# CLINICAL TEACHING IN THE INTENSIVE CARE UNIT: EVALUATION OF THE PERCEPTION OF TRAINEES AND PHYSICIANS

A Doctoral Thesis Presented to the
Faculty of the College of Education
University of Houston

In Partial Fulfillment of
the Requirements for the Degree

Doctor of Education

by

Mukhtar Al-Saadi

May 2018

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Dedication

To my wonderful family

To my love…To my life…Baghdad

**إلى عائلتي الرائعة**

**إلى حبيبتي... إلى حياتي... بغداد**

# CLINICAL TEACHING IN THE INTENSIVE CARE UNIT: EVALUATION OF THE PERCEPTION OF TRAINEES AND PHYSICIANS

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Abstract

**Background:** The education of trainees in the intensive care unit (ICU) is extremely challenging due to factors related to the ICU environment, ICU trainees and physicians, ICU subspecialty training, and safety and quality of care delivered to critically ill patients. There is a lack of standardized educational curricula and instructional methods for teaching in the ICU. The teaching practices, the learning climate, the instructional methods, and obstacles to learning and teaching in the ICU have not been evaluated. **Purpose:** The main aim of this study was to evaluate the teaching practices, the learning climate, the ICU environment, the preferred instructional methods, and obstacles to learning and teaching in the ICU from the perspectives of learners (trainees) and teachers (physicians). **Methods:** A survey was conducted using the Maastricht clinical teaching questionnaire and supplementary questions in a medical school in South Texas. Data were collected from ICU learners and teachers and were analyzed using ANOVA and multiple comparison procedures. **Results:** Learners rated the teaching practices and learning climate in the ICU significantly lower than teachers in all categories of the Maastricht clinical teaching questionnaire. Learners and teachers recognized the ICU environment as ideal to learn and teach complex clinical cases and to enhance procedural skills. Most teachers indicated bedside teaching and case-based learning as the preferred instructional methods while learners indicated a combination of methods as the preferred instructional strategy in the ICU. The main obstacle for learners was unclear expectations and objectives of the ICU rotation. The main obstacle for teachers was not enough time for teaching. **Conclusion:** A disparity of perceptions existed between ICU trainees and physicians regarding the teaching practices and learning climate in the ICU. The preferred instructional methods for

trainees are to use different instructional strategies. The ICU environment has many challenges for learners and teachers.

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# Chapter I

# Introduction

## The Environment

The Intensive Care Unit (ICU) is a unique system that can be classified as a complex adaptive system. It involves many components which continuously interact and adapt with each other (Holland, 2006). Within this system, different types of agents including variety of health care providers, medical trainees, administrative workers, technical assistants and others collaborate, deal with advanced therapies and interventions, and operate technologically advanced machines to achieve a common goal (Hall, Schmidt & Kress, 2015). The main goal of the ICU is to provide care to critically ill patients and their families in a positive environment.

Describing a typical day in the ICU is a challenge, as each day varies enormously (Hospital News, 2018). There is no normal work day or specific routine, yet I may describe a usual pattern of flow of events and interactions that happen on daily basis and get subjected to change at any minute or hour (KevinMD.com, 2018). For ICU trainees and ICU physicians, the ICU day starts early at around 6 am while nurses usually work in a 12-hour shift schedule from 7 to 7. Before the morning rounds, ICU trainees go from room to room checking on their patients, discussing with the nursing staff and the night team possible events that happened over the past 24 hours, and formulating a preliminary plan of care for the day (Kelly, 2013).

During ICU rounds, a group of healthcare providers that are made up of the ICU multidisciplinary team examines and evaluates each patient in the ICU. They move slowly throughout the ICU rooms; all clinical information and orders are being

scrutinized to determine if the plan of care is working and how it needs to be adjusted. During this time an official presentation of the patients' clinical condition and plan of care are collaboratively, interactively, and intensely discussed and decided among the entire ICU team. The entire medical chart is reviewed which includes vital signs, clinical examination, laboratory results, imaging studies, supportive machines, medications, consultations, procedures, and other therapies. Patients and families are usually included and counseled about the clinical condition, the caring plan, and prognosis. The round usually gets done before noon (UCSF Department of Anesthesia, 2018). Once the team finishes rounding on the entire ICU's patients, the trainees go for a teaching lecture and lunch.

The afternoon phase of the ICU physicians and trainees starts when the trainees get back from their lecture. It mainly involves following up on planned tasks and ongoing evaluation of patients' condition. Throughout the entire time of the day, interruption and excessive noise are the norm, new cases are admitted at any time, communication with nursing staff, other teams, providers, patients and families is continuous, and possible deterioration of patients' clinical condition or death are to be expected. There is a constant need for critical thinking, active physical involvement, and compassionate care in the ICU environment which predispose providers to emotional and physical stress (KevinMD.com, 2018).

The ICU day does not truly end. In the evening, a hand off will be conducted among the members of the care team that worked during the day and those that will work overnight. For the night team, the same activities will be carried out including an evening round and a hand off will be reported to the incoming ICU team in the morning. This

cycle is repeated daily. It is not uncommon for an ICU physician to work a 14 to 15 hour a day to complete tasks and entering notes into the electronic medical records, only to return the next morning between six and seven o'clock to resume the work. The days worked in a row varies, often ICU physicians work in blocks (seven days), depending on the ICU schedule and according to the ICU type and model. ICU trainees typically work six days per week, for 10-12 hour for a regular ICU day and 24-30 hours for a call ICU day followed by an off post-call day, one day off per week, and not to exceed 80 hours per week (Afessa et al., 2005).

The education of trainees in the ICU is challenging. Factors such as patients with life-threatening and unpredictable clinical conditions, inconsistency of patients' volume, rapid advancement in critical care as a subspecialty, variability in trainees' experience and their primary specialties, limitations in trainees' duty hours, competing responsibilities of ICU physicians, and factors related to achieving patient safety and optimal quality of care (Kaplan, 2011; see also Tainter, Wong, Cudemus-Deseda & Bittner, 2017) all contribute to generate these challenges.

Guidelines for critical care medicine training were established to achieve excellence in education yet neither an ideal educational curriculum nor a standardized approach is available (Barrett & Bion, 2005). In most critical care training programs, the most common teaching methods are traditional lectures and didactic learning. Most time is spent on patients care activities (Almoosa, Goldenhar, Puchalski, Ying & Panos, 2010). Recent studies indicated learners preferred teachers who enjoyed teaching, expressed empathy, explained the clinical reasoning, and had qualities of professionalism (Santhosh, Jain, Brady, Sharp & Carlos, 2017).

## Statement of the Problem

There is considerable variation in the instructional methods to teach trainees in the ICU. There are no standardized curricula. Currently, there are no approved methods to teach ICU trainees (Almoosa et al., 2010). In the ICU, clinical teaching practices and learning climate have not yet been evaluated to address the learning process in an overall dynamic environment.

## Purpose of the Study

This study evaluated the teaching practices and learning climate in the ICU, the preferred instructional methods in the ICU, the ICU environment, as well as the barriers and obstacles for teaching and learning in the ICU. This study compared the perceived teaching and learning practices between ICU trainees (learners) and ICU physicians (teachers). The comparison used a validated and reliable tool (the Maastricht clinical teaching questionnaire) as well as supplementary questions to examine the ICU environment, the preferred instructional methods, and obstacles for teaching and learning in the ICU to understand the status of the teaching and learning in the critical care setting.

## Research Question

This research question provided a platform to get rid of the dilemma posed in the statement of the problem:

What is the perception of ICU trainees (learners) compared to ICU physicians (teachers) of the current teaching practices, the learning climate, the preferred instructional methods, the ICU environment, and barriers for learning and teaching in the ICU?

## Context for the Study

The study was conducted in a medical school in South Texas. Enrollment of participants and data collection were completed in the medical school. Data analysis and discussion of the results were finalized in the University of Houston. The institution review boards of the medical school and the University of Houston reviewed and approved the study.

## Significance of the Problem

Currently, there is a considerable variably of the teaching practices and instructional methods for teaching in the ICU. This may affect the educational progress of trainees and the quality of care delivered to critically ill patients. Evaluating the teaching and learning environment in the ICU from the perspectives of learners and teachers may enhance the medical services provided to ICU patients and optimize clinical teaching and learning for ICU in-training physicians.

## Educational Value of the Study

Examining the teaching practices, the instructional methods, and the learning climate in the ICU provides valuable knowledge about the current learning process in ICU. The study complements the available evidence for ICU learners and teachers in a widespread spectrum including learning in critical care medicine, training ICU physicians, and the role of clinician-educators in the critical care setting. Adopting effective instructional strategies and improvement of the learning climate may advance training in the ICU, the process, delivery, and quality of medical care offered to critically ill patients.

**Definitions**

ICU: Intensive Care Unit,

ACGME: Accreditation Council for Graduate Medical Education,

ABIM: American Board of Internal Medicine,

GME: Graduate Medical Education,

PI: Principal Investigator,

CCM: Critical Care Medicine,

ICU trainees (Critical care medicine trainees, ICU in-training physicians): Post-graduate trainees who are required to received clinical training in the ICU. Critical care medicine trainees represent learners in my study,

ICU physicians (Critical care staff physicians): Practicing ICU physicians who instruct, supervise, and mentor ICU trainees (critical care medicine trainees) in the ICU. Critical care staff physicians represent teachers in the study

Junior ICU trainees: Trainees who spent between 4 weeks to 2 months of training in the ICU,

Senior ICU trainees: Trainees who spent 3 months and more of training in the ICU,

Teaching practices: Combinations of attitudes and behaviors which teachers use during the teaching process

Modeling: The teacher explicitly demonstrates a task, acts as a role model for students, and explains certain elements of the task

Coaching: The teacher observes learners performing a task and gives them feedback

Articulation: The teacher stimulates learners to externalize knowledge and skills,

Exploration: The teacher encourages learners' autonomy, formulating and pursuing their

own personal learning goals,

Learning climate: The environment that is created during learning process which includes the social and emotional states of the teachers and students, and affected by factors related to the interaction between the teacher and students (Ambrose, 2010),

ICU environment: The physical space of the ICU and all aspects associated with it,

Instructional (teaching) methods: The educational approaches to communicate and teach knowledge and skills to learners

**Limitations of the Study**

Our study has several limitations. The study examined the perception of learners and teachers. Self-reporting of subject participants' perception is subjective and may get affected by several personal and environmental factors when completing the survey and thus it may not reflect the objective nature of the teaching and learning in the ICU setting. One of the main limitations is the subjects' level of understanding for each category and question of the Maastricht clinical teaching questionnaire. The survey was designed to be post-event. Subjects documented their perception of past experiences in the ICU hence there is a possibility of recall bias. The small sample size may affect the generalizability of the results, yet this was a selective sample which specifically included trainees and physicians who worked exclusively in the ICU. Since leaners rated multiple teachers at the same time; their experiences with one teacher might affect the rating process of the overall teaching practices to all teachers. The study was conducted in a large academic center with tertiary ICUs, the results may not be generalized to all types of ICU especially in small community-based programs.

**Summary**

The ICU is an organizational system that provides care to critically ill patients and their families. The design, operation, staffing, interactions, and quality of health-care services provided qualify the ICU as a highly complex adaptive and unique system. The education of trainees in the ICU is extremely challenging due to many factors related to the ICU environment, ICU in-training physicians, critical care staff physicians, critical care subspecialty, and the safety and quality of care for critically ill patients. The main mission of critical care medicine training is to achieve excellence in education yet there is a lack of standardized curricula and instructional methods.

Although there are different innovative and efficient instructional methods, traditional lectures and didactic learning continued to be dominant in most critical care training programs. There are no known studies which have examined the clinical teaching practices and the learning climate in the ICU using validated and reliable tools. Efficient, effective, and creative instructional methods are required to be implemented to educate trainees in the ICU.

In the next chapter, a review of literature is discussed highlighting the existing evidence pertaining to the ICU environment, critical care medicine, and education in the critical care setting. The chapter is divided into three main topics: 1) The ICU as an organization of care, 2) Critical care medicine training, and 3) The current teaching practices, learning climate, and instructional methods in the ICU. The review focuses on the key components of the study that influence education in the ICU. The ICU as a physical place to provide care to critically ill patients, critical care medicine as a training subspecialty, and the current instructional strategies to train ICU in-training physicians.

# Chapter II

# Literature Review

## Overview

The major aspects affecting the teaching and learning process in the ICU are mainly divided into: The ICU as a special organized system that provides care to seriously ill patients and their families, critical care medicine as a relatively new integrated and rapidly developed subspecialty from different major specialties, learners and teachers interaction in the ICU unpredictable setting, and the availability of advanced and efficient instructional strategies to enhance education in the ICU (Amin et al., 2016; Croley & Rothenberg, 2007; Marshall et al., 2017). In this section, the ICU system is reviewed through discussions of its structure, environment, and staffing. The researcher also reviewed critical care medicine as a training subspecialty as well as the current instructional methods, teaching practices, and the learning climate in ICU.

## The Intensive Care Unit (ICU)

The ICU is an organized complex adaptive system which provides care to seriously ill patients (Holland, 2006). The ICU delivers specialized medical and nursing care, enhanced capacity for monitoring, multiple modalities of physiological organs support to sustain life during a period of life-threatening organ system dysfunction and failure. The ICU is structured in a defined geographic area of the hospital, but its activities often extend beyond the physical space of the ICU to include the emergency department, hospital wards, and follow-up clinics (Marshall et al., 2017). The organizational principles of the ICU are patient-centered, critical care physician-directed, collaborative, inter-professional, which follow strict protocols and guidelines to provide a

high quality of care to critically ill patients over a period of time contributing to the complexity of the ICU environment (Dorman et al., 2004).

The initiation of the ICU can be traced to the poliomyelitis era. Dr. Bjorn Ibsen was recognized as the founder of the ICU. Dr. Bjorn treated critically ill patients with respiratory failure during the poliomyelitis epidemics in Copenhagen in 1952 (Lassen, 1953). The origin of critical care medicine has not been clearly identified. Historic reports showed that the principles of intensive care medicine had been applied during the Napoleonic Wars when seriously injured patients during combats were evacuated and treated in specialized settings (Carrillo-Esper, 2011). Florence Nightingale is credited for the establishment of the precursor of the contemporary ICU. During the Crimean war in 1854, Florence Nightingale and a team of nurses created an area near a military field hospital which provided additional intensive nursing care for the most severely injured soldiers. From the time of Nightingale to the mid-1950s, intensive care was primarily intensive nursing care. With the development of techniques of hemodialysis and the widespread introduction of mechanical ventilation after World War II, the modern model of the ICU began to take shape (Lassen, 1953).

Ibsen in Denmark first used prolonged mechanical ventilation to support victims of the polio epidemics of 1952 and created the first ICU in 1953 (Reisner-Sénélar, 2011). Intensive care units were established in France in 1954 (Vachon, 2010), in Baltimore in 1957 (Safar, DeKornfeld, Pearson & Redding, 1961), and in Taranto in the late 1950s. Separate geographic areas within the hospital which used technologies for organ support such as mechanical ventilation, cardiovascular monitoring, and hemodialysis, were established to make the ICU functions as a specialized place in the hospital.

In the 1960s, the ICU had become an established entity to deliver intensive care to seriously ill patients, and critical care had developed as a medical subspecialty (Weil & Tang, 2011). Intensive care continued to advance, from a specialty defined by a discrete area of the hospital to one defined by the capacity to provide rapid resuscitated and supportive care. This care is needed in the hospital by dedicated rapid response teams, in the emergency department, in the prehospital setting, and in post ICU clinics providing follow up services to survivors and addressing rehabilitation (Marshall et al., 2017).

As the discipline of intensive and critical care matured and extended, ICU physicians and providers play an active role in the resuscitation of acutely unstable patients in the emergency department, on the hospital wards, and in the rehabilitation of survivors of critical illness. The expertise extends beyond the treatment of patients to support their families, the provision of compassionate care at the end of life, and developing societal preparedness for a future crisis (Modrykamien, 2011). The scope of modern and advanced intensive care includes dedicated skilled healthcare providers who provide exclusive care to critically ill patients with acute organ dysfunction and life-threatening conditions in the ICU and beyond the geographic space of the ICU in a timely fashion and for an extended period (Ferri, Zygun, Harrison & Stelfox, 2015). There are five main factors which distinguish intensive care from routine clinical care and make intensive care a distinct level of care: Discrete physical space, advanced supporting and monitoring technologies, availability of dedicated human resources, critical care services provided by multi-professional skilled teams, and scholarly activities of research, education, and quality improvement of care (Marshall et al., 2017).

**Structure and organization of the ICU.** The ICU is a unique division of the hospital. Its uniqueness comes from several factors: design, type of patients, clinical cases treated, health care providers who play key roles in the delivery of care, and teams interacting with each other (Fishman & Elias, 2008). The ICU provides care and interventions to critically ill patients with life-threatening conditions and multiple organ failures, in addition to less urgent care to individuals with possible organ dysfunction and expected deteriorating clinical conditions using standardized protocols and principles to reverse the pathophysiologic process (Hall et al., 2015).

Unlike other settings (inpatient and clinics); in the ICU, the severity of clinical cases, the unfamiliarity with chronic health history, and the availability of advanced diagnostic and therapeutic interventions over a sustained period of time coupled with well-trained staff to provide care to acutely ill patients give the ICUs crucial value (Hall et al., 2015). Sophisticated technologies are required to guide resuscitation and support of organ failure with experienced personnel in such technologies to provide care for critically ill patients (Kahn, Ten Have & Iwashyna, 2009).

ICUs are classified into three levels using a numeric scale to describe the expertise and support they offer. Level one ICU provides oxygen, noninvasive monitoring, greater intensive nursing care than wards. Level two ICU provides invasive monitoring and basic life support. While level three ICU provides a full-spectrum of monitoring and life-support services. This level is considered as a regional resource for care to critically ill patients, and play an active role in developing the specialty of intensive care research and education (Marshall et al., 2017).

In the United States, two types of ICU systems are recognized. The first is referred to as general ICU in which mixed medical and surgical care are delivered to patients with various diagnoses. This type constitutes the most common one and mainly located in smaller community-based hospitals. The second is referred to as specialty ICU such as coronary care units, neuro ICU, and cardiothoracic ICU, which delivers diagnoses-specific care and interventions given specific staff expertise (Hall et al., 2015). In the United States, ICUs were uncommon before the 1970s. The rapid increase of ICU beds per capita was reported to be 67,357 which consisted of critical care beds in approximately 6000 ICUs. Estimated annual admissions of 5.7 million patients. The average ICU size of 12 beds per ICU and the proportion of ICU beds per hospital (8%-9%) continue to be relatively stable since 1992 (Wunsch et al., 2008). The cost attributed to the care of critically ill patients persists to increase and currently exceeds 80 billion dollars, 13 % of hospital costs, 4% of the United States health care expenditures, and approximately 1% of the gross domestic product (Halpern & Pastores, 2015).

Patients with high risk for adverse outcomes are admitted to the ICU. Emergency Room (ER) constitutes approximately 50% of admissions, postoperative 25%, while the remaining are admitted from inpatient settings and other hospitals (Angus, 2006). The most common diagnoses for ICU admissions have been respiratory failures, postoperative cares, acute coronary syndromes, congestive heart failures, and severe sepsis. The average length of stay is approximately four days, with significant variability from hospital to hospital and among ICU types (Lott et al., 2009).

The organized care is implemented in the ICU once critically ill patients with physiologic derangements are identified in any other setting in the hospital such as ER,

inpatients, and clinics. Coordinated care may also start with prehospital care (Fishman & Elias, 2008). The process of transporting critically ill patients to ICU is initiated once the clinical condition is stabilized.

Two main models are available in the United States to operate ICUs. The first model is the opened model where care provided by physicians who have competing clinical responsibilities outside the ICU and critical care consultation is optional in this case. This model is also referred to as low-intensity staffing. The second model is the closed model with care provided by dedicated critical care specialists to all patients admitted to the ICU. This model is also referred to as high-intensity staffing (Carson, 1996; see also Hanson et al., 2001). The high-intensity staffing model showed better outcomes in terms of mortality, length of stay in the ICU, length of stay in the hospital, and the use of evidence-based methods to deliver care in the ICU (Pronovost, 2002). The critical care team is composed of physicians, nurses, respiratory therapists, physiotherapists, social workers, and palliative care specialists. They work in a multi-disciplinary team fashion to provide optimal collaborative care to critically ill patients. Personnel cooperates continuously with each other throughout the day to provide expertise, improve communication, decrease errors, and deliver efficient and cost-effective care (Leape, 1999).

The process of high-quality critical care includes multi-disciplinary rounds, use of evidence-based protocols and guidelines, and the use of checklists. It has been demonstrated that multi-disciplinary rounds reduce the length of stay in the ICU and patient mortality in the ICU (Pacheco et al., 2011). In a large population-based cohort study, the highest odds of survival were observed in patients managed by ICUs with

high-intensity staffing and multi-disciplinary rounds in which protocols and guidelines have been used to standardize the provided critical care (Kim, 2010). Other components of high-quality critical care medicine are effective team dynamics. Effective team dynamics rely on strong team leadership, effective communication among providers, and team structure (Merlani et al., 2011). Attributes which defined positive team dynamics included safe work environments where questions and concerns are encouraged and errors are reported, and recognizing team members skills and attributes, thereby promoting team-oriented approach to patient care in which the sum is greater than the parts (Manthous, Nembhard & Hollingshead, 2011).

**ICU environment.** Intensive care units were developed for patients with special needs and include a collection of advanced technologies to support seriously ill patients in a uniquely designed separate space and complex organized system (Garland, 2010). Ergonomics, human factors, and human performance face many obstacles in the ICU complex medical environment. Several factors contribute to the anxiety-provoking, unpredictable, and the sometimes-hostile environment in the ICU for both patients and ICU providers such as the care for patients with life-threatening conditions, the use of highly sophisticated supportive devices, enormous patients' data for one person to process effectively, work environment, and scheduling. These factors contribute to emotional and interpersonal stress among ICU health care providers (Chuang, Tseng, Lin, Lin & Chen, 2016; Surani, Guntupalli, Wachtel & Mallampalli, 2014). These stressful conditions make errors probable and contribute to provider's burnout and negative outcomes for patients (Donchin & Seagull, 2002).

From patient's perspectives, the ICU is considered a hostile environment due to the physical stress of illness, pain, sedation, interventions, mechanical ventilation, and the stressful environmental factors such as noise, ambient light, restriction of mobility, and social isolation. All these factors represent the main psychological and psychosocial stressors perceived by patients (Wenham & Pittard, 2009). Patients encountered many challenges in addition to critical illness and were usually found scared, confused, and uncomfortable (Jastremski, 2000).

**Staffing in the ICU.** The available evidence suggests that the quality of care in ICUs is strongly influenced by care delivered by ICU physicians. Better outcomes were achieved when ICU is staffed by ICU trained physicians (Carson, 1996). A closed-system ICU in which patients are treated specifically by ICU physicians and teams offered a higher quality of care and a lower rate of mortality and complications (The Leap Frog Group, 2016).

The role of a critical care specialist has been clearly established in the management of severely ill patients. The current evidence has demonstrated the presence of ICU specialists decreased morbidity, medical complications, costs, and mortality (Pronovost, 2002). Although the value of ICU physicians has been recognized among health care providers, the opened ICU model is still the most common one throughout many countries (Amin et al., 2016).

The presence of a well-trained ICU specialist has been shown to improve outcomes of ICUs worldwide (Reynolds, 1988). A critical care physician or an ICU specialist, also known as "Intensivist" is a medical professional trained in intensive or critical care medicine according to the standards set by the certifying body of the country.

This position cares for all patients in the ICU, makes all decisions regarding the treatment of the patients, including admissions and discharges, which physicians to consult, and daily care. Responsibilities also include protocols and procedures development and extent of patient monitoring. The ICU specialist must ensure that all procedures are carried out safely and competently. The optimal ICU physician to patient ratio may vary but it is recommended not to be higher than 1:15 and preferably no lower than 1:8 (Afessa, 2006; see also Dara & Afessa, 2005).

The best outcomes in the ICU resulted from an ICU physician-led multi-disciplinary team consisting of critical care physicians or physician's assistants as well as other allied health professionals including critical care nurses, nutritionists, physiotherapists, pharmacists, and some countries respiratory therapists (Kim, 2010). High-intensity ICUs are those where a full-time or consultant ICU physician manages all patients in the ICU and ICU physician leads the daily clinical rounds on all patients. Low-intensity ICUs either have no ICU physicians or offer elective consultations for ICU physicians. A recent meta-analysis showed that having a high-intensity staffing compared low-intensity staffing was associated with lower ICU mortality and hospital mortality, and a significant reduction in the hospital length of stay (Wilcox et al., 2013).

Specialized training in critical care is currently unavailable in many countries, and the number of trained ICU physicians is inadequate to meet the increased demand. Training differs from one country to another. In the European system, critical care is either a specialty with a direct entry from medical school after one year of internship or it is a subspecialty with training beginning after completion of specialty training, usually in internal medicine, anesthesia, surgery, or pediatrics (international standards for ICM

training in Europe, 2010). An international survey of intensive care medicine training programs conducted between 2003 and 2005 demonstrated the wide inequalities in the structures, content, processes, and outcomes of training in intensive care medicine which confirmed that ICU training and education standards vary worldwide (Barrett & Bion, 2005)

**Critical Care**

The critical care specialty is a relatively new and integrated one (Carrillo-Esper, 2011). It provides comprehensive treatment to patients with or at potential risk of life-threatening organ dysfunction in multi-disciplinary and inter-professional patterns (Amin et al., 2016). Critical care covers the diagnosis and treatment of a wide range of clinical problems in critically ill patients (American College of Physicians, 2017).

It utilizes a variety of technologies and expertise to support failing organ systems, mainly the brain, the lungs, the cardiovascular system, and the kidneys. The main goal is to prevent further physiologic deterioration and treat the provoking diseases. The exclusively trained multi-disciplinary and inter-professional team includes but not limited to physicians, nurses, respiratory therapists, physiotherapists, pharmacists, dietitians, social workers, ethics and spiritual care, and other specialists assisting in treating specific organ dysfunction and providing expertise in a particular disease process. The team works together to provide coordinated care to critically ill patients (Marshall et al., 2017).

**Critical care training and trainees.** Training in critical care medicine must include at least 12 months of supervised clinical activity directly related to the care of critically ill patients. It must provide a balanced experience in a variety of critical care settings, and must be broader in scope than the training for any single subspecialty of internal medicine (Dorman et al., 2004). The subspecialty of critical care medicine training can be done at one or more than one institution at the discretion of the subspecialty program directors. In cases of dual certification, the minimum total full-time clinical training is 18 months for the combination of certification in critical care medicine and pulmonary disease. It is 20 months for critical care medicine and nephrology, 22 months for critical care medicine and infectious disease, and 30 months for critical care medicine and cardiovascular disease (American Board of Internal Medicine, 2017).

The Accreditation Council for Graduate Medical Education (ACGME) accredits three types of fellowship programs in critical care medicine: Two-year critical care medicine programs (for internal medicine graduates); One-year critical care medicine programs (for subspecialty program graduates); and combined pulmonary and critical care medicine programs (Halpern, Pastores, Oropello & Kvetan, 2013). When combined with subspecialty training in pulmonary medicine (pulmonary and critical care medicine), a three-year fellowship is required after which the trainee is eligible for subspecialty certification in both pulmonary medicine and critical care medicine. For other internal medicine physicians, different routes of training in critical care medicine are available: A two-year accredited fellowship in critical care medicine after the internal medicine residency and two years of fellowship training in advanced general internal medicine

which include at least six months of critical care medicine (American College of Physicians, 2017).

Critical care medicine training should be based on a curriculum or educational plan that is separate from the curriculum of the combined programs, and that fulfills the program requirements for critical care medicine. The American board of internal medicine (ABIM) requires documentation that candidates for certification are competent in the six core competencies: patient care and procedural skills, medical knowledge, practice-based learning and improvement, inter-personal and communication skills, professionalism and systems-based practice (American Board of Internal Medicine, 2017). Trainees in the ICU come from different specialty and subspecialty backgrounds (internal medicine, emergency medicine, anesthesia, pediatrics, family medicine, and general surgery) with different experiences and expectations. The trainee should show a satisfactory development of the knowledge, skill, attitudes, and behaviors needed to advance in training. The trainee must demonstrate a learning trajectory which anticipates the achievement of competency for unsupervised practices which include the delivery of safe, effective, patient-centered, and efficient care. The ICU trainee must prove satisfactory skills in all six core competencies (American Board of Internal Medicine, 2017).

Physicians who had ICU training after July 1, 1991, must be accredited by the Accreditation Council for Graduate Medical Education (ACGME) or by the Royal College of Physicians and Surgeons of Canada while those who finished the training before July 1, 1991 must have completed in a program associated with an accredited residency in internal medicine in the United States or Canada (American Board of

Internal Medicine, 2017). To be admitted to an examination, candidates must have completed the required training in the subspecialty by October 31st of the year of the examination. ICU training must be conducted in a fellowship program within the department of medicine. Certification in critical care medicine is jointly administered by the American board of internal medicine, the American board of surgery, the American board of pediatrics, and the American board of anesthesiology. Certification in the subspecialties must meet ABIM requirements (American College of Physicians, 2017).

**Teachers in the ICU.** ICU physicians who were trained in critical care and work in the ICUs for hospitals in which residency or fellowship programs are available, take the role of teachers for in-training physicians. The Leapfrog group defines ICU physicians as one of the following: Board-certified physicians who are additionally certified in the subspecialty of critical care and/or physicians who are board-certified in medicine, anesthesiology, pediatrics, emergency medicine, or surgery and have completed training prior to the availability of a subspecialty certification in critical care; and provided at least six weeks of full-time ICU care each year (The Leap Frog Group, 2016).

The ICU physicians need to be competent in a broad range of conditions common among critically ill patients and with procedures and devices used in intensive care settings. The care of critically ill patients requires ICU physicians to be competent in areas such as end-of-life decisions, advance directives, prognosis, and counseling of patients and their families (American College of Physicians, 2017). ICU physicians fulfill the clinical requirement to deliver optimal care to critically ill patients and may lack formal training as a clinical teacher (Cottrell, Kilminster, Jolly & Grant, 2002).

**Clinical Teaching in the ICU**

Teaching critical care medicine is a challenging task because of variety of factors such as acuity and severity of clinical cases, rapidly developing subspecialty, restriction in trainees' duty hours, concern about patient safety and quality of care, and highly stressful environment in the ICU (Tainter et al., 2017). Graduate Medical Education (GME) is in a conflict between providing a high quality of care to patients and ensuring optimal education to trainees. GME is seeking an efficient, effective, and standardized system of medical education designed to achieve the dual goals (Croley & Rothenberg, 2007; Almoosa at al., 2010). Critical care medicine training guidelines have been published to promote excellence in critical care medicine education (Dorman et al., 2004).

An ideal education curriculum or standardized approach for teaching are lacking (Barrett & Bion, 2005). Training ICU physicians is a necessity as the need of subspecialty ICU physicians will continue to increase (Angus, 2006). Demographics of increasing numbers of patients requiring intensive care, combined with decreasing numbers of trained physicians will continue to increase with a sustained deficit of ICU providers at the national level resulting in a shortage of ICU physicians equal to 22% of demand by 2020 and 35% by 2030 (Angus, 2000).

A wide range of training specialties require trainees to rotate in the ICU. These include internal medicine, general surgery, anesthesiology, pediatrics, and emergency medicine. Other specialties with an elective rotation in the ICU include neurology, neurosurgery, and obstetrics and gynecology. Trainees in the ICU gain knowledge and skills through different strategies which included both active and passive learning

methods such as bedside teaching, formal and informal lectures, morbidity and mortality conferences, and journal clubs (Dorman et al., 2004). ICU trainees have multiple responsibilities such as clinical training, research, and administrative duties. ICU physicians face competing demands of a commitment to create an environment which promotes excellence in ICU education and to deliver optimal patient care to seriously ill patients (Lim, Dunn, Klarich & Afessa, 2005).

**Instructional methods in the ICU.** The objectives of the educational process in critical care medicine are to make trainees acquire the necessary knowledge, skills, and attitudes for sufficient, timely, and optimal care of seriously ill patients. The acquisition of competencies is attained in a specified duration of residency and fellowship training and continues throughout a trainee's professional career (Guidelines for advanced training for physicians in critical care, 1997; see also Guidelines for resident physician training in critical care medicine, 1995). The trainees should gain sufficient understanding of the pathophysiological course of different diseases, life-threatening organ dysfunction, emergent clinical conditions, treatments, interventions, end of life care, as well as synthesize, implement, and follow safe and cost-effective plans of care (Carrillo-Esper, 2011).

The education of trainees in the ICU is mainly dependent on an experiential pattern. The traditional approach in residency and fellowship training is related to the apprenticeship model of see one, do one, and teach one (Dunn, 2003). As a consequence of trainees' work hours restriction, medicolegal issues, billing purposes, and generational differences, the teaching process in critical care was reexamined to develop new,

effective, efficient, and cost-effective ways to achieve measurable outcomes through specific competencies in trainees' performance (Wong, 2005).

It has been found that learning in critical care medicine regarding vital topics and skills is suboptimal. About 92% of internal medicine residency directors felt that trainees in their programs were competent to provide mechanical ventilation while only 44% of trainees agreed. This showed the trainees' satisfaction within the U.S. internal medicine programs about their competence at the end of their training in the ICU was deficient (Cox et al., 2003). About 84% of trainees in this study reported that they might care for ventilated patients in their future careers. A survey among internal medicine trainees showed suboptimal training in important critical care medicine practices such as cardiopulmonary resuscitation (Hayes, Rhee, Detsky, Leblanc & Wax, 2007).

The amount of time devoted for teaching is varied among programs and ICUs (Hanson et al., 2001). Methods of teaching in the ICU have minimally changed even after implementing duty hours restriction by the Accreditation Council for Graduate Medical Education (Chudgar et al., 2009). Availability of clear objectives for the ICU rotation is only found in 27% of programs (Dunn, 2003). These factors have been considered to have serious clinical and educational challenges and affect both patient's care and the enthusiasm for trainees to consider a career in critical care medicine despite the extreme need for ICU physicians (Lorin, Heffner & Carson, 2005).

There are no standard critical care teaching practices or a general framework for learning in critical care training programs (Buckley et al., 2009). It is also not clear which methods are optimal for trainees' education in critical care medicine as demonstrated by national and international surveys evaluated ICU education practices. There is no

standardized approach to critical care medicine education, highly variable ICU environment and practice patterns. The international survey of training in adult intensive care medicine which conducted a survey in 41 countries demonstrated significant variability in ICU types (medical, surgical, cardiac) and sizes, trainee's workloads, ICU team structure, and the presence of night-float systems, caps on admissions, and continuation of residents' primary care clinics during their ICU service (Barrett & Bion, 2005).

Despite this lack of a standardized structure, most programs used similar traditional clinical teaching methods. All programs indicated that bedside teaching was the most common format to educate trainees, and many offered informal sessions and didactic lectures, including access to an online core curriculum of ICU topics. A web-based national survey conducted by Chudqar and colleagues to examine the teaching methods in the ICU showed that bedside case-based teaching and standardized lectures are the most common methods of education in the ICU. Patient safety and trainees' demands are two factors most likely to result in changes in instructional strategies in the ICU. Barriers to change in education include clinical workload and lack of protected time and funding. More than 80% of programs spend greater than two hours a day on bedside teaching. Lectures, case-based conferences, and journal club are also methods used by most programs. Virtual teaching is used less frequently with fewer than 30% of programs used internet-based educational materials, simulation, and standardized patients (Chudgar et al., 2009).

In another study, trainees' education in the ICU was provided using several formats. Bedside teaching was the most common and was offered by all programs.

Informal sessions such as a case or topic discussions away from the bedside were used in 91% and didactic lectures in 75% were also used often and were more common in larger ICUs (>20 beds). The use of different teaching strategies (bedside teaching, didactic lectures, and informal sessions) happened regularly only in 30% to 60% of programs depending on the type of the ICU. Technological tools for education, such as audiovisual aids or simulated procedures training, were used sometimes by many programs as reported to be 58% and 46% respectively, but the number of programs using these tools was too small to conduct any statistical comparisons in the study. ICU online core curriculum was available only in 53% of the training programs. Formal training in invasive procedures was done in 91% of programs (Almoosa et al., 2010). It has been suggested that critical care educators should rely less on traditional techniques of bedside teaching and classroom lectures and focus on developing problem-based learning discussions and objective structural clinical examinations and promote the use of standardized patients and simulated scenarios to advance education in critical care medicine (Croley & Rothenberg, 2007).

The ACGME established six core skills in which trainees must demonstrate competence by the time of graduation: Patient care, medical knowledge, practice-based learning and improvement, professionalism, interpersonal and communication skills, and system-based practice (Education Commission for Foreign Medical Graduates, 2017). Along with the recognition of the core competencies, the ACGME changed requirements for accreditation, mandating assessment of outcomes linked to these competencies. The ACGME outcome project was created to identify and disseminate assessment tools that could be used for training programs under this new system. The ACGME has recently set

a new course for graduate medical training programs in the United States. Residency and fellowship training programs will be evaluated on educational outcomes rather than on process and structure, as they had been previously.

This new program, the next accreditation system (Nasca, Philibert, Brigham & Flynn, 2012), has added reporting milestones, or sub-competencies, to the existing six core competencies of graduate medical education to better document the educational progress of medical trainees. These new sub-competencies represent specific, observable behaviors that can be measured at multiple points throughout training, defining milestones or steps toward competence and ability to practice independently. A working group derived from members of the American college of chest physicians, the American thoracic society, the association of pulmonary and critical care medicine program directors, and the society for critical care medicine have recommended curricular milestones and professional activities to be adopted by pulmonary and critical care medicine training programs (Fessler et al., 2014).

**Teaching practices in the ICU.** ICU physicians have many responsibilities including direct patient care, teaching, administrative, and research responsibilities (Spencer, 2003). ICU physicians are required to teach knowledge, skills, and attitudes about a variety of topics in a very interactive, complex, and unpredictable environment of the intensive care unit (Tainter et al., 2017). Their skills, behaviors, and attitudes are of profound importance to achieve dual results of optimal quality of care to critically ill patients and excellence in teaching in the challenging ICU setting (Santhosh et al., 2017).

The behavior of teaching faculty was examined in the outpatient settings (Irby, Ramsey, Gillmore & Schaad, 1991; see also Loftus, McLeod & Snell, 1993) and

inpatient settings (McLeod, James & Abrahamowicz, 1993; Wright 1996; Wright, Kern, Kolodner, Howard & Brancati, 1998). In the ICU, a multicenter study at four geographically diverse academic medical centers was published which identified the teaching behaviors of ICU physicians which are commonly observed in faculty educators in the ICU. The study surveyed internal medicine trainees and showed that the top five behaviors of attending physicians most valued by trainees were enjoyed teaching (66%), demonstrated compassion to patients and families (64%), explained the clinical reasoning and differential diagnoses (63%), treated non-physician staff members respectfully (60%), and showed enthusiasm on rounds (58%). While behaviors least commonly identified as important in ICU educators were high number of research publications, served as a chief resident, shared personal life with trainees, and organized end-of-rotation social events (Santhosh et al., 2017).

**Learning climate in the ICU.** The major activity of hospitals is to provide patient care rather than clinical teaching. Competing demands on staff physicians from service, research, administration and teaching in addition to time restraints made the hospital a highly unstructured and complex learning environment (Spencer, 2003), consequently trainees' learning experiences were determined by day-to-day events in the hospital rather than by educational considerations (Collins, 1989). This effect is magnified in the ICU as most of the teaching and learning are happening in the ICU setting.

Factors which affected the learning climate are: Trainees with different specialty background (surgery, anesthesiology, internal medicine, emergency medicine, neurology, neurosurgery, family medicine) and wide range clinical experience (medical students,

interns, junior residents, senior residents, and fellows), patients are critically ill with life threatening conditions and fluctuations in their acuity and volume, as well as the variability in disease states, limitation in trainees' duty hours, competing responsibilities of ICU physicians and trainees (clinical, administrative, research, documentation and billing) (Tainter et al., 2017; see also Ward, Read, Afessa & Kahn, 2012). The ICU is considered a valuable learning environment for trainees as it allows participating in the management of the most critically ill patients in the hospital where learners acquire broad critical care knowledge, interventional skills, and problems solving (Peets, McLaughlin, Lockyer & Donnon, 2008).

Limitations in duty hours of trainees have reduced clinical exposure and allowed less time for traditional methods of teaching. The scope of medical knowledge and clinical skills necessary for clinical practice continue to increase, while the hours available for education have not (Croley & Rothenberg, 2007; see also Prober & Heath, 2012). Advances in ICU care management and monitoring technology with a wide range of clinical information (from multiple sources such as laboratory tests, imaging studies, chart notes, computer displays, and bedside assessments of the patients) need to be displayed and evaluated in an organized pattern, and interpreted to arrive at a specific plan of care for each patient resulting in an exceptionally overwhelming and stressful learning environment in the ICU for learners and challenging for teachers. The availability of a greater volume of diagnostic data and therapeutic interventions may produce information overload for ICU trainees. ICU trainees learn in a charged environment where some patients do not improve or deteriorate despite thoughtful,

focused, and timely care. These factors represent the current stressful learning environment in the ICU (Hall et al., 2015).

**Summary**

The ICU is a unique complex adaptive system with dynamic, interactive, and rapid-paced learning environment. Its main goal is to provide care to critically ill patients and their families in a very stressful environment. The education of trainees in the ICU is extremely challenging due to many factors related to the ICU environment, ICU trainees and physicians, ICU subspecialty training, and safety and quality of care delivered to critically ill patients.

Critical care medicine training continues to be an increasingly required subspecialty as the need for ICU physicians continue to increase. GME is in a conflict between providing optimal patient care and excellence in education. GME is seeking an efficient, effective, and standardized system of medical education designed to achieve the dual goals of providing high-quality patient care and outstanding trainees education.

The teaching practices of the ICU physicians and the ICU learning climate have not been examined from ICU physicians and trainees' point of view. It is unclear which instructional methods are optimal for teaching and learning in the ICU. Specific barriers and obstacles for learning and teaching in the ICU setting have not been addressed.

In the next chapter, the researcher describes methods used in the study to evaluate the teaching practices in the ICU, the learning climate, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU. The study examines the research question as perceived by ICU trainees (learners) and

ICU physicians (teachers) using the Maastricht clinical teaching questionnaire and supplementary questions.

# Chapter III

## Methodology

A survey was conducted using a validated and reliable questionnaire (the Maastricht clinical teaching questionnaire) which evaluated the current teaching practices and learning climate in the ICU as perceived by both the ICU trainees (learners) and ICU physicians (teachers) in a medical school in South Texas. An anonymous voluntary questionnaire was disseminated to both learners and teachers which compared the perception of the clinical teaching practices and the learning climate in the ICU between learners and teachers. Data analysis was conducted using ANOVA. Supplementary questions to examine the ICU learning environment, the preferred instructional methods, and the barriers and obstacles to teaching and learning in the ICU were used.

### Research Question

What is the perception of ICU trainees (learners) compared to ICU physicians (teachers) of the current teaching practices, the learning climate, the preferred instructional methods, the ICU environment, and the barriers and obstacles for teaching and learning in the ICU?

### Variables

The perception of ICU trainees (learners) and ICU physicians (teachers) was evaluated using the Maastricht clinical teaching questionnaire. Five categories were analyzed: modeling, coaching, articulation, exploration, and climate. Supplementary questions were used to examine: the ICU environment, the preferred instructional methods, and the barriers for learning and teaching in the ICU.

**Measures, Scales, and Subscales**

The Maastricht clinical teaching questionnaire was used in its two formats (one for learners and the other for teachers). Each questionnaire contained a standard group of 14 questions in a Likert scale format ranging from one to five. The Maastricht clinical teaching questionnaire is a validated and reliable tool used in different clinical settings to evaluate clinical teaching (Stalmeijer, Dolmans, Wolfhagen, Muijtjens & Scherpbier, 2010). The questionnaire started with general information for both learners and teachers as follows: Years of post-graduate training (for learners), previous education in clinical teaching (for learners and teachers), and years for practice in the ICU (for teachers). The 14 questions were five-point Likert scale ranging from fully disagree to fully agree with an additional non-scored choice "unable to comment". The questions addressed the ICU teachers' attributes as perceived by ICU trainees (learners) and by ICU physicians (teachers). The surveys were sent to ICU trainees (learners) and ICU physicians (teachers) as a link by an e-mail and they were asked to complete it online. The answers were reported to the principal investigator only. The survey was obtained at the end of ICU rotation for three consecutive months. The projected sample size was 100 for learners and 33 for teachers. This was a selective sample. It included all participants in the ICU (trainees and physicians). ANOVA was used to analyze the data. Participation was voluntary, participants received no reward and the data was anonymized. IRB was obtained from the teaching institutes.

The questionnaire items reproduced the teaching methods of the cognitive apprenticeship model (Collins, 1989): modeling (three items), coaching (three items), articulation (three items), exploration (two items), and learning climate (three items).

Respondents were asked to rate items based on their perception on a five-point Likert scale. Standardized questions were followed by supplementary questions (similar for learners and teachers) to examine the ICU teaching and learning environment, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU.

## Reliability and Validity

Evaluation of clinical teaching must be done by a tool that is theory based, reliable, and valid (Stalmeijer et al., 2010). The Maastricht clinical teaching questionnaire is a valid and reliable instrument which used a cognitive apprenticeship model for clinical teaching evaluating: modeling, coaching, articulation, exploration, and learning climate in the clinical setting (Stalmeijer et al., 2010). It has been used to evaluate teaching in the general practice with high validity and reliability (Kelly, Bennet & McDonald, 2012). The Maastricht clinical teaching questionnaire has also been shown to be valid and reliable in short rotations (Boerboom et al., 2012).

## Research Design

**Characteristics of the participants.** Participants included ICU trainees (learners) and ICU physicians (teachers). The learners were post-graduate trainees from different subspecialties (internal medicine, pediatrics, family medicine, anesthesia, obstetrics and gynecology, transitional year, and advanced training in critical care medicine) and throughout different years of training ranging from post-graduate training year one to year six. The teachers were board-certified critical care medicine staff physicians and faculty of the medical school.

**Intervention**. A survey was conducted using the Maastricht clinical teaching questionnaire to evaluate the current teaching practices and learning climate in the ICU. A voluntary questionnaire was sent by the principal investigator to ICU trainees (learners) and ICU physicians (teachers) in the ICU. The survey was anonymous, including no identifiers, and did not require patients' involvement. Participants were asked to rate items based on their perception on a five-point Likert scale from (fully disagree, somewhat disagree, neutral, somewhat agree, and fully agree), and to answer supplementary questions. Participants were requested to fill the questionnaire at the end of the rotation in the ICU.

**Data Collection Procedures**

The questionnaire was sent as a link via e-mail. The e-mail included a survey letter which informed the participants of the purpose of the study. The participants were asked to complete the questionnaire online.

**Data Analysis Procedures**

SPSS 25.0 was used to analyze the data. Means and standard deviations were calculated by item for each category. ANOVA was used for analysis of the 14 standardized questions. The Maastricht clinical teaching questionnaire was a standardized 14-item questionnaire which had two formats, one for learners and the other for teachers. The learner format of the questionnaire had two introductory questions: Post-graduate year (PGY) and if the trainee had any professional degree or qualification in teaching. The teacher format of the questionnaire had two introductory questions: Number of years practicing in the ICU and if the teacher had any professional degree or qualification in

teaching. The 14 Items of the questionnaire were standardized between the two groups learners and teachers. The questions were grouped and analyzed as follows:

Modeling was evaluated using questions 1, 2, and 3 (1. Consistently demonstrated how to perform clinical tasks, 2. Created sufficient opportunity for the trainee to observe, and 3. Served as a role model as to the kind of health professional trainees would like to become). Coaching was evaluated using questions 4,5, and 6, (4. Gave useful feedback during or immediately after direct observation of the trainee's patient encounters, 5. Adjusted teaching activities to the level of experience of trainees, 6. Offered sufficient opportunities to trainees to perform activities independently). Articulation was evaluated using questions 7, 8, and 9, (7. Asked trainees to provide a rationale for their actions, 8. Asked trainee questions aimed at increasing their understanding, and 9. Stimulated trainees to explore their strengths and weaknesses. Exploration was evaluated using questions 10 and 11 (10. Encouraged trainees to formulate learning goals, 11. Encouraged trainees to pursue their learning goals). The learning climate was evaluated using questions 12, 13, and 14 (12. Created a safe learning climate, 13. Genuinely interested in the trainee as a student, and 14. Showed respect to the trainee) as demonstrated in Table 1.

Table 1

*Categories and questions of the Maastricht clinical teaching questionnaire*

| Questionnaire category | Questions |
|---|---|
| Modeling | 1. Consistently demonstrated how to perform clinical tasks<br>2. Created sufficient opportunity for the trainee to observe<br>3. Served as a role model as to the kind of health professional trainees would like to become |
| Coaching | 4. Gave useful feedback during or immediately after direct observation of the trainee's patient encounters<br>5. Adjusted teaching activities to the level of experience of trainees<br>6. Offered sufficient opportunities to trainees to perform activities independently |
| Articulation | 7. Asked trainees to provide a rationale for their actions<br>8. Asked trainee questions aimed at increasing their understanding<br>9. Stimulated trainees to explore their strengths and weaknesses |
| Exploration | 10. Encouraged trainees to formulate learning goals<br>11. Encouraged trainees to pursue their learning goals |
| Learning climate | 12. Created a safe learning climate<br>13. Genuinely interested in the trainee as a student<br>14. Showed respect to the trainee |

Supplementary questions were added to evaluate the ICU environment, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU. Similar questions were used to evaluate the perception of ICU

learners and teachers as follows: 15. How the ICU environment contributes to learning and teaching? 16. What instructional methods fit best for teaching and learning in the ICU? 17. What were the barriers and obstacles for learning and teaching in the ICU?

**Summary**

The teaching practices and learning climate in the ICU have not been examined. The researcher used the Maastricht clinical teaching questionnaire to compare between the perception of ICU trainees (learners) and ICU physicians (teachers). The questionnaire is a validated and reliable tool to assess the teaching practices and learning climate in any setting relying on the cognitive apprenticeship model. The questionnaire is composed of a group of standardized 14 items to both learners and teachers. Qualities of the teaching practices and learning climate were evaluated using five categories: modeling (three items), coaching (three items), articulation (three items), exploration (two items), and learning climate (three items). Respondents were asked to rate items based on their perception on a five-point Likert scale from (fully disagree, somewhat disagree, neutral, somewhat agree, and fully agree). ANOVA was used to analyze data. Supplementary questions were added to examine the perception of learners and teachers in regard to the ICU environment, the preferred instructional methods in the ICU, and the barriers and obstacles for learning and teaching in the ICU. In the next chapter, the results of the survey are presented.

# Chapter IV

## Results

The purpose of the study was to examine the teaching and learning process in the ICU. Five key areas were evaluated: the teaching practices, the learning climate, the ICU environment, the preferred instructional methods, and the barriers and obstacles for teaching and learning in the ICU. The perception of the ICU trainees (learners) and the ICU physicians (teachers) was evaluated using the Maastricht clinical teaching questionnaire to examine the teaching practices and the learning climate. Supplementary questions were used to examine the ICU environment, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU. In this chapter, the researcher presents the participation and response rate of the subjects, data analysis of the elements of the Maastricht clinical teaching questionnaire and the results of the ANOVA, the answers to the supplementary questions, and a summary of the results.

### Participants and Response Rate

A total 57 ICU trainees (learners) responded to the questionnaire out of 98 trainees who rotated in the ICU (response rate 58.16%) and 26 ICU physicians (teachers) out of 33 who taught in the ICU (response rate 78.78%). The 57 ICU trainees were categorized according to their post-graduate year (PGY) of training to PGY1, PGY2, PGY3, and PGY4-6. The trainees' percentages per PGY were: PGY1 31.58% (n = 18), PGY2 22.81% (n = 13), PGY3 21.05% (n = 12), and PGY4-6 24.56% (n = 14) as depicted in Figure 1. PGY 1 and PGY 2 are classified as junior trainees (trainees who spent between 4 weeks to 2 months in the ICU) and PGY 3 and PGY 4-6 are classified as

senior trainees (trainees who spent 3 months and more in the ICU) as shown in Figure 1.

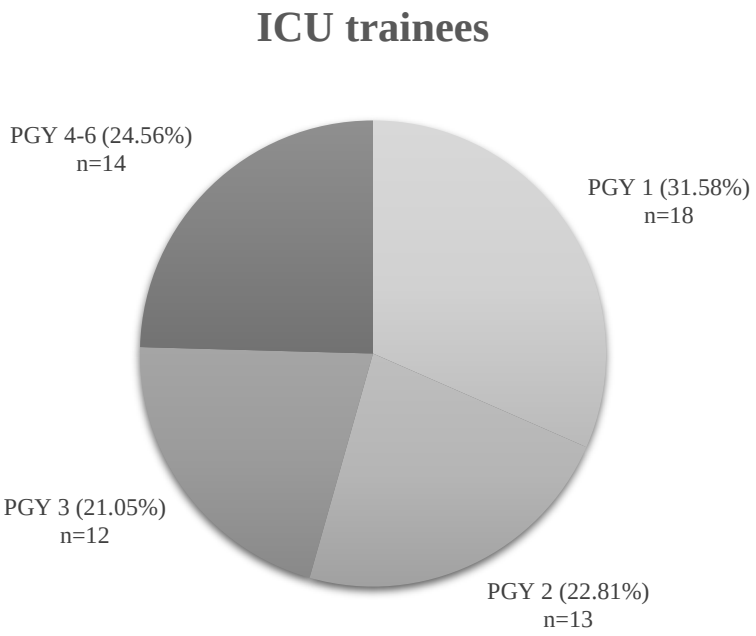


*Figure 1*. Percentage of ICU trainees, PGY: post-graduate year.

An inquiry about previous training in clinical teaching was obtained from ICU trainees and ICU physicians. A total of 52 ICU trainees (91.23%) reported no previous training in teaching, four trainees (7.02%) had basic training which included continuing medical education or workshops, and one trainee (1.75%) had an academic degree (master or doctorate degree) in teaching as depicted in Figure 2.

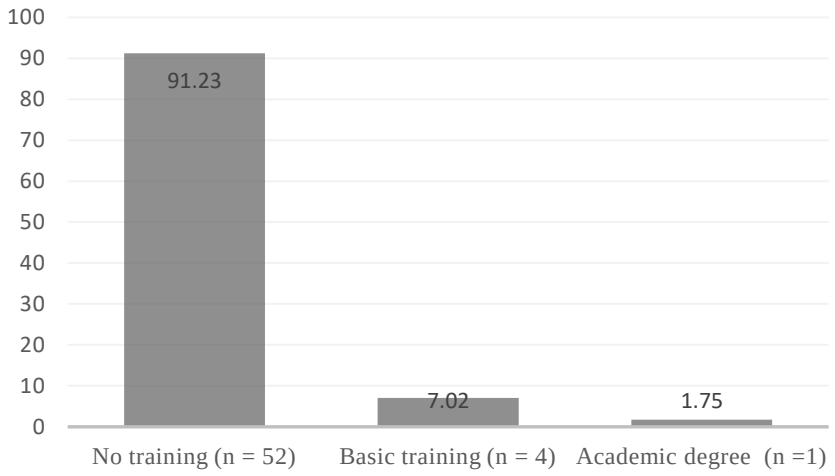


*Figure 2.* ICU trainees previous training in teaching.

A total of 13 ICU physicians (50%) reported no previous training in teaching, 11 ICU physicians (42.30 %) had basic training in teaching which included continuing medical education or workshops, and two ICU physicians (7.69%) had an academic degree in teaching as depicted in Figure 3.

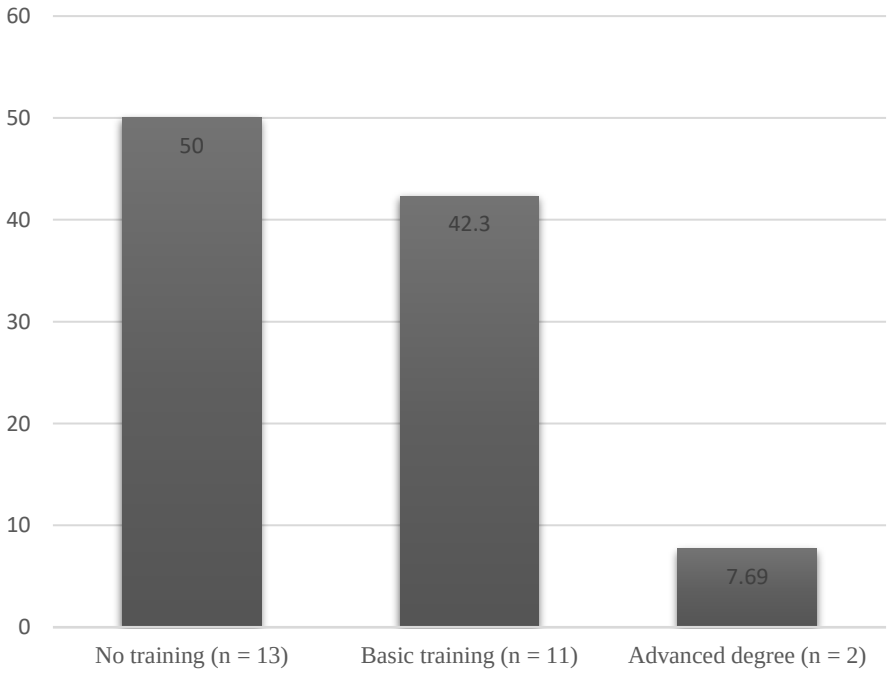


*Figure 3.* ICU physicians previous training in teaching.

An inquiry about ICU physicians' total years teaching in the ICU yielded the following results: 34.62% (n = 9) reported 1-4 years of practice in the ICU, 23.09% (n = 6) reported 5-9 years of practice in the ICU, 19.23 (n = 5) reported 10-14 years of practice in the ICU, and 23.09% (n = 6) reported 15 years and more of practice in the ICU as demonstrated in Figure 4.

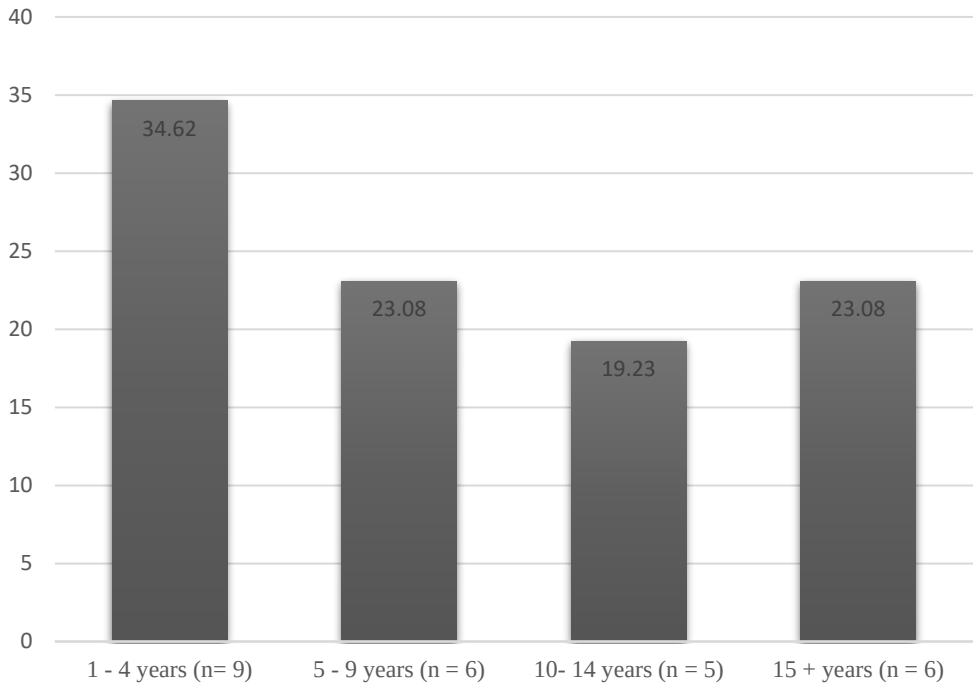


*Figure 4.* Staff ICU physicians' years of practice in the ICU.

## Data Analysis

**Analysis of the Maastricht clinical teaching questionnaire.** A one-way ANOVA was conducted to determine if the perception of learners and teachers in the ICU regarding the teaching practices and learning climate using the Maastricht clinical teaching questionnaire was different. The participants (independent variables) were classified into 3 groups: ICU teachers (physicians) (n = 26), junior ICU learners (trainees) (n = 31), senior ICU learners (trainees) (n = 26). The dependent variables included the five categories of the Maastricht clinical teaching questionnaire: modeling, coaching, articulation, exploration, and learning climate. Table 2 shows the skewness and kurtosis of the data. The z-scores of skewness for modeling, coaching, articulation, exploration, and climate are -0.5, -0.13, -0.4, 0.3, and -0.68 respectively. The values fall between -1.96 and 1.96 demonstrating normality of skewness (Cramer & Howitt, 2004). The z-scores of kurtosis for modeling, coaching, articulation, exploration, and climate are -1.98, -2.60, -2.2, -2.55, and -2.77 respectively. The values are minimally kurtotic.

There was homogeneity of variances, as assessed by Levene's test of homogeneity of variances for the modeling category ($p = .054$) but there was heterogeneity of variance for coaching ($p = 0.02$), articulation ($p = 0.019$), exploration ($p = 0.013$), and learning climate ($p < 0.005$) as demonstrated in Table 3.

Table 2

*Skewness and Kurtosis*

| Dependent Variables | Modeling | Coaching | Articulation | Exploration | Climate |
|---|---|---|---|---|---|
| N of subjects | 83 | 83 | 83 | 82 | 83 |
| Missing | 0 | 0 | 0 | 1 | 0 |
| Skewness | -.134 | -.035 | -.106 | -.081 | -.182 |
| Std. error of skewness | .264 | .264 | .264 | .266 | .264 |
| Kurtosis | -1.040 | -1.360 | -1.151 | -1.342 | -1.449 |
| Std. error of Kurtosis | .523 | .523 | .523 | .526 | .523 |

Table 3

*Test of Homogeneity of Variances*

| Category | Levene Statistic | df1 | df2 | Sig. |
|---|---|---|---|---|
| Modeling | 3.019 | 2 | 80 | .054 |
| Coaching | 4.122 | 2 | 80 | .020 |
| Articulation | 3.677 | 2 | 80 | .030 |
| Exploration | 4.568 | 2 | 79 | .013 |
| Climate | 12.170 | 2 | 80 | .000 |

Thus, a Welch test was used for coaching, articulation, exploration, and learning climate as shown in Table 4.

Table 4

*Welch Test for Heterogeneity of Variances*

| Category | Welch Statistic | Df1 | Df2 | Sig. |
|---|---|---|---|---|
| Modeling | 19.480 | 2 | 50.929 | .000 |
| Coaching | 47.269 | 2 | 50.513 | .000 |
| Articulation | 33.026 | 2 | 51.093 | .000 |
| Exploration | 27.925 | 2 | 51.593 | .000 |
| Climate | 64.713 | 2 | 43.704 | .000 |

ANOVA data was presented as mean ± standard deviation as shown in Table 5. An analysis of variance showed the perception of subjects (ICU trainees and ICU physicians) in all categories of the Maastricht clinical teaching questionnaire (modeling, coaching, articulation, exploration, and learning climate) was unequal and statistically significant with a large effect size (>0.14) calculated using Omega Squared ($\omega^2$) for all categories of the Maastricht clinical teaching questionnaire (Kirk, 1996) as follows:

- Modeling F (2,80) = 14.717, $p < .0005$, $\omega^2 = 0.24$
- Coaching Welch's F (2, 19.48) = 50.92, $p < .0005$, $\omega^2 = 0.44$
- Articulation Welch's F (2, 47.26) = 50.51, $p < .0005$, $\omega^2 = 0.35$
- Exploration Welch's F (2, 27.92) = 51.59, $p < .0005$, $\omega^2 = 0.32$
- Learning climate Welch's F (2, 64.71) = 43.70, $p < .0005$, $\omega^2 = 0.46$

Tables 5 and 6 show descriptive statistics of the participants and dependent variables, and ANOVA respectively. The modeling score is higher in the ICU physicians' group (M = 4.33, SD = .54) compared to the junior ICU trainees and senior ICU trainees' groups (M = 3.47, SD = .85), (M = 3.19, SD = .91) respectively, see Figure 5. The coaching score is higher in the ICU physicians' group (M = 4.48, SD = .56) compared to the junior and

senior ICU trainees' groups (M = 3.01, SD = .93), (M = 2.65, SD = .97) respectively, see Figure 6. The articulation score is higher in the ICU physicians' group (M = 4.58, SD = .45) compared to the junior and senior ICU trainees' groups (M = 3.56, SD = .77), (M = 3.43, SD = .71) respectively, see Figure 7. The exploration score is higher in the ICU physicians' group (M = 4.18, SD = .78) compared to junior and senior ICU trainees' groups (M = 2.53, SD = 1.25), (M = 2.46, SD = 1.13) respectively, see Figure 8. The learning climate score is higher for the ICU physicians' group (M = 4.73, SD = .31) compared to the junior and senior ICU trainees' groups (M = 3.42, SD = .91), (M = 2.91, SD = .92) respectively, see Figure 9.

Table 5

*Descriptive statistics of Subjects: Independent Variables, and Mean and Standard Deviation*

| Category | Subjects | N | Mean | Standard Deviation | 95% Confidence Interval for Mean |
|---|---|---|---|---|---|
| Modeling | Physicians | 26 | 4.33 | .54 | 4.11-4.55 |
| | Junior trainees | 31 | 3.47 | .85 | 3.15-3.78 |
| | Senior trainees | 26 | 3.19 | .91 | 2.82-3.55 |
| | Total | 83 | 3.65 | .91 | 3.45-3.85 |
| Coaching | Physicians | 26 | 4.48 | .56 | 4.25-4.71 |
| | Junior trainees | 31 | 3.01 | .93 | 2.66-3.35 |
| | Senior trainees | 26 | 2.65 | .97 | 2.25-3.04 |
| | Total | 83 | 3.36 | 1.14 | 3.11-3.61 |
| Articulation | Physicians | 26 | 4.58 | .48 | 4.40-4.77 |
| | Junior trainees | 31 | 3.56 | .77 | 3.28-3.85 |
| | Senior trainees | 26 | 3.43 | .71 | 3.14-3.72 |
| | Total | 83 | 3.84 | .83 | 3.66-4.02 |
| Exploration | Physicians | 26 | 4.18 | .78 | 3.85-4.50 |
| | Junior trainees | 31 | 2.53 | 1.25 | 2.07-2.99 |
| | Senior trainees | 26 | 2.46 | 1.13 | 2.00-2.92 |
| | Total | 83 | 3.01 | 1.33 | 2.71-3.30 |
| Climate | Physicians | 26 | 4.73 | .31 | 4.60-4.85 |
| | Junior trainees | 31 | 3.42 | .91 | 3.08-3.76 |
| | Senior trainees | 26 | 2.91 | .92 | 2.53-3.28 |
| | Total | 83 | 3.67 | 1.07 | 3.43-3.90 |

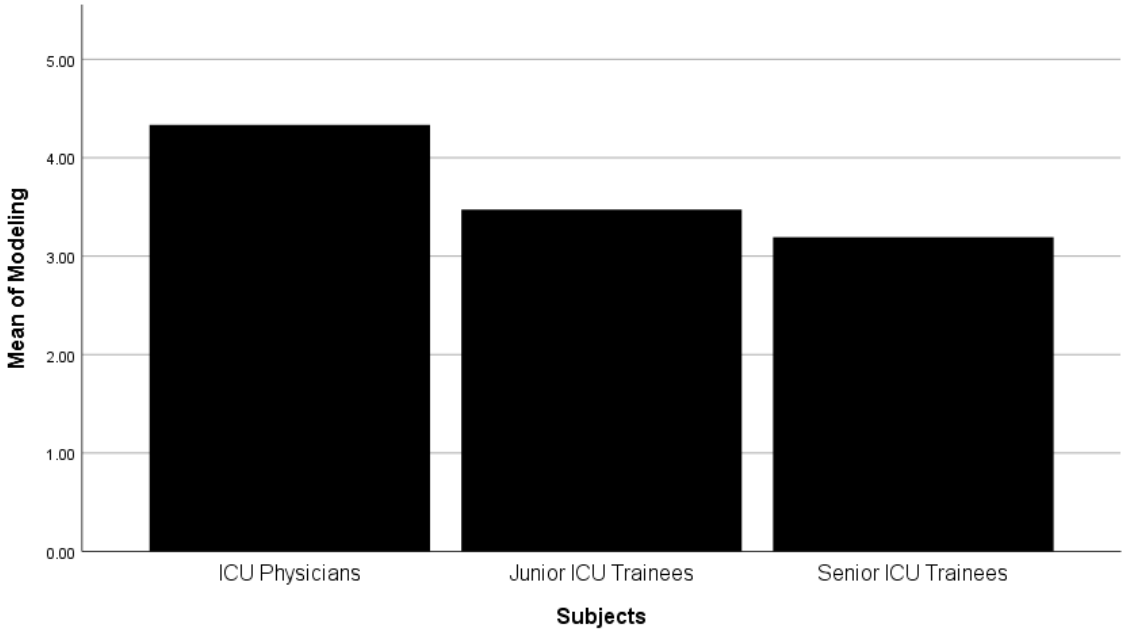


*Figure 5.* Bar graph demonstrating mean of modeling by subjects

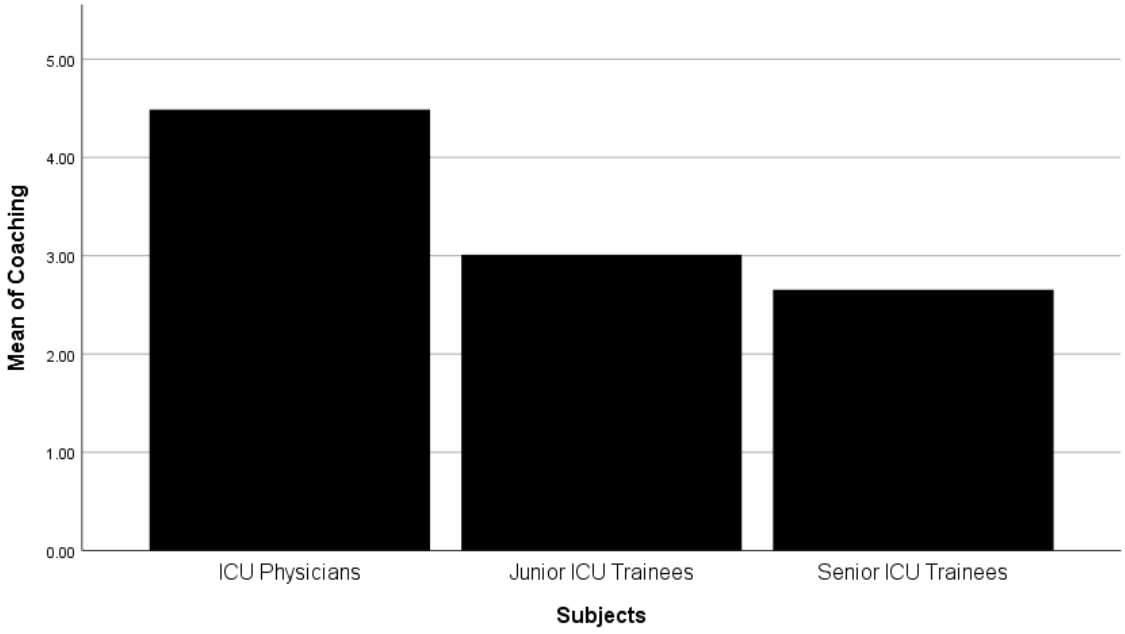


*Figure 6.* Bar graph demonstrating mean of coaching by subjects

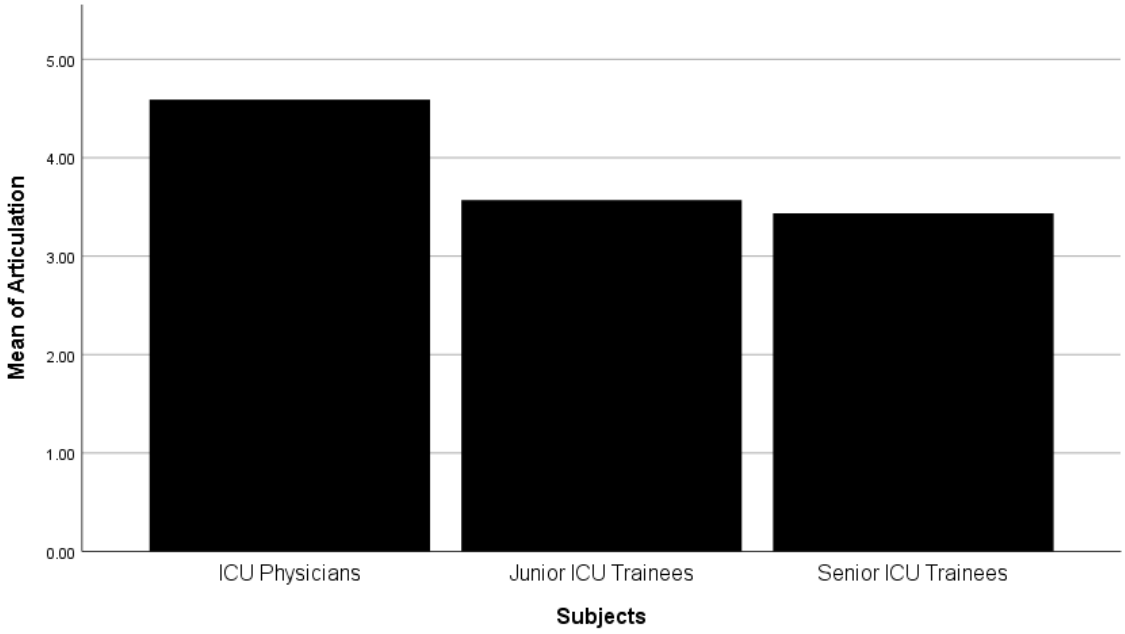


*Figure 7.* Bar graph demonstrating mean of articulation by subjects

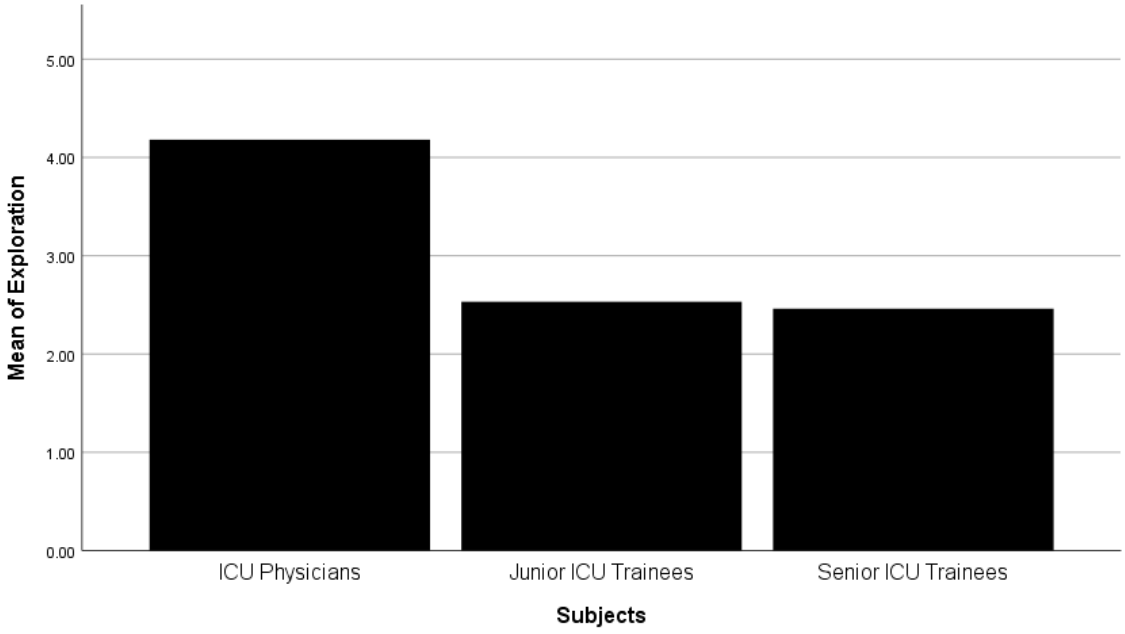


*Figure 8.* Bar graph demonstrating mean of exploration by subjects

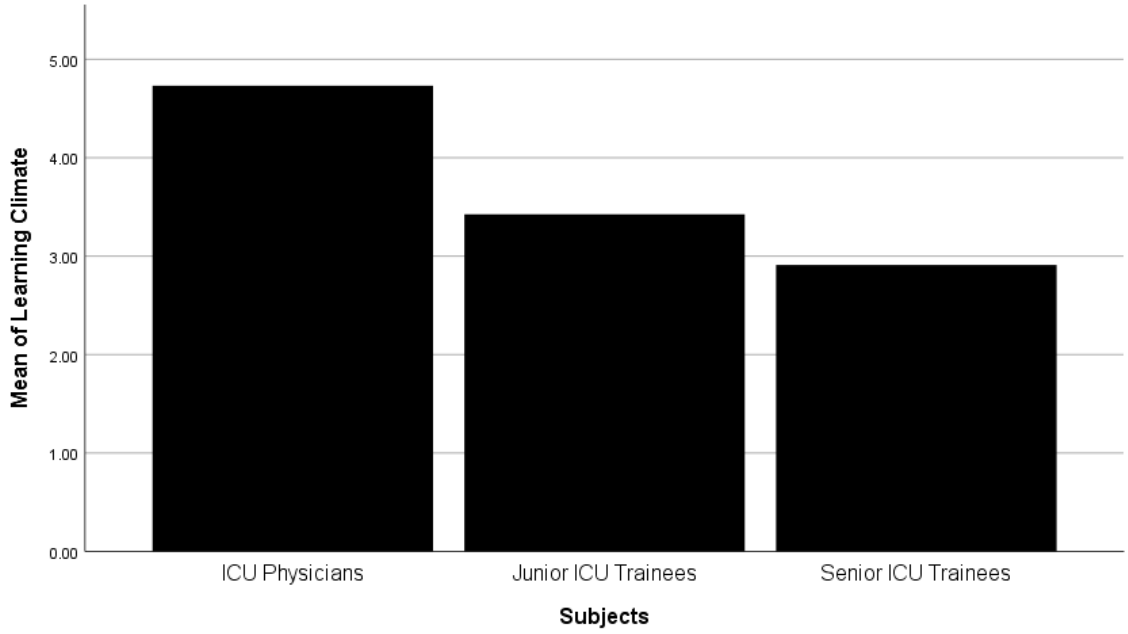


*Figure 9*. Bar graph demonstrating mean of learning climate by subjects

Table 6

*ANOVA*

| Category | Sum of Squares | df | Mean Squares | f | Sig |
|---|---|---|---|---|---|
| Modeling | 18.55 | 2 | 9.27 | 14.71 | .000 |
| Coaching | 49.78 | 2 | 24.89 | 34.17 | .000 |
| Articulation | 21.11 | 2 | 10.55 | 23.42 | .000 |
| Exploration | 49.11 | 2 | 24.55 | 20.45 | .000 |
| Climate | 46.12 | 2 | 2306 | 37.60 | .000 |

Post hoc comparisons were applied using the Tukey HSD test for modeling since a homogeneity of variances was achieved and Games-Howell test for coaching, articulation, exploration, and learning climate as the homogeneity of variances was not achieved as shown in Table 7. Post hoc comparisons revealed that the mean difference for modeling in the ICU physicians' group was higher than that of the junior and senior

ICU trainees' groups (0.86, 95% CI [0.35, 1.36]), (1.14, 95% CI [0.61, 1.66]) and it was statistically significant ($p < 0.005$). Post hoc comparisons revealed that the mean difference for coaching in the ICU physicians' group was higher than that of the junior and senior ICU trainees' groups (1.47, 95% CI [0.98, 1.98]), (1.83, 95% CI [1.29, 2.37]) and it was statistically significant ($p < 0.005$). Post hoc comparisons revealed that the mean difference for articulation in the ICU physicians' group was higher than that of the junior and senior ICU trainees' groups (1.01, 95% CI [0.62, 1.41), (1.15, 95% CI [0.74, 1.55]) and it was statistically significant ($p < 0.005$). Post hoc comparisons revealed that the mean difference for exploration in the ICU physicians' group was higher than that of the junior and senior ICU trainees' groups (1.64, 95% CI [0.98, 2.31]), (1.71, 95% CI [1.05, 2.38]) and it was statistically significant ($p < 0.005$). Post hoc comparisons revealed that the mean difference for the learning climate in the ICU physicians' group was higher than that of the junior and senior ICU trainees' groups (1.30, 95% CI [0.87, 1.73]), (1.82, 95% CI [1.34, 2.29]) and it was statistically significant ($p < 0.005$). Post hoc comparisons showed that the mean difference between the junior and senior ICU trainees' groups was not statistically different in all categories of the Maastricht clinical teaching questionnaire as depicted in Table 7.

Table 7

*Post Hoc Tests: Multiple Comparisons*

| Dependent Variable | Test | Subjects (I) | Subjects (J) | Mean Difference (I-J) | Sig. | 95% Confidence Interval |
|---|---|---|---|---|---|---|
| Modeling | Tukey HSD | Physicians | Junior trainees | 0.86 | .000 | 0.35-1.36 |
| | | | Senior trainees | 1.14 | .000 | 0.61-1.66 |
| | | Junior trainees | Physicians | -0.86 | .000 | -1.36- (-0.35) |
| | | | Senior trainees | 0.28 | .38 | -.022-0.78 |
| | | Senior trainees | Physicians | -1.14 | .000 | -1.66 - (-0.61) |
| | | | Junior trainees | -0.28 | .38 | -0.78-0.22 |
| Coaching | Games-Howell | Physicians | Junior trainees | 1.47 | .000 | 0.98-1.96 |
| | | | Senior trainees | 1.83 | .000 | 1.29-2.37 |
| | | Junior trainees | Physicians | -1.47 | .000 | -1.96- (-0.98) |
| | | | Senior trainees | 0.35 | .34 | -0.25- 0.97 |
| | | Senior trainees | Physicians | -1.83 | .000 | -2.37-(-1.29) |
| | | | Junior trainees | -0.35 | .34 | -0.97-0.25 |
| Articulation | Games-Howell | Physicians | Junior trainees | 1.01 | .000 | 0.62-1.41 |
| | | | Senior trainees | 1.15 | .000 | 0.74-1.55 |
| | | Junior trainees | Physicians | -1.01 | .000 | -1.41-(-0.62) |
| | | | Senior trainees | 0.13 | .77 | -0.34-0.61 |
| | | Senior trainees | Physicians | -1.15 | .000 | -1.55-(-0.74) |
| | | | Junior trainees | -0.13 | .77 | -0.61-0.34 |
| Exploration | Games-Howell | Physicians | Junior trainees | 1.64 | .000 | 0.98-2.31 |
| | | | Senior trainees | 1.71 | .000 | 1.05-2.38 |
| | | Junior trainees | Physicians | -1.64 | .000 | -2.31-(-0.98) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Senior trainees | 0.07 | .97 | -0.69-0.83 |
| | | Senior trainees | Physicians | -1.71 | .000 | -2.38-(-1.05) |
| | | | Junior trainees | -0.07 | .97 | -0.83-069 |
| Climate | Games-Howell | Physicians | Junior trainees | 1.30 | .000 | 0.87-1.73 |
| | | | Senior trainees | 1.82 | .000 | 1.34-2.29 |
| | | Junior trainees | Physicians | -1.30 | .000 | -1.73-(-0.87) |
| | | | Senior trainees | 0.51 | .10 | -0.07-1.10 |
| | | Senior trainees | Physicians | -1.82 | .000 | -2.29-(-1.34) |
| | | | Junior trainees | -0.51 | .10 | -1.10-0.07 |

**Analysis of supplementary questions.** The results of questions examining the ICU environment, the preferred instructional methods, and the barriers and obstacles for teaching and learning in the ICU are as follows.

1. How the ICU environment contributes to learning and teaching?

A total of 41 ICU trainees (75.54%) reported that the ICU provides opportunities to encounter multiple and complex clinical cases with different pathophysiologies while 14 ICU trainees (25.54%) reported the ICU offers different learning opportunities for clinical knowledge, skills, and procedures. Two ICU trainees did not answer this question. A total of 16 ICU physicians (61.53%) indicated that ICU provides variety of complex clinical teaching scenarios with variety of pathophysiologies, six ICU physicians (23.07%) reported that the ICU environment was excellent for learning clinical knowledge and procedural skills, and three ICU physicians (11.53 %) reported that the ICU environment was excellent for teaching and learning acute care management. One ICU physician did not answer this question.

2. What instructional methods fit best for teaching and learning in the ICU?

A total of 18 ICU trainees (32.14%) stated that bedside teaching or case-based learning was the best instructional method, 12 ICU trainees (21.43%) reported that e-learning using online courses and audiovisual resources were the best instructional method in the ICU, 12 ICU trainees (21.43%) reported that simulation was the best instructional method, 12 ICU trainees (21.43%) indicated that one-to-one teaching is the best instructional method in the ICU, and two ICU trainees (3.57%) reported that group discussion was the best instructional method in the ICU. One ICU trainee did not answer this question. A total of 19 ICU physicians (76%) reported that bedside teaching or case-based teaching was the best instructional method, five ICU physicians (20%) stated that group discussion was the best instructional method, and one ICU physician (4%) indicated that a variety of instructional methods was the best teaching strategy in the ICU. One ICU physician did not answer this question. Table 8 shows the preferred learning and teaching instructional methods as perceived by ICU trainees and physicians respectively.

Table 8

*The Preferred Learning and Teaching Methods in the ICU*

| The preferred instructional methods for ICU trainees | The preferred instructional methods for ICU physicians |
|---|---|
| Bedside teaching or case-based learning (32.14 %) | Bedside teaching or case-based teaching (76 %) |
| E-learning (21.43 %) | Group discussion (20%) |
| Simulation (21.43 %) | Using different methods (4 %) |
| One to one teaching (21.43 %) | |
| Group discussion (3.57 %) | |

3. What were the barriers and obstacles for learning and teaching in the ICU?

The subjects were asked to report all possible barriers for teaching and learning in the ICU. Participants were able to include multiple answers if deemed necessary. The results section for this question described the five most common themes stated by participants. The main barriers for ICU trainees were: Unclear expectations, goals, or objectives of the ICU rotation 89.29% (n = 50), too many distractions (phone calls, unstable patients, nurses and family members requests, others) 87.50% (n = 49), the ICU environment was not conducive for learning (no space, no demonstrations, no simulations, no ancillary tools for teaching) 69.64% (n = 39), not enough time for learning 67.86% (n = 38), and too exhausted to learn while working 37.50% (n = 21). One ICU trainee did not answer this question. The main obstacles for ICU physicians were: Not enough time for teaching 92% (n = 23), too many distractions (phone calls, unstable patients, nurses and family members requests, others) 88% (n = 22), unclear expectations, goals, or objectives of the ICU rotation 76% (n = 19), the ICU environment was not conducive for teaching (no space, no demonstrations, no simulations, no ancillary tools for teaching) 68% (n = 17), and high number of trainees 60% (n = 15). One ICU physician did not answer this question. Table 9 illustrations the five most common barriers and obstacles for learning and teaching in the ICU as perceived by both ICU trainees and ICU physicians respectively.

Table 9

*Barriers and Obstacles for Teaching and Learning in the ICU*

| ICU trainees' barriers and obstacles for learning | ICU physicians' barriers and obstacles for teaching |
|---|---|
| 1.Unclear expectations, goals, or objectives of the ICU rotation 89.29% | 1.No enough time for teaching 92% |
| 2.Too many distractions 87.50% | 2.Too many distractions 88% |
| 3.The ICU environment is not conductive for learning 69.64% | 3.Unclear expectations, goals, or objectives of the ICU rotation 76% |
| 4.No enough time for learning 67.86% | 4.The ICU environment is not conductive for teaching 68% |
| 5. Too tired to learn while working 37.50% | 5. High number of trainees 60% |

**Summary of Results**

The study was conducted to examine the teaching and learning process in the ICU. The perception of ICU learners (trainees) and ICU teachers (physicians) was analyzed to evaluate five key areas pertaining to teaching and learning in the critical care setting: the ICU physicians teaching practices, the learning climate, the ICU environment, the preferred instructional methods, and the barriers and obstacles for teaching and learning in the ICU. The Maastricht clinical teaching questionnaire was used to investigate the teaching practices and learning climate; supplementary questions were also used to examine the ICU environment, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU. Total participants were 83 subjects, 57 ICU trainees, and 26 ICU physicians. ANOVA was used for data analysis. Results revealed there was a significant statistical difference between the perceptions of ICU trainees (leaners) compared to that of ICU physicians

(teachers) with a large effect size. ICU physicians rated their teaching practices in all five categories of the Maastricht clinical teaching questionnaire on a five-point Likert scale higher than ICU trainees. Results of supplementary questions showed that both ICU physicians and trainees consider the ICU as a valuable learning place for different complex clinical cases, clinical knowledge and skills, and procedural skills. The preferred instructional methods for ICU physicians were bedside teaching and case-based learning while ICU trainees preferred having a combination of instructional strategies in addition to bedside teaching and case-based learning such as e-learning, one to one teaching, and simulation. ICU trainees reported that the main barriers for learning were unclear expectations and objectives of the ICU rotation, too many distractions in the ICU, the ICU environment was not conducive to learning, not enough time for learning, and being too exhausted to learn while working. ICU physicians reported the main obstacles for teaching were not enough time for teaching, too many distractions in the ICU, unclear expectations, goals and objectives of the ICU rotation, the ICU environment was not supportive for teaching, and had a high number of trainees. In the next chapter, the researcher discusses the results of the study, its main limitations, implications, and recommendations.

# Chapter V

# Conclusion

## Overview

There is a lack of evidence about the current teaching practices, learning climate, the preferred instructional methods, and the ICU teaching environment. This study was conducted to examine the teaching and learning process in the ICU. The study investigated the perception of ICU trainees (learners) compared to ICU physicians (teachers) regarding five major factors which play key roles in the process of teaching and learning in the critical care setting: the teaching practices, the learning climate, the ICU environment, the preferred instructional methods in the ICU, and the barriers and obstacles for teaching and learning in the ICU as demonstrated in Figure 10. A valid and reliable tool (The Maastricht clinical teaching questionnaire) and supplementary questions were used to analyze the perception of the ICU trainees compared to the ICU physicians. To the researcher's knowledge, this study is the first one to investigate the learning process in the ICU using a reliable and valid tool. Discussion of the results will focus on comparing the findings of the study with the available literature in clinical settings not limited to the ICU setting.

The response rate in this study was 58% (n = 57) for ICU trainees versus 78% (n = 26) for ICU physicians. The majority of the ICU physicians did not have specialized qualifications for teaching. The percentage of ICU physicians who have been in the clinical practice for only 1-4 years was higher than the ICU physicians who have been in the clinical practice for 5–9 years and more than 15 years.

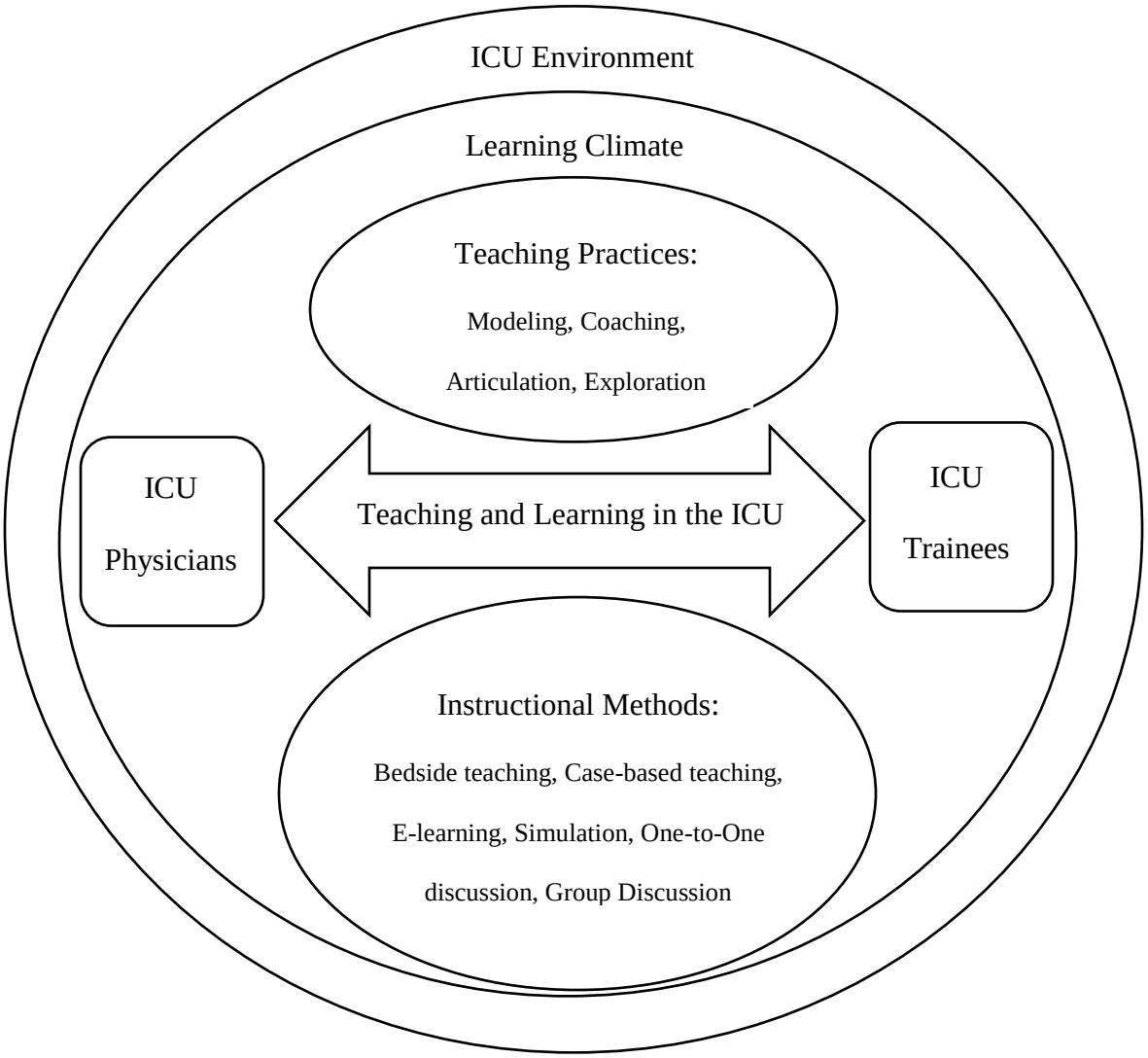


*Figure 10.* Factors influencing the teaching and learning process in the ICU setting

**Discussion of the Results of the Maastricht Clinical Teaching Questionnaire**

The results of the current study showed that there was a significant difference between the perception of the ICU learners (junior and senior ICU trainees) compared to

the ICU teachers (ICU physicians) in all five categories of the Maastricht clinical teaching questionnaire (modeling, coaching, articulation, exploration, and learning climate) with a large effect size (>0.14) (Kirk, 1996). The ICU physicians rated their teaching practices higher than the ICU trainees. These findings revealed that the perception of the ICU physicians about their teaching practices was inconsistent with the perception of the ICU trainees which implied that the ICU physicians perceived their teaching practices better for all categories of the questionnaire. This may lead to false impressions for the ICU teachers and consequently lead to invalid assessments of their teaching practices compared to what the ICU learners felt and needed. One of the explanations of the results of the Maastricht clinical teaching questionnaire is that the majority of ICU physicians who were functioning as clinical teachers had no professional qualifications in teaching. This may have contributed to an insufficient understanding of how modeling, coaching, articulation, and exploration were applied and communicated to the ICU trainees. Consequently, this led to inadequate and flawed understandings and applications of the teaching and supervisory roles by the ICU physicians.

Our study confirmed the findings of previous studies in healthcare settings other than the ICU which showed that physicians had not received formal training to function as teachers or supervisors (Cottrell et al., 2002; Gjerde, 1982). Physicians have different roles including clinical, teaching, administrative, and research. They received extensive training in clinical knowledge and skills but not in teaching and education (Ramani & Leinster, 2008). In this study, the ICU physicians evaluated themselves higher than how the ICU trainees rated them. Similar findings were observed in a multicenter cross-sectional survey conducted in the Netherlands to measure the teaching qualities of the

faculty. In that study, a total of 546 trainees and 629 medical faculty from 29 medical specialty training programs were surveyed and the results showed that physicians evaluated themselves higher than the trainees rated them (Arah, Hoekstra, Bos & Lombarts, 2011). Therefore, comprehensive faculty development programs were advocated. Implementation of faculty development programs include professional, instructional, leadership, and organizational faculty development to improve clinical teaching and supervisory roles (Jordan et al., 2017). The learning climate in the ICU was represented in the fifth category of the questionnaire and it was perceived differently between the two groups. The ICU physicians' survey revealed that the learning climate was optimal with a mean of 4.71 (SD = 0.31) while the ICU trainees rated the learning climate significantly lower with a mean of 3.4 and 2.9 for junior and senior ICU trainees respectively. The ICU trainees perceived the learning climate created by physicians to be sub-optimal compared to physicians. The literature addressed the concept of creating a safe, positive, and effective learning climate to be a vital component of the learning process (Carlos, Kritek, Clay, Luks & Thomson, 2016; Stalmeijer, Dolmans, Wolfhagen, Muijtjens & Scherpbier 2008). A survey of trainees who rotated in a Department of Veterans' Affairs hospital for the academic years 2011-2014 showed that psychological safety was strongly associated with how trainees rated the satisfaction of their clinical learning experience ($P < .001$). Establishing a safe learning climate for trainees affected their entire graduate medical education experiences (Torralba et al., 2016). The creation of a climate which allowed for positive and safe teacher-learner interaction could help promote a high degree of individualized medical education and enhance learning (Wang, 2017).

**Discussion of the Results of the Supplementary Questions.**

**The ICU environment.** Participants' response to a supplementary question that examined the ICU environment and how it affected the teaching and learning process confirmed the strength of the ICU environment as a learning one and identified the type of clinical cases and their educational value. Both ICU learners and teachers reported that the ICU environment represented a valuable resource for teaching and learning complex clinical cases with different pathophysiologies. The results confirmed the very nature of the ICU clinical cases which primarily include seriously ill patients with a variety of clinical conditions affecting different organ systems with high acuity and complexity (Besso, Bhagwanjee, Takezawa, Prayag & Moreno, 2006; Clay, Que, Petrusa, Sebastian & Govert, 2007). In one study, respondents reported that the critical care specialty offered trainees intellectual stimulation, opportunities to manage critically ill patients, application of complex physiologic principles and procedural skills, and academically challenging rounds (Lorin et al., 2005).

**The preferred instructional methods in the ICU.** The majority of ICU physicians reported that bedside teaching and case-based learning were the preferred instructional methods. This finding was consistent with currently used methods for teaching in the ICU (Almoosa et al., 2010). ICU learners chose combinations of methods as the preferred instructional strategy for learning in the ICU including but not limited to bedside teaching and case-based learning. ICU learners reported that e-learning, simulation, and one to one teaching provided other preferred alternative instructional methods in the ICU.

The findings established the disparity between the ICU teachers and learners' perceptions of the preferred instructional methods in the ICU. Although bedside teaching and case-based learning were rated the highest among ICU physicians (teachers) (76%) confirming the valued nature of this instructional strategy for teaching in the clinical setting (Carlos et al., 2016; Janicik & Fletcher, 2003) and the need to cultivate this instructional method; the ICU trainees (learners) ratings showed the need for implementing different instructional strategies for teaching in the critical care setting such as e-learning, simulation, and one to one discussion in addition to bedside teaching and case-based learning.

This finding also validated the need to practice innovative instructional strategies in the ICU given the nature of the ICU setting being dynamic, unpredictable, and stressful for both teachers and learners (Kleinpell et al., 2011; see also Morrison, 2005; and Tainter et al., 2015). A randomized crossover trial conducted among 122 internal medicine trainees in the continuity clinics of an academic internal medicine program showed that web-based learning increased learning efficiency (Cook, Beckman, Thomas & Thompson, 2008). E-learning includes a variety of web-based technologies which proved to be efficient and valuable for both teaching and learning (Mohanna, 2007). In a study conducted to identify and evaluate web-based resources for education in the ICU, Kleinpell and colleagues found more than 135 web-based resources for ICU education in different teaching and learning formats. Familiarity and usage of available resources by ICU physicians and trainees may positively affect teaching and learning in the critical care setting (Kleinpell et al., 2011). E-learning creates many advantages: it is interactive, requires less physician time, and it is self-paced. E-learning provides learners with a

variety of audiovisuals and demonstrations which facilitates the process of acquiring knowledge and skills in the ICU. Simulation-based learning was extremely vital in the intensive care setting. It was shown to improve trainees' knowledge and skills in the ICU (Schroedl et al., 2012). Simulation has been evaluated in the ICU to serve several purposes such as acquiring knowledge, improving skills and cultivating attitude (Grenvik, Schaefer, DeVita & Rogers, 2004).

It is crucially important to acknowledge and solve learners' need in providing variety of instructional strategies to teach in the ICU. Innovative educational approaches for learning in the ICU, which accounted for the exponential growth in medical knowledge, unique learning needs, and time constraints of the learners, while adapting to the dynamic and clinically demanding environment of the ICU are required (Croley & Rothenberg, 2007; Prober & Heath, 2012). Virtual teaching was used less frequently with fewer than 30% of programs using internet-based educational materials, simulation (human patient simulation, partial task simulators, and virtual reality simulators), and standardized patients (Chudgar et al., 2009). Adult learning, flipped classroom, simulation, personal portable electronic devices, and online education are all potential alternative teaching methods (Bhave & Brzezinski, 2013). Traditional pedagogical teaching methods were not ideal for the ICU's rapidly changing environment. Social media, online lecture resources, and a collaborative community would make this information more accessible, as well as foster discussion and development (Tainter et al., 2015). It is well acknowledged that e-learning technologies were beneficial for education and competency training. Several specific benefits such as having increased control over content learning, the ability to pace learning, control over time allocated for learning

activities, and the availability of enhanced media which allowed the learner to tailor their personal learning experiences. E-learning facilitated learning anywhere and at any time as web-based resources were readily available and could easily be integrated into critical care educational programs. Using e-learning resources also creates potential time savings implications for learners in the face of work hour restrictions for trainees and limited funding for educational time for critical care professionals.

Comparisons between e-learning and traditional methods of education, such as didactic lecture-based sessions demonstrated that e-learning was equivalent to traditional approaches in achieving learning outcomes (Cook, Beckman, Thomas & Thompson, 2008; see also Woltering, Herrler, Spitzer & Spreckelsen, 2009). In addition, the integration of e-learning in medical education was found to result in enhanced learning, increased interactivity, and improved self-learning experience (Tegtmeyer, Ibsen & Goldstein, 2001). Strategies for integrating web-based resources include ensuring access to resources during training programs. Electronic educational resources could be integrated with didactic learning and assessments through e-portfolios or clinical tools such as educational management systems. Programs like Virtual Critical Care Rounds (VCCR) enabled program directors to register trainees and track their progress across content areas as well as their performance on exams. Utilizing innovative methods, which included problem-based learning discussions or objective structural clinical examinations to better inspire more active discussions and knowledge retention (Rogers et al., 2000), trainees' knowledge and enthusiasm toward critical care medicine could be enhanced by microsimulation with computer-based virtual reality programs such as fiberoptic bronchoscopy or with macrosimulation utilizing full human patient simulators (Grenvik

et al., 2004). A simulation is ideally suited for critical care medicine. It allows demonstrations of many complex scenarios and errors to occur in a controlled environment which eliminated the concern for patient safety and permits repetition and structural debriefing.

**Barriers and obstacles for teaching and learning in the ICU.** The main learning barriers for the ICU trainees were unclear expectations, goals, and objectives of the ICU rotation followed by too many distractions in the ICU, the ICU environment was not helpful for learning, and there was not enough time for learning. While from the ICU physicians' perspective, the main teaching obstacles were not enough time for teaching, too many distractions, unclear expectations, goals, and objectives of the ICU rotation, the ICU environment was not helpful for teaching, and the presence of high number of trainees. The findings presented the priorities for both ICU trainees and physicians per their ratings. For ICU trainees, the most critical barrier was the lack of expectations and goals of the ICU rotation. This could be explained by the fact that an ideal education curriculum or standardized approach for critical care medicine education had not been established (Almoosa et al., 2010; Barrett & Bion, 2005; Shen, Joynt, Critchley, Tan & Lee, 2003) and consequently, a structured and systematic approach for learning would not be achieved. It has been strongly advocated to have specific curricula for trainees rotating in the ICU with topics encountered exclusively in the ICU to be included (Buchman, 2008).

While the most important obstacle for ICU physicians was insufficient time for teaching, this could be explained by the nature of the ICU environment and the competing responsibilities for ICU physicians. One study reported that ICU physicians

made more than 100 daily critical care decisions during rounds (McKenzie et al., 2015) which displayed how intense and stressful the ICU environment is to ICU physicians in managing critically ill patients. In addition, there are other administrative, teaching, and research responsibilities for both ICU physicians and trainees (Lorin, 2005). Both ICU trainees and physicians reported that the ICU was not supportive for clinical teaching due to factors related to space and availability of teaching and learning aids. Factors related to the structure and organization of the ICU to make it fit to provide patient care and serve as a better learning environment have been advocated (Valentin & Ferdinande, 2011). These factors include the availability of a formal teaching room for discussion equipped with seating, projection facilities, wall board, video equipment, and an internet connection. The ICU physicians reported that the high number of trainees was one of the obstacles to provide optimal teaching. This finding may need to be interpreted in the context where the study was conducted. This study was performed in a large academic institute with a variety of specialties and training programs, thus it is expected to have a high number of trainees. This obstacle adds to the existing evidence the importance of implementing innovative, effective, and efficient teaching strategies in the critical care setting to overcome the current barriers and obstacles.

**Limitations**

The study has several limitations. The study examined the perception of ICU trainees and physicians. Self-reporting of participants' perception is subjective; thus, their perceptions could have been affected by several personal and environmental factors when they completed the survey and did not reflect the objective nature of the critical care teaching and learning. One of the main points was subjects' understanding of each

category and question of the Maastricht clinical teaching questionnaire which could have influenced their answers.

The survey was a post-event documenting the perception of ICU trainees and physicians of what they experienced in the ICU; hence, there is a possibility of recall bias. The sample size was small; thus, answers might not be generalized. Yet this was a selective sample which involved trainees and physicians who worked specifically in the ICU; thus, it would be representative for the ICU setting. To overcome this limitation, the effect size was calculated in the data analysis. The ICU trainees rated multiple ICU physicians at the same time; thus, their experiences with one ICU physician might affect the rating process to the overall teaching practices of all ICU physicians. The study was conducted in a large academic center with tertiary intensive care units. The results may not be generalized to all types of ICUs, especially, small community-based programs.

## Implications

**Implications for future research.** The study examined several areas of the teaching process in the ICU. Future research to investigate the use of different instructional methods in the ICU and to evaluate their effects and significance for both ICU teachers and learners is necessary. Qualitative studies may also provide additional knowledge to address how to improve the teaching process in the ICU and find solutions for the barriers and obstacles identified.

**Implications for practice.** The study showed that the ICU is an optimal environment for teaching and learning complex clinical cases with a higher level of acuity yet had a variety of barriers and obstacles for teaching and learning to ICU learners and teachers, specifically distractions, being disorganized, and insufficiently equipped for teaching and learning. Finding solutions for these problems could enhance the learning process and facilitate the teaching process. Conducting quality improvement projects to address distractions in the ICU and creating a better physical learning space in the ICU may affect the overall perception of ICU learners and teachers and improve learning.

**Implications for education and training.** The main finding of the study was the significant difference between the perception of the ICU learners compared with the perceptions of the ICU teachers of the five categories of the Maastricht clinical teaching questionnaire: modeling, coaching, exploration, articulation, and learning climate. The ICU trainees rated the ICU physicians significantly lower and the ICU physicians who served as teachers may have lacked the necessary knowledge and skills to function as clinical teachers in the ICU setting. This area represents a serious challenge to the teaching and learning process which necessitates an organized intervention to improve ICU physicians' teaching skills, and to offer ICU trainees an optimal learning experience.

## Conclusions

This study examined the teaching practices, the learning climate, the preferred instructional methods in the ICU, the ICU environment, and the barriers and obstacles for the teaching and learning processes in the ICU. ICU physicians perceived their teaching practices and the learning climate to be in the range of satisfactory (higher) while ICU

trainees perceived the teaching practices and the learning climate to be significantly lower. Although the intensive care unit provided an optimal teaching environment for a variety of complex clinical cases, acute care management, and procedural skills, the environment had many challenges to the teaching and learning process. The preferred instructional method for ICU learners was a combination of instructional strategies to overcome some of the barriers of the ICU learning environment. Table 10 displays the findings and recommendations of the study.

Table 10

*Findings and Recommendation*

| Findings | Recommendations |
|---|---|
| 1. Suboptimal ICU physicians' teaching practices | Faculty development courses for certification in clinical teaching |
| 2. Suboptimal ICU learning climate | Creating a positive and supportive learning climate |
| 3. Trainees preferred different instructional strategies | Variety of teaching strategies should be available to trainees in the ICU |
| 4. Unclear goals and objectives of the ICU rotation | Establishing clear and organized goals and objectives of the ICU rotation for ICU learners and teachers |
| 5. ICU environment is not supportive for teaching and learning | Addressing barriers of the ICU environment such as distraction, space, learning aids and resources |

**Recommendations**

ICU physicians who serve as clinical teachers for trainees in the ICU should be required to have faculty development courses for certification to be qualified to function as teachers in the critical care setting. A variety of instructional strategies should be available to ICU trainees to optimize learning in the ICU. Establishing clear and structured goals and objectives for the ICU rotation for ICU learners and teachers is

essential. Creating protocols to decrease interruption in the ICU to enhance the learning process may improve teaching and learning. Providing an optimal learning environment in the ICU which includes, but is not limited to, dedicated space, demonstrations, audiovisual educational resources, online educational material, and simulations may facilitate teaching and learning in the ICU. Further studies are needed to investigate a larger sample size of ICU trainees and physicians and the effects of applying different instructional methods on the learning process in the ICU.

# References

Afessa, B. (2006). Intensive care unit physician staffing: Seven days a week, 24 hours a day. *Critical Care Medicine, 34*(3), 894-895. http://dx.doi.org/10.1097/01.ccm.0000202443.69670.6b

Afessa, B., Kennedy, C., Klarich, K., Aksamit, T., Kolars, J., & Hubmayr, R. (2005). Introduction of a 14-hour work shift model for house staff in the Medical ICU. Chest, 128(6), 3910-3915. http://dx.doi.org/10.1378/chest.128.6.3910

Almoosa, K., Goldenhar, L., Puchalski, J., Ying, J., & Panos, R. (2010). Critical care education during internal medicine residency: A national survey. *Journal of Graduate Medical Education, 2*(4), 555-561. http://dx.doi.org/10.4300/jgme-d-10-00023.1

American Board of Internal Medicine. (2017). Critical care medicine certification policies. Retrieved from http://www.abim.org/certification/policies/internal-medicine-subspecialty-policies/critical-care-medicine.aspx

American College of Physicians. (2017). Critical care medicine. Retrieved from https://www.acponline.org/about-acp/about-internal-medicine/subspecialties/additional-training-options/critical-care

Ambrose, S. (2010). *How learning works*. San Francisco, CA: Jossey-Bass

Amin, P., Fox-Robichaud, A., Divatia, J., Pelosi, P., Altintas, D., & Eryüksel, E. et al. (2016). The intensive care unit specialist: Report from the task force of world federation of societies of intensive and critical care medicine. *Journal of Critical Care, 35*, 223-228. http://dx.doi.org/10.1016/j.jcrc.2016.06.001

Angus, D. (2000). Current and projected workforce requirements for care of the critically ill and patients with pulmonary disease. Can we meet the requirements of an aging population? *The Journal of the American Medical Association, 284*(21), 2762. http://dx.doi.org/10.1001/jama.284.21.2762

Angus, D. (2006). Critical care delivery in the United States: Distribution of services and compliance with Leapfrog recommendations. *Critical Care Medicine, 34*(4), 1016-1024. http://dx.doi.org/10.1097/01.ccm.0000206105.05626.15

Arah, O., Hoekstra, J., Bos, A., & Lombarts, K. (2011). New tools for systematic evaluation of teaching qualities of medical faculty: Results of an ongoing multi-center survey. *Plos ONE, 6*(10), e25983. http://dx.doi.org/10.1371/journal.pone.0025983

Barrett, H., & Bion, J. (2005). An international survey of training in adult intensive care medicine. *Intensive Care Medicine, 31*(4), 553-561. http://dx.doi.org/10.1007/s00134-005-2583-7

Besso, J., Bhagwanjee, S., Takezawa, J., Prayag, S., & Moreno, R. (2006). A global view of education and training in critical care medicine. *Critical Care Clinics, 22*(3), 539-546. http://dx.doi.org/10.1016/j.ccc.2006.04.001

Bhave, M., & Brzezinski, M. (2013). Teaching in the ICU. *ICU Director, 4*(6), 270-278. http://dx.doi.org/10.1177/1944451613510317

Boerboom, T., Mainhard, T., Dolmans, D., Scherpbier, A., Van Beukelen, P., & Jaarsma, A. (2012). Evaluating clinical teachers with the Maastricht clinical teaching questionnaire: How much teacher is in student ratings? *Medical Teacher, 34*(4), 320-326. http://dx.doi.org/10.3109/0142159x.2012.660220

Buchman, T. (2008). Achieving the aims of education: curricular decisions in critical care. *Critical Care, 12*(6), 188. http://dx.doi.org/10.1186/cc7094

Buckley, J., Addrizzo-Harris, D., Clay, A., Curtis, J., Kotloff, R., & Lorin, S. et al. (2009). Multisociety task force recommendations of competencies in pulmonary and critical care medicine. *American Journal of Respiratory and Critical Care Medicine, 180*(4), 290-295. http://dx.doi.org/10.1164/rccm.200904-0521st

Carlos, W., Kritek, P., Clay, A., Luks, A., & Thomson, C. (2016). Teaching at the bedside: Maximal impact in minimal time. *Annals of The American Thoracic Society, 13*(4):545-8. http://dx.doi.org/10.1513/annalsats.201601-018as

Carrillo-Esper, R. (2011). La educación en la unidad de cuidados intensivos. *Cirugia Cirujanos, 79*(1), 92-99. Retrieved from http://www.medigraphic.com/pdfs/circir/cc-2011/cc111m.pdf

Carson, S. (1996). Effects of organizational change in the medical intensive care unit of a teaching hospital. *The Journal of the American Medical Association, 276*(4), 322. http://dx.doi.org/10.1001/jama.1996.03540040066035

Chuang, C., Tseng, P., Lin, C., Lin, K., & Chen, Y. (2016). Burnout in the intensive care unit professionals. *Medicine, 95*(50), e5629. http://dx.doi.org/10.1097/md.0000000000005629

Chudgar, S., Cox, C., Que, L., Andolsek, K., Knudsen, N., & Clay, A. (2009). Current teaching and evaluation methods in critical care medicine: Has the Accreditation Council for Graduate Medical Education affected how we practice and teach in the intensive care unit? *Critical Care Medicine, 37*(1), 49-60. http://dx.doi.org/10.1097/ccm.0b013e31819265c8

Clay, A., Que, L., Petrusa, E., Sebastian, M., & Govert, J. (2007). Debriefing in the intensive care unit: A feedback tool to facilitate bedside teaching. *Critical Care Medicine, 35*(3), 738-754. http://dx.doi.org/10.1097/01.ccm.0000257329.22025.18

Collins, A. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. B. Resnick (Ed.), Knowing, learning, and instruction: Essays in honor of Robert Glaser. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc.

Cook, D., Beckman, T., Thomas, K., & Thompson, W. (2008). Adapting web-based instruction to residents' knowledge improves learning efficiency. Journal of *General Internal Medicine, 23*(7), 985-990. http://dx.doi.org/10.1007/s11606-008-0541-0

Cottrell, D., Kilminster, S., Jolly, B., & Grant, J. (2002). What is effective supervision and how does it happen? A critical incident study. *Medical Education, 36*(11), 1042-1049. http://dx.doi.org/10.1046/j.1365-2923.2002.01327

Cox, C., Carson, S., Ely, E., Govert, J., Garrett, J., & Brower, R. et al. (2003). Effectiveness of medical resident education in mechanical ventilation. American *Journal of Respiratory and Critical Care Medicine, 167*(1), 32-38. http://dx.doi.org/10.1164/rccm.200206-624oc

Cramer, D., & Howitt, D. (2004). A practical resource for students in the social sciences (1st ed.). London: Sage Pub.

Croley, W., & Rothenberg, D. (2007). Education of trainees in the intensive care unit. *Critical Care Medicine, 35*(Suppl), S117-S121. http://dx.doi.org/10.1097/01.ccm.0000252917.25301.18

Dara, S., & Afessa, B. (2005). Intensivist-to-bed ratio. *Chest, 128*(2), 567-572. http://dx.doi.org/10.1378/chest.128.2.567

Donchin, Y., & Seagull, F. (2002). The hostile environment of the intensive care unit. *Current Opinion in Critical Care, 8*(4), 316-320. http://dx.doi.org/10.1097/00075198-200208000-00008

Dorman, T., Angood, P., Angus, D., Clemmer, T., Cohen, N., & Durbin, C. et al. (2004). Guidelines for critical care medicine training and continuing medical education. *Critical Care Medicine, 32*(1), 263-272. http://dx.doi.org/10.1097/01.ccm.0000104916.33769.9a

Dunn, W. (2003). Education theory applied to critical Care. *American Journal of Respiratory and Critical Care Medicine, 167*(1), 4-5. http://dx.doi.org/10.1164/rccm.2210008

Education Commission for Foreign Medical Graduates. (2017). ACGME core competencies. Retrieved from https://www.ecfmg.org/echo/acgme-core-competencies.html

Ferri, M., Zygun, D., Harrison, A., & Stelfox, H. (2015). Evidence-based design in an intensive care unit: End-user perceptions. *BioMedCentral Anesthesiology, 15*(1). http://dx.doi.org/10.1186/s12871-015-0038-4

Fessler, H., Addrizzo-Harris, D., Beck, J., Buckley, J., Pastores, S., & Piquette, C. et al. (2014). Entrustable professional activities and curricular milestones for fellowship training in pulmonary and critical care medicine. *Critical Care Medicine, 42*(10), 2290-2291. http://dx.doi.org/10.1097/ccm.0000000000000615

Fishman, A., & Elias, J. (2008). Fishman's pulmonary diseases and disorders. New York: McGraw-Hill Medical.

Garland, A. (2010). Figuring out what works: A need for more and better studies on the relationship between ICU organization and outcomes. *Critical Care, 14*(1), 108. http://dx.doi.org/10.1186/cc8843

Gjerde, C. (1982). Resident and faculty perceptions of effective teaching in family practice. *The Journal of Family Practice, 14*(2), 323 - 327.

Grenvik, A., Schaefer, J., DeVita, M., & Rogers, P. (2004). New aspects on critical care medicine training. *Current Opinion in Critical Care, 10*(4), 233-237. http://dx.doi.org/10.1097/01.ccx.0000132654.52131.32

Guidelines for advanced training for physicians in critical care. (1997). *Critical Care Medicine, 25*(9), 1601-1607. http://dx.doi.org/10.1097/00003246-199709000-00032

Guidelines for resident physician training in critical care medicine. (1995). *Critical Care Medicine, 23*(11), 1920-1923. http://dx.doi.org/10.1097/00003246-199511000-00020

Hall, J., Schmidt, G., & Kress, J. (2015). Principles of critical care (1st ed.). New York [u.a.]: McGraw-Hill Education.

Halpern, N., & Pastores, S. (2015). Critical care medicine beds, use, occupancy, and costs in the United States. *Critical Care Medicine, 43*(11), 2452-2459. http://dx.doi.org/10.1097/ccm.0000000000001227

Halpern, N., Pastores, S., Oropello, J., & Kvetan, V. (2013). Critical care medicine in the United States. *Critical Care Medicine, 41*(12), 2754-2761. http://dx.doi.org/10.1097/ccm.0b013e318298a6fb

Hanson, C., Durbin, C., Maccioli, G., Deutschman, C., Sladen, R., Pronovost, P., & Gattinoni, L. (2001). The anesthesiologist in critical care medicine. *Anesthesiology, 95*(3), 781-788. http://dx.doi.org/10.1097/00000542-200109000-00034

Hayes, C., Rhee, A., Detsky, M., Leblanc, V., & Wax, R. (2007). Residents feel unprepared and unsupervised as leaders of cardiac arrest teams in teaching hospitals: A survey of internal medicine residents. *Critical Care Medicine, 35*(7), 1668-1672. http://dx.doi.org/10.1097/01.ccm.0000268059.42429.39

Holland, J. (2006). Studying Complex Adaptive Systems. *Journal of Systems Science and Complexity*, *19*(1), 1-8. http://dx.doi.org/10.1007/s11424-006-0001-z

Hospital News. (2018). A day in the life of the ICU at Mount Sinai Hospital. Retrieved from http://hospitalnews.com/a-day-in-the-life-of-the-icu-at-mount-sinai-hospital/

International standards for programmes of training in intensive care medicine in Europe. (2010). *Intensive Care Medicine, 37*(3), 385-393. http://dx.doi.org/10.1007/s00134-010-2096-x

Irby, D., Ramsey, P., Gillmore, G., & Schaad, D. (1991). Characteristics of effective clinical teachers of ambulatory care medicine. *Academic Medicine, 66*(1), 54-5. http://dx.doi.org/10.1097/00001888-199101000-00017

Janicik, R., & Fletcher, K. (2003). Teaching at the bedside: a new model. *Medical Teacher*, *25*(2), 127-130. http://dx.doi.org/10.1080/0142159031000092490

Jastremski, C. (2000). ICU bedside environment. *Critical Care Clinics, 16*(4), 723-734. http://dx.doi.org/10.1016/s0749-0704(05)70143-3

Jordan, J., Yarris, L., Santen, S., Guth, T., Rougas, S., Runde, D., & Coates, W. (2017). Creating a cadre of fellowship-trained medical educators, part II. Academic Medicine, 92(8), 1181-1188. http://dx.doi.org/10.1097/acm.0000000000001460

Kahn, J., Ten Have, T., & Iwashyna, T. (2009). The relationship between hospital volume and mortality in mechanical ventilation: An instrumental variable analysis. *Health Services Research, 44*(3), 862-879. http://dx.doi.org/10.1111/j.1475-6773.2009.00959.x

Kaplan, L. (2011). Standards for education and credentialing in critical care medicine. *The Journal of the American Medical Association, 305*(3), 296. http://dx.doi.org/10.1001/jama.2010.1997

Kelly, J. (2013). Where night is day (1st ed.). Ithaca: ILR Press.

Kelly, M., Bennett, D., & McDonald, P. (2012). Evaluation of clinical teaching in general practice using the Maastricht clinical teaching questionnaire. *Medical Teacher, 34*(12), 1089-1089. http://dx.doi.org/10.3109/0142159x.2012.716562

KevinMD.com (2018). An ICU physician's work is never done. Retrieved from https://www.kevinmd.com/blog/2014/04/icu-physicians-work.html

Kim, M. (2010). The effect of multidisciplinary care teams on intensive care unit mortality. *Archives of Internal Medicine, 170*(4), 369. http://dx.doi.org/10.1001/archinternmed.2009.521

Kirk, R. (1996). Practical Significance: A Concept Whose Time Has Come. *Educational and Psychological Measurement, 56*(5), 746-759. http://dx.doi.org/10.1177/0013164496056005002

Kleinpell, R., Ely, E., Williams, G., Liolios, A., Ward, N., & Tisherman, S. (2011). Web-based resources for critical care education. *Critical Care Medicine, 39*(3), 541-553. http://dx.doi.org/10.1097/ccm.0b013e318206b5b5

Lassen, H. (1953). A preliminary report of the 1952 epidemic of poliomyelitis in Copenhagen with special reference to the treatment of acute respiratory insufficiency. *The Lancet, 261*(6749), 37-41. http://dx.doi.org/10.1016/s0140-6736(53)92530-6

Leape, L. (1999). Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. *The Journal of the American Medical Association, 282*(3), 267. http://dx.doi.org/10.1001/jama.282.3.267

Lim, K., Dunn, W., Klarich, K., & Afessa, B. (2005). Internal medicine resident education in the medical intensive care unit: The impact on education and patient care of a scheduling change for didactic sessions. *Critical Care Medicine, 33*(7), 1534-1537. http://dx.doi.org/10.1097/01.ccm.0000168595.03058.6d

Loftus, T., McLeod, P., & Snell, L. (1993). Faculty perceptions of effective ambulatory care teaching. *Journal of General Internal Medicine, 8*(10), 575-577. http://dx.doi.org/10.1007/bf02599643

Lorin, S., Heffner, J., & Carson, S. (2005). Attitudes and perceptions of internal medicine residents regarding pulmonary and critical care subspecialty training. *Chest, 127*(2), 630-636. http://dx.doi.org/10.1378/chest.127.2.630

Lott, J., Iwashyna, T., Christie, J., Asch, D., Kramer, A., & Kahn, J. (2009). Critical illness outcomes in specialty versus general intensive care units. *American Journal of Respiratory and Critical Care Medicine, 179*(8), 676-683. http://dx.doi.org/10.1164/rccm.200808-1281oc

Manthous, C., Nembhard, I., & Hollingshead, A. (2011). Building effective critical care teams. *Critical Care, 15*(4), 307. http://dx.doi.org/10.1186/cc10255

Marshall, J., Bosco, L., Adhikari, N., Connolly, B., Diaz, J., & Dorman, T. et al. (2017). What is an intensive care unit? A report of the task force of the world federation of societies of intensive and critical care medicine. *Journal of Critical Care, 37*, 270-276. http://dx.doi.org/10.1016/j.jcrc.2016.07.015

McKenzie, M., Auriemma, C., Olenik, J., Cooney, E., Gabler, N., & Halpern, S. (2015). An observational study of decision making by medical intensivists. *Critical Care Medicine, 43*(8), 1660-1668. http://dx.doi.org/10.1097/ccm.0000000000001084

McLeod, P., James, C., & Abrahamowicz, M. (1993). Clinical tutor evaluation: A 5-year study by students on an in-patient service and residents in an ambulatory care clinic. *Medical Education, 27*(1), 48-54. http://dx.doi.org/10.1111/j.1365-2923.1993.tb00228.x

Merlani, P., Verdon, M., Businger, A., Domenighetti, G., Pargger, H., & Ricou, B. (2011). Burnout in ICU caregivers. *American Journal of Respiratory and Critical Care Medicine, 184*(10), 1140-1146. http://dx.doi.org/10.1164/rccm.201101-0068oc

Modrykamien, A. (2011). The ICU follow-up clinic: A new paradigm for intensivists. *Respiratory Care, 57*(5):764-72. http://dx.doi.org/10.4187/respcare.01461

Mohanna, K. (2007). The use of elearning in medical education. *Postgraduate Medical Journal, 83*(978), 211-211. http://dx.doi.org/10.1136/pgmj.2007.058610

Morrison, E. (2005). The on-line clinical teaching perception inventory: A snapshot of medical teachers. *Journal of Family Medicine, 37*(1), 48 - 53.

Nasca, T., Philibert, I., Brigham, T., & Flynn, T. (2012). The next GME accreditation system — Rationale and Benefits. *New England Journal of Medicine, 366*(11), 1051-1056. http://dx.doi.org/10.1056/nejmsr1200117Pacheco, E., Campos, I., Seixas, J., Conejo, S., Vieira, H., & Mazutti, S. et al. (2011). Daily multidisciplinary rounds reduce ICU length of stay. *Critical Care, 15*(S2), 53. http://dx.doi.org/10.1186/cc10201

Peets, A., McLaughlin, K., Lockyer, J., & Donnon, T. (2008). So much to teach, so little time: a prospective cohort study evaluating a tool to select content for a critical care curriculum. *Critical Care, 12*(5), R127. http://dx.doi.org/10.1186/cc7087

Prober, C., & Heath, C. (2012). Lecture halls without lectures — A proposal for medical education. *New England Journal of Medicine, 366*(18), 1657-1659. http://dx.doi.org/10.1056/nejmp1202451

Pronovost, P. (2002). Physician staffing patterns and clinical outcomes in critically ill patients. *The Journal of the American Medical Association, 288*(17), 2151. http://dx.doi.org/10.1001/jama.288.17.2151

Ramani, S., & Leinster, S. (2008). AMEE Guide no. 34: Teaching in the clinical environment. *Medical Teacher, 30*(4), 347-364. http://dx.doi.org/10.1080/01421590802061613

Reisner-Sénélar, L. (2011). The birth of intensive care medicine: Björn Ibsen's records. *Intensive Care Medicine, 37*(7), 1084-1086. http://dx.doi.org/10.1007/s00134-011-2235-z

Reynolds, H. (1988). Impact of critical care physician staffing on patients with septic shock in a university hospital medical intensive care unit. *The Journal of the American Medical Association, 260*(23), 3446. http://dx.doi.org/10.1001/jama.1988.03410230064029

Rogers, P., Jacob, H., Thomas, E., Harwell, M., Willenkin, R., & Pinsky, M. (2000). Medical students can learn the basic application, analytic, evaluative, and psychomotor skills of critical care medicine. *Critical Care Medicine, 28*(2), 550-554. http://dx.doi.org/10.1097/00003246-200002000-00043

Safar, P., DeKornfeld, T., Pearson, J., & Redding, J. (1961). The intensive care unit. *Anaesthesia, 16*(3), 275-284. http://dx.doi.org/10.1111/j.1365-2044.1961.tb13827.

Santhosh, L., Jain, S., Brady, A., Sharp, M., & Carlos, W. (2017). Intensive care unit educators: A multicenter evaluation of behaviors residents value in attending physicians. *Annals of The American Thoracic Society, 14*(4), 513-516. http://dx.doi.org/10.1513/annalsats.201612-996bc

Schroedl, C., Corbridge, T., Cohen, E., Fakhran, S., Schimmel, D., McGaghie, W., & Wayne, D. (2012). Use of simulation-based education to improve resident learning and patient care in the medical intensive care unit: A randomized trial. *Journal of Critical Care, 27*(2), 219.e7-219.e13. http://dx.doi.org/10.1016/j.jcrc.2011.08.006

Shen, J., Joynt, G., Critchley, L., Tan, I., & Lee, A. (2003). Survey of current status of intensive care teaching in English-speaking medical schools. *Critical Care Medicine, 31*(1), 293-298. http://dx.doi.org/10.1097/00003246-200301000-00047

Spencer, J. (2003). ABC of learning and teaching in medicine: Learning and teaching in the clinical environment. *British Medical Journal, 326*(7389), 591-594. http://dx.doi.org/10.1136/bmj.326.7389.591

Stalmeijer, R., Dolmans, D., Wolfhagen, I., Muijtjens, A., & Scherpbier, A. (2010). The Maastricht clinical teaching questionnaire (MCTQ) as a valid and reliable instrument for the evaluation of clinical teachers. *Academic Medicine, 85*(11), 1732-1738. http://dx.doi.org/10.1097/acm.0b013e3181f554d6

Stalmeijer, R., Dolmans, D., Wolfhagen, I., Muijtjens, A., & Scherpbier, A. (2008). The development of an instrument for evaluating clinical teachers: involving stakeholders to determine content validity. *Medical Teacher, 30*(8), e272-e277. http://dx.doi.org/10.1080/01421590802258904

Surani, S., Guntupalli, K., Wachtel, S., & Mallampalli, A. (2014). Burnout in the intensive care unit professionals. *Indian Journal of Critical Care Medicine, 18*(3), 139. http://dx.doi.org/10.4103/0972-5229.128703

Tainter, C., Wong, N., & Bittner, E. (2015). Innovative strategies in critical care education. *Journal of Critical Care, 30*(3), 550-556. http://dx.doi.org/10.1016/j.jcrc.2015.02.001

Tainter, C., Wong, N., Cudemus-Deseda, G., & Bittner, E. (2017). The Flipped Classroom model for teaching in the intensive care unit. *Journal of Intensive Care Medicine, 32*(3), 187-196. http://dx.doi.org/10.1177/0885066616632156

Tegtmeyer, K., Ibsen, L., & Goldstein, B. (2001). Computer-assisted learning in critical care: From ENIAC to HAL. *Critical Care Medicine, 29*(Supplement), N177-N182. http://dx.doi.org/10.1097/00003246-200108001-00006

The Leap Frog Group. (2016). ICU physician staffing. Retrieved from http://www.leapfroggroup.org/survey

Torralba, K., Loo, L., Byrne, J., Baz, S., Cannon, G., & Keitz, S. et al. (2016). Does psychological safety impact the clinical learning environment for resident physicians? Results from the VA's learners' perceptions survey. *Journal of Graduate Medical Education, 8*(5), 699-707. http://dx.doi.org/10.4300/jgme-d-15-00719.1

UCSF Department of Anesthesia. (2018). A typical day in the ICU. Retrieved from https://anesthesia.ucsf.edu/typical-day-icu

Vachon, F. (2010). Histoire de la réanimation médicale française: 1954–1975. *Réanimation, 20*(1), 72-78. http://dx.doi.org/10.1007/s13546-010-0141-y

Valentin, A., & Ferdinande, P. (2011). Recommendations on basic requirements for intensive care units: structural and organizational aspects. *Intensive Care Medicine, 37*(10), 1575-1587. http://dx.doi.org/10.1007/s00134-011-2300-7

Wang, Y., Yang, X., Talmy, T., Zhu, C., Li, P., & Wang, W. et al. (2017). Evaluation of teaching and learning: A basis for improvement in medical education. *Chinese Medical Journal, 130*(10), 1259. http://dx.doi.org/10.4103/0366-6999.205851

Ward, N., Read, R., Afessa, B., & Kahn, J. (2012). Perceived effects of attending physician workload in academic medical intensive care units. *Critical Care Medicine, 40*(2), 400-405. http://dx.doi.org/10.1097/ccm.0b013e318232d997

Weil, M., & Tang, W. (2011). From intensive care to critical care medicine. *American Journal of Respiratory and Critical Care Medicine, 183*(11), 1451-1453. http://dx.doi.org/10.1164/rccm.201008-1341oe

Wenham, T., & Pittard, A. (2009). Intensive care unit environment. Continuing Education in Anaesthesia, *Critical Care & Pain, 9*(6), 178-183. http://dx.doi.org/10.1093/bjaceaccp/mkp036

Wilcox, M., Chong, C., Niven, D., Rubenfeld, G., Rowan, K., Wunsch, H., & Fan, E. (2013). Do intensivist staffing patterns influence hospital mortality following ICU admission? A systematic review and meta-analyses. *Critical Care Medicine, 41*(10), 2253-2274. http://dx.doi.org/10.1097/ccm.0b013e318292313a

Woltering, V., Herrler, A., Spitzer, K., & Spreckelsen, C. (2009). Blended learning positively affects students' satisfaction and the role of the tutor in the problem-based learning process: results of a mixed-method evaluation. *Advances in Health Sciences Education, 14*(5), 725-738. http://dx.doi.org/10.1007/s10459-009-9154-6

Wong, N. (2005). Medical education in critical care. *Journal of Critical Care, 20*(3), 270-273. http://dx.doi.org/10.1016/j.jcrc.2005.08.001

Wright, S. (1996). Examining what residents look for in their role models. *Academic Medicine, 71*(3), 290-2. http://dx.doi.org/10.1097/00001888-199603000-00024

Wright, S., Kern, D., Kolodner, K., Howard, D., & Brancati, F. (1998). Attributes of excellent attending-physician role models. *New England Journal of Medicine, 339*(27), 1986-1993. http://dx.doi.org/10.1056/nejm199812313392706

Wunsch, H., Angus, D., Harrison, D., Collange, O., Fowler, R., & Hoste, E. et al. (2008). Variation in critical care services across North America and Western Europe. *Critical Care Medicine, 36*(10), 2787-e8. http://dx.doi.org/10.1097/ccm.0b013e318186aec8

# Appendix A

## Survey Letter

Dear Potential Research Subject:

We in the Department of Medicine, Pulmonary/Critical Care Section are beginning to research teaching strategies in the ICU. You are being asked to take part either at the end of your rotation in the ICU. We are contacting you because you are or have been a trainee or faculty in the ICU.

The study will address the perceptions of attending physicians and trainees in the ICU regarding the learning and teaching process in the ICU. If you fill out this anonymous questionnaire (survey), you are consenting or agreeing to take part in this research. We will take all steps legally possible to keep this information confidential.

You decide whether you want to take part or not. If you do not take part, you will lose none of your rights. It will not affect you badly in any way. You may decide to stop taking part at any time. It will not cost you to take part in this study. We will not pay you to take part.

If you have any questions about this survey or the study, please contact Dr. Mukhtar Al-Saadi. If you have additional questions about your rights as a research subject, contact the Institutional Review Board for Human Subject Research.

Sincerely,

UNIVERSITY of HOUSTON

DIVISION OF RESEARCH
Institutional Review Boards

# ACKNOWLEDGEMENT OF RELIANCE ON AN EXTERNAL IRB

January 4, 2017
Mukhtar Al-Saadi
maal-saadi@uh.edu
Dear Mukhtar Al-Saadi:
On 1/4/2017, the IRB Office reviewed your request for external IRB review for the following study:

| | |
|---|---|
| Type of Review: | Initial Study |
| Title of Study: | TEACHING IN THE INTENSIVE CARE UNIT |
| Investigator: | Mukhtar Al-Saadi |
| IRB ID: | STUDY00000123 |
| Funding/proposed funding: | Name: Unfunded |
| IND, IDE, or HDE: | None |
| Documents Reviewed: | • BCM Approval LTR 8-19-2016.pdf, Category: IRB Protocol;<br>• Survey letter 6-2016.pdf, Category: Consent Form;<br>• BCM Protocol Summary 8-19-2016.pdf, Category: IRB Protocol;<br>• BCM Approval LTR 8-19-2016.pdf, Category: Letters of Cooperation / Permission;<br>• Study Protocol Summary, Category: Other;<br>• Questionnaire for learners 2.pdf, Category: Study tools (ex: surveys, interview/focus group questions, data collection forms, etc.);<br>• Questionnaire for educators 1.pdf, Category: Recruitment Materials;<br>• Survey Letter, Category: Letters of Cooperation / Permission;<br>• Questionnaire for educators 1.pdf, Category: Study tools (ex: surveys, interview/focus group questions, data collection forms, etc.);<br>• Questionnaire for learners 2.pdf, Category: Recruitment Materials; |
| Review Category | External IRB |
| Committee Name | Not Applicable |
| IRB Coordinator | Danielle Griffin |

This notification serves to acknowledge your request to rely on Baylor College of Medicine (BCM) as the IRB of record for the above listed study and does not constitute an approval to conduct the research.

Baylor College of Medicine (BCM) review and approval of the study is required prior to study initiation.

Promptly notify the UH IRB Office upon:

1. Notification that Baylor College of Medicine (BCM) has approved the research
2. Notification that Baylor College of Medicine (BCM) has renewed its approval at continuing review
3. Any findings by the External IRB of serious or continuing non-compliance
4. Changes of the financial status of study team members that may require review for conflict of interest
5. Closure of the study

Sincerely,

Office of Research Policies, Compliance and Committees (ORPCC)
University of Houston, Division of Research
713 743 9204
cphs@central.uh.edu
http://www.uh.edu/research/compliance/irb-cphs/

## Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals

**RENEWAL**

**Protocol Number:** H-39350
**Principal Investigator:** KALPALATHA K GUNTUPALLI
**Initial Submit Date:** 06/23/2016
**Renewal Submit Date:** 05/22/2017
**Protocol Title:** SURVEY: TEACHING IN THE INTENSIVE CARE UNIT

**SUBJECTS**
During your last approval period, you were approved to enroll 200 subjects locally and 200 subjects worldwide.

LOCAL: 20
WORLDWIDE: 20

**MONITORED**
**If the study was monitored during the last approval period, please indicate by whom and provide a brief description of the findings:**
Not Applicable

**PROTOCOL STATUS**
**If the study will not be open to recruitment during the next approval period, indicate why the study should remain open:**
Not Applicable

**NEW INFORMATION**
I am aware of no new information that might effect a subject's willingness to continue participating in this study.

**GENERAL SUMMARY**
Data collection continues for this survey study. There have been no adverse events, no unanticipated problems involving risks to subjects or others, no withdrawals nor any complaints.

**RISK/BENEFIT RATIO**
The risk to benefit ratio remains on the side of benefit as to potential knowledge gained.

**EVENTS**
No Events have been reported.

**EXCEPTIONS**
No Exceptions have been reported.

**DEVIATIONS**
No Deviations have been reported.

**AMENDMENTS** (As of: 6/14/2017 10:00:32 AM) (Sort Order: Amendment Date)

**Amendment Submit Date:** 02/09/2017
**Reason:** Other Amendment
**Description:** We are changing Dr. Al-Saadi's status from Baylor to non-Baylor co-investigator. He is working with University of Houston on this project.

August 19, 2016

KALPALATHA K GUNTUPALLI
BAYLOR COLLEGE OF MEDICINE
MEDICINE: PULMONARY

Baylor College of Medicine
Office of Research
One Baylor Plaza, 600D
Houston, Texas 77030
Phone: (713) 798-6970
Fax: (713) 798-6990
Email: irb@bcm.tmc.edu

**H-39350 - SURVEY: TEACHING IN THE INTENSIVE CARE UNIT**

**APPROVAL VALID FROM 7/13/2016 TO 7/12/2017**

Dear Dr. GUNTUPALLI

The Institutional Review Board for Human Subject Research for Baylor College of Medicine and Affiliated Hospitals (BCM IRB) is pleased to inform you that the research protocol named above was reviewed and approved by Expedited procedures on 7/13/2016 by Board 3.

The study may not continue after the approval period without additional IRB review and approval for continuation. You will receive an email renewal reminder notice prior to study expiration; however, it is your responsibility to assure that this study is not conducted beyond the expiration date.

Please be aware that only IRB-approved informed consent forms may be used when written informed consent is required.

Any changes in study or informed consent procedure must receive review and approval prior to implementation unless the change is necessary for the safety of subjects. In addition, you must inform the IRB of adverse events encountered during the study or of any new and significant information that may impact a research participants' safety or willingness to continue in your study.

The BCM IRB is organized, operates, and is registered with the United States Office for Human Research Protections according to the regulations codified in the United States Code of Federal Regulations at 45 CFR 46 and 21 CFR 56. The BCM IRB operates under the BCM Federal Wide Assurance No. 00000286, as well as those of hospitals and institutions affiliated with the College.

Sincerely yours,

FLOR MUNOZ-RIVAS, M.D.
Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals

May 23, 2017

KALPALATHA K GUNTUPALLI
BAYLOR COLLEGE OF MEDICINE
MEDICINE: PULMONARY

Baylor College of Medicine
Office of Research
One Baylor Plaza, 600D
Houston, Texas 77030
Phone: (713) 798-6970
Fax: (713) 798-6990
Email: irb@bcm.tmc.edu

**H-39350 - SURVEY: TEACHING IN THE INTENSIVE CARE UNIT**

**APPROVAL VALID FROM 5/23/2017 TO 5/22/2018**

Dear Dr. GUNTUPALLI

The Institutional Review Board for Human Subject Research for Baylor College of Medicine and Affiliated Hospitals (BCM IRB) is pleased to inform you that the research protocol named above was reviewed and approved by Expedited procedures on 5/23/2017 by Board 2.

The study may not continue after the approval period without additional IRB review and approval for continuation. You will receive an email renewal reminder notice prior to study expiration; however, it is your responsibility to assure that this study is not conducted beyond the expiration date.

Please be aware that only IRB-approved informed consent forms may be used when written informed consent is required.

Any changes in study or informed consent procedure must receive review and approval prior to implementation unless the change is necessary for the safety of subjects. In addition, you must inform the IRB of adverse events encountered during the study or of any new and significant information that may impact a research participants' safety or willingness to continue in your study.

The BCM IRB is organized, operates, and is registered with the United States Office for Human Research Protections according to the regulations codified in the United States Code of Federal Regulations at 45 CFR 46 and 21 CFR 56. The BCM IRB operates under the BCM Federal Wide Assurance No. 00000286, as well as those of hospitals and institutions affiliated with the College.

Sincerely yours,

JULIE PAMELA KATKIN, M.D.

Institutional Review Board for Baylor College of Medicine and Affiliated Hospitals

# Appendix B

## Tables of Subjects Effect Size

Table B1

*Modeling: Subjects effect size*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 18.555[a] | 2 | 9.278 | 14.717 | .000 | .269 |
| Intercept | 1108.000 | 1 | 1108.000 | 1757.589 | .000 | .956 |
| Subjects | 18.555 | 2 | 9.278 | 14.717 | .000 | .269 |
| Error | 50.433 | 80 | .630 | | | |
| Total | 1177.556 | 83 | | | | |
| Corrected Total | 68.988 | 82 | | | | |

a. R Squared = .269 (Adjusted R Squared = .251)

Table B2

*Coaching: Subjects effect size*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 49.780[a] | 2 | 24.890 | 34.174 | .000 | .461 |
| Intercept | 943.923 | 1 | 943.923 | 1296.027 | .000 | .942 |
| Subjects | 49.780 | 2 | 24.890 | 34.174 | .000 | .461 |
| Error | 58.266 | 80 | .728 | | | |
| Total | 1045.889 | 83 | | | | |
| Corrected Total | 108.046 | 82 | | | | |

a. R Squared = .461 (Adjusted R Squared = .447)

Table B3

*Articulation: Subjects effect size*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 21.118[a] | 2 | 10.559 | 23.425 | .000 | .369 |
| Intercept | 1231.498 | 1 | 1231.498 | 2732.102 | .000 | .972 |
| Subjects | 21.118 | 2 | 10.559 | 23.425 | .000 | .369 |
| Error | 36.060 | 80 | .451 | | | |
| Total | 1285.778 | 83 | | | | |
| Corrected Total | 57.178 | 82 | | | | |

a. R Squared = .369 (Adjusted R Squared = .354)

Table B4

*Exploration: Subjects effect size*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 49.119[a] | 2 | 24.559 | 20.451 | .000 | .341 |
| Intercept | 760.105 | 1 | 760.105 | 632.958 | .000 | .889 |
| Subjects | 49.119 | 2 | 24.559 | 20.451 | .000 | .341 |
| Error | 94.869 | 79 | 1.201 | | | |
| Total | 888.000 | 82 | | | | |
| Corrected Total | 143.988 | 81 | | | | |

a. R Squared = .341 (Adjusted R Squared = .324)

Table B5

*Climate: Subjects effect size*

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. | Partial Eta Squared |
|---|---|---|---|---|---|---|
| Corrected Model | 46.128[a] | 2 | 23.064 | 37.606 | .000 | .485 |
| Intercept | 1121.540 | 1 | 1121.540 | 1828.708 | .000 | .958 |
| Subjects | 46.128 | 2 | 23.064 | 37.606 | .000 | .485 |
| Error | 49.064 | 80 | .613 | | | |
| Total | 1214.750 | 83 | | | | |
| Corrected Total | 95.191 | 82 | | | | |

a. R Squared = .485 (Adjusted R Squared = .472)

# Appendix C Boxplot Figures for Outliers

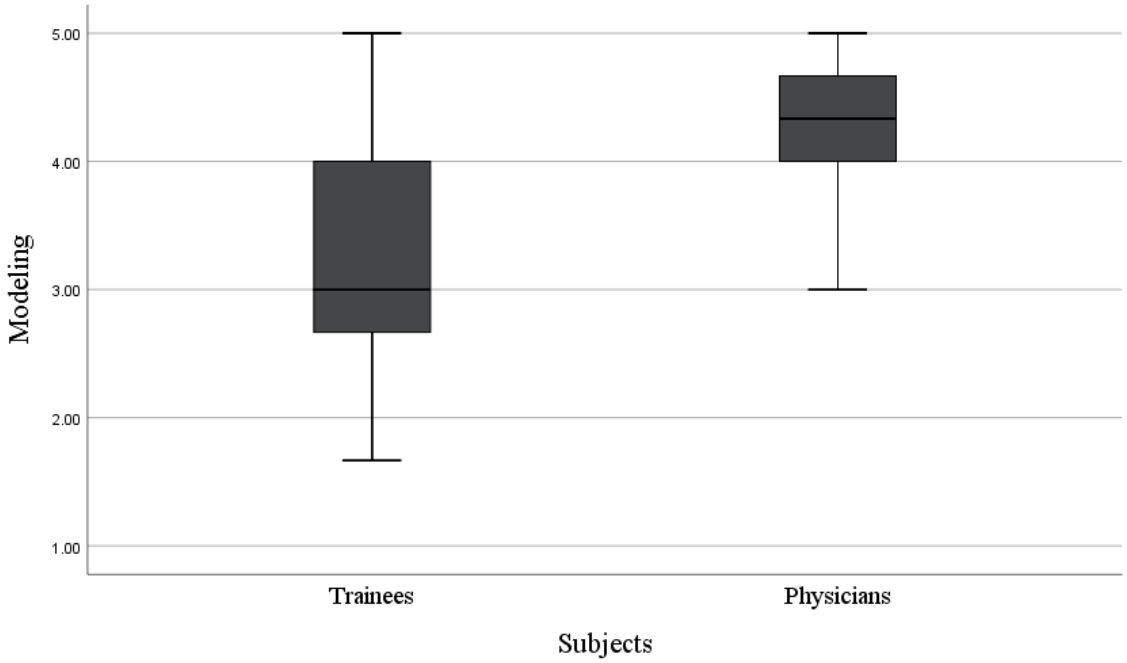


*Figure C1*. Subjects outliers for modeling

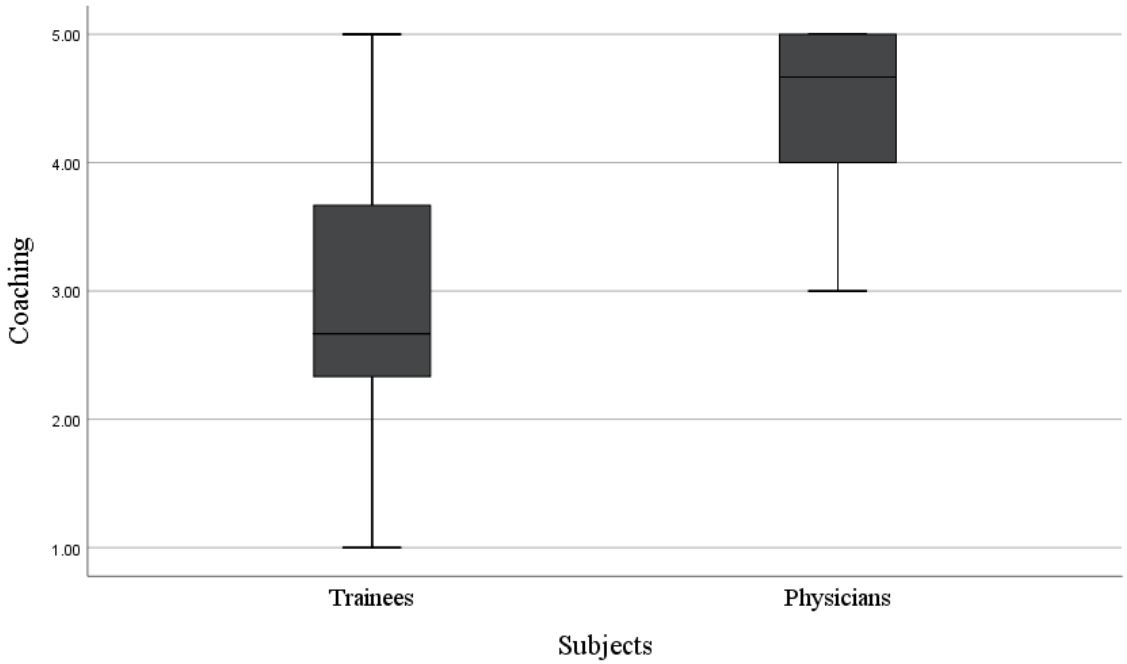


*Figure C2*. Subjects outliers for coaching

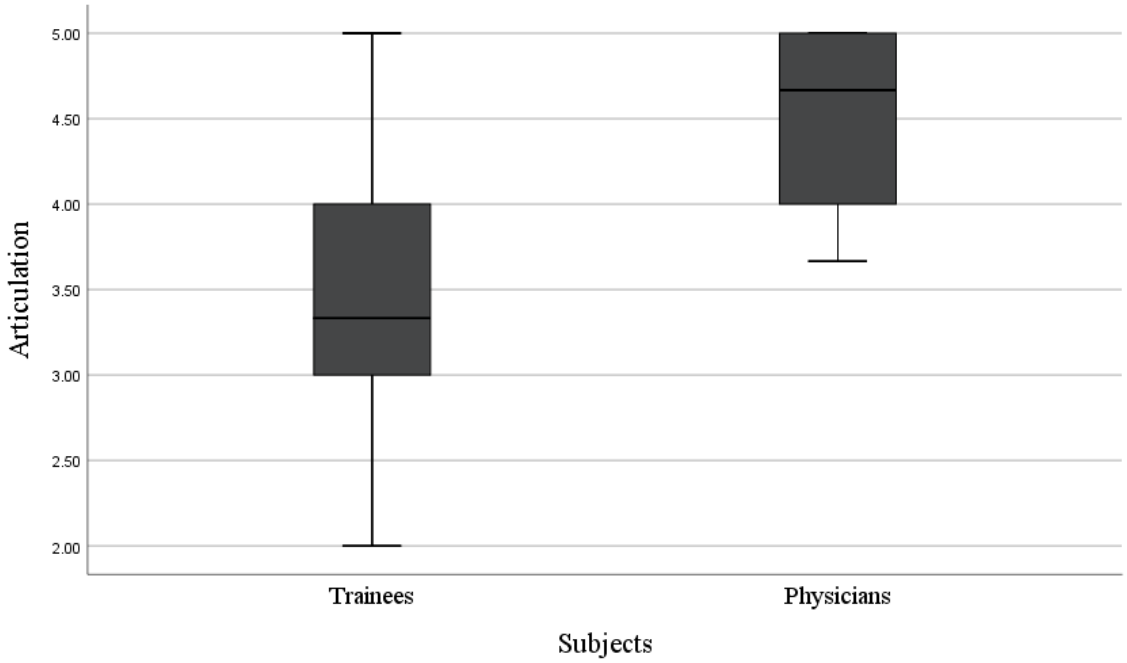


*Figure C3.* Subjects outliers for articulation

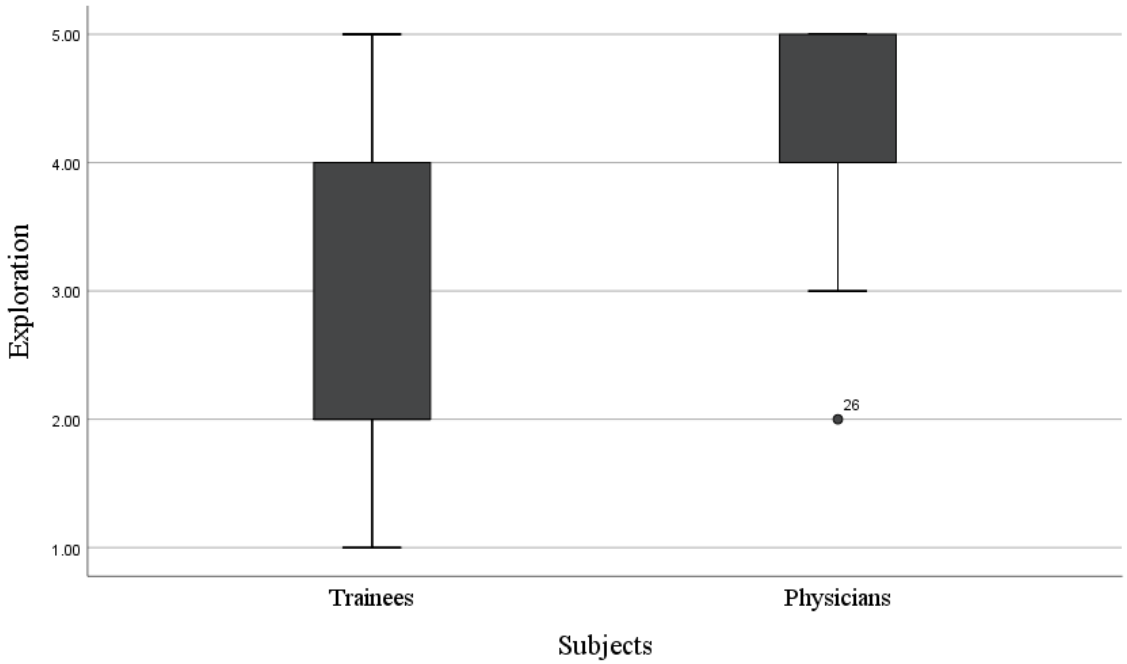


*Figure C4.* Subjects outliers for exploration

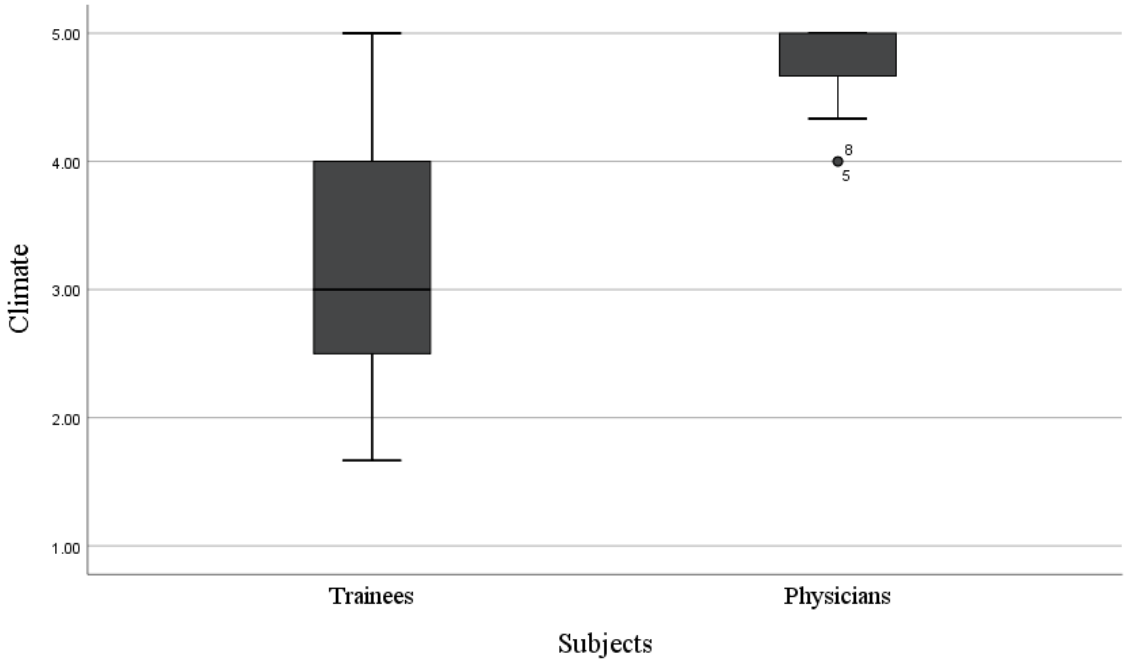


*Figure C5*. Subjects outliers for climate