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Dedication

The journey to complete my EdD has been a long one but a truly life-changing one. I dedicate this summative work to my ever-supportive spouse of 37 years, Denise, to whom I forever owe everything. To my three adult children, Kristina, Andrew, and Jaime committed to lifelong learning and contributing to the next generation of learners. To my supportive friends during my absence from life during the past three-and-a-half years. This journey would not have been possible without the never-ending support of all my Cohort #1 colleagues in this program. For my Mom for believing in me, and finally, for my Dad. I miss you.

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This work would not have been possible without the support of Orange County Emergency Services. Their commitment to improving the educational journey for prehospital providers is embedded in the everyday actions of Dinah Jeffries, Kim Woodward, Kyle Ronn, Kirby Saunders, and Dr. Joe Grover.

Thank you to all of the faculty, administration, and staff at Peabody College for preparing me to be worthy of the title of Doctor of Education.

I am endlessly thankful to my advisor, Christine Trank, for guiding the way during this journey. Thank you for the privilege of your guidance and for molding me into a true scholar-practitioner.

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Executive Summary

Orange County Emergency Services (OCES) in North Carolina responds to more than 16,000 9-1-1 calls, 24 hours a day, year-round. OCES paramedics treated 11,865 patients in FY 2019-2020 and transported 9,314 patients to medical facilities in Orange County and neighboring counties for treatment[1]. While under the care of OCES, patient treatment is provided by highly trained emergency medical services (EMS) health care providers, credentialed by the State of North Carolina as Paramedics or Emergency Medical Technicians (EMT)[2]. Paramedic training in North Carolina meets national EMS standards with up to 1,000 hours of training, including clinical education in various medical settings, which include intensive care units and hospital emergency departments. The purpose of the clinical setting training is to build up a "library" of patient care experiences to draw upon in clinical decision-making[3].

While under the care of paramedics, patients are assessed using patient interviews, history gathering and physical examination to determine a "first impression." This first impression process is intended to develop an accurate differential diagnosis, where signs and symptoms of a patient presentation are used to determine an accurate treatment plan. Treatment plans for a differential diagnosis in EMS for OCES are provided in protocols approved by the Medical Director. Differential diagnosis information is coded in patient care reports (PCRs) as first impressions, and this information is provided to receiving physicians at the emergency department (ED) for all treated patients. The first impression information is utilized by the ED as part of the patient handover process. During the handover process, completeness and accuracy of information is an important step in the continuity of patient care (Maser & Foster, 2011). Additionally, incorrect first impressions have the potential to impact patient outcomes.

[1] Orange County Annual Budget FY 2019-2020
[2] For this project, EMS providers are referred to as "paramedics" as a generic term to encompass all provider skill levels.
[3] North Carolina Office of EMS Paramedic Education Requirements

PCRs are regularly reviewed by OCES as part of an ongoing quality assurance (QA) process. During QA reviews, differences were noted in a significant portion of reviewed PCRs. While complete agreement is not expected between first impressions and the ED diagnosis, OCES does expect consistency in first impressions determined by paramedics. Additionally, inconsistencies were noted in how paramedics use the first impression codes. OCES attempted to address the differences and inconsistencies in first impressions with additional training for specific conditions, such as respiratory emergencies, in an effort to improve the paramedic's ability to correctly identify the patient's condition and subsequent treatment plans. Repeated training efforts failed to improve the rate of differences and inconsistencies. The assumption was that the paramedics' competence was responsible for the first impression differences and inconsistencies.

In an effort to understand the failure of the training efforts, OCES's assessment of the issue of inconsistency in first impressions agreement with ED physicians raised concerns that the training effort was not addressing the root cause of the inconsistencies. Using a clinical decision model that considered a rational multifaceted approach to decision-making (Donn, 2017), several primary research questions with sub-question are posed for review:

Research Question #1

When considering a paramedic's intellectual ability (instinctual ability):

How does a paramedic choose a first impression?

1. Is this dependent on patient presentation?
2. How often is this occurring?

Research Question #2

When considering a paramedic's knowledge base (cognitive ability):

What information do paramedics use to reach a first impression?

1. What information is needed to make an accurate first impression?

Research Question #3

When considering a paramedic's critical thinking skills (emotional ability):

How do paramedics learn clinical skills?

1. What role do EMS partners play in this process?
2. What role do physicians in the ED play in this process?

Research Question #4

When considering a paramedic's individual characteristics (social ability):

How do paramedics improve their competence?

1. What role do professional relationships play in professional development?

Using this approach to understanding the first impression differences and inconsistencies, the source and type of the inconsistencies were identified in patient presentations with a two-year review of secondary data. Additionally, using survey instruments and semi-structured interviews, a set of recommendations was developed to address the research questions.

Recommendation #1
(related to addressing the differences and inconsistencies in the PCRs)

A. Review the coding structure and purpose with paramedics.
B. Create a guide for coding accuracy by symptoms, event, and differential diagnosis to match treatment protocols.
C. Socialize this process with ED physicians.

Recommendation #2
(related to what information do paramedics use to reach a first impression)

A. Clarify the use of first impression coding with ED physicians for a more proficient patient information transfer process.
B. Introduce conceptual models to paramedics to aid in the decision-making process.

Recommendation #3
(related to how do paramedics learn clinical skills)

A. Provide opportunities for cross-training with EMS providers and physicians to improve the differential diagnosis of paramedics.

Recommendation #4
(related to how do paramedics improve their competence)

A. Create opportunities to establish professional learning relationships to strengthen the individual “in the moment” case feedback loop.

Ultimately, this study project identified some root causes of the differences and inconsistencies. It is not always an error in the documentation of the first impression code selection, for example, which code to use in which circumstance. Still, that first impression clinical decision-making for paramedics is a complex process and involves

multiple constructs that need various approaches to resolve. Implementation of the recommendations should improve the differences and inconsistencies and help OCES focus professional development training that improves paramedic competency and patient care outcomes.

Introduction

Emergency Medical Services (EMS) is a relatively new healthcare profession, created in the late 1960s following the publication of the landmark report *Accidental Death and Disability: The Neglected Disease* (Brooks, Sayre, Spencer, & Archer, 2016). The report set the agenda for EMS education for decades. The *EMS Education Agenda for the Future*, published in 2000 by the National Highway Traffic and Safety Administration, changed the educational direction of that original report by creating an environment for EMS to operate in an interconnected environment with other health professions. The interconnection with other professions is critical to ensure improved patient outcomes (IOM, 2007). As EMS becomes a more professional provider of health care (O'Meara, 2009), the interactions are critically important (Mohaupt, 2016). While these interactions have been extensively studied in other healthcare professions such as nurses, respiratory technicians, and physicians, EMS providers have not benefited from this type of research. EMS providers have traditionally been in the role of providers, called paramedics or EMTs[4], as it is those individuals who treat patients outside the hospital and transport patients to the emergency department for further treatment.

Paramedics are increasingly part of the healthcare service equation. For more than a decade, EMS as a profession has seen changes to its level of clinical practice, education and training. O'Meara (2009) notes that these changes have moved paramedics to a more integrated role within the healthcare system. These changes to the EMS profession in the United States are written in a document titled *EMS Agenda 2050: A People-Centered Vision for the Future of Emergency Medical Services* (EMS Technical Expert Panel, 2019). The vision outlined in the report highlights EMS systems that focus on practices that yield improved outcomes and reduce patient harm will be more successful and integrated in the healthcare system. In order to achieve this goal,

[4] For clarity in this report, all levels of EMS providers (paramedics, EMT-A, EMT-B) are referred to as paramedics.

paramedics must focus on clinical decision-making. This goal can be achieved with a focus on problem-solving patient presentations and making clinical decisions.

Clinical decision-making is a critical step in the treatment of patients in EMS (Schuster & Nathan-Roberts, 2017). Making a clinical decision guides the paramedic to treatment protocols. The challenge is that clinical decision-making is made in unpredictable, time-constrained, and oftentimes urgent situations (Reay et al., 2018). Moreover, these decisions need to be timely and accurate to positively impact patient care and outcomes (Schuster & Nathan-Roberts, 2017). Making improvements to the decision-making process for highly trained paramedics has not been well researched in recent years (Elstein & Schwartz, 2002).

The clinical decision made by paramedics is typically reflected in first impressions documented on patient care reports (PCRs). First impressions are constructed from event history, presentation, and physical examination of the patient. The first impression data guides the treatment provided to the patient, and this information is shared as part of the PCR to the receiving hospital and physician. Continuity of care is critical to EMS providers and receiving physicians (Haggerty et al., 2003). The continuity is most visible during the patient handover phase from EMS to receiving physician and highly dependent on the paramedic's first impression. The first impression not only guides the care of the patient in the pre-hospital environment, but it is also the starting point for the physician's assessment of the patient. First impressions have been determined to be a reliable predictor of outcome for ED physicians (Beglinger et al., 2015; Brabrand, Hallas, & Knudsen, 2014). Given the importance of the first impression for both the paramedic's choice in treatment protocols and its subsequent use by physicians, it is important for information to be accurate. Moreover, the PCRs as part of the medical records are very important to physicians in emergency departments (Bledsoe, Wasden, & Johnson, 2013).

Multiple studies have shown that paramedic first impressions when compared with the physician's differential diagnosis are inaccurate (Christie et al., 2016; Koivulahti, Tommila, & Haavisto, 2020; Wilson, Harley & Steels, 2019). Depending on the patient presentation, there is a tremendous amount of variation in studies that looked at a particular prehospital diagnosis or first impression and the corresponding hospital differential diagnosis. The variation ranged from 14 percent to 100 percent in a review of more than 380,000 patients in fifteen different studies (Wilson, Harley & Steels, 2019). In Bledsoe's work (2013), 88.6 percent (n= 1,932) of responding physicians noted that PCRs were a key component of their decision-making process.

This variation issue is present with the partner organization for this project. The Orange County Emergency Services (OCES) department is headquartered in Hillsborough, North Carolina. The department provides service to about 146,000 residents[5]. The most visible group in the department, and the subject of the capstone project, are the first responders to 9-1-1 calls. The Emergency Medical Service (EMS) first responders division responds to requests for medical services 24 hours a day, year-round. OCES responded to 16,500 emergency calls in FY 2019-20 , attended to 11,865 patients and transported 9,314 to medical facilities in Orange and neighboring counties[6]. This division has nine stations across the county with approximately 104 staff involved in direct patient care. In partnership with OCES, emergency department (ED) physicians employed by the University of North Carolina Health (UNC Health) also participated in this project. UNC Health Care ED is the primary transport destination for OCES.

OCES conducts regular quality assurance (QA) reviews on all PCRs. The QAs are a tool used at OCES to provide insight into paramedic competence and examine patient outcomes. The QAs conducted typically by the training department and the medical director revealed the same types of variations noted in previous EMS research. OCES identified differences between documented first impression diagnostic operational data

[5] Orange County census data retrieved from Ccensus.gov November 20, 2019
[6] Orange County FY 2019-2020 Annual Budget

on the prehospital patient record (PCR) when compared to the ED admission record at hospital admissions at UNC facilities. The initial findings by OCES are reflected in a wide range of EMS responses from respiratory complaints to abdominal pain. This type of variation can potentially lead to poor patient outcomes resulting from inaccurate clinical diagnosis in the field by paramedics. In conversations with OCES, previous attempts to correct this issue involved multiple training programs using the same training modalities.

OCES assumed that the variations were related to the competency of individual paramedics and introduced training sessions on specific topics aimed at reducing the level of variation between paramedic first impressions and physician differential diagnosis. The lack of training success is evidenced by no reduction in first impression variations and suggests other underlying issues. Despite additional training over several months, a root cause for this difference with first medical impressions between the two groups of practitioners has not been identified.

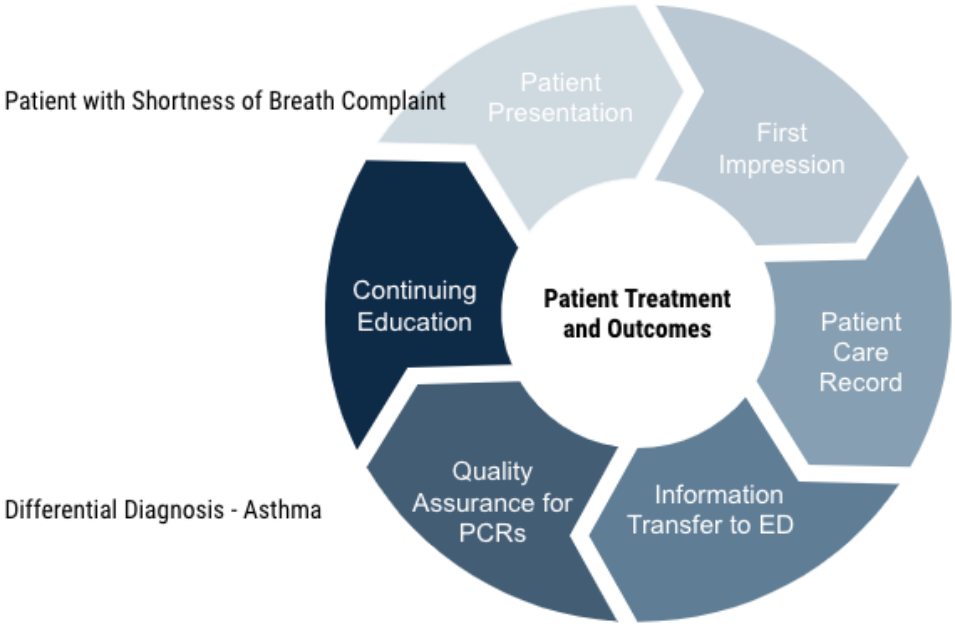
Training sessions at OCES are part of ongoing continuing education (con-ed) aimed at ultimately improving paramedic competence and patient outcomes. Gent (2016) asserts that clinical practice is an essential component of a con-ed program for paramedics. Furthermore, Hearle and Lawson (2019) in the United Kingdom emphasize that any knowledge and skills gained while undertaking con-ed activities can enhance the paramedic practice and also benefit patients. OCES subscribes to this effort but has not been able to identify the specific issues causing the variations. In addition, there are concerns with the inconsistent use of first impressions by paramedics in any given patient presentation. These two issues are the problem of practice being investigated for this project.

Context and Problem

OCES relies in part on QA reviews to determine con-ed topics. For example, if a QA review identifies significant variation in respiratory emergencies in a series of PCRs, training sessions will be offered on respiratory emergencies, which is one of the most common 9-1-1 requests for support.

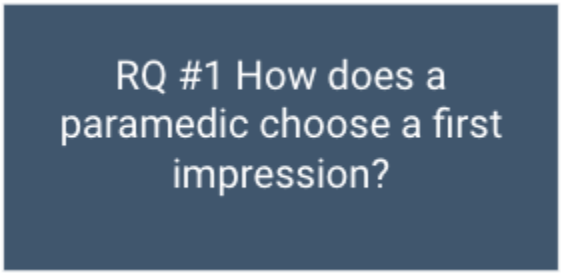
A typical process followed by paramedics and OCES is diagrammed in Figure 1. Using the patient presentation, a paramedic will form a first impression and record this information in a PCR. This information is transferred to the Emergency Department (ED) physicians. Subsequently, a QA review is completed, which could be days or weeks from the original call. In the final step is the con-ed, which is based on the variations noted in the QA process. An example of the problem of practice that follows this diagram is when a patient presents with shortness of breath and is treated for this symptom, but the differential diagnosis noted in the chart is asthma.

Figure 1. Cycle of a Typical Response Review

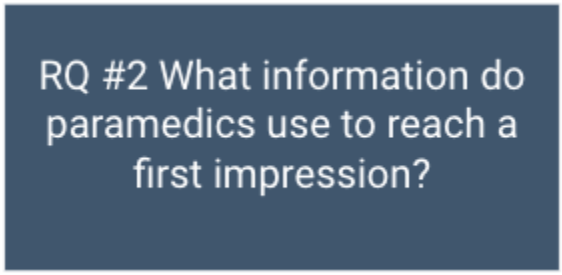


In order to understand the root cause of the problem of practice, it is important to understand a few key points about paramedic practice. As noted previously, there is a meager amount of research in the area of decision-making specific to EMS as a profession and for paramedics as healthcare providers (Shaban, Wyatt-Smith & Cumming, 2004). Reinforcing this lack of research in paramedic decision-making is work by Higgs et al.(2019). The mechanics of this process is the first step in understanding how paramedics with OCES make those critical first impressions. Shaban argues that decision-making for paramedics is done so in a constant state of uncertainty, given the nature of EMS in the provision of care in typically emergency situations or even in non-urgent but unfamiliar situations.

The first primary research question is focused on understanding the first step. Early work in paramedic decision-making considered two skills that are part of the national paramedic education curriculum used in North Carolina. These two skills are reasoning and critical thinking (Janning, 1994; Dalton, 1996). In more recent work by Croskerry et al.(2010) the skills are defined as core skills and include the concept that paramedics have core knowledge.

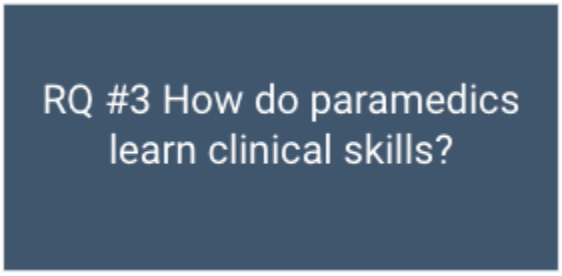


To understand how OCES reaches that first impression decision, another research question is proposed.

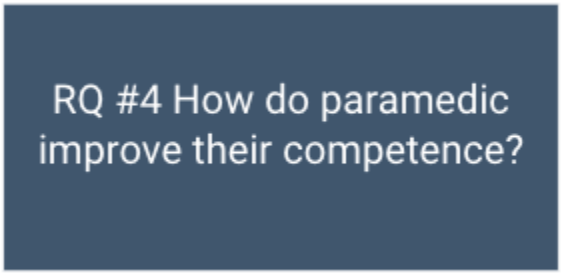


Fundamental to the first two research questions is the acquisition of knowledge. How do paramedics acquire or learn clinical skills? How is that acquisition supported with partners and physicians? There are multiple approaches to consider about the acquisition of knowledge. For this project, I am focused on clinical skills that can be defined as the gathering of information by touch and talk and interpretation of that information to treat a patient (Elder, 2018).

A group of researchers (Michels, Evans & Block, 2012) asked a simple question: What is a clinical skill; and how do you teach it? Before this question can be answered for OCES, we first need to understand the process paramedics at OCES currently use to learn those skills. Research Question #3 will attempt to provide some answers.



Finally, Research Question #4 is aimed at understanding how paramedics improve their competence. Recall that OCES assumes that competency is the issue for the variations in first impressions. It is argued that clinical skills require more than just competency (Jarvis-Selinger, Pratt, & Regehr, 2012). For this project, I will focus on professional relationships specifically given the nature of the variations between paramedics' first impressions and physicians' differential diagnoses.



Literature Review

Clinical Decision Making

Understanding the implications of first impressions on patient care and outcomes is an important component of the con-ed program at OCES. Using the research questions as a guide, a literature review was completed first, considering how a paramedic chooses a first impression. In addition, the review was guided by the current national paramedic curriculum standards (Paris & Roth, 2014), which include competence and problem solving as key indicators of clinical decision-making. Clinical decision-making is at the core of clinical practice for all healthcare providers (Higgs et al., 2019). Multiple models have been proposed for healthcare providers in recent years. In 1989, Miller's exemplar pyramid was well known as a foundational tool for the assessment of clinical decisions with four levels ("knows," "knows how," "shows how," "does") of a framework (Cate et al., 2021). The framework created a process for the clinical decision assessment for physicians, but most importantly connected the

professional development of physicians with the education process aimed at improving knowledge and skill (Williams, et al., 2016). A review of assessment tools conducted by Tay et al. (2020) covering a period between 1990 to 2018 showed that Miller's pyramid is widely used and has been adapted since 1989 to account for changes in both practice and medical education paradigms.

These changes to the medical education curriculum include strategies on team-based learning, multi-professional education, and interprofessional education (Al-Eraky & Marei, 2016). As a result, Miller's pyramid has changed in terms of structure in recent years (see Appendix 1). The most significant changes are the additions of the top level of "is" and the overall dimensions of attitudes, skills, and knowledge (Cruess, Cruess & Steinert, 2016; Williams et al., 2016). The addition of the attitudes, skills, and knowledge constructs is key to understanding how paramedics choose first impressions. As noted by Thampy, Willert & Ramani (2019), these constructs are important when considering different patient presentations. Miller's pyramid has been reviewed in the context of paramedic clinical decision-making, most recently in work by Tavares & Boet (2016), where the researchers stated that attitudes, skills, and knowledge are key elements of decision-making.

Making a clinical first impression is the first step in the process, but we also need to understand what information paramedics use to reach that clinical decision. Expanding the second research question from "what information do paramedics use to reach first impressions?" to "what strategies are used to make these decisions?" is helpful in understanding the process. In two Canadian studies (Jensen, 2011), this question was specifically asked, and researchers outlined the implications for clinical practice and education. It was determined that paramedics use rational over-experiential thinking. Work by Peona, Rahman & O'Meara (2019) reinforces the rational approach. In a review of 362 studies, researchers noted that paramedics choose intuitive and conscious thought processes. This approach is consistent with the dual-process theory.

Kahneman's (2010) dual-process thinking system is known as System 1 (fast thinking) and System 2 (slow thinking) (see Appendix 2 for model). System thinking integrates both non-analytical and analytic processes of cognition (Marcum, 2012), as well as metacognition. Metacognition is important in the development of decision models at the practitioner level (Al-Azri, 2020). The literature review by Perona, Rahman & O'Meara (2019) confirmed that the dual-process theory is the primary method by which paramedics make decisions, combined with experience as practitioners.

Two authors (Banning, 2005; Marcum, 2012) discuss the role of dual-process thinking. Both authors explain that this model is less of a mutually exclusive approach for paramedics. Instead, it is a continuum of approaches with a blend of system 1 and 2 thinking depending on the situation, the urgency and the experience of the provider. Marcum (2012) argues that the relationship between these two systems is important and must be considered when considering experience and expertise and how clinical skills are learned by providers. A review of clinical decision-making for paramedics by Lord & Simpson (2019) confirms that the dual-approach theory is a mix of approaches. The mix of approaches is influenced heavily by experience and expertise but also knowledge, emotions, values, and reflective practice and communication (Epstein & Hundert, 2002). These constructs create the professional competence necessary to be an effective provider. Moreover, clinical reasoning required for professional competency is impacted by interpersonal interactions (Brandling et al., 2016). While the models described previously are traditionally from an older paradigm perspective (Rosen et al., 2017), rationality being the primary driver of the paradigm, it does not account for the non-cognitive components that are part of any decision-making approaches. Croskerry (2009) indicates that System 1 thinking in clinical decision-making is bound in the context of the situation and will be influenced by many factors.

"Whilst this system uses heuristics to recognise patterns, there are risks that less experienced clinicians will lack the exposure on which to base these, resulting in an inherent risk that an incorrect diagnosis will be made when the presentation is atypical. System 2 reasoning may be employed when the signs and symptoms of a problem are not so readily recognised, but this type of reasoning is not so immediate in its provision of solutions, because it is necessarily analytical and takes longer." (p.34)

Within the System 1 and 2 thinking concepts, there are multiple clinical decision-making models to consider. There are multiple clinical decision-making models in use today in medicine. In the prehospital setting, this activity is critically important (Keebler, Lazzara & Misasi, 2017). As noted by Schuster and Nathan-Roberts in Keebler's work (2017), improving the decision-making of highly trained professionals is a difficult challenge, according to Reason (1995). The broad range of decision-making models can be summarized for prehospital care providers into five models.

Hypothetical-Deductive approach

This is the most widely used and best known clinical decision-making model used by healthcare practitioners (Marcum, 2012). It is also the most studied in psychology research (Kovacs & Croksberry, 1999). This method asserts that paramedics make informed decisions using three specific areas of reasoning (Blaber, 2018).

a) Paramedics make a conscious decision to rule in or out gathered data while actively considering findings that are significant to the patient.
b) Paramedics understand the information provided that supports the decision they are making in the course of treating a patient.
c) Paramedics' decisions can be justified.

As noted in Blaber's (2018) foundations of paramedic work, this model requires experience in the paramedic field of practice in order to be effective. This model has been found to be ineffective for novice providers. In recent work by Aldamiri et al. (2018), this assumption was confirmed. There is a link between the experience of practitioners and the ability to make correct decisions (O'Meara & Others, 2009). An example of this type of approach is the ABCDE mnemonic for airway, breathing, circulation, disability, and exposure (Logarajah & Alinier, 2014).

Algorithmic Model

This approach to clinical decision-making is quite common in the prehospital field. It is recognized as the checklist approach to decision-making. One such example is the "emergency severity index" (Mistry et al., 2018). This approach is at times considered a less intellectual approach to clinical decisions, but the creation of the algorithm/checklist is based on sound science and research (Kovacs & Croskerry, 1999). As noted by Sandhu et al. (2006), this approach is a time-saving method, but practitioners must also be familiar with the research beyond the algorithm.

Pattern Recognition Model

This type of decision-making is typically associated with the limitations of short-term and the capacity of long-term memory (Alexander, 2009). As a practitioner's experience increases, they are more likely to use this model to make decisions about a patient and the clinical diagnosis process they are likely to apply (Banning, 2008). As Banning notes in her work, it is important to mention that with an increase in practitioner experience, this model is more likely to be replaced with more sophisticated pattern recognition approaches. One important distinction of this model is noted by Marcum (2012), that this model is opposite of the hypothetical-deductive approach and relies on the practitioner using a "whole person" approach and is most definitely a "non-analytical approach."

Rule-out Worst-Case-Scenario Model

This model has been researched extensively in EMS (Reay et al., 2018) and is often utilized by paramedics given the nature of the work, which requires timely decision-making and is often of an urgent nature. However, less than 10 percent of EMS work is classified as "urgent" or "life-threatening" in the United Kingdom (McCann & Granter, 2019) and slightly lower in the U.S. at 8.7 percent[7] nationally based on 3.4 million 9-1-1 responses in 2018. Sandhu et al.(2006) notes that a broad-based approach looking for life-threatening issues is reflective of the provider's inability to be certain of an issue, and this approach is often used by novices in the field.

Event-Driven Model

This model most closely resembles the ED approach relative to the activity undertaken and presented to the practitioner (Sandhu et al., 2006). One way to think about this model is to realize that the only action taken is on the presentation of the patient's primary issue. For example, is the patient breathing? If not, a specific action is taken to resolve that issue, and then paramedics can move on to the next presented issue. While the event-driven model approach is flexible, it is also more likely to be more resource-intensive for the practitioner (Sandhu et al., 2006).

All of these approaches to decision-making are traditional decision-making models - that is, the paradigm requires an inherent level of knowledge at the onset of decision-making in order to be effective (Wyatt, 2003). Wyatt (2003) further notes that the result of his work identified the role of experience as an important component in decision-making. This thinking is in agreement with the constructivist theory (Piaget,1972; Olson & Ramirez, 2020), where learning takes place with the mental construction of knowledge (Bada & Olusegun, 2015). The theory developed by Piaget proposes that by acquiring knowledge, we construct meaning from our experiences.

[7] National Emergency Medical Services Information System nemsis.org

This is critically important for healthcare providers, especially paramedics (Tavares & Mausz, 2015). However, paramedics are restricted by two important factors when making decisions: a) time and b) available information (Croskerry, 2000; Rosen et al., 2017). A more recent decision-making paradigm called naturalistic decision-making (NDM) is making inroads in the field of prehospital care as a preferred approach (Harencarova, 2017). The author suggests that natural decision-making NDM is best suited for paramedics because they work in dynamic environments that are not typically well defined and have a time-stress element to decision-making.

Natural Decision Making

The NDM paradigm "is the study of action, rather than the study of choice," states Orasanu & Connolly (1993). NDM helps direct some answers for Research Question #3; how do paramedics learn clinical skills? In the work by Harencarova (2017), the first study of this model in an unpredictable environment was with fire ground commanders, which is a similar environment to EMS. At the core of NDM is the idea that decision-makers choose a path and how attributes of the environment shape the decisions that are made in a natural environment. The NDM model emphasizes making decisions in an informal environment typically characterized by ill-defined problems (Elstein, 2001). However, the NDM paradigm is also missing the non-cognitive attributes necessary in effective decision-making. As noted by the work of Wyl et al., (2009), proficiency is not the sole requirement for proficiency for a healthcare provider. What is required are non-technical skills, including leadership and communication skills, situational awareness, and the ability to have interpersonal exchanges.

NDM leads to Research Question #4: How do paramedics improve their competence? It is argued that improving the competence of individual learners is the responsibility of the learner (Martin, 2015). Furthermore, Martin (2015) argues that for paramedics, improving competence and consequently patient care outcomes requires more than self-motivation. Improved competence is dependent on a multitude of factors, including self-reflection and a combination of activities that include formal and informal feedback, and a robust con-ed program. Moreover, NDM takes place in a clinically relevant environment, which is important to receive feedback and improve over time (Pinnock & Welch, 2014).

Capabilities

This literature review identified multiple constructs that create the decision models. The models are either traditional or naturalistic in design. However, the models do not account for the non-cognitive attributes necessary to be a proficient and competent paramedic. In order to further understand the components of effective decision-making for paramedics, a framework for further investigation is required, based on the literature findings (see summary in Appendix 3). From this literature review, what is clear is the clinical decision-making is a multilayer process that requires considerations of several components. OCES is looking to understand the first impressions conundrum of differences between paramedics and physicians; as well as the inconsistencies of first impressions.

In a paper by Stephenson (1998), educational pursuits are discussed in the context of learning capabilities. Stephenson discussed capabilities as an integration of knowledge, skills, personal qualities, and sensible action. Capabilities are viewed by Stephenson (1998) as what can be observed as abilities in:

a) Taking effective and appropriate action
b) Explaining what they are about
c) Living and working effectively with others; and

d) Continuing to learn from experiences as individuals and in association with others.

Key to Stephenson's capabilities model is the ability to adapt to unpredictable situations, fluid environments typically seen in EMS work. Paramedics work in highly complex and unpredictable environments that require ongoing clinical decision-making (Reay et al., 2018). Higgs et al. (2019) describe adaptive learning skills for healthcare providers as an essential element. Additionally, Higgs describes work by Cutrer et al. (2017) as expanding on the idea that adaptive learners are self-motivated, can innovate, and be enabled to perform well in complex situations. Higgs' work on clinical decision-making is the basis of the model on clinical reasoning capabilities used in the book "Clinical Reasoning in the Health Professions." Higgs adapts the model to a variety of occupations, from dentists to surgeons, and includes paramedics. For paramedics, Higgs et al (2019). did report that, as previously noted, few research activities are specific to this role. The profession does have some parallel occupations where time constraints and unpredictable situations are part of the work, and clinical decision-making is an important component of the work.

Higgs reported on work by Smith, Higgs, and Ellis (2010) on factors that impact clinical decision-making for acute respiratory care physiotherapists. These factors are outlined in the figure below. Smith's research is important in this project because she noted that decision-making in the context of practice could not be separated from the context in which it occurred (Higgs et al., 2019). It is with this perspective that I created a framework to investigate the research questions and the problem of practice. Smith's summary work is in Figure 2 below.

Conceptual Framework

A complete description of the model developed by Smith, Higgs & Ellis (2010) can be found in figure 2 below.

Figure 2. Smith Model

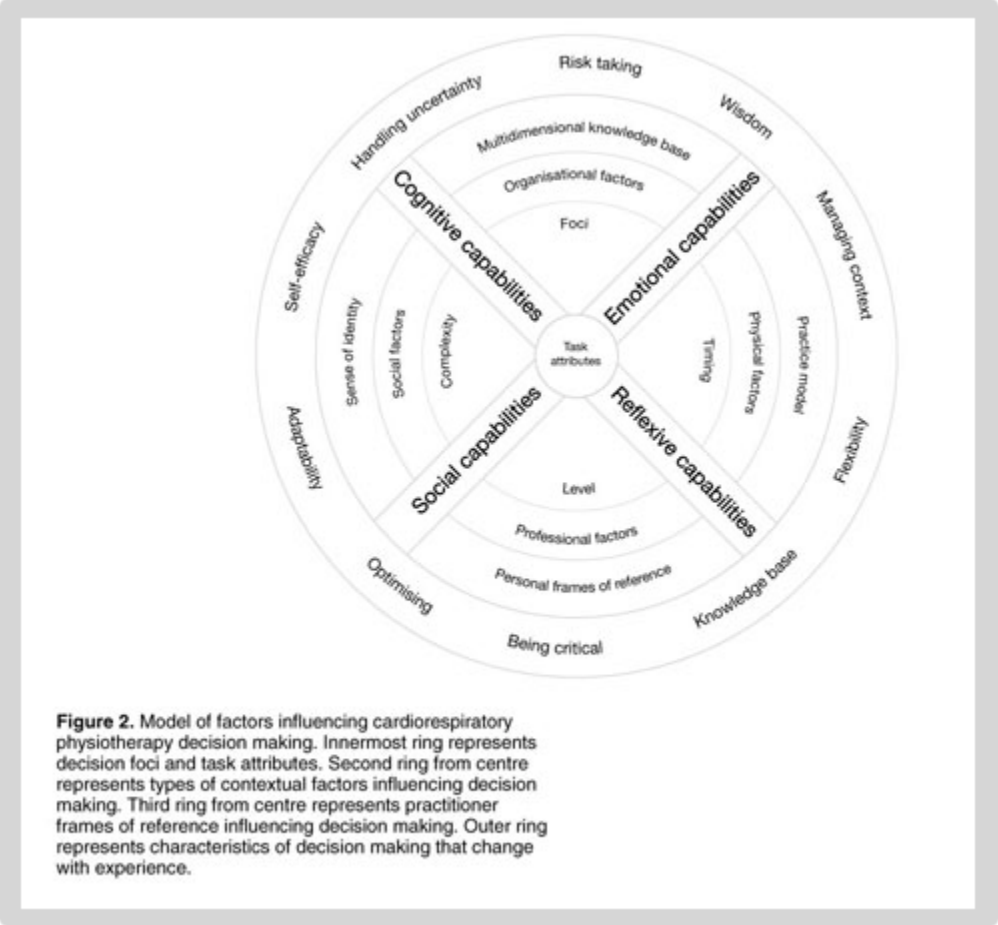


Figure 2. Model of factors influencing cardiorespiratory physiotherapy decision making. Innermost ring represents decision foci and task attributes. Second ring from centre represents types of contextual factors influencing decision making. Third ring from centre represents practitioner frames of reference influencing decision making. Outer ring represents characteristics of decision making that change with experience.

The capabilities of the framework mirror the work completed by Stephenson, as noted in table 1 below. The Smith (2010) framework is divided into four distinct capabilities as shown in table 1 below.

Table 1. Capabilities Summary

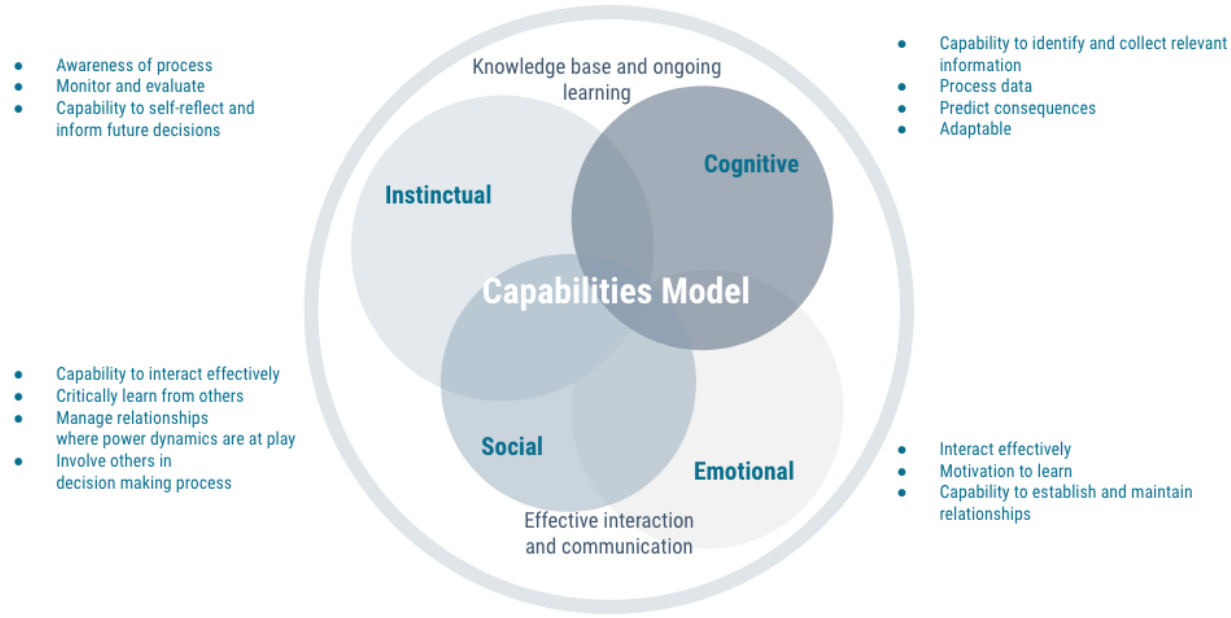
Stephenson Capabilities	Smith Capability Framework (adapted)
Take effective and appropriate action	Cognitive
Continue to learn from experiences as individuals and in association with others	Social
Live and work effectively with others; and	Emotional
Explain what they are about	Reflexive (Instinctual)

For this project, I have adapted the Smith model for use in the investigation of the research questions. The capabilities are discussed in work by Boshuizen & Schmidt (2008) in the development of clinical reasoning expertise. This research relied on previous work by Elstein, Shulman, and Sprafka (1978) and was supported by follow-up work by Custers (2013).

Cognitive capability is important in the process of clinical decision-making. Without the prerequisite intellectual skills needed to manage the types of complex interactions encountered when providing healthcare, decisions have to rely solely on other capabilities (Noon, 2014). Work by Hagbaghery, Salsali & Ahmadi (2004) on social capability confirms that being capable of establishing and managing relationships when there is a power dynamic and being self-confident are factors that facilitate clinical decision-making. Emotional capabilities have been linked by multiple researchers to effective clinical decision-making (Kozlowski et al., 2017) where traditionally cognition has been considered the only primary driver of good decisions. Emotional capability does not imply “being emotional” during a decision, but rather the ability to interact with others and being motivated to learn in the context of this framework. Finally, the instinctual capability (also called reflexive) captures the idea that healthcare providers are self-aware and capable of self-reflection. The two attributes are important (Preisz, 2019) in the professionalization of paramedics as they work with other healthcare

providers. Figure 3 below represents a summary of the capabilities and the associated individual characteristics.

Figure 3. Project Framework

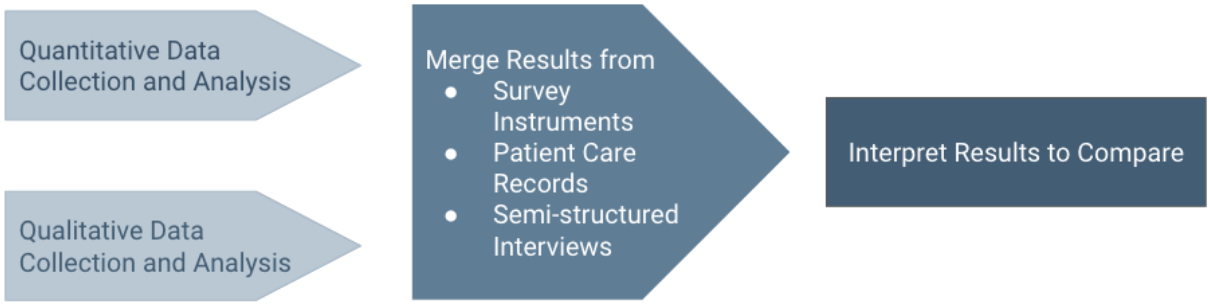


Project Design

A systematic one-phase convergent mixed-methods approach (Fetter, Curry & Creswell, 2013; Creswell & Creswell, 2017) is used to investigate the research questions. This method allows for the collection of quantitative and qualitative data at the same time, merging the results to validate each data set. I reviewed secondary quantitative data for all OCES responses from January 2018 to December 2020. A survey was distributed through Survey Sparrow. It was designed to collect demographic information and the cognitive, affective, and instinctual capability of EMS practitioners at the paramedic and physician levels. Finally, I conducted semi-structured interviews with EMS practitioners to better understand their EMS experiences, relationships with different providers, and the learning process utilized by individual providers. Figure 4

below shows the one-phase convergent mixed-methods approach. To ensure compliance with human research, the convergent mixed-methods study was submitted to Vanderbilt University's Institutional Review Board (IRB) as a quality improvement project. IRB approval for the qualitative study was granted on December 30, 2019. In addition, consent was obtained from Orange County to use patient care records for this project.

Figure 4. Project Design



Quantitative Data Collection

All PCR data is stored in a commercial database licensed to OCES. The review of the secondary data was completed by access to ESO Suite (ESO, Austin, TX.) using outcomes reporting for each patient encounter. Data were anonymized and downloaded to a secure Vanderbilt Box storage folder. The data was analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0 (SPSS, Inc., Chicago, IL). ESO data patient care data was merged with existing OCES first impression coding currently utilized by paramedics. Each patient care record was reviewed for outcome data to identify the first impression as determined by the paramedic and the differential diagnosis as noted by the physician in the patient chart.

Qualitative Data Collection

Interview participants were recruited using the snowball sampling method (Patton, 2002). Semi-structured interviews were conducted in the Fall of 2020 and Winter of 2021 using Zoom. Interviews were recorded using Otter.ai (Otter, Los Altos, CA.). All participants consented to audio recordings by submitting a REDCap[8] built form. All recordings were transcribed using this recording tool, and both the audio and transcribed files were stored in a secure online folder, hosted by Vanderbilt University. All transcribed files were analyzed for themes and content using Nvivo software (QSR International, Melbourne, Australia). The semi-structured interview questions are available in Appendix 4.

In total, survey requests were sent to 104 OCES employees via email with invitations supported by the OCES Director and OCES Operations Manager. A total of four requests were sent over a 60-day period. For the physician group, survey requests were sent directly to individual physicians. Individual physician contacts were provided by the OCES Medical Director. Physician participants are currently associated with the University of North Carolina at Chapel Hill Hospitals, the University of North Carolina at Chapel Hill Medical School EMS Fellowship program, or Wake County Emergency Medical Services. A website was created to recruit all participants and to communicate project information to stakeholders.

The survey included the collection of demographic information (Appendix 5), and five individual instruments. The instruments were sourced from the National Center for Interprofessional Practice and Education[9] and adapted for an EMS audience . For example, for the EMS provider a question appeared as:

"I communicate with ED physicians in a way they can understand without using profession-specific jargon."

[8] REDCap is a tool developed by Vanderbilt University and available at https://projectredcap.org/
[9] https://nexusipe.org/advancing/assessment-evaluation-start

For the physician provider a question appeared as:
"I communicate with paramedics in a way they can understand without using profession-specific jargon."

Table 2 below provides a summary of the instruments utilized for the collection of quantitative information related to the framework. The survey instruments were selected to inform the research questions using the conceptual framework. The Assessment for Collaborative Environments (ACE-15) (Tilden, Eckstrom & Dieckmann, 2016) and the Interdisciplinary Education Perception Scale (IEPS) (Furze, Lohman & Mu, 2008) instruments were used to collect data on collaboration and interdisciplinary cooperation. The ACE-15 (15 items) measures a single factor of "teamness" based on core principles and values of effective team-based healthcare (Mitchell et al., 2012).The IPES instrument (18 items with a five-point scale) is designed to assess perceptions of experiences of interprofessional education. The tool has one subscale on interdisciplinary practice.

The Readiness for Interprofessional Learning Scale (RIPLS) (Curran et al., 2008) was utilized to measure professional identity and roles relative to interprofessional education. The tool is a 19-item instrument using a five-point scale to assess healthcare providers' attitudes toward interprofessional education and collaboration. RIPLS has three subscales on teamwork and collaboration, negative and positive professional identity, and roles and responsibilities. The Interprofessional Professionalism Scale (IPA) (Frost et al., 2019) is a 26-item tool with five subscales on professionalism covering the domains of altruism, excellence, ethics, respect, communication, and accountability. All four instruments are included in the Appendix section .

Table 2. Capabilities and Instruments.

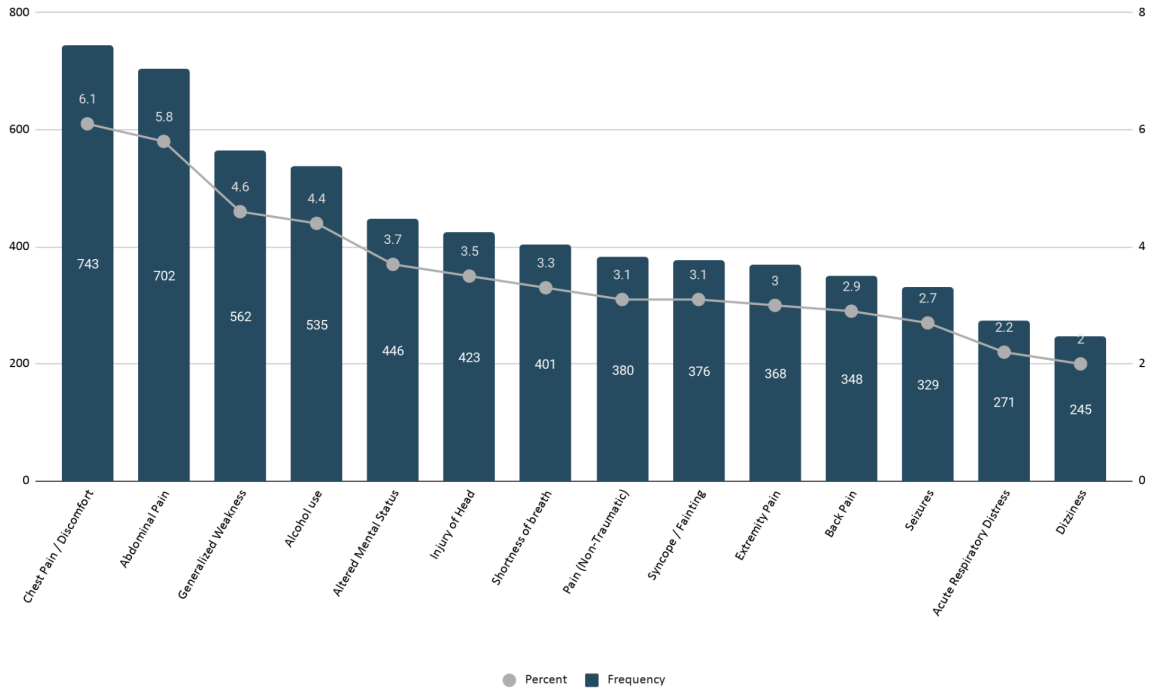
Quantitative Survey Instrument	Reference	Framework Capabilities
Assessment for Collaborative Environments (ACE-15)	Tilden (2016)	Social/Emotional
Interdisciplinary Education Perception Scale (IEPS)	Furze, 2008	Cognitive/Social
Readiness for Interprofessional Learning Scale (RIPLS)	McFadyen (2005)	Instinctual/Social
Interprofessional Professionalism Assessment (IPA)	Furze (2008)	Instinctual/Cognitive /Emotional

Data Analysis

Quantitative Data - Secondary Data

A total of 12,093 PCR records were reviewed in ESO for the period from January 1, 2019, to December 31, 2020. The most frequent first impression clinical decision by paramedics is chest/pain discomfort (6.1 percent), as noted in Figure 5 below. OCES uses 279 individual codes for first impressions. Fifteen of these codes account for 50 percent of all calls. A complete distribution of first impressions is available in Appendix 9. PCRs were completed by a total of 176 providers at OCES; 24 individual providers are responsible for 50.5 percent of the total responses and coded first impressions in the 24-month review period. Summary data is in Figure 5 below for the top 50.5 percent of all first impressions as coded by paramedics.

Figure 5. Top 50% of First Impression Coding.



The review of the first impression coding by paramedics when compared to the differential diagnosis of physicians revealed differences in a significant portion of PCRs. This comparison showed that for the top 50.5 percent of all first impressions, there are differences ranging from 0 percent to 100 percent between what a paramedic listed as a first impression and what a physician indicated during the ED visit. The comparison was made for agreement, not to confirm a correct diagnosis. When comparing paramedic first impression to physician differential diagnosis, there was a 51.8 percent agreement overall (n=5822). When comparing physician differential diagnosis to paramedic first impressions, there is agreement 20.8 percent of the time (n=2437). The differences in agreement between the two providers highlight the challenges faced by OCES in the QA process.

A review of first impression coding also revealed that in some cases, the differences are likely the result of a data entry error. For example, an entry as an “injury

to the ear" vs. "an injury to eye" or "head" vs. "face" injury. These types of errors vary by first impression category from less than 1 percent to as high as 3 percent for some of the first impression codes. The data entry errors can be confirmed with a manual review of each PCR. Additionally, the use of codes by paramedics is not consistent. This is likely due to the structure of the codes used for first impression.

There are currently some 275 individual codes used for first impressions. Based on an individual review of these codes, they appear to be categorized into three groups: a) symptoms, b) events/condition, and c) clinical diagnosis. Examples of this trichotomy are shown in Table 3.

Table 3. Code Structure Examples

First Impression Coding	Observed Category
Drowning	Event
Electrocution	Event
Pregnancy-related condition	Event
Fever	Symptom
Nausea	Symptom
Shortness of breath	Symptom
Subarachnoid hemorrhage	Clinical diagnosis
ST-elevation myocardial infarction (STEMI)	Clinical diagnosis
Rhabdomyolysis	Clinical diagnosis

Statistically, the differences between paramedic first impressions and physician differential diagnoses were measured using Krippendorf's Alpha (K Alpha) for nominal data (Hayes & Krippendorf, 2007; Krippendorf, 2008). The inter-coder reliability varies between the first impression type. The K Alpha range is -1 to +1, where negative values indicate a reverse relationship to a + 1 where there is a complete agreement. A value at or near 0 shows a complete disagreement. The range of values showing the distribution for a selected group of first impressions is noted in the table below. Krippendorf testing was completed on first impressions where a comparison could be examined. The range is negative for some first impression coding i.e., "no complaint or injury noted" and up to 100 percent for the "cardiac arrest" first impression. A selected list of K Alpha results can be found in Appendix 11. A summary table of the K Alpha is in Table 4.

Table 4. K Alpha Summary

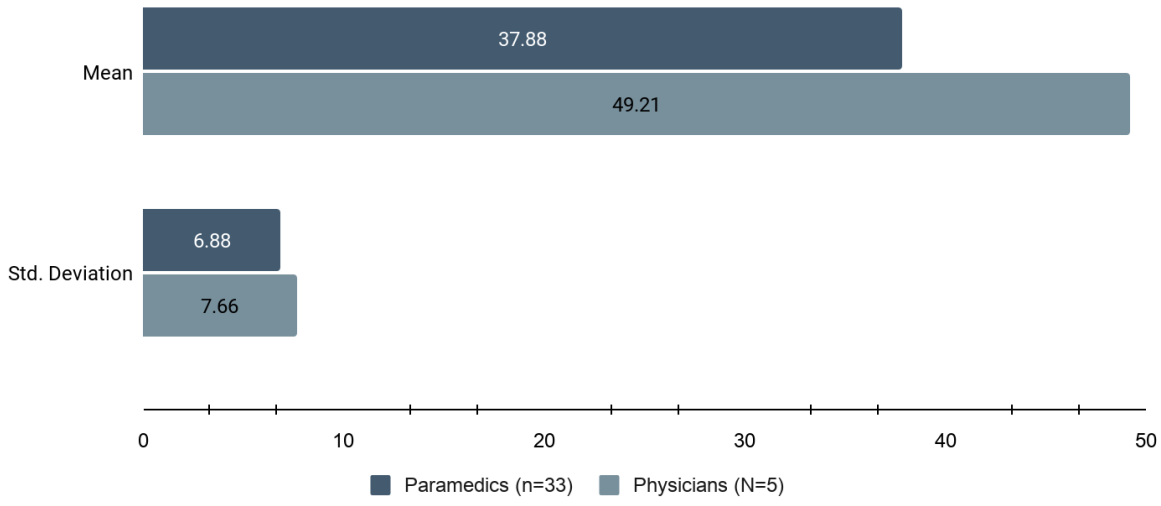
First Impression	K Alpha	n cases
Cardiac arrest	1.00	23
Chest pain/discomfort	.809	743
Shortness of breath	.810	401
Altered mental status	.722	446
Anxiety	.567	187
Seizure	.368	329
Overdose ETOH	.346	75
Chest pain - non-cardiac	.264	113
Abdominal pain	.135	702

Quantitative Data - Survey Data

A total of 49 surveys were started by respondents. The response rate was 46.6 percent. In total, 38 completed surveys (77 percent) were submitted. The net response rate was 37 percent. Surveys were excluded when not all required answers were completed in various sections and/or the respondents failed to submit the survey, thereby failing to complete the consent form. In total, 33 paramedics and five physicians completed the survey in full, including the consent form.

The following tables and figures report the response for each instrument and subscales. The ACE-15 instrument was developed to assess the ability of providers to move from a classroom to a clinical setting for interprofessional education. The results from the survey show that paramedics scored lower (M=37.88, SD = 6.88)[10] than physicians (M=49.21, SD=7.66) in this assessment, indicating that they are less prepared than physicians to learn in a clinical environment. Figure 6 shows the data results for this instrument.

Figure 6. ACE-15 Total Scores

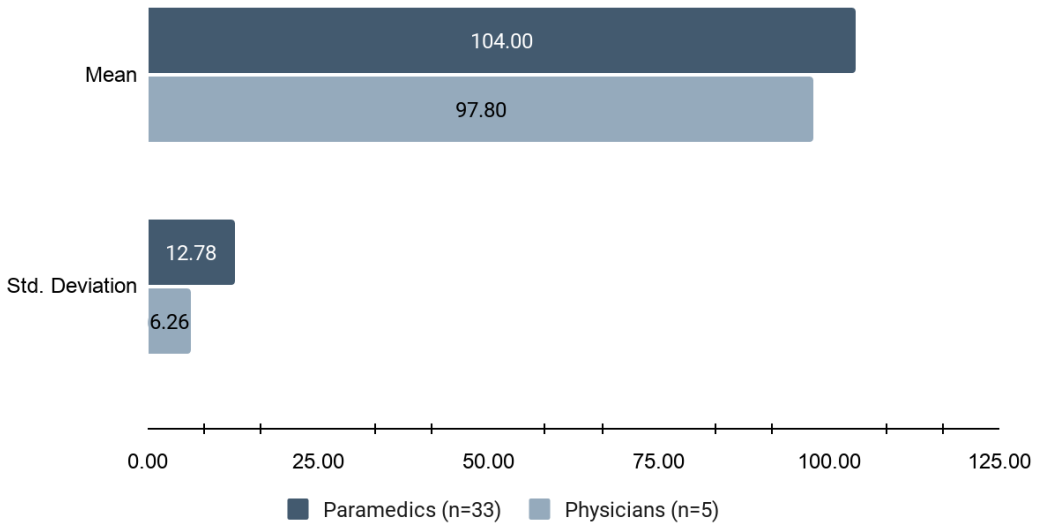


[10] M=mean and SD = Standard Deviation

For the ACE-15 instrument overall scale used in this project, the calculated Cronbach's α with 15 items was (α = .862).

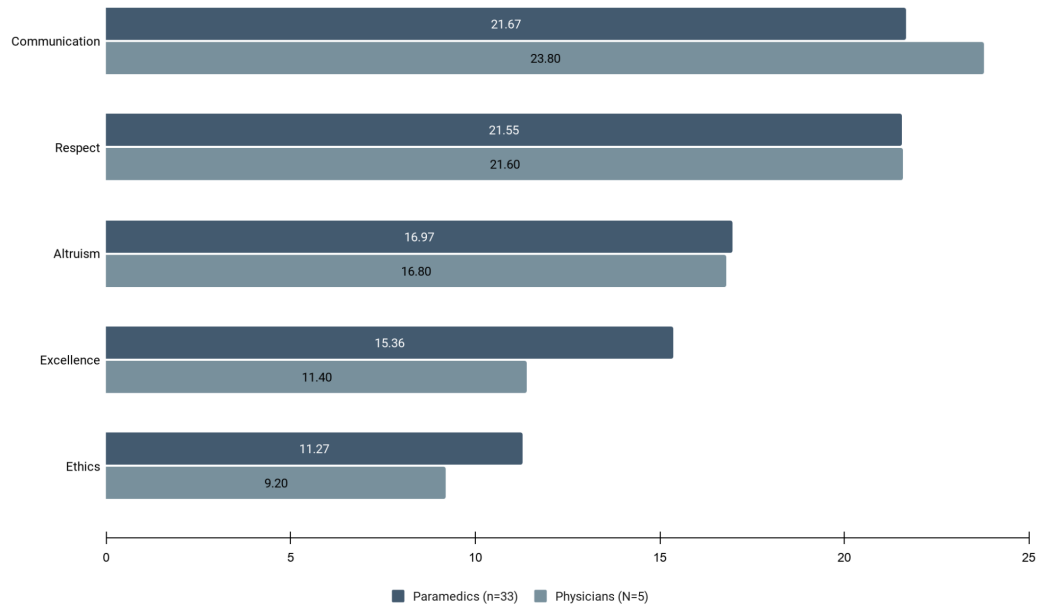
The IPA instrument measures professionalism using five constructs: communication, respect, altruism, excellence, and ethics. It is intended to provide information about the provider with respect to professionalism and the provision of patient care. For the IPA instrument overall scale, the paramedic mean score is 104 with an SD=12.78. For the physician responses, M=97.80, SD=6.26. Cronbach's α for the overall instrument with 26 items was (α = .812). Overall, paramedics scored higher than physicians, but there is higher variability in the responses. As the IPA has an element of accountability built into the questions (Frost et al., 2018), physicians while focusing on patient care do have other responsibilities while caring for patients, for example, other healthcare providers under their leadership, which may impact the response to the IPA. Figure 7 shows the data results for this instrument.

Figure 7. IPA Mean Scores Overall



The IPA subscales provide interesting insights into the framework capabilities. For the communication subscale, paramedics (M=21.67, SD=2.78) scored lower than the physicians (M=23.80, SD=1.09). This difference in communication is supported by the qualitative data collected during the semi-structured interviews. Paramedics indicated that they are less likely to discuss cases with physicians. The respect and altruism subscales mean scores are nearly identical for both providers. There is perceived higher excellence (defined as adhering to policy and standards) for paramedics (M=15.36, SD=3.78), perhaps indicating the constraints to protocols when compared to physicians' responses (M=11.40, SD=.54). Note that the physicians' responses are much less variable than the paramedic responses. This could be related to the experience of each provider; however, this is not specifically related to the problem of practice, therefore not examined in this project. Figure 8 shows the data results for the IPA instrument subscale means scores.

Figure 8. IPA Subscales Mean Scores



There are some interesting variations in the standard deviations for the overall and subscales, especially in the accountability scale, a subscale that measures perception on the ability to influence patient care and patient care. Both provider groups show a high level of variability in accountability. The variations for the overall and subscales are shown in Table 5.

Table 5. IPA Subscales Std. Deviation.

	Communication	Respect	Altruism	Excellence	Ethics	Accountability
Paramedics (n=33)	2.78	2.69	3.19	3.78	2.77	3.87
Physicians (n=5)	1.09	2.82	1.09	0.54	3.83	5.47
Overall (n=38)	2.69	2.59	2.99	3.77	2.25	4.08

Cronbach's α for the individual scales are noted in Table 6 below. These inter- reliability coefficients are lower than the norms established by the developers of the IPA.

Table 6. Cronbach's Alpha for Individual Scales in IPA Instrument

	Communication (5 items)	Respect (4 items)	Altruism (5items)	Excellence (4 items)	Ethics (4 items)	Accountability (4 items)
n=38	0.69	0.59	0.67	0.54	0.53	0.54

The IPES instrument was developed to measure competence and autonomy, perceived for professional cooperation, perception of actual cooperation, and understanding the value of other professions (Vaughan et al., 2014). Physicians (M=92.20, SD=3.83) scored much higher on the overall scale than paramedics (M=74.76, SD=15.88). This finding is in line with the semi-structured interview results where paramedics reported less autonomy as healthcare providers. On the subscales, paramedics (M=21.67, SD=8.35) report feeling less competent than physicians

(M=23.80, SD=.54). It is important to note the higher variability for paramedics. The perceived need subscale (M=10.30, SD=11.40) and actual cooperation (M=21.58, SD=5.42) subscale for paramedics show lower scores than the physicians on the same subscale. For the understanding value subscale, paramedics (M=7.70 SD=2.28) perceive less value for their role when compared to physicians (M=9.60, SD=3.28). Figure 9 shows the data results for this instrument, both the overall and the subscales. Table 7 and Table 8 report the SD for overall and subscales as well Cronbach's α respectively.

Figure 9. IEPS Overall and Subscales Mean Scores.

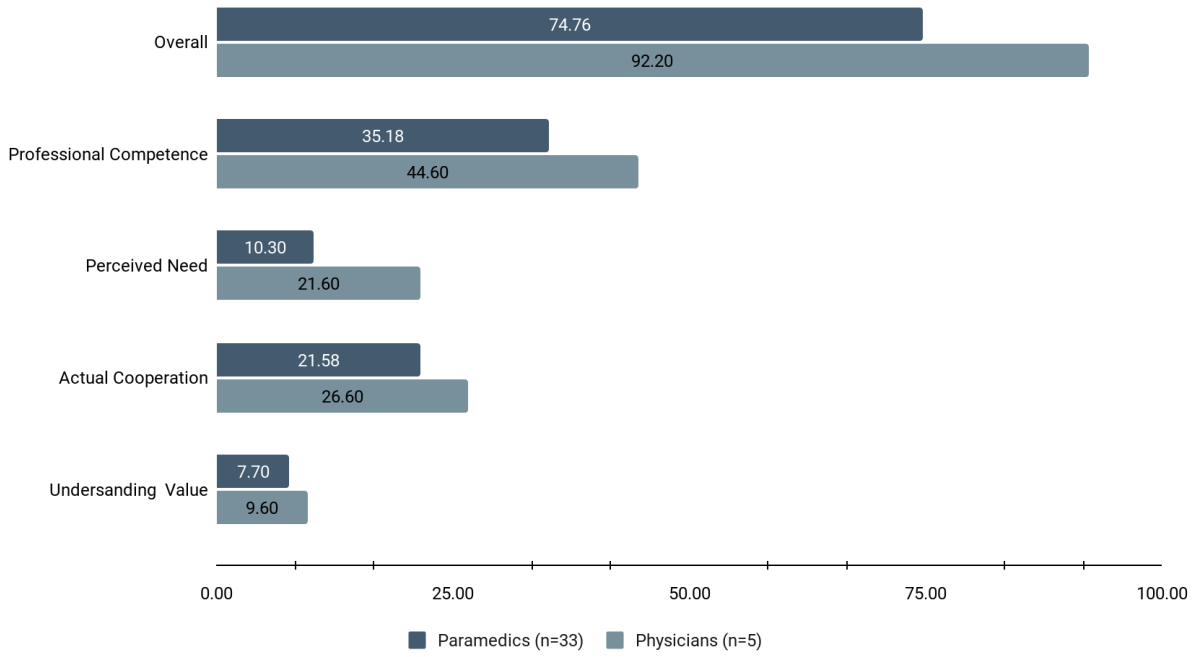


Table 7. IEPS Std Deviation for Overall and Subscales

	Overall	Professional Competence	Perceived Need	Actual Cooperation	Understanding Value
Paramedics (n=33)	15.88	8.35	2.34	5.42	2.28
Physicians (n=5)	3.83	0.54	0.54	0.54	3.28
Overall (n=38)	15.98	8.41	2.21	5.32	2.47

Table 8. IEPS Cronbach's Alpha for Overall (18-items) and Subscales

	Overall	Professional Competence (8 items)	Perceived Need (5 items)	Actual Cooperation (5 items)	Understanding Value (3 items)
(n=38)	0.94	0.912	0.94	0.92	0.59

The last instrument used in the project, the RIPLS instrument, overall scores, and subscales are shown in Figure 10. The standard deviations and Cronbach's alpha are shown in Table 9 and 10, respectively. The RIPLS instrument is primarily concerned with teamwork, professional identity, and roles and responsibilities (McFadyen et al., 2005). This instrument's mean scores for paramedics (M=59.61, SD=5.35) and physicians (M=58.82, SD=3.57) are nearly identical. The differences are in the subscale for teamwork and collaboration where paramedics (M=38.21, SD=5.24) perceived a greater level of teamwork and collaboration than physicians reported (M=32.40, SD=3.36). Figure 10 shows the data results for these instruments' overall scores and subscales.

Figure 10. RIPLS Overall and Subscales Mean Scores

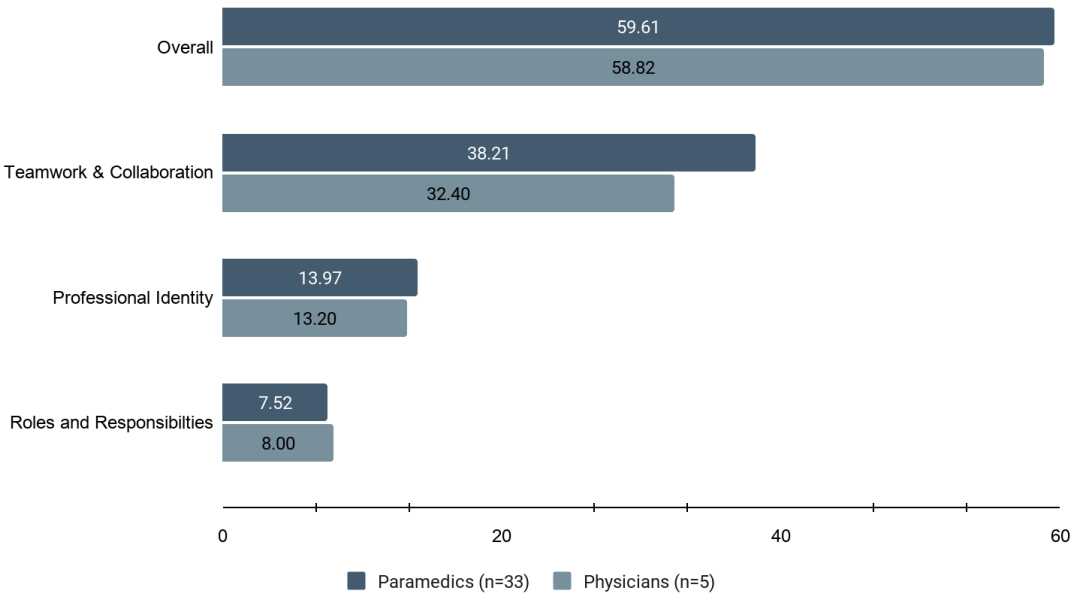


Table 9. RIPLS Overall and Subscale Standard Deviations

	Overall	Teamwork & Collaboration	Professional Identity	Roles and Responsibilities
Paramedics (n=33)	5.35	5.24	1.33	1.67
Physicians (n=5)	3.57	3.36	0.44	0.00

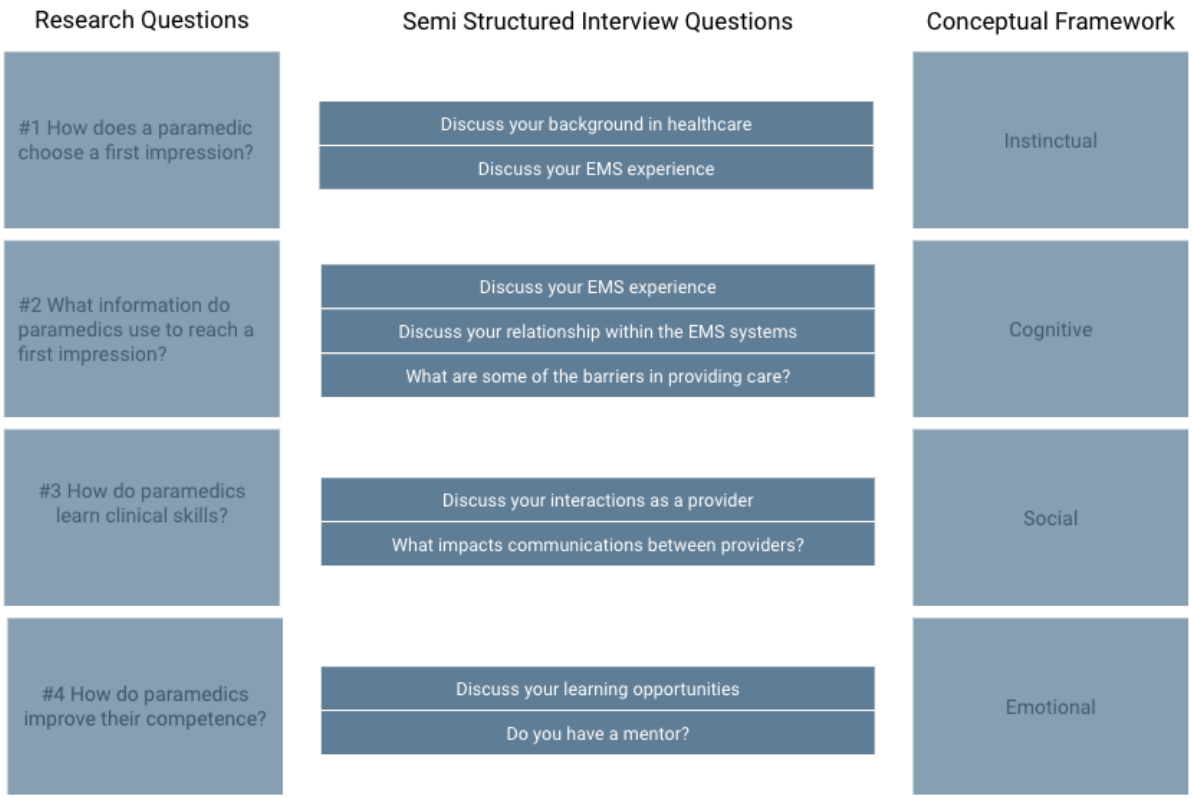
Table 10. RIPLS Overall (19 items) and Subscale Cronbach's α

	Overall	Teamwork & Collaboration(9 items)	Professiona l Identity (6 items)	Roles and Responsibilities (3 items)
n=38	0.64	0.89	0.83	0.70

Qualitative Data

To address the four research project questions, the qualitative interview questions were aligned with the conceptual framework. This alignment is shown in Figure 11.

Figure 11. Research Questions and Framework Alignment



Through a rigorous method of data analysis with the quantitative information collected and a coding process for the qualitative data interviews, themes and patterns emerged. The coding process involved reviewing a total of 840 minutes (14 hours) of interviews with eight paramedics and four physicians. The review and coding included notes made during the interviews as well as the recorded transcripts. The transcripts for all 12 interviews totaled nearly 114,000 words. The conceptual framework was the primary driver for the thematic analysis. The analysis involved multiple stages, including

collecting, refining, and categorizing the data. The analysis process is based on grounded theory (Glaser & Strauss, 2017) and the continuous data comparison in the mixed-methods approach. The first step in the analysis was to conduct an exercise of open coding, followed by axial coding, to draw connections between the codes. Following axial coding, selective codes were determined, and themes and patterns were identified. Table 11 below outlines the process from open codes to selective coding (Kolb, 2012; Gorra & Kornilaki, 2010).

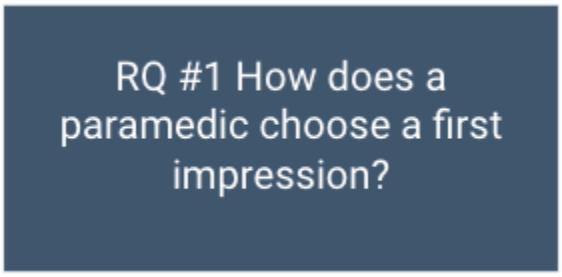
Table 11. Coding Schema for Capabilities

Open Codes	Axial Codes	Themes	Framework
Problems Learn Calls Paramedics Physicians Skills Autonomy	Experience Shared learning Partners	Paramedics don't always rely on experience Physicians do rely on experience Both desire to learn from others	Instinctual
Patient care Trauma calls Quality calls Teachable Quality assurance Information Content of calls Handover	Outcomes Quality care Case studies Clarification Diagnosis	Paramedics do not participate in case reviews regularly Physicians use case reviews Desire to learn from others	Cognitive
Approach ER Staff Professional Students Communication	Experience Shared learning Partners Openness	Fail to appreciate each other's contributions	Social
Interactions Group Team Practice	Relationships Decisions	Work well with others Paramedics believe they have good relationships with physicians	Emotional

Discussion

For clarity, the discussion section is outlined based on the project research questions, which appears in the individual boxes below.

Research Question #1



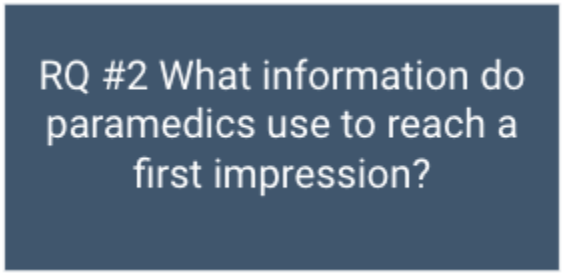
The quantitative data analysis related to the coding structure revealed two important findings. First, if the first impression codes are to drive educational interventions as part of professional development, the method on how these first impressions are recorded requires a review. Second, using the framework of capabilities, there are differences between the two types of practitioners (paramedics and physicians) on the process utilized for arriving at their first impression and differential diagnosis and how each uses the information while interacting and applying this information in a professional development environment.

The first impression process for paramedics is a technique taught early in their training. However, the actual process of determining first impressions is not well documented (Carter & Thompson, 2015). Carter and Thompson note that this process lacks the focus present in other healthcare professions such as emergency nursing. Theoretical foundations are necessary to influence the professionalization of nurses and consequently for other providers that require this foundation (Shaban et al., 2017). Paramedics may require the same level of professionalization that nurses receive to address the first impression determination.

While first impressions are coded in PCRs and collected at both the state and federal level in an EMS database for analysis, there is no formalized system for documentation of this information at OCES. This is not a unique issue for OCES. A 2018 literature review by Martin et al. (2015) outlined the need for a more accurate health information exchange in EMS. Moreover, the accuracy of the information is a concern. Incorrect information is not useful in setting professional development goals or improving patient care (Christie et al., 2016; Green et al., 2016; Koivulathi, Tommila & Haavisto, 2020).

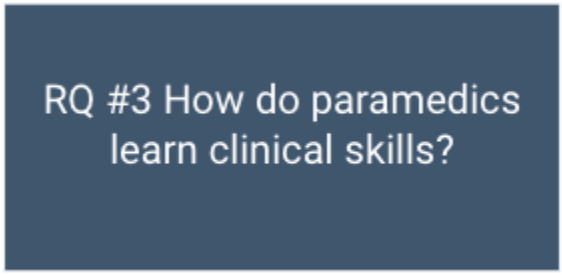
In the case of OCES, there are two issues. First, the method of coding currently utilized requires a review in order to consider the information which is valuable for paramedic professional development. In one of the interviews with a physician on this topic, first impressions were referred to as an *"artful process of clinical decision-making.*" The "art" is somewhat confusing for EMS providers and those reviewing the information. There are currently some 275 individual codes used for first impressions. Based on an individual review of these codes, they appear to be categorized into three groups: a) symptoms, b) events/condition, and c) clinical diagnosis. This can create confusion for paramedics having to make a choice, then determine a treatment plan and subsequently providing this information to the physicians in the ED. While paramedics might rely on instinctual capabilities to make a choice on first impressions, they are challenged by a lack of structure. The impact of paramedics making a decision on first impressions can impact the work being done in the ED (Studnek et al., 2012). Work by Belinger et al. (2015) showed that no specific complaints admitted to the ED have higher morbidity.

The impact of these decisions can vary depending on the patient presentation; the more complex the patient presentation, the less likely the first impressions are in agreement with the physician's differential diagnosis.



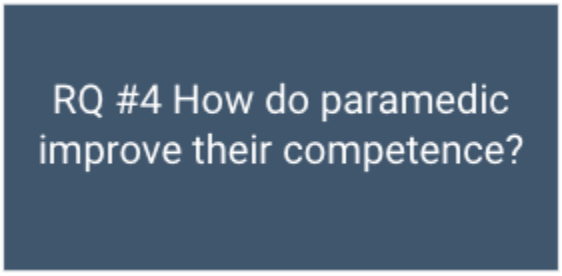
Research Question #2

The information used to make a first impression is considered to be a cognitive ability (Noon, 2014). Croskerry (2013) argues that this very cognitive ability also creates a bias in decision-making for paramedics. “It is not a lack of knowledge, but an issue with the clinician’s thinking”, says Croskerry. He notes that common illnesses are commonly misdiagnosed. This situation has also been seen in the data in the patient care reports for OCES. The information needed by paramedics to be accurate is available as noted by one of the interviewed physicians, “*so I think there is a goldmine of information and hopefully the important stuff comes in the initial presentation*.” What is challenging with OCES is that information transfer is not occurring at the right time between providers. This theme was noted during the interviews as well as reported in the survey data where respondents indicate communication is considered a concern for paramedics. Additionally, paramedics reported feeling less competent about their skill level. This is a concern when considering communication is an important component of relationships, and actual cooperation between paramedics and physicians is not optimal. Paramedic clinical decision-making skills can be supported with case reviews, especially those that occur outside a QA process. Parrot et al., (2021) work reinforces that a data-driven process (see RQ#1 discussion) can improve clinical skills, and collaboration with other professionals on case reviews can be more advantageous.



Research Question #3

As noted in the interviews and confirmed with survey data, collaboration is an important component of learning. Learning clinical skills is critical to paramedics. EMS partners are a valuable tool while treating patients, but if the first impression is vague or ill-defined from the start, the learning process can be sabotaged from the onset. Banning (2018) argues that the interplay is critical in clinical skills development. This multiple-layer approach is not well constructed at OCES. As one paramedic stated*, "It is challenging to talk to physicians when we have different goals- treat, deliver the patient and move on - there is no time to talk."* Moreover, paramedics reported that actual cooperation is lacking with physicians.



Research Question #4

Improving competence is at the root of the problem of practice. OCES originally considered competence as the cause of the differences in first impressions and differential diagnoses by physicians. Paramedics reported feeling less competent than they need to be, but the interviews provided clarification on this point. Paramedics want to be recognized for their skill level and advanced ability to provide patient care in the pre-hospital care environment. As noted by one paramedic, *"I think part of the problem is not all providers are aware of these expectations."* Relationships are a key part of improving competence. Olson et al. (2009) work reinforces the need for multiple capabilities including individual competencies, team-based competencies, and system-based competencies. The competencies address the conceptual framework capabilities of social, emotional, instinctual, and cognitive needs required to improve competency.

Recommendations and Conclusion

The recommendations are outlined in Table 12 below for review. The key to the recommendations is that they be implemented in the order presented to maximize progress toward resolving the issue of the contrary codes. If first impression codes are to drive the educational interventions and be part of a con-ed process as described in the problem of practice, a review of the code types is needed. Additionally, a guide should be created to increase the accuracy of coding by those same events, symptoms, and diagnosis to match the treatment protocols.

Secondly, introduce to paramedic providers the same types of decision-making models used in nursing and for physicians. For example, they are using a “hypothetical deductive reasoning model” when knowledge is sufficient to address a patient presentation or a “rule out a worst-case-scenario model” when knowledge is lacking. Introducing these models would support the idea that paramedics are looking at patient presentation from the same or similar perspective.

Third, create joint learning opportunities between paramedics and physicians with the goal of educating each other about the role they each play in EMS. Furthermore, provide opportunities for cross-training with EMS providers and physicians to improve the differential diagnosis of paramedics, for example, case reviews outside the QA process.

Finally, consider the implementation of a process that could improve paramedic and physician relationships, to allow and improve opportunities to “learn in the moment” cases outside the QA feedback loop.

Ultimately, this project identified some root causes for the differences and inconsistencies in first impression documentation, but more work is needed with the implementation of the recommendations to help OCES focus con-ed on activities that improve paramedic competency, and ultimately patient care outcomes.

Table 12 - Recommendations

Recommendation	Research Question	Link to Framework
#1 Review code structure for events/symptoms/condition Create a guide for the coding process Socialize the process with physicians	How do paramedics choose a first impression?	Instinctual (Social)
#2 Introduce conceptual models for paramedics to aid in clinical decision-making skills.	How do paramedics use information to reach a first impression?	Cognitive
#3 Joint learning opportunities with a goal of educating each profession about the role Provide opportunities for cross-training with EMS providers and physicians to improve the differential diagnosis of paramedics	How do paramedics manage relationships to improve competence?	Social
#4 Create opportunities for the establishment of professional learning relationships to improve the individual 'in the moment' case feedback loop	How do paramedics learn from colleagues?	Emotional

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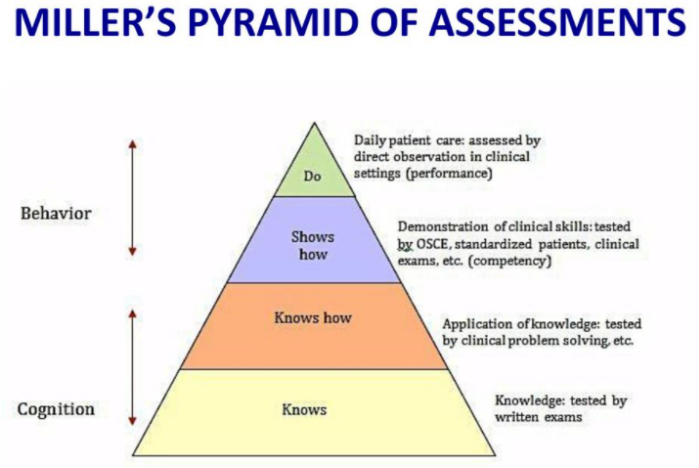
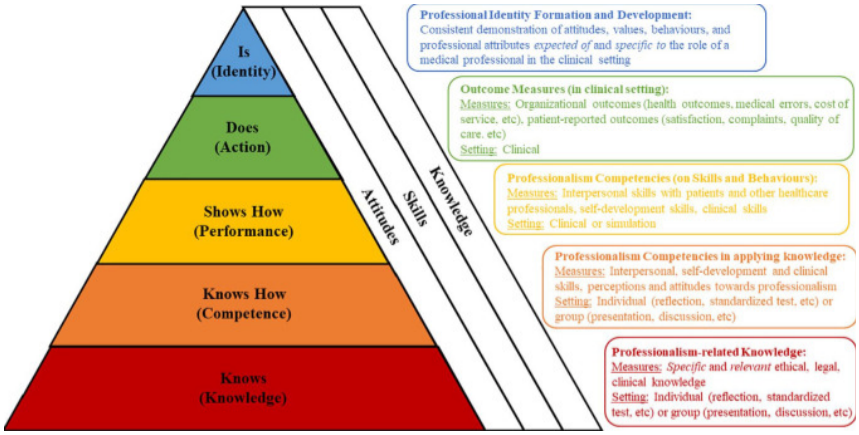
Appendices

Appendix 1 - Miller's Pyramid Changes Over Time

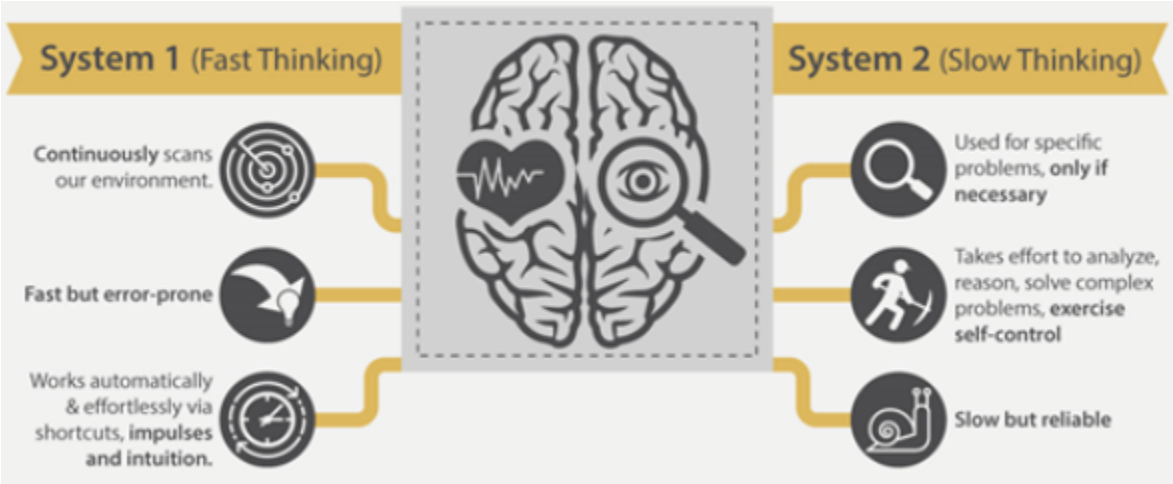
Original Version



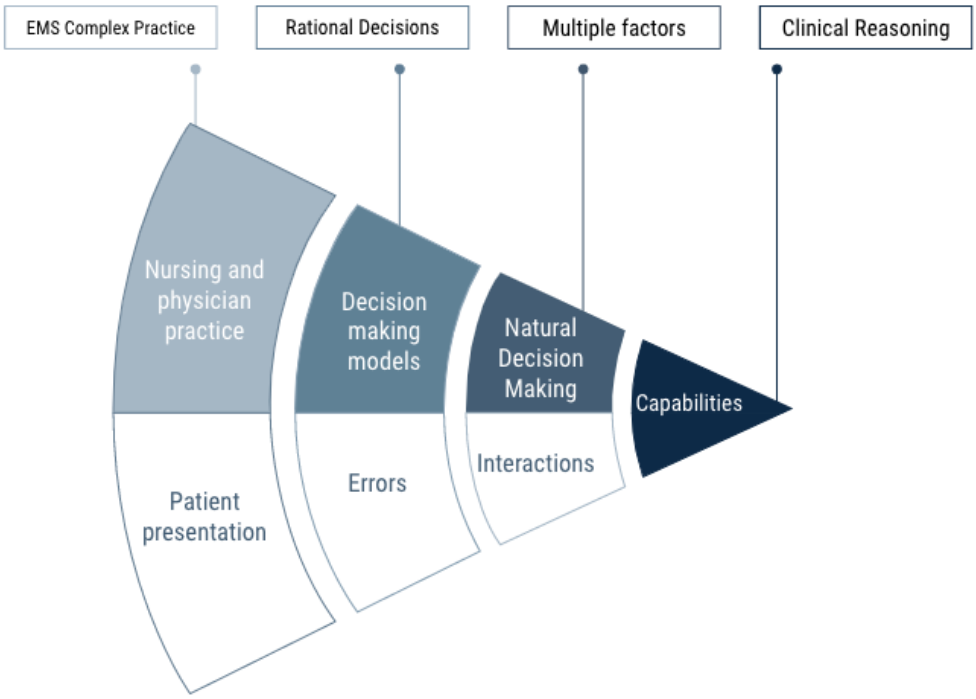
Updated Version



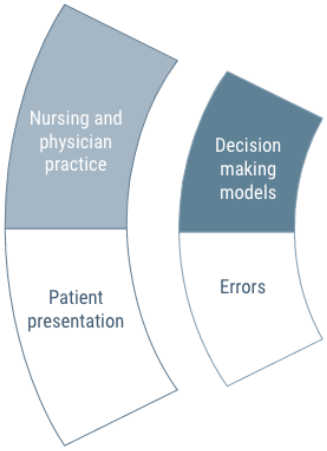
Appendix 2 - Kahneman's System Thinking



Appendix 3 - Literature Findings Summary



Appendix 3 - Literature Findings Summary (continued)



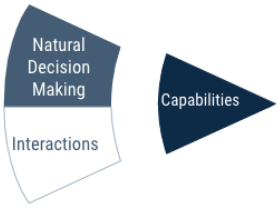
Educational Constructivism
Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*.

Interprofessional relationships
Norris, J., Carpenter, M. J. G., Eaton, M. J., Guo, J.-W., Lassche, M. M., Pett, M. A., & Blumenthal, D. K. (2015). Development and construct validation of the interprofessional attitudes scale. *Academic Medicine: Journal of the Association of American Medical Colleges*, *90*(10), 1394.

Professional Development
Hearle, D., & Lawson, S. (2019). Continuing Professional Development Engagement—A UK-based Concept Analysis. *The Journal of Continuing Education in the Health Professions*, *39*(4), 251.

Psychology
Kahneman, D. (2011). *Thinking, Fast and Slow*. Macmillan.

Psychology
Reason, J. (1995). Understanding adverse events: human factors. *Quality in Health Care: QHC*, *4*(2), 80–89.



EMS Educational Agenda
Croskerry, P, Wears, R.L. & Binder, L.S. (2000). Setting the educational agenda and curriculum for error prevention in emergency medicine. *Academic Emergency Medicine: Official Journal of the Society for Academic Emergency Medicine*, *7*(11), 1194–1200.

Decision-making skills for EMS providers are key in providing accurate patient care
Keebler, J. R., Lazzara, E. H., & Misasi, P. (2017). *Human Factors and Ergonomics of Prehospital Emergency Care*.

EMS Practice borrows from nursing and physician literature
Donn (2017). Expertise and Decision-making in EMS. In *Human Factors and Ergonomics of Prehospital Emergency Care* (pp. 71–94).

Decision-making models - Hypothetical-deductive approach
Marcum, J. A. (2012). An integrated model of clinical reasoning: dual-process theory of cognition and metacognition. In *Journal of Evaluation in Clinical Practice* (Vol. 18, Issue 5, pp. 954–961).

Appendix 4 - Qualitative Survey Questions

A) Background

I want to start discussing your background in healthcare
Where did you start - in what role?
What interested in EMS and/or Emergency medicine?
What does that journey look like for you?

B) Experience

Discuss your EMS experience
What did the learning opportunities look like for you as an EMS provider?
Can you provide some examples of cases?
Did you have a mentor?

C) Communication

What worked for you as an EMS provider?
Tell me about your EMS partners - in terms of what they taught you and what you learned?

Tell me about your interactions with MDs as an EMS provider?
What do you see as barriers in communication between EMS and MDs?
What impacts communication between the two groups?
Any examples?
How can this be improved?

Tell me about your interactions with EMS as an MD healthcare provider?
If applicable - What role do you see yourself playing given your background as an EMS provider now that you are a physician in the ED?
What do you see as barriers in communication between EMS and MDs?
What impacts communication between the two groups?
Any examples?
How can this be improved?

Appendix 5 - Demographic Data Collection

Questions listed with answer choices in brackets.

a) Practitioner level (EMS Provider, ED Physician EMS Medical Director)

b)Gender (Female, Male, Prefer not to answer, Prefer to self describe)

c) Race (Asian, Black/African/Caucasian/Hispanic/Latinx/Native American/Pacific Islander/Prefer not to answer, Other)

d)Current Role (Student EMT, Student Paramedic, EMT, Paramedic, ED Physician, EMS Medical Director, EMS Administrator, Other, EMS Educator)

e) Primary role status (Student EMT, Student Paramedic, EMT, Paramedic, ED Physician, EMS Medical Director, EMS Administrator, Other, EMS Educator)

f) Years of Experience in each role (Student EMT, Student Paramedic, EMT, Paramedic, ED Physician, EMS Medical Director, EMS Administrator, Other, EMS Educator)

g)Additional comments (If you have any comments, additional information, or concerns to share with Jacques, please add your comments in the text box below)

h)If you would like to ask additional questions or receive information about this project - include your email below.

Appendix 6 - ACE-15 Survey Instrument

Table 1. ACE-15: Assessment for collaborative environments.

	Strongly disagree	Disagree	Agree	Strongly agree
1. Team members contribute to setting and evaluating goals for improving the practice	1	2	3	4
2. The team has a culture of mutual continuous learning	1	2	3	4
3. The team fosters a culture of continuously improving communication	1	2	3	4
4. The team is well supported by the overall organization (e.g. practice improvement is encouraged; team training is supported)	1	2	3	4
5. Team members fail to appreciate each other's values and diversity	1	2	3	4
6. Team members appreciate each other's roles and expertise	1	2	3	4
7. Team members have the autonomy to implement their part of the plan once the patient's needs and goals are clear	1	2	3	4
8. The team is effective in assigning and implementing administrative tasks (e.g. leadership, record keeping, meeting facilitation, etc.)	1	2	3	4
9. Team members do not feel safe bringing up concerns about roles and responsibilities for discussion, proactive improvement, and prevention	1	2	3	4
10. All voices on the team are heard and valued.	1	2	3	4
11. The team encourages trust by paying attention to important personal or professional connections (e.g. celebrating achievements, milestones, etc.)	1	2	3	4
12. Members of the team are active listeners and pay close attention to the contributions of others, including the patient and family	1	2	3	4
13. The team engages in routine, frequent, meaningful evaluation to improve its performance	1	2	3	4
14. Team members tend not to recognize their own limitations in knowledge and skills	1	2	3	4
15. The team constructively manages disagreements among team members	1	2	3	4

Appendix 7 - IEPS Survey Instrument

INTERDISCIPLINARY EDUCATION PERCEPTION SCALE

PRE / POST

You will be asked to complete this at the beginning and end of your placement. Thanks for your assistance.

Mother's date of birth (To allow us to match the pre and post responses): _____

Using the scale below, (Strongly Disagree–1 to Strongly Agree–6) please rate your perception of your profession and other disciplines.

DESCRIPTOR	Strongly Disagree 1	Moderately Disagree 2	Somewhat Disagree 3	Somewhat Agree 4	Moderately Agree 5	Strongly Agree 6
1. Individuals in my profession are well-trained.	1	2	3	4	5	6
2. Individuals in my profession are able to work closely with individuals in other professions.	1	2	3	4	5	6
3. Individuals in my profession demonstrate a great deal of autonomy.	1	2	3	4	5	6
4. Individuals in other professions respect the work done by my profession.	1	2	3	4	5	6
5. Individuals in my profession are very positive about their goals and objectives.	1	2	3	4	5	6
6. Individuals in my profession need to cooperate with other professions.	1	2	3	4	5	6
7. Individuals in my profession are very positive about their contributions and accomplishments.	1	2	3	4	5	6
8. Individuals in my profession must depend upon the work of people in other professions.	1	2	3	4	5	6
9. Individuals in other professions think highly of my profession.	1	2	3	4	5	6
10. Individuals in my profession trust each other's professional judgment.	1	2	3	4	5	6
11. Individuals in my profession have a higher status than individuals in other professions.	1	2	3	4	5	6
12. Individuals in my profession make every effort to understand the capabilities and contributions of other professions.	1	2	3	4	5	6
13. Individuals in my profession are extremely competent.	1	2	3	4	5	6
14. Individuals in my profession are willing to share information and resources with other professionals.	1	2	3	4	5	6
15. Individuals in my profession have good relations with people in other professions.	1	2	3	4	5	6
16. Individuals in my profession think highly of other related professions.	1	2	3	4	5	6
17. Individuals in my profession work well with each other.	1	2	3	4	5	6
18. Individuals in other professions often seek the advice of people in my profession.	1	2	3	4	5	6

Student IEPS - Luecht et al, (1990, Journal of Allied Health, 181-191) with permission.

Appendix 8 - IPA Survey Instrument

INTERPROFESSIONAL PROFESSIONALISM ASSESSMENT

Purpose:
The purpose of the Interprofessional Professionalism Assessment (IPA) is to evaluate an entry-level health professional's demonstration of professionalism when interacting with members of other health professions.

Application:
The Interprofessional Professionalism Assessment can be used by health professionals to evaluate themselves or others including learners, peers, supervisors, or subordinates.

Definition:
Interprofessional professionalism: "Consistent demonstration of core values evidenced by professionals working together, aspiring to and wisely applying principles of [1], altruism and caring, excellence, ethics, respect, communication, accountability to achieve optimal health and wellness in individuals and communities."

[1]Stern DT. *Measuring Medical Professionalism*. Oxford University Press. New York, NY; 2006:19.

Directions:
Using the rating scale provided below, please express your level of agreement with each of the items based on your overall impressions and observations of the **individual's behavior** throughout the practice experience. This should represent your final assessment of the individual at the conclusion of the practice experience. Definitions are provided as a context for each of the categories provided.

Rating Scale:
SD = Strongly disagree; D = Disagree; N=Neutral, A = Agree; SA = Strongly agree; N/O = No opportunity to observe in this environment

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Communication
Communication: Impart or interchange of thoughts, opinions or information by speech, writing, or signs; "the means through which professional behavior is enacted." (Arnold and Stern in Stern 2006)

1.	Works with members of other health professions to coordinate communication with patients/clients and family members.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
2.	Demonstrates active listening with members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
3.	Communicates respectfully with members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
4.	Communicates with members of other health professions in a way they can understand, without using profession-specific jargon.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
5.	Responds to questions posed by members of other health professions in a manner that meets the needs of the requester.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Communication, including those that are positive and those needing improvement.

IPA Survey Instrument (Continued)

INTERPROFESSIONAL PROFESSIONALISM ASSESSMENT

Respect

Respect: "Demonstrate regard for another person with esteem, deference and dignity . . . personal commitment to honor other peoples' choices and rights regarding themselves . . . includes a sensitivity and responsiveness to a person's culture, gender, age and disabilities . . . the essence of humanism . . . signals the recognition of the worth of the individual human being and his or her belief and value system." (Arnold and Stern in Stern, 2006)

6.	Demonstrates confidence, without arrogance, while working with members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
7.	Recognizes that other health professions may have their distinct cultures and values, and shows respect for these.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
8.	Respects the contributions and expertise of members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
9.	Seeks to understand the roles and responsibilities of members of other health professions as related to care.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
10.	Determines patient care roles and responsibilities in a respectful manner with members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Respect, including those that are positive and those needing improvement.

Altruism and Caring

Altruism and Caring: Overt behavior that reflects concern, empathy, and consideration for the needs, values, welfare, and well-being of others and assumes the responsibility of placing the needs of the patients or client ahead of the professional interest.

11.	Offers to help members of other health professions when caring for patients.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
12.	Demonstrates empathy for members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
13.	Models for other health professionals compassion towards patients/clients, families and caregivers.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
14.	Places patient/client needs above own needs and those of other health professionals.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Altruism and Caring, including those that are positive and those needing improvement.

IPA Survey Instrument (Continued)

INTERPROFESSIONAL PROFESSIONALISM ASSESSMENT

Excellence

Excellence: Adherence to, exceeds, or adapts best practices to provide the highest quality care.

15. Coordinates with other health professions and the patient/client, family and caregivers to produce an optimal plan of care.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
16. Reviews all relevant documentation from other health care professions prior to making recommendations to plan of care.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
17. Contributes to decisions about patient care regardless of hierarchy/profession-based boundaries.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
18. Works with members of other health professions to assure continuity of care for patients.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Excellence, including those that are positive and those needing improvement.

Ethics

Ethics: Consideration of a social, religious, or civil code of behavior in the moral fitness of a decision of course of action, especially those of a particular group, profession, or individual, as these apply to every day delivery of care.

19. Interacts with members of other health professions in an honest and trustworthy manner.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
20. Works collaboratively with members of other health professions to resolve conflicts that arise in the context of caring for patients/clients.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
21. Discusses with members of other health professions any ethical implications of healthcare decisions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
22. Reports or addresses unprofessional and unethical behaviors when working with members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Ethics, including those that are positive and those needing improvement.

INTERPROFESSIONAL PROFESSIONALISM ASSESSMENT

Accountability

Accountability: Accept the responsibility for the diverse roles, obligations, and actions, including self-regulations and other behaviors that positively influence patient and client outcomes, the profession, and the health needs of society.

23. Engages with members of other health professions in quality assurance/improvement activities.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
24. Seeks clarification from members of other health professions about unclear information.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
25. Accepts consequences for his or her actions without redirecting blame to members of other health professions.	☐SD	☐D	☐N	☐A	☐SA	☐N/O
26. Works with members of other health professions to identify and address errors and potential errors in the delivery of care.	☐SD	☐D	☐N	☐A	☐SA	☐N/O

Provide comments related to the behaviors associated with Accountability including those that are positive and those needing improvement.

Overall Strengths related to Interprofessional Professionalism

Areas for Improvement related to Interprofessional Professionalism

Appendix 9 - RIPLS Survey Instrument

Please complete the following questionnaire.

		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1.	Learning with other students / professionals will make me a more effective member of a health and social care team					
2.	Patients would ultimately benefit if health and social care students / professionals worked together					
3.	Shared learning with other health and social care students students / professionals will increase my ability to understand clinical problems					
4.	Communications skills should be learned with other health and social care students students / professionals					
5.	Team-working skills are vital for all health and social care students students / professionals to learn					
6.	Shared learning will help me to understand my own professional limitations					
7.	Learning between health and social care students students before qualification and for professionals after qualification would improve working relationships after qualification / collaborative practice.					

RIPLS Survey Instrument (continued)

		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
8.	Shared learning will help me think positively about other health and social care professionals					
9.	For small-group learning to work, students / professionals need to respect and trust each other					
10.	I don't want to waste time learning with other health and social care students / professionals					
11.	It is not necessary for undergraduate / postgraduate health and social care students / professionals to learn together					
12.	Clinical problem solving can only be learnt effectively with students / professionals from my own school / organisation					
13.	Shared learning with other health and social care professionals will help me to communicate better with patients and other professionals					
14.	I would welcome the opportunity to work on small group projects with other health and social care students / professionals					
15.	I would welcome the opportunity to share some generic lectures, tutorials or workshops with other health and social care students / professionals					
16.	Shared learning and practice will help me clarify the nature of patients' or clients' problems					
17.	Shared learning before and after qualification will help me become a better team worker					
18.	I am not sure what my professional role will be / is					
19.	I have to acquire much more knowledge and skill than other students / professionals in my own faculty / organisation					

If you have any further comments regarding interprofessional education please enter them in the box below

Appendix 10 - First Impression Table

Specified First Impression	Frequency	Percent	Valid Percent	Cumulative Percent
Abdominal Pain	702	5.8	5.8	5.8
Acute appendicitis	1	0	0	5.8
Acute Bronchitis	2	0	0	5.8
Acute Bronchospasm	10	0.1	0.1	5.9
Acute Coronary Syndrome	2	0	0	5.9
Acute Pain, not elsewhere classified	66	0.5	0.5	6.5
Acute Respiratory Distress (Dyspnea)	271	2.2	2.2	8.7
Alcohol dependence with withdrawal	41	0.3	0.3	9.1
Alcohol use	535	4.4	4.4	13.5
Allergic Reaction	120	1	1	14.5
Altered Mental Status	446	3.7	3.7	18.2
Anaphylactic Shock	3	0	0	18.2
Anaphylaxis	17	0.1	0.1	18.3
Angina pectoris	3	0	0	18.3
Anxiety reaction/Emotional upset	187	1.5	1.5	19.9
Apparent Life-Threatening Event	1	0	0	19.9
Asthma	29	0.2	0.2	20.1
Back Pain	348	2.9	2.9	23
Behavioral/psychiatric episode	208	1.7	1.7	24.7
Burn	20	0.2	0.2	24.9
Cancer	1	0	0	24.9
Cannabis-related disorder	5	0	0	25
Carbon Monoxide poisoning	2	0	0	25
Cardiac arrest	23	0.2	0.2	25.2
Cardiac arrhythmia/dysrhythmia	118	1	1	26.1
Cellulitis	6	0	0	26.2
Chemical burn	1	0	0	26.2
Chest Pain / Discomfort	743	6.1	6.1	32.3
Chest pain on breathing	48	0.4	0.4	32.7
Chest Pain, Other (Non-Cardiac)	113	0.9	0.9	33.7

Chronic Obstructive Pulmonary Disease (COPD)	34	0.3	0.3	34
Cocaine related disorders	2	0	0	34
Common Cold	20	0.2	0.2	34.1
Concussion	4	0	0	34.2
Concussion without loss of consciousness	1	0	0	34.2
Confusion/Delirium	39	0.3	0.3	34.5
Congestive heart failure (CHF)	13	0.1	0.1	34.6
Constipation	32	0.3	0.3	34.9
Contact with Venomous Animal	5	0	0	34.9
Cough	51	0.4	0.4	35.3
COVID-19 - Confirmed by testing	46	0.4	0.4	35.7
COVID-19 - Exposure to confirmed patient	10	0.1	0.1	35.8
COVID-19 - Suspected - no known exposure	13	0.1	0.1	35.9
Dehydration	42	0.3	0.3	36.3
Diabetic Hyperglycemia	93	0.8	0.8	37
Diabetic Hypoglycemia	64	0.5	0.5	37.6
Diarrhea	208	1.7	1.7	39.3
Displacement of urinary catheter	29	0.2	0.2	39.5
Dizziness	245	2	2	41.5
Dystonic reaction	2	0	0	41.6
Ear problem	3	0	0	41.6
Electrocution	3	0	0	41.6
Encephalitis/encephalomyelitis	1	0	0	41.6
End-stage renal disease (ESRD)	1	0	0	41.6
Epistaxis	35	0.3	0.3	41.9
Esophagitis	1	0	0	41.9
Esophageal obstruction	8	0.1	0.1	42
Extremity Pain	368	3	3	45
Eye Injury	16	0.1	0.1	45.2
Eye Pain	14	0.1	0.1	45.3
Fatigue	22	0.2	0.2	45.5
Febrile Seizures	23	0.2	0.2	45.6
Fever	181	1.5	1.5	47.1
Foreign Body in Ear	1	0	0	47.2
Foreign Body in Genitourinary Tract, Part Unspecified	2	0	0	47.2
Foreign Body in Larynx	2	0	0	47.2

Foreign Body in Nostril	1	0	0	47.2
Foreign Body in Pharynx	1	0	0	47.2
Foreign Body in Respiratory Tract	8	0.1	0.1	47.3
Foreign Body in Trachea	2	0	0	47.3
Foreign Body of Alimentary Tract, Part Unspecified	3	0	0	47.3
Frostbite, with Tissue Necrosis	1	0	0	47.3
Gastro-esophogeal reflux disease (GERD)	7	0.1	0.1	47.4
Gastrointestinal hemorrhage	45	0.4	0.4	47.7
Gastrostomy malfunction	15	0.1	0.1	47.9
Generalized edema	36	0.3	0.3	48.2
Generalized Weakness	562	4.6	4.6	52.8
Hallucinogen related disorders	7	0.1	0.1	52.9
Headache	189	1.6	1.6	54.4
Health hazard contact /Suspected exposure	2	0	0	54.5
Heat Exhaustion	22	0.2	0.2	54.6
Heatstroke and Sunstroke	4	0	0	54.7
Hematemesis	8	0.1	0.1	54.7
Hematoma (Non-Traumatic)	4	0	0	54.8
Hemorrhage	110	0.9	0.9	55.7
Hyperglycemia (Not Diabetic)	6	0	0	55.7
Hyperkalemia	3	0	0	55.8
Hypertension	85	0.7	0.7	56.5
Hypertensive crisis	4	0	0	56.5
Hyperventilation	6	0	0	56.5
Hypoglycemia (Not Diabetic)	5	0	0	56.6
Hypotension	71	0.6	0.6	57.2
Hypothermia	4	0	0	57.2
Hypovolemia	4	0	0	57.2
Infectious Disease	13	0.1	0.1	57.3
Influenza	6	0	0	57.4
Inhalant related disorders	2	0	0	57.4
Inhalation Injury (Toxic Gas)	1	0	0	57.4
Injury	243	2	2	59.4
Injury of Abdomen	14	0.1	0.1	59.5
Injury of Ankle	75	0.6	0.6	60.2
Injury of Ear	2	0	0	60.2

Injury of Elbow	20	0.2	0.2	60.3
Injury of External Genitals	5	0	0	60.4
Injury of Face	129	1.1	1.1	61.4
Injury of Foot	27	0.2	0.2	61.7
Injury of Forearm	34	0.3	0.3	62
Injury of Head	423	3.5	3.5	65.5
Injury of Hip	216	1.8	1.8	67.2
Injury of Lower Back	50	0.4	0.4	67.7
Injury of Lower Leg	96	0.8	0.8	68.4
Injury of Neck	98	0.8	0.8	69.3
Injury of Nose	9	0.1	0.1	69.3
Injury of Pelvis	39	0.3	0.3	69.7
Injury of Shoulder or Upper Arm	116	1	1	70.6
Injury of Thigh (Upper Leg)	33	0.3	0.3	70.9
Injury of Thorax (Upper Chest)	40	0.3	0.3	71.2
Injury of Wrist, Hand, or Fingers	80	0.7	0.7	71.9
Intestinal obstruction	4	0	0	71.9
Kidney stones	22	0.2	0.2	72.1
Labor and delivery complications	1	0	0	72.1
Labor and delivery, uncomplicated	1	0	0	72.1
Laceration/Abrasion/Hematoma (minor surface trauma)	146	1.2	1.2	73.3
Laryngitis/Croup	1	0	0	73.3
Leakage of vascular dialysis catheter	3	0	0	73.3
Malaise	83	0.7	0.7	74
Medical device failure	16	0.1	0.1	74.2
Melena	1	0	0	74.2
Meningitis	1	0	0	74.2
Mental disorder	14	0.1	0.1	74.3
Migraine	10	0.1	0.1	74.4
Nausea	179	1.5	1.5	75.9
Need for continuous medical supervision	18	0.1	0.1	76
No Complaints or Injury/Illness Noted	238	2	2	78
Opioid-related	1	0	0	78
Opioid related disorders	3	0	0	78
Orthostatic Hypotension	6	0	0	78.1
Other stimulant related disorders	3	0	0	78.1

Other tracheostomy complication	2	0	0	78.1
Overdose - Acetaminophen	6	0	0	78.2
Overdose - Alcohol	75	0.6	0.6	78.8
Overdose - Amphetamine	2	0	0	78.8
Overdose - Benzodiazepine	1	0	0	78.8
Overdose - Cannabis	7	0.1	0.1	78.9
Overdose - Cocaine	4	0	0	78.9
Overdose - Hallucinogens	2	0	0	78.9
Overdose - Heroin	24	0.2	0.2	79.1
Overdose - Opium	1	0	0	79.1
Overdose - Other opioids	17	0.1	0.1	79.3
Overdose - Synthetic narcotics	4	0	0	79.3
Overdose - Unspecified	105	0.9	0.9	80.2
Pain (Non-Traumatic)	380	3.1	3.1	83.3
Palpitations	31	0.3	0.3	83.6
Patient assist only	5	0	0	83.6
Pelvic and Perineal Pain	27	0.2	0.2	83.8
Pitting Edema	13	0.1	0.1	83.9
Pneumonia	36	0.3	0.3	84.2
Poisoning / Drug Ingestion	31	0.3	0.3	84.5
Pre-eclampsia	1	0	0	84.5
Pregnancy Complications	2	0	0	84.5
Pregnancy-related conditions	8	0.1	0.1	84.6
Pregnancy with contractions	10	0.1	0.1	84.7
Preterm labor without delivery	3	0	0	84.7
Psychogenic Shock	1	0	0	84.7
Pulmonary Edema, Acute	4	0	0	84.7
Pulmonary Embolism	1	0	0	84.7
Rash	3	0	0	84.8
Reduced Mobility	2	0	0	84.8
Renal Failure	2	0	0	84.8
Respiratory Arrest	8	0.1	0.1	84.9
Respiratory Condition due to Chemicals, Gases, Fumes,	1	0	0	84.9
Respiratory disorder	14	0.1	0.1	85
Respiratory Distress of Newborn	2	0	0	85
Respiratory Failure	3	0	0	85

Respiratory Shock	2	0	0	85
Respiratory Syncytial Virus (RSV)	1	0	0	85
Sedative, hypnotic, or anxiolytic related disorders	1	0	0	85
Seizures	329	2.7	2.7	87.8
Seizures with status epilepticus	15	0.1	0.1	87.9
Seizures without status epilepticus	22	0.2	0.2	88.1
Sepsis/Septicemia	56	0.5	0.5	88.5
Septic Shock	3	0	0	88.6
Sexual Abuse	3	0	0	88.6
Shortness of breath	401	3.3	3.3	91.9
Skin infection	73	0.6	0.6	92.5
Smoke Inhalation	5	0	0	92.5
Spontaneous abortion (Miscarriage)	5	0	0	92.6
ST elevation (STEMI) myocardial infarction anterior wall	1	0	0	92.6
ST elevation (STEMI) myocardial infarction inferior wall	3	0	0	92.6
Stroke	126	1	1	93.7
Substance abuse	10	0.1	0.1	93.7
Suffocation or Asphyxia	1	0	0	93.8
Suicidal Ideation	53	0.4	0.4	94.2
Suicide attempt	25	0.2	0.2	94.4
Syncope / Fainting	376	3.1	3.1	97.5
Toothache	5	0	0	97.6
Tracheostomy obstruction	1	0	0	97.6
Tracheostomy problem	3	0	0	97.6
Transient Cerebral Ischemic Attack (TIA)	22	0.2	0.2	97.8
Unconscious	21	0.2	0.2	97.9
Urinary system disorder	5	0	0	98
Urinary Tract Infection (UTI)	49	0.4	0.4	98.4
Vaginal Hemorrhage	16	0.1	0.1	98.5
Visual Disturbance	10	0.1	0.1	98.6
Vomiting	169	1.4	1.4	100%
Total	12093	100%	100%	

Appendix 11 - Quantitative K Alpha Results

First Impression Code	K Alpha	LL 95% CI	UL 95% CI	n
abdominal pain	0.1350	0.0607	0.2063	702
acute respiratory distress (dyspnea)	-0.5882	-0.1000	-0.1551	14
alcohol dependence with withdrawal	--0.3400	-0.3295	0.2614	41
alcohol use	-0.6478	-0.7173	-0.5784	535
allergic reaction	0.5063	0.3361	0.6995	120
altered mental status	0.7220	0.6549	0.7843	446
anxiety reaction/emotional upset	0.5673	0.4421	0.6926	187
asthma	0.7962	0.5385	1.000	29
back pain	0.0593	-0.0544	0.1729	348
behavioral/psychiatric episode	-0.0240	-0.1733	0.1254	208
burn	-0.3929	-0.8571	0.0714	20
cardiac arrest	1.0000	1.0000	1.0000	23
cardiac arrhythmia/dysrhythmia	-0.4948	-0.6883	-0.3073	118
chest pain/discomfort	0.0894	0.7609	0.8646	743
chest pain, other (non-cardiac)	0.2647	0.0809	0.4485	113
confusion/delirium	-0.1138	-0.5593	0.3317	39
constipation	0.5435	0.1630	0.8478	32
cough	0.2327	-0.0904	0.5154	51
diarrhea	-0.0425	-0.1994	0.1145	208
dizziness	0.3513	0.2349	0.4678	245
extremity pain	-0.0606	-0.3813	0.2354	368
fever	0.3961	0.2276	0.5506	181
hemorrhage	-0.2669	-0.5352	0.0034	110

hyperglycemia	0.5877	0.3477	0.7595	64
hypertension	0.3111	0.1111	0.5111	93
hypoglycemia (not diabetic)	0.5877	0.3815	0.7938	64
injury	-0.0189	-0.6303	0.5924	243
injury of ankle	-0.3560	-0.6083	-0.1037	75
injury of face	-0.2080	-0.3500	0.2756	129
injury of hip	-0.0463	-0.2556	0.1630	216
injury of lower leg	-0.2095	-0.5838	0.0028	96
injury of neck	-0.1017	-0.5656	0.3042	98
injury of shoulder or upper arm	-0.3430	-0.5892	-0.0968	116
injury of wrist, hand, or fingers	-0.4196	-0.6563	-0.1535	80
laceration/abrasion/hematoma	-0.1086	-0.4134	0.1866	146
malaise	-0.2791	-0.5902	0.0321	83
nausea	-0.2400	0.2038	0.1559	179
overdose - alcohol	0.3460	0.1051	0.5870	75
overdose - unspecified	-0.2364	-0.5051	0.0324	105
pain (non-traumatic)	-0.0323	-0.2179	0.1533	380
seizures	0.3684	0.2610	0.4694	329
shortness of breath	0.8100	0.7500	0.8650	401
skin infection	-0.6477	-0.8182	-0.4489	73
stroke	0.4532	0.2719	0.6152	126
syncope / fainting	0.5146	0.4230	0.6009	376
vomiting	-0.0471	-0.2194	0.1252	169