICU setting. Overall, this scholarly project has the potential to improve the quality of care for patients by providing critical care nurses with evidence-based information on the use of anesthesia workstations as ICU ventilators. Additionally, the CE module will decrease the knowledge gap of critical care nurses by providing evidence-based information on the use of anesthesia workstations as ICU ventilators. Furthermore, the guidance protocol has yet to be implemented or tested, so there is no guarantee that it will effectively improve the efficiency and quality of CE

module development. Therefore, the implementation and evaluation of its effectiveness will need to be addressed by a future scholarly project team.

Limitations

The most significant limitation to this scholarly project is time. There are multiple steps prior to submission of a Continuing Education (CE) module for AANA and ANCC review. Thus, the estimated time of completion for this scholarly project was approximately 2 years. Resulting in the completion of only the FOCUS P portion of the FOCUS PDCA improvement process. Additionally, the result of implementation of the CE module are unknown, thus creating an uncertainty on the safe and effective use of anesthesia workstation as intensive care ventilators by novice healthcare providers. Furthermore, considering the guidance protocol has not been implemented or tested, there is no guarantee it will effectively improve the efficiency and quality of the CE module development. Therefore, applying and testing its effectiveness will need to be accomplished by a future scholarly project team.

Conclusion

The use of the anesthesia workstation as an alternative device does not stop at the patient with coronavirus. The anesthesia workstation is a viable way to curb the incessant demand of the intensive care ventilators in the case of another pandemic or epidemic. This device can be used for any circumstance where the patient is in need of respiratory support and the traditional intensive care ventilator is not available. Conditions such as acute lung injury, the inability of the patient to protect their airway, pneumonia, or any circumstance that causes severely low oxygen levels or extremely high CO2 levels may also require the use of the anesthesia workstation for ventilatory support when ICU ventilators are limited.

This scholarly project can potentially improve the quality of care for patients by providing critical care nurses with evidence-based information on the use of anesthesia workstations as ICU ventilators. Additionally, the guidance protocol can potentially improve the quality of development of CE modules by decreasing barriers and optimizing facilitators for future SRNA scholarly projects.

Dissemination

This scholarly project was presented to AHU faculty members, the Echelon Director, and key players through an in-person PowerPoint and a poster presentation. In addition, CE credit through the ANCC and AANA was achieved.

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Appendix A

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Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One To analyze the experience of nurses in regard to shift patterns while providing care during COVID-19 pandemic. **Study Two** Determine if the use of rapid prototyping technologies is an adequate alternative device for mechanical ventilation in respiratory failure.	**Study One** Primary Outcome: Optimize nursing workflow and experience. Secondary Outcome: Improve the quality of care provided by nurses. **Study Two** Primary Outcome: Development of an effective rapid prototype ventilator. Secondary Outcome: The demonstration of mechanical efficiency of the prototype ventilator when compared with the standard ventilator.	**Study One** 14 nurses in Chinese Hospital **Study Two** Three 10-week healthy female large white pigs that were approximately 35-40 kg. (1 pig testing version 1) (2 pigs testing version two)	**Study One** Colaizzi's seven step method (an interview approach) **Study Two** Two-way ANOVA test	**Study One** Theme 1: assess competency of nurses to assign nursing work scientifically and reasonably Theme 2: reorganize nursing workflow Theme 3: communication between managers and nurses Theme 4: nurses' views on shift patterns **Study Two** version 1 ventilator (within the 12 h duration of the ventilator at the 6th hour a total of 2 motor failures occurred) version 2 ventilator (the vital parameters were clinically normal, normal CXR) The overall result was $p>0.05$ between standard ventilator vs. test ventilator.	**Study One** **Methodological flaws:** Small sample size. Purposive sampling. **Inconsistency:** None **Indirectness:** None **Imprecision:** No range of values to show precision of study. **Publication bias:** None **Study Two** **Methodological flaws:** One mode of ventilation. Longer duration of study. Human testing. No testing with a disease process. Small sample size. **Inconsistency:** No numbers given to confirm results. **Indirectness:** None **Imprecision:** No range of values to assess Two-way ANOVA test **Publication bias:** None
Design				**Implications**	
Study One Qualitative Study (qualitative exploratory descriptive design) **Study Two** Animal Research Study				**Study One** Provides useful information to manage shift patterns **Study Two** Use of cost-effective and rapidly produced prototyping ventilator machines.	

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Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One Creation of a tool to help evaluate and estimate the healthcare demand during the COVID-19 pandemic. **Study Two** The purpose is to provide knowledge on ventilatory management of COVID-19 patients to non-anesthesiology trainees and evaluate the effectiveness of the teaching.	**Study One** Primary outcome: to project the pandemic's local spread Secondary outcome: Assist public health officials in choosing locally appropriate intervention strategies and by how much to increase hospital treatment capacity. **Study Two** Primary outcome: Provide adequate ventilatory management education. Secondary outcome: Provide and effective ventilatory care to COVID-19 patient.	**Study One** Chile, a Southern Hemisphere country, population of Chile. **Study Two** 26 trainees (general surgeon 14, dermatology 3, orthopedic 6, ophthalmology 3)	**Study One** Sensitivity Analysis **Study Two** Pre and post evaluations from student t-test Direct observation of procedural skills (DOPS) Likert's score (for feedback form participants)	**Study One** The number of severely ill patients could overwhelm the treatment capacity. **Study Two** Pre-test= 7.42±2.12 Post-test= 14.92±2.9 P value of 0.00001 16 point score 88.4% met expectations or exceeds expectations 3 (11.6%) met the borderline expectations or below. 5 point Likert scale 100% - highly satisfactory	**Study One** **Methodological flaws:** Lack of knowledge. Untrained staff. Uncertainty of course of disease. **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None **Study Two** **Methodological flaws:** Small sampling size Single center study **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None
Design				**Implications**	
Study One Experimental design **Study Two** Quasi experimental cross-sectional pilot study				**Study One** Decreases morbidity and mortality during the COVID-19 pandemic. **Study Two** Reduces the margin of error in relation to the care of COVID-19 patients. Helps decrease patient safety concerns. Safety of HCP.	

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Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One To demonstrate the capacity to simultaneously ventilate two test lungs of different compliances using only standard hospital equipment, modify the pressure delivered and flow and volume in each test lung. **Study Two** To provide data on ventilator sharing with patients that have COVID-19 associated ARDS.	**Study One** Primary outcome: Increase the number of ventilations. Secondary outcome: Exploring ventilator splitting with flow restriction with the use of commonly available medical components. **Study Two** Primary outcome: Increase the amount ventilators available. Secondary outcome: Provide a protocol that implements patient safety features.	**Study One** Simulated Lungs (test lungs) **Study Two** Six patients with ARDS from COVID-19 in New York	**Study One** All pressures were recorded via a LabJack U6 Pro (10 Hz sampling rate) Hamilton flow meter (flows) **Study Two** Times series plots w/ SAS instituting w/o imputing missing data	**Study One** The restriction apparatus was successful in modifying the inspiratory pressure, minute ventilation, and volume delivered to in high and low compliance simulation lungs using different modes of ventilation. **Study Two** It is feasible to use for 2 days ventilator sharing for COVID-19 associated ARDS w/ clinical protocol when patient pairs are carefully selected w/ the use of NMB. If all alternatives exhausted.	**Study One** **Methodological flaws:** Unregulated Untested. Unable to deliver PEEP. Not tested on spontaneous breaths. Not test humans. **Inconsistency:** None **Indirectness:** None **Imprecision:** No range of values to show precision of study **Publication bias:** None **Study Two** **Methodological flaws:** Small duration of study. Small sample size. Unclear risk of NMB. **Inconsistency:** None **Indirectness:** None **Imprecision:** No range of values to show precision of study **Publication bias:** None
Design **Study One** Experimental Design Study **Study Two** Experimental Design Study				**Implications** **Study One** Provide an increase in ventilators. **Study Two** To provide an alternative ventilatory support method if all other options have been exhausted.	

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Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One Assess the ability of the ICUs to respond to the anticipated increase in healthcare demand during COVID-19 pandemic. **Study Two** Show the comparison of triggering and pressurization of five anesthesia ventilators with four intensive care ventilators	**Study One** Primary Outcome: Obtain information on the capability the ICUs to respond the surge. Secondary Outcome: To bring awareness to the needs of the ICUs prior to the anticipated surge. **Study Two** Primary Outcome: evaluate the performance of the new generation anesthesia ventilators Secondary Outcome: Assess how they compare with ICU ventilators	**Study One** All Australian ICUs and veterinary facilities. **Study Two** Anesthesia Ventilators: Felix, Kion, Fabius GS, Primus, and Avance workstation model 7900 ventilators ICU ventilators: Servo 900C, Servo 300, Horus, Evita	**Study One** ANZICS registry data, supplemented w/ ICU surge capability survey and veterinary facilities survey. **Study Two** Kruskal-Wallis one-way analysis of variance on ranks Post Hoc analysis: Scheffe test	**Study One** An additional 4528 ICU beds (191%) 2631 ventilators (120%) Doctors: 4092 (245%) RNs: 42720 (269%). **Study Two** All five anesthesia ventilators, PSV functioned appropriately. New generation ICU ventilators had higher performance. Significance $P<0.05$	**Study One** **Methodological flaws:** Accuracy of reported capacity. **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None **Study Two** **Methodological flaws:** No human testing **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None
Design				**Implications**	
Study One Retrospective Design Study with addition of surveys **Study Two** Evaluation Study Design				**Study One** Awareness of the need to Increase ICU beds, staffing, and ventilators. **Study Two** Further understand possible use of anesthesia machine in place of ICU ventilators.	

References

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Purpose	**Variables**	**Setting/Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One The purpose is to inform about the use of ventilators designed for domiciliary support of patients w/ chronic respiratory failure may be used for invasive support. **Study Two** The purpose of this study is to help develop guidelines and policies by identifying instruments, analyze their structures in order to allocate mechanical ventilators.	**Study One** Primary outcome: Sleep apnea ventilator use for COVID-19 patients. Secondary outcome: Decrease the need for mechanical ventilators during surge via alternative home ventilators. **Study Two** Primary Outcome: Develop screening protocols Secondary Outcome Allocate Mechanical Ventilators.	**Study One** San Raffaele Scientific Institute, ICU. Milan, Italy. 7 patients. **Study Two** Databases and Articles within them	**Study One** Arterial Blood Gases Increments of time (hourly), and line graph. **Study Two** databases search: ASSIA, Embase, PubMed, Scopus, and academic platform ScienceDirect.	**Study One** No worsening hypoxemia during intervention period. PaCO2(coefficient variant 3-9.3%) Ph (coefficient variant 0.0-0.3%) **Study Two** Seventeen screening considerations are required to support the development of the screening protocol, but it is limited due to ethical consideration of participant from the population.	**Study One** **Methodological flaws:** Small Sample Size. No controls. Longer duration. Small ventilator sample **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None **Study Two** **Methodological flaws:** Test subjects Need for laboratory tests for evaluation Inability to reproduce the instrument needed to allocate the Mechanical Ventilator **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None
Design				**Implications**	
Study One Proof-of concept Study **Study Two** Meta-Analysis				**Study One** Use of home ventilator machine during surge. **Study Two** Allocate scarce resources to stop the spread of the COVID pandemic.	

References

Bottiroli, M., Calini, A., Pinciroli, R., Mueller, A., Siragusa, A., Anelli, C., Urman, R., Nozari, A., Berra, L., Mondino, M., & Fumagalli, R. (2021). The repurposed use of anesthesia machines to ventilate critically ill patients with coronavirus disease 2019 (COVID-19). https://doi.org/10.21203/rs.3.rs-228821/v1

Burnett, G. W., Katz, D., Park, C. H., Hyman, J. B., Dickstein, E., Levin, M. A., Sim, A., Salter, B., Owen, R. M., Leibowitz, A. B., & Hamburger, J. (2020). Managing COVID-19 from the epicenter: Adaptations and suggestions based on experience. Journal of Anesthesia, 35(3), 366-373. https://doi.org/10.1007/s00540-020-02860-1

Purpose	Variables	Setting/Subjects	Measurement and Instruments	Results	Evidence Quality
Study One The purpose of the article was to retrospectively study the use of Anesthesia Machines vs. ICU ventilators and the increase in deaths. **Study Two** the goal of this article is to assist others in preparation for what may come next with COVID-19 as well as potential future pandemics	**Study One** Primary Outcome: To analyze if the anesthesia machine will have worse outcomes than the ICU ventilator. **Study Two** Primary Outcome: It is our goal for this to be a framework for departments of anesthesiology preparing for those departments currently experiencing a peak, a potential second wave of COVID-19, or for potential future pandemics. Secondary Outcome: redeployment strategies, specialized teams, and special initiatives in simulation education and innovation research.	**Study One** Large tertiary urban hospital in northern Italy (Niguarda Hospital) **Study Two** New York City large urban academic hospital.	**Study One** The Mann-Whitney U test or Fisher's exact test Kaplan-Meier survival analysis Log-Rank Test (significance) **Study Two** Team members were encouraged to identify challenges and provide solution in real-time w/ knowledge that leadership would work w/ them and support efforts to improve care and wellness.	**Study One** The use of Anesthesia Machines for prolonged periods might be associated w/ the risk of tech. failure or airway occlusion **Study Two** General and icu admission are down and our practice is returning to normal.	Methodological flaws: **Study One** Small sample size. Only one facility. **Study Two** Small sample size. Only one facility Inconsistency: **Study One** none **Study Two** none Indirectness: **Study One** none **Study Two** none Imprecision **Study One** None **Study Two** none Publication bias **Study One** none **Study Two** none
Design **Study One** Retrospective Study comparing intubated COVID-19 w/ anesthesia machine vs ICU ventilators **Study Two** Case Study				**Implications** **Study One** Prolonged ventilation with anesthesia machines as safe alternative device. **Study Two** New York City was accountable for approximately 10.8% of all cases and 19.8% of deaths du to COVID-19 in the United States.	

References

de Souza, D. B., de Oliveira Andrade, A., Milagre, S. T., & Pereira, A. A. (2021). Possible solutions for oxygenation support in critically ill patients with COVID-19. Research on Biomedical Engineering, 1-14.

Pham, V., Nguyen, L., Hedin, R. J., Shaver, C., Hammonds, K. A., & Culp Jr, W. C. (2021). Coronavirus Disease 2019: Anesthesia Machine Circuit Pressure During Use as an Improvised Intensive Care Unit Ventilator. Anesthesia & Analgesia, 132(5), 1191-1198.

Purpose	**Variables**	**Setting/ Subjects**	**Measurement and Instruments**	**Results**	**Evidence Quality**
Study One To perform a systematic review of the benefits and disadvantages of possible solutions in oxygenation support **Study Two** To stimulate an anesthesia machine operating in an ICU environment without WAGS availability	**Study One** Independent: shared mechanical ventilator, ECMO, fast or low-cost production equipment, non-invasive ventilation, high-flow nasal cannula (HFNC), and use of anesthesia equipment as a mechanical ventilator Dependent: efficacy and safety for the COVID-19 patients **Study Two** Independent: Anesthesia Machine Circuit pressure Dependent: Continuous positive airway pressure (CPAP)	**Study One** 41 publications **Study Two** ICU setting	**Study One** Sensitivity analysis **Study Two** Measures: Bland-Altman plots Instruments: Dräger Perseus A500, Dräger Apollo and GE Avance CS^2	**Study One** Oxygenation support via shared mechanical ventilator, ECMO, fast or low-cost production equipment, non-invasive ventilation, high-flow nasal cannula (HFNC), and use of anesthesia equipment as a mechanical ventilator. **Study Two** Using nonparametric Bland-Altman analysis, measurements of PIP displayed median variations of -0.40 cm H2O 95% limits of agreement (LOA), Drager Apollo: -1.00 to 0.55), Drager Perseus: -0.40 cm H_2O (95% LOA, -1.10 to 0.41), and GE Avance CS^2: 1.70 cm H_20) (95% LOA, 0,80-3.00). At FGF 2 LPM and PEEP 0 cm H_20 with the WAGS disconnected, the Drager Apollo had a variation in PEEP of 0.02 cm H_20 (95% CL, -0.11; *P*=1.00); and the GE Avance CS^2, 8.62 cm H_20 (95% CL, 8.55-8.69; P< .0001). after removing the hose connected to the AGSS and the visual indicator bag on the GE Avance CS^2, the PEEP difference was 0.12 cm H_20 (95% CL, 0.059-0.181; P=.0002).	**Study One** **Methodological flaws:** Small sample size **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None **Study Two** **Methodological flaws:** All types of anesthesia machines were not tested **Inconsistency:** None **Indirectness:** None **Imprecision:** None **Publication bias:** None
Design **Study One** Systematic review **Study Two** Quasi-experimental design				**Implications** **Study One** Provides techniques, which can be employed in the routine health services as oxygenation support approaches, in critical situations, such as those caused by pandemics including COVID-19. **Study Two** Provides information on the use of anesthesia machines for ICU to relieve internal pressure build-up	

Appendix B

• **Task**	**Trimester**
• **Determine topic for DNAP Project**	**2nd Trimester - Fall**
• Create a clinical problem and innovation PICOT	2nd Trimester - Fall
• Retrieve Literature Review Articles	2nd Trimester - Fall
• Create a matrix table with retrieved articles	2nd Trimester - Fall
• Creation of a Synthesis Paper	2nd Trimester - Fall
• Completion of CITI Training Modules	2nd Trimester-Fall
• **Form DNAP Scholarly Project Committee/Refine Research**	**4th Trimester - Summer**
• Obtain PICOT questions approval from Chair	4th Trimester - Summer
• Refined and review Matrix table	4th Trimester - Summer
• Meeting with the CARES team to determine methodology for Scholarly project	4th Trimester - Summer
• Scholarly Project Paper Draft Editorial Service Review	4th Trimester - Summer
• Determine Key Players with the help/approval of Project Chair	4th Trimester - Summer
• Analysis and Comparison of Key Players	4th Trimester- Summer
• Creation of proposed methods PowerPoint/ presentation	4th Trimester - Summer
• Edit Scholarly Paper per Editorial Recommendation for Project Chair Review	4th Trimester - Summer
• Creation of Scholarly Project Committee and Approval from DNAP Department Chair	4th Trimester - Summer
• Obtain Study Site Approval from DNAP Department Chair	4th Trimester - Summer

• Submission of Curriculum Vitae and Biography to Echelon Director	4th Trimester - Summer
• Accessing Activity Value to Echelon Director (Topic must be approved by Echelon)	4th Semester -Summer
• Activity Planning Form to Echelon Director o To include topic description, needs assessment, references, glossary of terms, objectives, and outline	4th Semester-Summer
• **IRB/SRC determination and Initial Scholarly PowerPoint Presentation**	**5th Trimester-Fall**
• Scholarly Project Paper First Draft Submission for Scholarly Project Committee Review	5th Trimester-Fall
• Fidelity Outcome Measure	5th Trimester-Fall
• Determination of IRB Designation	5th Trimester-Fall
• Informed Consent or Notification of Voluntary Participation (Turn in CE exemption email if applicable)	5th Trimester-Fall
• First Draft of Scholarly Project Initial PowerPoint Presentation for Chair Approval	5th Trimester-Fall
• Instrumentation (Turn in CE exemption email if applicable)	5th Trimester-Fall
• Submit Final Draft Scholarly Project Initial PowerPoint Presentation	5th Trimester-Fall
• Presentation to DNAP faculty and AHU staff	5th Trimester-Fall
• SRC/ IRB Submission: Partially Completed DNAP Department Chair Letter of Support (Turn in CE exemption email if applicable)	5th Trimester-Fall
• SRC Submission: Confirmation (Turn in CE exemption email if applicable)	5th Trimester-Fall
• Submit Department Chair Letter of Support	5th Trimester-Fall
• Scholarly Project Paper Final Draft	5th Trimester-Fall
• **Activity Planning Form to Echelon Director** o **To include topic description, needs assessment, references, glossary of terms, objectives, and outline**	**6th Semester-Spring**
• Creation of A Microsoft Teams Account	6th Trimester- Spring
• Submit Final Draft to Literature Review to Echelon Director	6th Trimester- Spring

• Submit Final Drafts of COI, CV, and Consent to Accredit to Echelon Director	6th Trimester-Spring
• Submit PDIS document to Echelon Director	6th Trimester-Spring
• Submit first draft of Objectives for CE modules	6th Trimester-Spring
• Submit Objectives with Module Drafts to Echelon Director	6th Trimester-Spring
• Submit Educational Planning Table (Part 1) to Echelon Director o To include objectives/outline	6th Trimester-Spring
• Start the first draft of CE Transcript to Echelon Director (6,000-word requirement)	6th Trimester-Spring
• **Education Planning Table Part 2** o to include Self-Checks and Post-Test	**7th Trimester-Summer**
• Final Draft of CE Transcript to Echelon Director	7th Trimester-Summer
• Insert Media (Images) into Final Draft of CE Transcript to Echelon Director	7th Trimester-Summer
• Format a Media Folder with all Original Images to TEAMS account	7th Trimester-Summer
• Create Quiz Questions for each Module and submit draft to Echelon Director	7th Trimester-Summer
• Create a Glossary for the CE Transcript to Echelon Director	7th Trimester-Summer
• **Develop CE application for approval and accreditation with Echelon Director**	**8th Trimester- Fall**
• Submit for Accreditation with Echelon	8th Trimester-Fall
• Write results/findings, conclusion/limitations, and application to CRNA practice sections	8th Trimester- Fall
• If CE is accredited submit the following to Election o Author Release Form o Media Script o Peer Reviewers	8th Trimester- Fall
• **SRNA QA to Echelon Direction**	**9th Trimester- Spring**
• Course Release	9th Trimester-Spring