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Factors that Affect Reattempting the Emergency Medical Technician Cognitive Certification Examination

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Factors that Affect Reattempting the Emergency Medical Technician Cognitive

Certification Examination

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Education with an emphasis in Educational Leadership & Policy Studies

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Abstract

Certification as an Emergency Medical Technician (EMT) is often the entry point for firefighting careers and is a pre-requisite to enter Advanced EMT or paramedic programs. EMT candidates in most of the United States must pass the National Registry of EMTs cognitive examination (NREMT-C) to be eligible for state licensure. Many candidates who fail their first NREMT-C attempt never take even one of the five additional possible attempts within the specified two-year time frame. Using binary logistic regression with de-identified existing NREMT test data from 2007 through 2012, this research attempted to develop a model to show the relative contribution of previous NREMT-C score, demographic factors, pay status, employment status, and school accreditation to predict candidates' likelihood of retesting. A literature review suggested that these factors influence candidates' success on their first exam attempt, however no literature has examined if these factors predict a candidate's decision to take at least one additional examination attempt. Results showed that the theta score from the prior attempt was a strong predictor of reattempting examinations two through six. Female gender was negatively associated with attempting examinations two through five. Younger candidates were more likely to attempt examinations two through four, whereas at attempt five the odds an older candidate would try again were slightly higher. Military candidates were much more likely to persist through examination attempt three, however this trend reversed at attempts four and five when they were less likely to reattempt. Having someone pay for the prior exam enhanced candidates' odds of taking the second and third examination. All race and ethnic categories (except Hispanic) were weakly associated with the odds of taking a second examination but not in any subsequent

attempts. Students who attended schools associated with accredited paramedic programs were slightly more likely to persist through exams two through four as were individuals having more education. While this analysis identified some factors related to examination persistence, it produced weak models, suggesting that many more individual variables are associated with the decision to persist after failing the NREMT-C EMT examination than those examined.

Keywords: Emergency medical technicians, certification, adult education, examination, competency, persistence.

For my grandmother Catherine Ida Jean Mains. Though she never graduated high school, she taught me the value of persistence, positive attitude and life-long learning.

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List of Abbreviations

| | |
|---------------------|---|
| AEMT | Advanced Emergency Medical Technician |
| Agenda | The National EMS Education Agenda for the Future |
| ALS | Advanced life support |
| ANOVA | Analysis of variance |
| CAAHEP | Commission on Accreditation of Allied Health Education Programs |
| CAT | Computerized adaptive testing |
| CoAEMSP | Committee on Accreditation of Educational Programs for the Emergency Medical Services Professions |
| Core Content | National EMS Core Content |
| DIF | Differential item functioning |
| Education Standards | National EMS Education Standards |
| EMR | Emergency Medical Responder |
| EMS | Emergency Medical Services |
| EMT | Emergency Medical Technician |
| ERE | EMT Readiness Examination |
| ETCC | Elapsed time from course completion |
| FISDAP | A private EMS computer software company |
| GPA | Grade point average |
| IOM | Institute of Medicine |
| IRT | Item response theory |

| | |
|---------------|---|
| MD | Medical doctor |
| NAEMSE | National Association of EMS Educators |
| NASEMSO | National Association of State EMS Officials |
| NCCA | National Commission for Certifying Agencies |
| NCES | National Center for Education Statistics |
| NCLEX™ | National Council Licensure Examination |
| NCLEX-RN | National Council Licensure Examination for the Registered Nurse |
| NCSB | National Council for State Boards of Nursing |
| NEMSAC | National EMS Advisory Council |
| NET | Nursing Entrance Test |
| NHTSA | National Highway Traffic Safety Administration |
| NREMT | National Registry of EMTs |
| NREMT-C | National Registry of EMTs Cognitive Examination |
| NURS | Nontraditional Undergraduate Retention and Success model |
| PCRF | Prehospital Care Research Forum |
| Third Service | Third service government-based EMS systems that are not fire departments. |
| WIS | Weighted Importance Score |

Chapter 1

Introduction

Emergency Medical Services (EMS) is the discipline at the “intersection between public health, health care and public safety” (American College of Emergency Physicians, 2010, para. 2). Most EMS providers practice at either EMS agencies where they assess and care for patients during emergent and scheduled transports on ambulances, or as first responders on fire apparatus, in police cars or in a variety of roles in the United States Armed Forces. In the United States (U.S.), there are presently over one million EMS professionals (NREMT, 2014) providing care to nearly 20 million patients annually (U.S. Department of Transportation, 2007). For EMS providers, entry into practice is contingent upon successfully navigating through the elements of the national EMS education infrastructure.

The EMS Education Agenda for the Future: A Systems Approach

The EMS Education Agenda for the Future: A Systems Approach (the Agenda) is the model that describes the educational infrastructure for EMS in the U.S. (U.S. Department of Transportation, 2000). The Agenda evolved from the EMS Agenda for the Future, a consensus blueprint document published in 1996 that provided a vision for future development of the EMS industry (U.S. Department of Transportation, 1996). The Agenda is comprised of five elements: National EMS Core Content (Core Content),

National EMS Scope of Practice (Scope of Practice), National EMS Education Standards (Education Standards), National EMS Education Program Accreditation and National EMS Certification (Certification) (U.S. Department of Transportation, 2000).

The Core Content was developed under the leadership of the National Association of EMS Physicians, under a grant from National Highway Traffic Safety Agency (NHTSA) (U.S. Department of Transportation, 2005). The Core Content outlines the broad domain of knowledge and skills for the entire EMS profession.

The National Association of EMS Officials (NASEMSO) headed the team to develop the Scope of Practice Model (U.S. Department of Transportation, 2007). The Scope of Practice outlines skills and knowledge specific to each of the four levels of EMS licensure. This document is designed to encourage uniform state regulations that assure a foundation for competency.

The National Association of EMS Educators (NAEMSE) led the consensus process to develop the Education Standards (U.S. Department of Transportation, 2009). Taking into consideration elements from the Core Content and Scope of Practice documents, the Education Standards define terminal objectives within a framework that lists competencies, knowledge, clinical behaviors and judgments, and education infrastructure. The Education Standards replaced prescribed curricula that were often outdated and restricted educational delivery methods.

The Education Agenda envisioned a single national accreditation agency that would be uniformly accepted by all State EMS offices. Accreditation agencies are charged with assuring quality and fostering change in educational institutions (Boelen, 2009). The accreditation process protects the student by developing standards and

guidelines to enhance the quality of education and promote continuous improvement within EMS programs (NREMT, 2012). The Commission on Accreditation of Allied Health Education Programs (CAAHEP) accredits AEMT and paramedic programs upon the recommendation of the Committee on Accreditation of Educational Programs for the Emergency Medical Services Professions (CoAEMSP). The CAAHEP does not accredit EMT programs, however many schools that conduct paramedic programs also offer EMT classes.

National EMS Certification is the final element in the Education Agenda model (U.S. Department of Transportation, 2000). Certification is the last step in the EMS entry-level educational process. The National Registry of EMTs is a private not-for-profit agency that uses cognitive and psychomotor examinations to certify clinical proficiency of EMS providers for most states. These certification examinations are designed to assure the public that EMS practitioners have entry-level competence. Candidates who pass the certification examination qualify for State licensure within their given EMS scope of practice. Failure to successfully achieve certification means the individual cannot practice as an EMS provider.

In a 2014 report to the National EMS Advisory Council (NEMSAC), NASEMSO identified progress toward implementation of the EMS Education Agenda with 100% of states indicating they either have or plan to adopt the EMT and Paramedic Scope of Practice. Their report cites gains from 2007 to 2013 in the number of states adopting the Scope of Practice at the EMR (58% to 76%), EMT (78% to 100%), AEMT (58% to 88%) and paramedic (76% to 100%) levels. They also reported increases in the number of

states requiring National EMS Certification for initial licensure at the EMR (+6%), EMT (+8%), AEMT (+8%) and Paramedic (+6%) scopes of practice.

Scope of Practice

When adopted into regulation at the state level, a professional's scope of practice defines "what a licensed individual legally can, and cannot, do" (U.S. Department of Transportation, 2007, p. 9). The federal government can recommend the components of a scope of practice, but only the states have the authority to issue professional licensure.

While states are not mandated to adopt the Scope of Practice, their federal partners have strongly encouraged them to do so. Uniformity in scope of practice more clearly delineates EMS provider roles for the public and facilitates rapid deployment of personnel with appropriate skill sets during national disasters.

The national scope of practice model describes the minimum skills and knowledge at four levels of EMS practice: Emergency Medical Responder (EMR), Emergency Medical Technician (EMT), Advanced Emergency Medical Technician (AEMT), and Paramedic. The EMR may begin emergent care to seriously ill or injured patients who activate the emergency response system (U.S. Department of Transportation, 2007). Certification as an EMR is not a pre-requisite for other levels of licensure. The EMT provides basic emergency care and transports patients under the guidance of a medical director. The AEMT scope of practice essentially mirrors that of the EMT with the addition of several skills and the ability to administer several medications. Paramedic is the highest-level EMS practitioner. Paramedics have complex clinical decision making ability and perform advanced skills to provide emergency care and transition patients into the health system.

Emergency Medical Technicians. The EMT is the foundational level to achieve professional emergency services certification in most settings. It is the lowest level EMS provider that can care for and transport patients to an emergency department (U.S. Department of Transportation, 2007). As such, licensure as an EMT is the minimal requirement for employment on an ambulance as a patient-care provider. In addition, entry into most AEMT and paramedic programs requires certification as an EMT.

Likewise, EMT certification is often a mandatory prerequisite to work in the fire service. The Bureau of Labor Statistics noted that most firefighters must be certified as an EMT (2014).

Because of its central role for entry into the profession, it is clear that the ability to pass the EMT certification is crucial to achieving an EMS career. Those who fail to do so will not be able to pursue this career path.

Certification

Most health professions have adopted certification requirements to assure external verification of entry-level provider competency to protect the public from unsafe practitioners (Hale, 2012). Certification is a summative assessment “designed to test the knowledge, skills, and abilities required to perform a particular job, and upon successfully passing a certification exam, to represent a declaration of a particular individual’s professional competence” (National Commission for Certifying Agencies, 2014, What is Credentialing?, para. 2).

The Institute of Medicine report on the EMS system issued a recommendation for states to “accept national certification as a prerequisite for state licensure and local credentialing of emergency medical services providers” (Institute of Medicine, 2007,

p.126). They acknowledged that this recommendation would take time to phase in because of cost and the need for education programs to adapt to the change.

The National Registry of EMTs (NREMT) is generally accepted as the national certifying agency for the EMS professions, although not all states have adopted it for all levels of EMS providers. The NREMT certifies paramedics in 44 states and EMTs in 37 (NREMT, 2014). The National Commission for Certifying Agencies (NCCA) accredits the NREMT (NREMT, 2014). The NCCA develops standards that comply with The Standards for Educational and Psychological Testing to define all aspects of certification programs (NCCA, 2014). The NCCA also accredits certification examinations for nursing, respiratory therapists and other professions.

To become certified by the NREMT, EMT candidates must pass both a psychomotor practical examination, and a cognitive examination (NREMT-C). The cognitive assessment is a computer adaptive examination based on item response theory. Candidates have a maximum of six attempts to pass the NREMT-C within two years. Failure to do so requires the candidate to retake the entire EMT program to be eligible to reattempt.

In 2012, of the 65,365 candidates who made their first attempt at the EMT NREMT-C examination, 76% passed (NREMT, 2014). A total of 81% passed within three attempts. According to Bill Brown, former Executive Director of the NREMT, a significant number of EMT candidates who fail their first attempt never retake the test (personal communication, April, 2013). This choice not to reattempt, in essence ends the candidate's aspiration for a career in EMS or the fire service. But having a barrier to progression in a career is not unique to EMS.

In the sciences and health professions, selected science classes were felt to “weed out” students (Hurtado, 2009). These “weed-out” courses disproportionately affected underrepresented minorities and thus impact the diversity of the workforce. Certification is also a type of “gate or screen” (Russ-Eft, 2008, p. 1). It is not known, however, whether it contributes to the age, race, ethnicity and gender disparities present in the profession.

High-stakes testing. High-stakes testing is associated with a consequence (Amrein & Berliner, 2002). Historically, such tests have been used to determine who could immigrate, be placed in higher or remedial academic programs, or be turned away from military service. In the past, they were also used to differentiate groups by race, ethnicity and class.

For a high-stakes examination to accurately measure the intended knowledge it must be reliable and valid. To be reliable, there must be evidence to demonstrate consistency. Validity is achieved by measuring the proper attributes in the correct proportion; using scoring consistent with the domain being measured; demonstrating reliability of scores for each context and group being evaluated; using the scores appropriately for their intended use in a uniform manner; recognizing the short- and long-term effects of the results; and, assuring that the examination outcomes are consistent with its intended purpose (National Research Council, 1999).

Fairness is another key element essential for high-stakes examination design (National Research Council, 1999). The concept of fairness should be applied throughout the test development, administration, and evaluation. A fair test in the high-stakes setting should not rely on one score to make a final judgment. On the other hand, fairness does

not necessarily imply that all groups will demonstrate equal performance on a given exam. Differences in education and other group differences can account for these disparities. Despite this, experts agree that, “a test should not systematically under predict the performance of any group” (p. 79).

High-stakes tests should be conducted based on standards established by experts in evaluation. These standards should determine criterion that distinguish competent from incompetent performance (Cizek, 1996).

Factors related to success on the NREMT-C. A limited amount of research has focused on success on the NREMT-C or on an exam that predicts NREMT-C success at the EMT level. There is much more research in this area at the paramedic level. At the paramedic level studies have identified positive correlations between examination success and student factors such as high school rank (Margolis & Wagoner, 2004), educational background (Studnek, 2005), and motivation (Margolis, Studnek, Fernandez & Mistovich, 2008). Program factors associated with examination success include class size (Wanzek et. al, 2012), institutional support, and pre-requisites (Margolis et al., 2009). Instructor attributes reported to contribute to success are quality (Russ-Eft, 2005), qualifications and inter-instructor communication (Margolis et al., 2009). Instructional strategies related to examination performance are simulation-based learning (Syverson & Hing, 2011), multiple assessment, standardized lesson plans, passing standard above minimal competency level, instructional consistency, clear objectives, immediate feedback on assessments, and test-taking skills (Margolis et al., 2009). Several authors have identified relationships between the students’ field and clinical experiences and

examination performance (Carhart et al., 2012; Houston et al., 2011; Ricketts et al., 2010).

There is a gap in the research relating to differences between candidates who fail their first attempt on the EMT or paramedic exam and never take the exam again. No such studies appear to exist in the literature based on a search of the Education, ERIC, Medline (EBSCO) and CINAHL databases using the key search terms Emergency Medical Services, Emergency Medical Technician, Paramedic paired with persistence, high-stakes examination, examination, certification and licensure.

Diversity in the EMS Workforce

The Institute of Medicine (IOM) (Institute of Medicine, 2002) outlined the crisis of inequity in American health care. They explained that, “minorities may experience a range of other barriers to accessing care, even when insured at the same level as whites, including barriers of language, geography, and cultural familiarity” (p.1). The IOM report suggested a number of solutions to narrow this gap including reimbursement, workforce development, training, data collection for monitoring, and regulatory action.

A lack of diversity in health care providers and leadership has been cited as a factor that influences these disparities (Betancourt, Green & Carrillo, 2002). These authors note that, despite the fact that in 2000 minorities constituted 28 percent of the American population, yet they only made up “3 percent of medical school faculty, 16 percent of public health school faculty, and 17 percent of all city and county health officers” (p.3).

This disparity also extends into pre-hospital emergency care. As compared to other health professions, females have comprised a significantly smaller proportion of the

EMS workforce (U.S. Department of Transportation, 2008). In 2007, 29% of registered EMTs were female. This compares to 93% for nursing and 89% for health aids and medical assistants. This also contrasts to the 2010 US Census population distribution finding that 50.8% of Americans were female (U.S. Department of Commerce, Census Bureau, 2014).

The EMS workforce was also younger than other health or public safety professions identified in the 2008 EMS Workforce agenda report, with the average age of a paid EMS provider (no distinction between EMT and paramedic) at 35 years as compared to medical assistants (37 years), 42 years for respiratory therapists, and 44 years for nurses (U.S. Department of Transportation, p. 31).

The ethnicity of the EMS workforce also differed significantly from the population as a whole. White, non-Hispanic or Latino EMTs licensed by the NREMT comprised 75% of the EMS workforce in 2007 as compared to 63% of the U.S. census in 2010 (U.S. Department of Commerce, 2014; U.S. Department of Transportation, 2008). Hispanic EMTs were five percent of the EMS workforce (16.9% U.S. census) and only three percent of EMTs identified as black or African American alone (Census 13.1%). A similar difference was seen in Asian EMTs (1%) versus 5.1% reported in the U.S. Census. Native Americans EMTs were reported as one percent, which is similar to the 1.2% reported in the U.S. Census.

Because of these gaps, the federal EMS Workforce Report (2008) recommended that EMS “will need to likely focus on diversity, drawing from new pools of workers” (p. 88) to better reflect American population demographics. Yet workforce disparities can become self-perpetuating. The decision to choose a career is determined in part by an

individual's belief that he or she can succeed in their chosen vocation. Hunter (2005) found that people were more likely to feel they could be successful in a health profession proportionately higher in their gender. Likewise, he found self-efficacy was lower for racial and ethnic persons in health professions underrepresented by minorities.

Problem Statement

This dissertation research examined how initial NREMT-C test score, demographics such as age, gender, race/ethnicity, and years of education, employment status and school factors predicted which EMT candidates who failed their first attempt at the NREMT-C exam would reattempt even once (reattempt group). It attempted to uncover the relative contribution of each factor to shed light on the associate of reattempts with initial test score, specific demographic characteristics, examination payment type, and program accreditation status. In particular, this study addressed the following questions:

1. Do higher theta NREMT-C examination scores on the prior examination attempt predict those who would reattempt the examination?
2. Do the demographic characteristics (age, gender, race/ethnicity, employment status, or years of education) of the candidates predict their likelihood to reattempt the examination?
3. Does examination payment type, or program accreditation status predict candidates who reattempted the examination?

Delimitations

This research was conducted retrospectively from existing NREMT databases on EMT candidates who attempted the NREMT-C exam and failed the first attempt but never reattempted within the two-year time limitation as well as those who failed the first attempt and reattempted the examination at least once. To assure the full two-year deadline to attempt had passed, their first attempt was in 2012 or earlier. The data collection began with candidates who tested in 2007, when the NREMT changed the examination to the computer-adaptive format.

Limitations

Data were only gathered from states that used the NREMT-C for certification. This limits the generalizability of the findings. Demographic data were limited to data collected by the NREMT-C at the time the candidate applied for initial certification. These data are optional for applicants, and therefore were not available for all candidates.

The lack of qualitative data related to factors that affect participation and persistence in education such as student motivation, expectancy, attribution and self-efficacy was a significant limitation. Knowing those attributes would help to more fully define a model to explain the lack of persistence in some candidates.

Study Significance

EMT certification is the gatekeeper for entry into a career in EMS and the fire service. Students who fail this exam and elect not to reattempt end their chance to enter these fields. There was no research describing factors associated with the likelihood to reattempt the NREMT-C based on a review of Education, ERIC, Medline (EBSCO) and CINAHL databases using the key search terms Emergency Medical Services, Emergency

Medical Technician, Paramedic with persistence, high-stakes examination, examination, certification and licensure.

This study provided a glimpse at candidate characteristics that may influence their decision to reattempt the exam after an initial failed attempt.

EMS educators will be able to use this information to counsel current and prospective students and to identify candidate characteristics that make them at risk for lack of exam persistence after failure. Likewise, students can be more informed about personal characteristics that might influence their likelihood of reattempting the examination.

These results may provide the NREMT with insight about risk factors for examination attempt non-persistence. If the predictive weight of some factors was large, it may have suggested bias in the examination if it pointed to significantly strong predictive value for lack of persistence relating to either age, gender, race or ethnic groups.

Industry leaders who are anxious to know more about the EMS workforce will also be interested in these findings. Results demonstrating strong correlation between reattempts in areas where there are known demographic disparities in the EMT workforce may help to explain this phenomenon and provide a target area in which to improve it. The EMS Workforce Agenda report notes that, “the lack of complete data about students in the EMS educational pipeline hinders efforts to assess the future supply of workers” (U.S. Department of Transportation, 2011).

Summary

This research attempted to identify factors that predict an EMT candidate's likelihood to reattempt the NREMT-C examination after failing it on the first attempt. The analysis was conducted on data gathered from existing NREMT databases. Knowing the relationship between initial test scores, demographic features, payment type and school accreditation status provides a basic framework to understand why some candidates persist after an initial failed attempt, while others never reattempt, even once. These findings may demonstrate whether the gatekeeping effects of the EMT certification examination influence the industry disparities in age, gender, race and ethnicity. Further, it may provide new information related to factors that influence persistence on NREMT-C examination attempts.

Chapter 2 describes literature that supports a theoretical framework for this research, elaborates on how certification testing is structured, and discusses factors known to impact success on the certification examinations in EMS and other health professions. Chapter 3 describes the research methods used to collect and analyze the data for this study. In Chapter 4, the results of the research are presented. The implications of these research findings are described in Chapter 5, as well as recommendations for future research.

Chapter 2

Literature Review

This study developed models to illustrate how demographic factors, payment status, employment and school accreditation status predicted Emergency Medical Technician (EMT) candidates who failed their first attempt at the National Registry of EMTs (NREMT-C) exam and their likelihood to reattempt the exam even once. It described attributes to test-takers by attempt, and uncovered the contribution of each variable relative to retest likelihood to shed light on factors associated with exam persistence.

This chapter begins with an outline of factors known to affect adult participation and persistence in education. Next, the purpose of high-stakes credentialing exams is described followed by an overview of computer adaptive testing and an outline of the characteristics of the NREMT-C EMT examination. Subsequently, the discussion focuses on factors known to influence success on high-stakes examinations generally; and, in particular, those used for allied health certification. There is little research related to the EMT in this area, therefore paramedic and nursing factors found in the literature were predominantly explored to inform the discussion. Likewise, no research in EMS describes those who do not pass the NREMT-C exam on the first attempt. Even in medicine and nursing, where much more literature exists about factors that influence certification examination success, few studies addressed the characteristics of candidates who do not pass their first attempt.

Participation in Adult Education

In the period from 2002 and 2012, the number of adults over 25 years of age who had completed high school increased (84 to 88%), as did the number of adults with a bachelor's degree (27 to 31%) (National Center for Education Statistics [NCES], 2013). During the past 35 years there has been substantial growth in post-secondary minority enrollment and a concurrent decline in Caucasian student enrollment (Table 1).

Table 1

United States college enrollment changes by race & ethnicity 1976 to 2011

| Race or ethnicity | 1976 | 2011 |
|--------------------------------|------|------|
| American Indian/Alaskan Native | 0.7% | 0.9% |
| Asian/Pacific Islander | 2% | 6% |
| Black | 10% | 15% |
| Hispanic | 4% | 14% |
| White | 84% | 61% |

(NCES, 2012)

Despite this increase in college completion, it was evident that many students did not persist to graduation. According to NCES data (2012) only 59% of students attending a four-year school in 2005 graduated within six years. These rates showed racial and ethnic differences with progressively declining rates of graduation from Asians (70%), multi-racial students (64%), whites (62%), Hispanics (51%), Pacific Islanders (48%) to 40% for Blacks and American Indians/Alaska Natives. Measures of college readiness such as college performance and scores on standardized entrance exams demonstrated that less than two thirds of high school graduates met English benchmarks

set for college success, with even fewer (52%) achieving those set points for reading, mathematics (43%) or science (29%) (NCES, 2011).

The Effect of Motivation in Participation

Many factors influence whether adults participate in education. Motivation is a powerful influence. Houle (1961) divided learning motivation into three categories and described them as those who are: goal-oriented (wish to meet a specific objective); activity-oriented (enjoy the activity itself); and learning oriented (enjoy the learning) (Cross, 1981; Long, 2004). These groups were expanded by the work of Morstain and Smart (1974), who identified six principal factors influencing adult education participation: social relationships (to meet others); external expectations (directed by an authority figure); social welfare (to prepare for community service); professional advancement (to gain forward job mobility); escape or stimulation (to relieve boredom); and cognitive interest (the desire to acquire knowledge). In 1991, Boshier developed an instrument to differentiate between students' rationale for attending education. Its seven factors are communication improvement, social contact, educational preparation, professional advancement, family togetherness, social stimulation, and cognitive interest. Boshier's instrument was based on the premise that adult learners cannot isolate their motivation to learn to one factor. In a follow-up study evaluating Boshier's instrument, Fujita-Starck (1996) validated that assertion. She found that motivation varied among curricular groups that had diverse student characteristics. Early research between 1957 to 1984 found that adults who participate in education are more likely to have a higher level of education, be working (in a skilled as opposed to manual job), be involved in the community, have a higher socioeconomic status, and pursue more active leisure activities

(Courtney, 1992). During that time there was a large growth in the number of women pursuing adult education while the male participation shrank. Motivation appeared to vary by age and younger adults were more likely to seek education to get a job (Long, 2004). For many adults, anticipation of achieving a specific goal was central to their motivation (Goto & Martin, 2009). The belief that they could attain that goal was essential to persistence, despite the many barriers adults faced to finish their education. Goals and motivation are bound tightly with self-efficacy, which is the learner's perception of "their capacity to act" (p. 11).

Barriers to Participation

Many barriers prevent even motivated adults from attending education. Early work in this area by Darkenwald (1985) found the following factors were deterrents to adult education: 1) Lack of confidence characterized by "self-doubt, diffidence, and low academic self-esteem" (p. 183); 2) Lack of Course Relevance; 3) Time Constraints; 4) Low Personal Priority; 5) Cost; and, 6) Personal Problems. Some of these factors were found to be more prevalent in specific demographic groups. As an example, the lack of confidence factor was correlated to those who were older and had less income or education. Likewise, the cost factor was a barrier for women, younger adults, and in those with lower income or less education.

In other research, people often reported lack of time or money as the factors that stopped their participation (Merriam & Cafarella, 1999). But these barriers may have been coupled with or incorporated into other factors. Johnstone and Rivera (1965) divided these into external (situational) and internal (dispositional or psychosocial) participation barriers. External barriers are outside of the control of the individual (for

example cost) as compared to internal barriers, which included attitudes and perceptions. In 1981, Cross added institutional barriers as a third classification, which represented policies that prevent working adults from educational participation. Finally, Darkenwald and Merriam (1984) expanded the list to include informational barriers. This attribute involves the failure of some “adults, particularly the least educated and poorest, to seek out or use the information that is available” (p.137).

In an attempt to identify barriers for undergraduate nursing students, Gardner conducted a qualitative study of 25 racially and ethnically diverse nursing students attending three, four-year California universities. The eight themes that emerged from her research were: loneliness and isolation; differentness; absence of acknowledgement of individuality from teachers; peers’ lack of understanding and knowledge about cultural differences; desiring support from teachers; coping with insensitivity and discrimination; determination to build a better future; and overcoming obstacles. This research underscored the role of educators in recognizing the impact of cultural differences on student persistence and the need for empathy toward these students to promote success.

Participation Theories

Merriam and Cafarella (1999) listed seven theories describing factors that influenced adult education participation. Many of them have similar elements or build off each other. This discussion centers on Boshier’s Congruency Model and Cross’s Chain-of-Response Model.

Boshier’s Education Participation Scale. In the early 1970s there was not a theory of social and educational participation (Boshier, 1971, 1973). Boshier developed the Educational Participation Scale (EPS) to identify factors association with

participation. He asserted that there is no unitary concept to describe the factors influencing participation. Rather, he described participation as an interplay between, “internal psychological and external environmental variables” (p. 256). Boshier claimed “that ‘congruence’ both within the participant and between the participant and his educational environment determine participation/non-participation and dropout/persistence” (1973, p. 256). As his research was replicated, it was refined to have more parsimony, yet he concluded that further work was needed to delve more fully into the psychological precursors to motivation (Boshier, 1976, 1977).

Boshier performed a factor analysis of statements relating to “motives for attendance” and classified the motivations of participants in non-credit classes as either “deficiency or growth motivated” (Boshier, 1973, p. 256). Participants motivated by ‘deficiency’ motivation are driven by the need to satisfy personal needs or cultural expectations. They have “intra-self incongruence” with themselves, the lecturer and other unknown factors (Boshier, 1973, p. 256). This led them to be dissatisfied with the educational environment and more susceptible to dropping out if they felt something in that environment was unfavorable. They were constantly on the lookout for failure and disappointment. As an example from Boshier’s research, students who dropped out were more likely than persisting students to feel the faculty and other students were unfriendly. It appears these are the ‘glass half empty’ type of people who are less likely to enter the education system or persist in it when minor life crises occur. The tendency toward deficiency motivation occurred more often in younger adults and may reflect their developmental stage.

Students with growth motivation wanted more knowledge and their growth was a perpetual cycle in which they continued to want to learn. These students were more autonomous, had an open attitude and were more creative. Developmentally, students with growth motivation were likely to be closer to the self-actualization tip of Maslow's original hierarchy of motivational needs. This student group was more likely to feel satisfied and to persist, even in cases where the educational environment was not optimal.

Cross's Chain of Response Model. Cross's Chain-of-Response Model was built on earlier participation models developed by Miller, Boshier and Rubenson (as cited by Merriam & Cafarella, 1999). Her model incorporated psychological and environmental factors - but she asserted that the psychological factors were most important.

The Cross model represented a conceptual framework that "assumes that participation in a learning activity, whether in organized classes or self-directed, is not a single act but the result of a chain of responses, each based on an evaluation of the individual in his or her environment" (Cross, 1981). This model was based on the belief that influences affecting participation begin intrinsically and tend to move toward extrinsic factors although they are not unidirectional.

Intrinsic factors begin with self-evaluation (Cross, 1981). Individuals who lack confidence in their ability to learn are unlikely at risk of failure by participating. Hurtado (2007) found that racial climate was an important feature of the learning environment that influenced success of minority students. Attitudes toward education were the second factor. These are based on previous experience of the learner as well as others they know. Participation was likely in persons who felt positive about both of these attributes because they felt up to the challenge. The next factor in the chain was: "importance of

goals and expectation that participation will meet goals” (Cross, 1981, p. 124). The two elements that comprised this factor were valence (importance of the goal) and expectancy (the belief that success is likely). A tangible goal was found to be a powerful motivator. High expectancy, which is determined by self-esteem, was linked tightly to the goal. To set a goal that one believed they could not achieve would hinder motivation to participate. The next factor was life transitions such as pregnancy or job loss. The resultant changes these produced could either enhance or diminish motivation to participate in education.

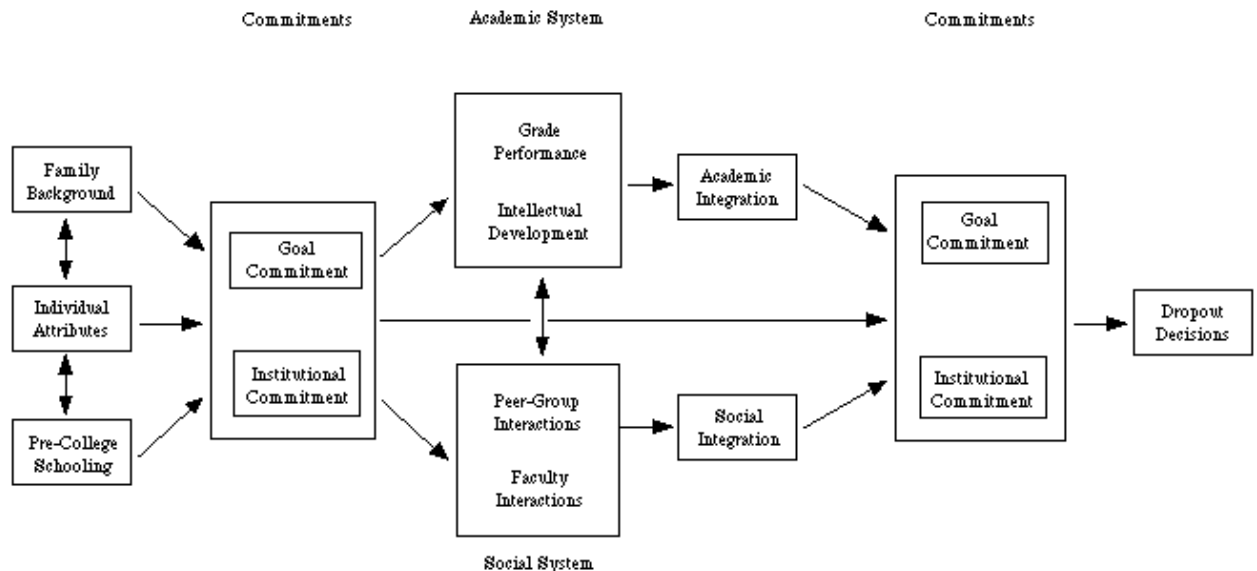
At this point the model shifted toward extrinsic factors (Cross, 1981). The learner is motivated and the degree to which this was true impacted the likelihood that he or she would overcome the challenges posed by the next factor, opportunities and barriers. The information factor could serve to reduce the challenges posed by barriers to learning or could open up opportunity. The importance of this factor was confirmed by Goto and Martin (2009) who found that learners’ decisions to continue their education were enhanced by their understanding of resources and how the educational program could help them achieve their ultimate goal. Participation was the final step in the model. Cross acknowledged that her model was unlikely to predict participation, but she suggested it may serve as a framework for research that would expand knowledge about this topic.

Persistence in Education

Starting college is only the first step toward achieving a degree. Persistence to graduation is difficult for many students as shown earlier in the low college graduation rates. Tinto (1975) was one of the earliest educational researchers to explore this phenomenon. Using the psychology of suicide as its root, Tinto hypothesized that

insufficient interactions with others in college (social and academic), mal-alignment of individual versus institutional values and individual psychological attributes contributed to college dropout. He emphasized that an individual's goals and expectancy for academic success and institutional choice were essential elements to consider when predicting college attrition. In particular, the strength of an individual's long-term goals related to career and academic achievement were seen as essential. Tinto envisioned his Interactionalist Model of Student Persistence model as more than a snapshot of factors at a fixed point in time, but rather as an evolving series of institutional, academic, social, and individual factors that evolved in an interdependent manner as seen in the model (Figure 1).

Figure 1



Tinto's original SIM (adapted by Ian McCubbin from Tinto, V. (1975)
 "Dropout from Higher Education: A Theoretical Synthesis of Recent Research"
 Review of Educational Research Vol.45, No.1, pp.89-125)

Tinto (1975) emphasized the distinction between types of student attrition and the underlying characteristics of students. Students withdrawing voluntarily from college or

stopping out temporarily tended to have generally good grades but lower commitment to finishing college (Hackman & Dysinger, 1970). Those with a strong goal commitment but lower academic ability persisted to completion or to dropout because of academic failure. Finally, students who had both low commitment and poor academic skills tended to permanently dropout.

Student demographics such as socio-economic status, were also known to influence persistence (Pascarella & Terenzini, 2005; Tinto, 1975). This, coupled with high school grades and ACT scores were believed to be the top two predictors of college graduation (Bean, 1982). These factors, along with the rigor of the students' high-school curriculum, strongly correlated with graduation. Although the ACT reported a relationship between students' success and their academic motivation, self-discipline and self-confidence, less is known about the relationship between students' dispositions or the influence of family on college success. Student dispositions were found to have a greater influence on success in non-traditional schools such as commuter institutions (Braxton, 2004).

The social dimension of post-secondary education also plays a role in college persistence. Students involved in academically aligned extra-curricular school activities with a supportive subculture were less likely to voluntarily withdraw or drop out (Tinto, 1975). In particular, "it is the individual's perceptions of his 'social fit' that are <sic> important in decisions of dropout" (p. 107).

Tinto (1975) felt that institutional factors, although at that time under-researched, played an important role in school persistence. As an example, public entities had higher dropout rates than did private schools, as did two-year compared to four-year colleges.

This fact may have related to more rigorous academic admission standards. In two-year colleges, the general student bodies' lower SES may have also played a role. With regard to higher success rates at higher quality schools, there may have been a more intangible feature, the "frog pond effect" that posited, "a direct relationship exists between the ability level of the student body of an institution and the expectations individuals will hold for themselves" (p. 113).

Another dimension correlated to persistence involves peer culture and social integration (Reason, 2009). This incorporated racial and gender climate as factors that may have exerted a positive influence on minority students if they perceived it as welcoming and inclusive. An organizational factor known to relate to college success is where a student begins his or her college education. Persistence for black students has been higher at historically black colleges, and for women at historically female institutions (Reason, 2009). Perceptions that a college is impersonal or that the faculty are not accessible have had a negative effect on persistence (Pascarella, 1985). The second institutional feature correlated with success was quality of the educational entity. This attribute is complex, and often related to admission policies associated with academic factors known to be predictive of success in college. The extent to which students felt the school's actions align with its institutional mission, vision and values also related to persistence.

The last area influencing persistence are individual student experiences such as coursework (and the pedagogies therein), academic major and how oriented the student is to that field, and exposure to concrete experiential activities related to their major. Students who attended orienting first year classes that incorporated development of

academic skills have been shown to have greater persistence. Active classroom teaching environments that promoted cooperative and collaborative learning improved retention as did clear, organized, knowledgeable instruction (Braxton, Bray, & Berger, 2000; Braxton, Milem, & Sullivan, 2000; Pascarella & Terenzini, 2005). Student engagement, as evidenced by study time, class preparation, and involvement in student groups such as organizations, especially those with an educational purpose, have also increased retention to graduation.

To more fully describe factors that influence first-year college success, Reason, Terenzini and Domingo (2005) published a model that includes student precollege characteristics and experiences such as demographic features, academic history and disposition (goals, motivation); organizational context; and peer environment that is influenced by classroom experiences, out-of-class experiences and curricular experiences. They emphasized the importance of a student's first year in college in both acquiring knowledge and skills that influenced college completion.

Knowledge of the relationship of these factors, while explanatory, has not led to great increases in the percentage of students who graduate. Braxton (2004) acknowledged the complexity of this issue when he described college attrition as "an ill-structured problem" (p. 2). Each factor does not exist as a unitary independent concept but rather plays a role within a heterogeneous system of features - each of which can influence the others. As persistence in nursing and EMS are examined, it is evident that many of these factors relate to education in these professions.

Persistence in Nursing Education

Persistence in nursing is an area of concern. This is related to the costs associated with attrition, the negative perceptions about programs with high drop-out rates, and the need for nurses (Cameron, Roxburgh, Taylor & Lauder, 2011).

In a review of the literature on attrition in undergraduate nursing and midwife students, Cameron et al. (2011) identified a lack of high-quality research, particularly as it related to identification of students at risk for dropping out or strategies for retention. She concluded that student attributes and good support are central to persistence in nursing programs.

Pitt, Powis, Levett-Jones and Hunter (2012) undertook a more detailed integrative literature review of factors affecting nursing student attrition. They determined that demographic, academic, cognitive and personality/behavioral factors all impacted attrition and academic performance in nursing programs, although they noted that, in many cases the study design limited generalizability of the authors' conclusions.

Self-efficacy as a predictor of attrition was explored by Harvey and McMurray (1994). They found that nursing students who left the program have lower academic and general self-efficacy and noted that it could often predict future behavior more accurately than could past behavior. Nurses who had higher self-efficacy were "more committed, had a greater sense of personal control and less belief in chance or control of powerful others in their lives" (p. 482).

Jeffreys's Nursing Universal Retention and Success Model. Jeffreys (2003 & 2004) first introduced the Nontraditional Undergraduate Retention and Success (NURS) model to provide a framework to describe factors influencing nursing student retention

and success. This was later expanded in scope and renamed as Jeffrey's Nursing Universal Retention and Success model (Jeffreys, 2012, 2013, 2015). The model was based on an "interaction of student profile characteristics, student affective factors, academic factors, environmental factors, professional integration factors, academic outcomes, psychologic outcomes, and outside surrounding factors" (Jeffreys, 2012, p. 161) as earlier conceptualized by Bean and Metzner (1985) and later refined for non-traditional students (Metzner & Bean, 1987). Jeffrey confirmed the model assumption that environmental factors play the largest role in predicting success for non-traditional students. The non-traditional students included those students: "(1) aged 25 years or older; (2) commuter; (3) enrolled part-time; (4) male; (5) member of an ethnic and/or racial minority group; (6) speaks English as a second (other) language; (7) has dependent children; (8) has a general equivalency diploma; and (9) requires remedial classes" (p. 161). Environmental factors which included living arrangements, financial status, family financial support for school, and family responsibilities among others, had a higher factor loading (explained 25.8% of variance; $\alpha = .74$). This was followed by institutional interaction and integration factors, which included tutoring, counseling, student support, mentoring and advisement (explained 9.8% of variance, $\alpha = .73$). The other elements of the instrument included personal academic factors, college academic facilities and friend support). Each accounted for approximately six percent or less of the explained variance.

Persistence in EMS Education

The issue of participation has received almost no attention in the EMS literature. The EMS workforce has not reflected the ethnic or gender diversity of the general

population (U.S. Department of Transportation, 2008). In an examination of factors that influence choice of professions, Hunter (2005) found that self-efficacy for participation in EMS education was strongly influenced by knowing someone in the profession. No other research was identified on this topic.

Noting a poor EMT course completion rate in a group of non-matriculating students in North Carolina, researchers adapted Tinto's (1975) interactional model for student retention to develop a preparatory course (Renkiewicz & Hubble, 2014). The 24-hour course introduced students to expectations for a career as an EMT. An assessment of basic skills in reading, math, locating information, teamwork, listening and writing was performed. Students who did not meet the minimum competencies set by the state in those areas were enrolled in remediation activities to help them meet those goals. Prior to implementing the preparatory course, 24.7% of students completed the EMT program as compared to 67.5% who completed the program after the intervention ($p < 0.01$). The pass rates on the certification exam also showed significant improvement in pass rates which were 18.6% in the pre-group and 60.9% in the post-implementation group ($p < 0.01$).

An Australian study by Madigan (2006) might have some bearing on the subject. She examined factors that predict first-year academic performance of prehospital students. In Boshier's theory (1973) it was suggested that dropout and participation were parallel events - therefore it is possible that some of the predictors of success Madigan (2006) identified may influence the decision to participate. The factors she found associated with first-year success were a score of >50 on the University Admission Index, higher postsecondary education, prior healthcare experience, mature-entry students and male gender.

The dearth of research in this area left open the opportunity for EMS researchers to develop projects or perhaps replicate the research of others in this area. Yet, there is still much unknown about factors that influence persistence from EMT to paramedic education.

Assessing Entry-Level Competence

High-stakes medical certification examinations aim to protect the public by assuring that after graduation the candidate has met a pre-defined measure of competence. Yet, competence involves much more than can be measured by one type of assessment taken at a fixed point in time. Professional competence is a multi-layered characteristic that involves using habits of mind to integrate cognitive, technical, relationship, affective, and moral dimensions of practice within specific contexts (Epstein & Hundert, 2002).

Some have criticized the trend toward competency-based assessment in healthcare. Talbot (2005) argued that measuring competence at a fixed point in time is short sighted, and that it takes much more time to develop “emotion, reflection and attitudinal development” (p. 592) essential for true professional competence. Likewise, Grant (1999) noted that objectives and competencies would never be able to fully encompass the human behaviors necessary for professional practice. She suggested there was one truth that underscored teaching clinical reasoning, “there is no unitary, common, universal approach to a problem” (p. 274) and that in fact, the clinician’s expertise was not derived from meeting certain objectives, but was rather based on the sum of individual differences in knowing, experiences and application of experience. Further,

Epstein (2006) pointed out that there was little credible evidence to demonstrate that competency assessment protected patients from harm related to poor care.

Clements and Mackenzie (2005) defined competence broadly for EMS as “the ability to operate to an adequate, safe standard” (p. 516). They reflected that while competence defines a minimum standard, EMS providers should ultimately aspire to perform at a higher level.

Despite these criticisms, most healthcare professions follow a competency-based approach that includes high-stakes testing after program exit. Often, multiple choice examinations are used for this purpose because, when well-constructed, they are an efficient, valid, reliable and defensible way to assess that a graduate has met key elements of competence as defined by their profession.

Nursing assesses competence for licensure using the National Council for State Boards of Nursing (NCSB) National Council Licensure Examination (NCLEX™). In EMS, entry-level competence after graduation from an accredited paramedic program is measured using a practical examination and the National Registry of EMTs computer adaptive multiple-choice examination (NREMT-C).

Computer Adaptive Testing

Many health professions use computer adaptive testing to administer cognitive certification examinations. Closest to EMS in clinical practice is Nursing, whose NCLEX™ exam shares many similarities with the NREMT exams. Both use computer adaptive examinations (CAT) based on item response theory as a cognitive test platform.

Classical test theory assigns one point for a correct answer and zero if the answer is incorrect. The test-taker’s true ability is thought to be their score plus error (Devellis,

2006; Mislevy, 1996). Item-response theory (IRT) assumes that each test-taker has an underlying trait or ability that determines test performance (Weiss & Kingsbury, 1984). As a consequence, measurement within IRT assesses each item as it relates to the latent trait of that specific test-taker. The individual's responses are plotted onto a curve. Each item has a location based on trait level. That location defines the amount of the individual's latent trait needed to have a 50% chance of answering the item correctly. In IRT, the item's discrimination relates to its ability to differentiate a particular trait level. Adaptive testing strategies select individual items contingent on the examinee's response to the previous question after estimating the candidate's trait level. Computer adaptive tests represent the marriage of item response theory, adaptive testing, and computerized test administration.

The nursing and EMS CAT are criterion-referenced examinations, which measure a candidate's knowledge of specified standards. Both have a pre-established passing standard established by a panel of subject experts, which is expressed as either a logit or a theta (θ) score. A logit measures "the relative differences between candidate ability estimates and item difficulties" (National Council for State Boards of Nursing, 2014, CAT Definitions, para. 4) whereas the theta is the individual ability trait. Each item in the pool is assigned a difficulty level, and there must be sufficient items in the pool to traverse the desired range of population trait levels (Weiss & Kingsbury, 1984). Items with high discrimination permit accurate measurement using the fewest number of items. Bias is minimized in this technique by having an item pool that has equal numbers of questions at each difficulty level and with similar discriminations. Adaptive testing has higher classification validity compared to conventional exams because of its ability to

differentiate between student achievement levels. This effect is greatest in candidates who are not close to the pre-determined mastery cut score (Weiss & Kingsbury, 1984).

A CAT is substantially different from a linear examination because each individual receives a different exam tailored to their ability so the items offered to the candidate are selected as they take the examination (NREMT, 2014). Each item is a four-response multiple-choice question with one correct answer. For each response the candidate's answer determines the difficulty and content of the next question. The first item administered to all candidates is calibrated just below the passing standard. If the candidate answers correctly, the questions become increasingly more difficult until ultimately, questions are missed, at which point they become slightly easier again. Using this process, early in the exam, the computer algorithm determines the candidate's ability estimate expressed as a theta estimate with an error variance calculated as a confidence interval (Weiss & Kingsbury, 1984). The program subsequently delivers questions that are close to this level and that the candidate has a 50% chance of answering correctly (NCSB, 2014). This continues until the statistical software determines with 95% confidence that the candidate's score will remain above or below the pre-determined passing standard. The EMT candidates can achieve a confidence interval of 95% in as few as 70 questions or anywhere up to 120 questions, which is the maximum number of questions on the test. Each question is appropriate to a candidate's ability level and reduces the chance that results will be skewed. It provides a more precise measurement of individual ability and because each candidate sees different questions, it improves test security.

The NREMT Cognitive Examination

The NREMT cognitive examination is a CAT that is administered at the four levels of EMS scope of practice. In 2013, 3,354 examinations were administered to Emergency Medical Responder candidates and 62,987 exams to EMT candidates as compared to 3,231 at Advanced EMT and 10,143 at the paramedic levels (NREMT, 2014).

Multiple-choice examinations offer a practical way to reliably measure terminal competency. This type of exam assesses knowledge, comprehension, and problem solving and can begin to uncover clinical reasoning in context (Epstein & Hundert, 2002).

Exam Validity

Medicine has a few studies that show correlation between exit assessments and performance in real patient settings. They include a study by Tamblyn et al. (2002) who identified a correlation between Quebec family medicine physicians' qualifying examination and the likelihood they would make particular drug prescribing errors, or refer certain types of patients to specialists over their first four to seven years after graduation.

There is limited evidence that these correlations exist in EMS. In the only study found that evaluated how the NREMT-C relates to clinical practice in EMS, researchers assessed cognitive knowledge using the NREMT-C as compared to success on simulated field scenarios in a group of experienced paramedics (Studnek, Fernandez, Shimberg, Garifo, & Correll, 2011). They found a significant correlation between passing the multiple-choice examination and passing the simulation.

The NREMT consults a variety of materials to establish the depth and breadth of its certification items (NREMT, 2010). Principal among them are the “National EMS Education Standards; the National EMS Practice Analysis; the most current American Heart Association guidelines; organizational position statements; current peer-reviewed literature; and content of EMS textbooks” (NREMT, 2010, p. 2). An expert team representing the EMS community interprets these printed sources. The NREMT Practice Analysis committee determined that competent patient care blends knowledge and skill for patients of all ages in broad content areas that include: airway, respiration, ventilation; cardiology; trauma; and medical, obstetrics, and gynecology.

One measure of validity for certification examinations is the extent to which the content of the test is relevant to the practice of individuals within that certification level. It must assess the problems encountered by individuals within that level of certification and the “knowledge, skills and judgment required to handle these problems” (Kane, 1997, p. 5). The practice analysis is the step in the examination development process that determines those attributes. It establishes a framework that describes the profession’s practice patterns upon which to construct the exam (Soto, 2011). From this framework, information about the depth and breadth of knowledge and skills is derived. The NREMT (2010) cautioned that, “competence is a challenging construct, and includes many aspects of behavior that are not included in an analysis of practice” (p. 4).

The NREMT conducts a practice analysis at five-year intervals as the first step to test-plan development or revision. The most recent EMS practice analysis was conducted in 2014 (NREMT, 2015) however, earlier practice analysis used to blueprint the exams conducted during the study period. In 2009, experts in EMS and NREMT leadership

gathered and using the 2004 Practice Analysis, developed a 69 item task list that incorporated patient conditions with appropriate assessment and management; operational tasks and skills within the domain of EMS (NREMT, 2010). Then, the group determined that the importance of a task would be established by assessing how often EMTs performed it and how critical it was to the patient outcome. They developed Likert-type scales to determine task frequency and criticality (based on the potential for patient harm). For the operational tasks (such as rescue techniques), the questions were modified to reflect criticality to both patient and all others on the scene. Respondents were given the option to select, "I am not authorized to perform this task" (p. 6) in the skills tasks section. Nine demographic questions were asked to detect response bias and for proper representation of respondent characteristics. The surveys were mailed to a random sample of the 240,000 non-military EMS personnel who were certified at each level of practice. The sample was stratified by minority status and an oversampling strategy was used in an attempt to achieve an adequate minority response. The EMT sample of 2,500 (71% white; 29% minority) was derived from a population of 145,282. The Practice Analysis committee determined it was representative of the population.

The results were analyzed and a Weighted Importance Score (WIS) ranging from 1.0 to 4.0 was calculated based on the sum of $1/3$ frequency and $2/3$ potential for harm (NREMT, 2010). This allowed the committee to determine relative weights for each content section of the examination within the test plan (Table 2).

Table 2

Content distribution for EMT test plan from 2009 practice analysis

| Content Area | % of exam |
|-----------------------------------|-----------|
| Airway, respiration & ventilation | 17-21 |
| Cardiology & resuscitation | 16-20 |
| Trauma | 19-23 |
| Medical/Obstetrics/Gynecology | 27-31 |
| EMS operations | 12-16 |

(NREMT, 2010)

In 2010, in a major change from earlier tests, the pediatric section of the NREMT-C was removed. Instead, the pediatric items were integrated within each patient care content section incorporating 85% adult and 15% pediatric questions within each area. This created a distribution of the item patient population consistent with industry ambulance response data (NREMT, 2010).

After establishing the test blueprint, the NREMT determines the need to create exam items or to modify or delete existing items in the test bank. Items are developed by expert teams who submit questions in an assigned content area and then assemble at the NREMT headquarters in Columbus, OH, where their questions are anonymously examined for parsimony, structure, accuracy, cognitive level, and difficulty. Using the Bloom's taxonomy of educational objectives as a framework, the exam developers attempt to assure that a variety of levels of questions are asked, and that higher levels (particularly application and analysis) of knowledge are targeted as opposed to asking simply knowledge and comprehension-level questions (Bloom, 1956). As suggested by

Gronlund and Brookhart (2009) these objectives must be “in harmony with the content standards” (p. 46). For EMS, the standards are The National EMS Education Standards (U.S. Department of Transportation, 2009).

Examination Pass/Fail Status Determination

The candidates’ NREMT-C pass or fail status is determined when they have answered enough multiple-choice items to establish that they exceed, or in the case of the unsuccessful candidate, fail to reach the passing standard with a 95% confidence interval (NREMT, 2014). The passing standard for the NREMT is set by the NREMT Standards and Examination Committee. This decision is made between a minimum of 70 and a maximum of 120 questions at the EMT level. If a candidate reaches 120 questions without achieving the 95% confidence interval, a slightly different algorithm is applied. If the ability estimate is above the passing standard, the benefit of the doubt is given to the candidate and he or she passes. Candidates who fail to demonstrate the passing standard within the two-hour maximum time frame fail the exam.

Exam Reliability

Exam reliability is determined by measures that assess “the consistency of the assessment results” (Miller, Linn & Gronlund, 2009, p. 71). Assessing reliability in a computer adaptive test varies from standardized test reliabilities (Wainer, 2000). The NREMT-C uses a decision consistency statistic to measure reliability. This assesses reliability of pass/fail decisions by determining the probability that the test-takers true ability (not the estimate of it) exceeds or is less than the passing standard (NCLEX, 2014). Another measure of reliability assessed by the NREMT is differential item functioning (DIF) (NREMT, 2014). The DIF measure detects bias in how the items

function for different groups of test-takers who have similar ability. For example, if an item is statistically less likely to be answered correctly by test-takers of a particular age who are determined to have the same ability, DIF exists. To address this, the NREMT convenes periodic meetings with ten members of the EMS community representing a variety of ages, genders, ethnic/minority and geographic status. This group evaluates items determined to have DIF and assesses the need to remove them from the exam item pool.

Examination Process

At the end of their EMT program, graduates create an account on the NREMT website. Candidates must be 18 years or older to meet registration requirements. Eligibility to take the NREMT-C examination is verified by the EMT program director electronically on that website to attest that the learner has successfully demonstrated all affective, cognitive and psychomotor competencies of the course. After the program completion is verified and the candidate pays the \$70.00 fee to take the exam, authorization to test is granted (NREMT, 2014). This allows the student to access the Pearson Vue website, the authorized NREMT test administrator, and schedule their examination at one of their secured testing sites.

After examination completion, the candidate and program director access the results within their respective NREMT accounts. Candidates who complete their examination before noon typically receive results by mid-afternoon that same day while completion after noon yields results at the beginning of the next business day.

When the student successfully completes both the cognitive and psychomotor elements of the examination they become NREMT registered EMTs. This credential

makes them eligible for licensure or certification within the states that use the NREMT as a certification examination.

Candidates who fail the NREMT-C must wait 14 days before they schedule another exam. Each candidate can attempt the cognitive examination a maximum of six times. If the sixth attempt is unsuccessful or two years has elapsed since the course completion verification, authorization to test ends and the entire EMT program must be repeated.

Factors that Influence Outcomes on Nursing and EMS Certification Examinations

Factors that influence passing high-stakes certification examinations are multi-dimensional and have been studied widely in nursing and to a lesser extent in EMS. Non-cognitive, cognitive and demographic factors have all been shown to contribute to exam success. In nursing, cognitive factors are widely considered to have the greatest influence (Griffiths, Papastrat, & Czekanski, 2004). There are much less data in EMS and most of the existing research at the time of writing was at the paramedic level of certification.

Factors Influencing Success on the NCLEX™

The ability to predict students who will be successful in the nursing program, and subsequently on their certification exam (the NCLEX™), begins before the student is admitted to the nursing program. Consistent with persistence research, the academic performance of a student before entering a nursing program yields valuable information.

In a meta-analysis of nursing research that examined nursing school and NCLEX-RN success, Campbell and Dickson (1996) found studies that included the following cognitive predictors for NCLEX-RN success: college grade point average (GPA), pre-nursing GPA, nursing GPA, GPA from biological sciences, chemistry, liberal arts, social

psychology and mathematics. Standardized tests used most frequently to predict success were the SAT®, ACT®, or National League for Nursing Pre-Admission examinations. Other assessments mentioned several times were the Watson-Glaser Critical Thinking Appraisal and the Mosby Assess Test. Preadmission predictor variables were high school GPA, high school rank, and number of credit hours in college. Variables with positive predictive values that were evaluated just once were self-perceived NCLEX™ scores and a variety of other assessment exams. Non-cognitive predictors studied most frequently were cognitive/learning style, self-concept/esteem, test anxiety, social support, and situational characteristics. Demographic predictors with significant results evaluated educational level of parents, age, finance, and race/ethnicity.

One unsuccessful attempt to establish such a connection was in a study conducted by Gallagher, Bomba, and Crane (2001). They sought to establish a relationship between the Nurse Entrance Test (NET) and students' academic success in the program and likelihood of passing the NCLEX™. They found the NET correlated to success in one of their final nursing courses, and the reading subtest target score increased the likelihood that students would earn a B or higher (p. 133). They were not able to establish a relationship between the NET and the NCLEX™ pass or fail status.

Science classes serve as pre-requisites to nursing and paramedic programs. These programs can create a barrier to entry into the program as failure to pass them eliminates a student's chance of admission.

In an Australian University, Whyte, Madigan, and Drinkwater (2010) evaluated students enrolled in the first year of a nursing, paramedic or nursing/paramedic double degree program. The University Admission Index, a ranking based on high-school

performance, followed by mature entry had the highest correlation to grade point average (GPA) in the entry-level science course. Interestingly, previous clinical experience had a significant but negative relationship to GPA. It seems counter-intuitive that experience within a health profession would lower a student's grades.

Many EMT programs have no pre-requisite courses. Those housed within a college setting may require pre-admission reading assessments, however many EMT programs are offered through the State EMS office or in local non-academic training programs (U.S. Department of Transportation, 2011). The National EMS Education Standards do not define minimal entry pre-requisites. That means that students who attend EMT programs have a broad range of educational backgrounds.

The ability to predict NCLEX™ performance based on standardized program assessments was evaluated by Yeom (2013). In contrast to most NCLEX™ studies, which focused on predicting students who could pass the exam, this author sought to more accurately identify those at risk for failure. Yeom assessed baccalaureate-nursing graduates from one Midwestern university. The sample yielded a somewhat lower than national average first attempt pass rate. A model was constructed to identify those likely to pass on the first attempt. It was correct in predicting success for over 90 percent of those who passed the exam. The medical-surgical, pharmacology, and community health standardized examinations were all significant predictors. Although the model was also statistically significant in predicting failure, it did so in just over one-third of the cases.

The positive predictive value of another commercial test series was confirmed by Alameida et al. (2011) who evaluated the Assessment Technologies Institute predictor exam in a group of racially diverse students and found there was a significant relationship

between the predictor exam and first-attempt pass rate on the NCLEX™. There was also a difference between the pass and fail group means in race and ethnicity however there was no statistically significant difference in age, gender or program type.

Factors Influencing Success on the NREMT Cognitive Examination

The two chief sources of research in cognitive examination success for the NREMT-C exams are from the registry themselves, and from Fisdap, a commercial company that provides web-based clinical scheduling, skills tracking and summative examinations used by 75% of accredited paramedic programs (Fisdap, 2014). Fisdap hosts annual research summits, which serve as research incubators. Participants interested in research are assigned to a group with an experienced researcher and an epidemiologist or statistician. Each group selects a principal investigator and over a period of two days, the group develops a research question, Fisdap staff pull the data, and the statistician helps the group run the appropriate tests to answer their research question and then draft a preliminary abstract. Abstracts are typically submitted to the Prehospital Care Research Forum (PCRF) where peer reviewers may select them for oral or poster presentation at the National Association of EMS Educators annual symposium. Unfortunately, these principal investigators rarely develop the abstracts into journal articles so their abstracts have limited distribution and most are never published in an indexed database.

Almost all of the prehospital research related to exam success or failure involved retrospective and correlational studies, with a few regression analyses. Robust experimental research in this area was not yet available. In an editorial about prehospital clinical research, Callahan (1997) pointed out this dearth of experimental research in

EMS, which he defined as “impressively deficient” (p. 786). This vacuum also exists with regard to quality EMS education research. In a review of dissertation and thesis research from colleges and universities in the U.S. and Canada in EMS, McKenna (2012) found 94 dissertations related to EMS education. Of these, only 18 (19%) used an experimental or quasi-experimental design in which an intervention or treatment was introduced.

The research in EMS participants’ success on the NREMT exams focuses primarily on program, faculty, clinical, and demographic factors that influence success. Unlike nursing, non-cognitive factors such as motivation, metacognition, persistence, self-efficacy, and test anxiety are absent from literature examining this topic in EMS.

Program factors. A number of authors have assessed program factors associated with first-attempt NREMT-C exam success. Bentley, Fernandez, Brown and Margolis (2009) found program size was a significant factor influencing success on the paramedic NREMT-C. These authors classified 733 paramedic programs as small (1-10 students), medium (11 -19 students) and large (>20 students). They demonstrated that the first-attempt pass rate was lowest in small programs and incrementally increased with program size. The difference between large and small programs was statistically significant as well as between large and medium programs.

In a similar study of EMT students, Wanzek et al. (2012) compared EMT class size to their pass or fail status on the Fisdap EMT Readiness examination (ERE). Passing the ERE means a student will likely pass the EMT NREMT-C as it has a 97.4% positive predictive value (Page, Johnson, Briguglio & Salzman, 2008). The sample used by Wanzek et al., included 1,289 students from 36 programs (2012). The mean class size

was 19 (range 1-67). Class section size was significantly related with passing the ERE-2 (1-16 students =23.9%; 17-23 students = 35.9%; >23 students = 43.9). The odds of passing the ERE-2 was 2.5 times greater for students in the largest as compared to smallest group after controlling for race, gender and accreditation status. This supports Bentley et al.'s (2009) finding that class size does matter.

An early study by Cannon and Margolis (1998) compared paramedic didactic training hours and paramedic exam performance on the NREMT-C. They examined 1,600 applicants, excluding 29 that did not include didactic information. Reported didactic hours ranged from 64 to 1,594. It is important to note, unlike almost all other studies on this topic, these authors did not specify that the candidate passed on the first attempt - only that they passed the exam. They found no statistically significant correlation between didactic training hours and outcome on the NREMT-C. The data available for this dissertation research did not include either class size or program length. Therefore, the influence of these variables on the candidates' decision to retest were not evaluated.

In the only quasi-experimental approach on this topic identified in the EMS literature, Syverson and Hung (2011) compared two non-randomized EMT classes. One class was provided traditional instruction with PowerPoint-supplemented lectures preceding skills training. The second class was instructed using simulation activities in which the instructor guided the learning process through modeling the expected clinical findings and interventions. Both groups' performance was evaluated using the Fisdap EMT readiness examination (ERE). The simulation group outperformed the traditional

group in 21 of 22 categories on the ERE. Statistical significance was achieved in problem-solving questions related to cardiology.

Predictive models. Dickison, Hostler, Platt and Wang (2006) collected data on NREMT-C paramedic test candidates for one year. At the time of the test, the examinees completed a survey. The survey data included program attended (accreditation status was later determined using a list from the CoAEMSP), age, employment type (fire, private or third service, hospital-based, government, and other), years of education, number of examination attempts and race. The authors evaluated relationships between passing the NREMT-C and attendance at an accredited paramedic program along with demographic variables. Of the 12,773 cases they reviewed, 74.6% were male. There was an increased chance of passing for those who attended an accredited paramedic program. The strongest demographic predictor was years of education. Other factors associated with increased chance of passing were fire department as compared to private ambulance or municipal third service employment and Asian race. Variables associated with lower exam success rates were repeated exam attempts and African American race. Even after accounting for the confounding effects of the other variables, multivariate logistic regression showed that attendance at an accredited program was independently associated with success on the exam. This work suggests that both program accreditation and ethnicity influences candidates' success on the examination. The influence of both of these variables were evaluated in this dissertation.

Using the same data set as reported in Dickison, Hostler, Platt and Wang (2006), and including some information available from the licensure application, Fernandez, Studnek and Margolis (2008) "hypothesized that a combination of student and program

characteristics will influence the probability of passing the national paramedic certification exam” (p. 259). Race was modified to three categories (white, African American, other) and age was also categorized into three levels (20-26, 27-35, and 36-68 years). They also included elapsed time from course completion (ETCC) and categorized it into groups ranging from 14 to 732 days. Measures demonstrating the highest effect in the multivariable model were: 16 to 17 years of education; high school class rank in the bottom 10% had much lower odds than those in the top 10%; and attending an accredited paramedic program was, as Dickison et al. (2006) found, associated with significantly higher odds of passing. Several other significant variables were included in the model. Paramedic instructor alone was less likely to be successful than were either registered nurse or than any degree (beta coefficients increased as the instructor’s degree level did). Male gender was associated with greater success than was female. African American race was negatively associated with passing. The days elapsed to test were significant in the 27 to 54 day group and in the 55 to 732 day group. Candidates outside the 27 to 35-year-old age group were less likely to pass. This is the most complete model predicting performance on the NREMT-C examination and provides a broader, although certainly not complete picture of factors that influence success on this exam. Again, one must consider that these data were collected prior to the transition to CAT testing. Male gender appeared to be associated with increased success on the NREMT-C. It is unknown whether females who fail are more or less likely than males to reattempt the exam after they fail. The instructor qualifications of candidates were not known in the present research.

Faculty credentials. As more programs moved toward accreditation, the question of who should be teaching paramedic programs became a controversial topic. Early in the development of the profession, nurses and physicians typically taught paramedics because the practice was new and there were no paramedics qualified to teach. As time passed, paramedics began to take on roles as primary instructors. The suggestion that a degree should be required to become a program director was met with considerable resistance from the industry. Margolis and Dickison (2005) compared pass rates on the NREMT-C based on instructor qualifications. They found that first-time pass rates were significantly different between instructors who were credentialed as nurses (73%), MDs (67%) and paramedics (54%). Their findings also illustrated that instructor education was significantly related to success. Pass rates grew by a statistically significant margin with each increase in instructor degree from Associate through Doctoral Degree.

A model proposed by Russ-Eft, Dickison and Levine (2010) examined relationships between program instructional materials and an EMT instructor's technical knowledge, practical knowledge, teaching ability, enthusiasm and availability on the graduate's first attempt score at the EMT certification exam and number of attempts needed to pass the exam. They found both instructor practical knowledge and enthusiasm were significantly correlated with exam scores and fewer attempts required to pass. Instructional materials were not significantly correlated.

In his dissertation research, Drees examined factors associated with persistence in a paramedic program and passing the NREMT-C (2006). He found graduation was higher in candidates who had a higher EMT GPA, natural science GPA and number of

college hours. Student GPA in the EMS preparatory, trauma and assessment-based management courses predicted success on the paramedic NREMT-C.

Field and clinical experience. The issue of how clinical and field experiences affect outcomes on the NREMT-C has been assessed at both the EMT and paramedic levels of practice. As in other areas, much more research in these indicators of success has been done at the paramedic level, which requires many more hours (hundreds in both ambulance and hospital) as compared to EMT programs that typically require less than 50 hours of hospital and ambulance clinical. No firm numbers are found in this area, although the Education Standards noted that the average length (incorporating didactic, lab, hospital and field) of an EMT program across the U.S. would be about 150 to 190 hours of training (to include didactic, laboratory and clinical) (NHTSA, 2009) while the paramedic program is typically 1,000 or more hours of training (CAAHEP, n.d.).

Some of the clinical and field correlational research has used performance on the Fisdap summative exams as a proxy for the NREMT-C because meeting the cut score on their examinations has been shown to predict success on the NREMT-C (Fisdap, 2014). After the Education Standards were released in 2009 with a new requirement for EMT field clinical that included a minimum of 10 patient contacts, Ricketts et al. (2010) examined whether field and clinical experience make a difference in EMT students' critical thinking performance on the ERE exam. They collected data from 1,038 students using Fisdap who also took the ERE exam and found that field contacts, clinical hours and patient contacts were predictive of higher overall scores on the ERE. Field contacts and clinical hours were also significant predictors of higher scores on the ERE critical thinking items.

In an attempt to refine the work of Ricketts et al. (2010), Houston et al. (2011) compared field and clinical hours and patient contacts to the score on the first-attempt at the Fisdap ERE exam. Using a multivariate analysis, they found that patient contacts in the field (ambulance) predicted higher scores on the ERE. The highest predicted scores related to 15 field contacts and 12 clinical hours. More than 12 hours of hospital clinical was associated with lower ERE test scores.

Carhart et al. (2012) examined the effect of skills observed and performed during their ambulance and hospital clinical on EMT students' performance on the ERE. His group found that the total number of skills correlated with ERE exam success, regardless of setting.

At the paramedic level, considerable research has examined the relationship between clinical and field hours and skill requirements. Fisdap has collected data on paramedics for a longer period of time and the depth and breadth of their experiences in clinical settings is far greater than for EMTs.

Salzman, Dillingham, Kobersteen, Kaye and Page (2008) were the first to examine the relationship between field and clinical experience and the likelihood of passing the paramedic NREMT-C. Using Fisdap data, they retrospectively reviewed 396 paramedic student records and, using logistic regression, determined that the predictors of passing the NREMT-C were number of advanced life support (ALS) ambulance runs and total patient contacts.

Building on the work of Salzman et al. (2008), Bercher et al. (2009) examined the success of paramedic students by program to see how field and hospital experience related to their NREMT-C pass rates. There were 928 students in 34 programs in the

study. Significant correlations were identified between NREMT-C passing and ALS runs, field patient contacts, and field hours. No hospital clinical variables were related to success on the NREMT-C.

As paramedic programs transitioned to accreditation, their program directors needed to identify a rationale for setting clinical and field hour and skill requirements as a means to achieve competency. The National EMS Education Standards eliminated a prescriptive number of hours, skills and patient contacts in clinical as they had been formerly required in the national standard curriculum. Lawler and Chambers (2010) quantified the effect of a specified number of medical (as opposed to trauma) advanced life support (ALS) team leads on the likelihood a candidate would pass the Fisdap summative exam at the cut score of 73%. Using data collected in Fisdap, they evaluated 1,350 paramedic students who completed 35,732 team leads. Using linear regression, they found that 45 ALS team leads predicted passing the summative examination.

Wilfong et al. (2010) explored the relationship between cardiac patient and cardiac arrest patient contacts during paramedic hospital and field clinical and the student's score on the cardiovascular section of the Fisdap summative paramedic examinations. They found cardiac field experience correlated with scores on the OSPE summative exam, however there was not a significant relationship between hospital cardiac patient contacts and cardiac exam scores.

Most recently, Page, Martin, Hubble and Mortenson (2013) compared paramedic student patient contacts on non-emergency calls versus emergency calls with the likelihood of scoring higher on the Fisdap summative paramedic exit exam (which is shown to predict NREMT-C performance). Exam scores for the 1,335 students enrolled

in their study showed negative correlation with number of patient contacts during non-emergency calls, but positive correlation with the number of emergency patient contacts. This significant relationship was observed in knowledge, application and problem-solving level questions.

This growing body of knowledge related to the field and clinical experiences of students, has demonstrated the relationship between the students' practicum and their success on high-stakes examinations, but also their ability to answer higher-level application and problem-solving questions, which relate to the situations they will likely encounter in their jobs as EMTs.

Elapsed time to take the exam. Fernandez and Studnek (2007) assessed the effect of elapsed time between course completion, and attempting the NREMT-C for the first time. This was before the NREMT began using computer adaptive testing and at that time there was an established examination cut score of 70%. At the paramedic level 8,791 candidates were assessed. Their mean elapsed time from course completion to NREMT-C (ETCC) was 59 days with a predicted score of almost 75% if ETCC was zero. For every one-day increase in ETCC, there was a decrease in score of 0.009%. Similarly, the mean ETCC of the 8,185 EMT candidates was 59 days. A score of 73.07% was predicted at ETCC = 0. In this sample, there was a 0.011% decrease in score for each day the ETTC increased. Although their results reached statistical significance, the authors point out there may not be much practical value because it would take 18 months for a paramedic candidate's score and 10 months for an EMT candidate's score to drop below the passing standard.

Employment Experience. Historically, EMTs worked on an ambulance for a period of time before or during paramedic education. As the industry transitioned from an apprenticeship model with training largely housed in fire stations or EMS agencies, to a professional model with training provided in colleges and universities, administrators and educators asked whether this field experience should be a necessary pre-requisite to attend a paramedic program. Fernandez, Studnek and Cone (2008) studied the effect employment in the field as an EMT had on success on the NREMT-C. They examined first-attempt success of candidates attempting the NREMT-C paramedic, compared to the elapsed time from their EMT NREMT-C exam. It is important to note that this elapsed time was inferred to be time they worked in the field and was a surrogate as opposed to an actual field employment time measurement. The authors categorized the data into three groups. The group with 0 to 2.5 years of EMT experience were less likely to pass the exam when compared to EMTs with 2.5 to 10 years of experience. Those with more than 10 years of experience were even less likely to pass.

Subsequently, these same authors dichotomized the time of EMT certification variable to include groups with either more than or less than 1.6 years EMT experience (Fernandez, Studnek, & Cone, 2009). They found that EMTs licensed for more than 1.6 years of EMT experience were more likely to pass the NREMT-C on the first attempt. They also examined the effect of EMT NREMT-C test score and found a “statistically significant difference among the categories of EMT-B cognitive exam score with respect to the percentage passing the national paramedic certification examination” (p. 884). This study had access to the type of job, but not the length of employment. Employment

status was categorized into public safety, healthcare and other categories to see if the candidate's employment status was related to their likelihood of persisting on the test.

Time to complete the examination. At the EMT NREMT-C exam, candidates are allotted a maximum of two hours to complete their test (NREMT, 2014). Candidates who run out of time before completing the exam fail. Davis (2010) asked if test-taking time was related to scores on the Fisdap summative paramedic and EMT examinations. She found no significant relationship between elapsed time to overall paramedic exam score however exam scores were significantly lower for EMT students who took more than 184 minutes to complete the exam.

Qualitative research. Much of the research related to NREMT-C has been conducted using quantitative approaches. In 2009, Margolis, Romero and Studnek employed a qualitative method to try and get at factors influencing success on the paramedic NREMT-C that had not yet been captured. Twelve representatives from high-performing paramedic programs, defined as having a 75% first-attempt pass rate for four of five years and who had more than 20 graduates per year, participated in a focus group to try and identify common characteristics of success. Using a nominal group process, they came to consensus on 12 strategies leading to a successful paramedic educational program. Most program representatives were from accredited programs, and three-quarters of them had a Bachelor's degree or higher. The mean number of years teaching was 22 years. The 12 strategies they identified were: (1) become nationally accredited; (2) set appropriate program prerequisites; (3) establish clear expectations for student success (knowledge, behaviors, attitudes); (4) assure on-going program quality improvement; (5) develop your own instructional materials (lesson plans, presentations,

assessments) using an evidence-based approach; (6) reinforce EMT knowledge and skills throughout the program; (7) use authentic cases scenarios to promote active learning; (8) require sufficient team leads on advanced life support calls; (9) develop valid assessment tools that have been rigorously reviewed; (10) provide routine, objective formal and informal feedback to students about their performance; (11) assure that student assessment includes critical thinking and problem-solving activities; (12) and have students take a predictive assessment before their certification examination. The authors suggested follow up to determine whether implementation of these strategies would improve performance on the NREMT-C.

Later, Margolis, Studnek, Fernandez and Mistovich (2009) replicated this research with 10 EMT program participants. Their findings were somewhat different, reflecting the one-semester nature and less detailed content of EMT programs. The recommendations they proposed were: accept motivated students; assure institutional support; perform multiple assessments; standardize lesson plans between instructors; set the passing grade above the minimum competency level; hire faculty that exceed minimum instructor requirements; establish routine communication between faculty in class and clinical areas; be sure instructors provide consistent material; provide clear learning objectives for students and faculty; set minimum prerequisite standards such as English, math or science; and actively incorporate test-taking skills within the coursework.

Previous examination performance. Briguglio, Soucheray, Young, and Eaton (2009) found a relationship between the number of application and problem-solving level questions answered correctly on the Fisdap summative examination and the likelihood of

passing the NREMT-C. The percentage of application and problem-solving questions answered correctly was a significant, positive predictor of passing the NREMT-C however knowledge level questions were not.

Pre-assessment and remediation. Renkiewicz and Hubble (2014) implemented a preparatory course for a group of non-matriculating EMT students. They demonstrated significant increases in course completion rates and on passing the state certification examination.

Characteristics of Those Who Do Not Successfully Complete Certification Exams

The first-attempt pass rate on the national certification exam is a highly valued measure of entry-level program performance by agencies that accredit nursing and EMS programs. What happens to candidates who fail is of much less significance from a regulatory standpoint. As a consequence, literature examining characteristics of and factors that influence exam reattempts was almost non-existent. Likewise, documented resources and assistance targeted to this group was lacking (Griffiths, Papastrat, Czekanski, & Hagan, 2004). In nursing there was scant research on this topic, and this author was able to find only one EMS study that even marginally examined this issue.

Briguglio (2010) did evaluate whether paramedic student performance on knowledge (and comprehension) or critical thinking (application, analysis, and evaluation level) questions improved based on elapsed time to second attempt on a Fisdap summative paramedic examination. She identified no significant relationship between elapsed time between tests and scores on critical thinking questions, however there was a small negative correlation between time and answering knowledge-level questions correctly.

In 2004, the National Council for State Boards of Nursing surveyed a group of U.S. and international nursing and practical nursing candidates eligible to take the NCLEX™ examination that never made even one attempt. Although their response rate was only 15%, a comparison with examination registration data found that this was a representative sample. Asked to select all reasons influencing their decision to never attempt the exam, the respondents most frequently cited lack of confidence in their ability to pass the examination, registration or authority-to-test letter expired, not enough time to prepare and general test anxiety.

Using a hermeneutic phenomenological approach, Poorman and Webb (2000) followed 11 NCLEX™-RN candidates who failed their first examination attempt. Nine of the 11 eventually passed their examination. Through interviews and evaluation of student logs as they progressed through the remediation process and subsequent examination attempts, the authors were able to uncover the lived experience of these aspiring nurses. Their participants were at first immobilized by their failure and the wish to maintain secrecy about it. The three themes that emerged were living the failure, wanting, and daring to hope. Living the failure meant carrying its weight daily in a way that dominated their lives and involved isolation, loss of identity and feelings of self-doubt. The theme of wanting embodied the emptiness and abandonment unsuccessful candidates felt as a result of their failure. They expressed a want for support that they felt was lacking. One participant related that, those who fail “walk on a narrow beam, and when they reach out a hand for someone to steady them, often no one is there” (p. 178). Daring to hope emerged as candidates began to regain determination and see possibilities for success and what that success would look like to their future life.

In an attempt to increase understanding of the factors that contributed to a candidate's failed attempt on the NCLEX-RN examination; feelings related to their failure; and changes they made that contributed to their success on a later attempt, Griffiths et al. conducted research on nursing candidates (2004). They note that 21 of "approximately 25" surveys (p. 323) that were distributed were returned from the program directors to whom they were distributed. Many of the respondents indicated they struggled during school. Reasons offered for their failed attempt included: "poor program preparation, inadequate study habits, lack of knowledge about how to prepare, difficulty in setting priorities, lack of confidence, inability to control anxiety, poor test-taking skills, overwhelming family responsibilities, and employment" (p. 324). Follow-up telephone interviews revealed the emotional impact related to their unsuccessful attempt. Participants reported lowered self-confidence and self-perception. Most feared not passing another attempt. Coping strategies varied significantly, with some reaching out to friends or faculty for support, while others did not wish to share the news, particularly with faculty with whom they felt their relationship was poor. Unfortunately, as the author pointed out, problems with this study's methodology limit its generalizability.

These qualitative glimpses at the experience of failing the nursing certification examination provided interesting data not otherwise available about the candidates who did not pass. They suggested that non-cognitive factors played a significant role in the exam outcome for some of the participants. It would be helpful to have this information in EMS as well.

After the National Council of State Boards of Nursing transitioned from paper-and-pencil testing to the CAT format for the NCLEX™ nursing exam, Gorham and Bontempo (1996) studied characteristics of candidates who reattempted the exam at least once. At that time, repeaters constituted about 20% of test-takers. Pass rates for repeaters were 45% to 50% compared to first time test-takers pass rates of 85 to 90%. These rates were consistent with that of traditional NCLEX™ pencil-and-paper examinations. In subsequent attempts, however, the number of examinees declined significantly. Their exam scores also experienced a linear decline between attempts two through four.

Summary

EMS authors have begun to explore factors that affect success on the NREMT-C, particularly as they relate to paramedic students first attempt on the exam. As in nursing, EMS researchers have largely neglected examinees who do not pass the test on their first attempt. This absence of evidence is particularly true for EMT candidates. An understanding of this group would expand instructors' ability to intervene appropriately after failure - and perhaps identify students at risk before they test the first time.

Chapter 3

Methods

This chapter describes the design, sampling, data collection, data analysis procedures and limitations involved in this study. This dissertation research explored how initial test score, demographic features, employment status, payment type or school accreditation predicted which EMT candidates who failed their first attempt at the NREMT-C exam would reattempt even once (reattempt group). It attempted to uncover the relative contribution of each factor to shed light on whether reattempts were associated with initial test score or specific demographic characteristics. In particular, this study addressed the following questions:

1. Do higher theta NREMT-C examination scores on the first attempt predict those who would reattempt the exam?
2. Do the demographic characteristics (age, gender, race/ethnicity, employment status, or years of education) of the candidates predict their likelihood to reattempt the exam?
3. Does examination payment type, or program accreditation status predict candidates who reattempted the examination?

Research Design

This study used a causal comparative research design. Predictive research is conducted to forecast success (Gall, Gall, & Borg, 2007). Specifically, a causal comparative (ex post facto) research design attempts to determine if there is a causative relationship between the independent variable(s) and a dependent variable in a setting

wherein the researcher may not manipulate the variables in a pre-existing group. This method allowed exploration of the relationships between prior attempt test scores, payment status, school accreditation affiliation status and demographic features of the reattempt group and the non-attempt group. After the presence of significant relationships were detected, a further evaluation of the data was performed using binary logistic regression analysis to build a predictive model. This model sheds light on the relative importance of each independent variable in predicting the likelihood a given candidate will reattempt the NREMT-C after failing it on their first attempt. The model will, in essence, help educators, students and EMS regulators understand who is at risk for not persisting to retake the examination based on these particular variables.

Population and Sample

The population of interest for this study was EMT test candidates who failed their first attempt on the NREMT-C and either reattempted the examination once or never reattempted the examination at least once within the two-year time limit from their course completion. Because of the two-year time window allowed to take all six attempts on the NREMT-C examination, data was collected only on candidates from the target population who had course completion no sooner than two-years before the data collection began.

The NREMT-C transitioned from a pencil-and-paper to a computer-adaptive test (CAT) in January of 2007 (NREMT, 2013). For this reason, to assure that the test design is uniform, only candidates who tested after implementation of the CAT were evaluated. This was a convenience sample of all EMT candidates who failed their first-attempt at the NREMT-C between January 1, 2007, and December 31, 2012.

Data Collection Procedures

This researcher obtained exempt institutional board approval from the University of Missouri-St. Louis. The NREMT privacy policy (NREMT, 2014) states that personally identifiable information may be disclosed for “legitimate research purposes” (NREMT, 2014, Other Transfer of Information section, para 1) and that by registering for the examination, the candidate will, “give your consent for your personal information to be transmitted in the situations outlined above” (NREMT, 2014, Other Transfer of Information section, para 1). The NREMT policy further states that data used for research, “will be handled according to the protocol approved by the Institutional Review Board” of the principal investigator of the study (NREMT, 2014, Research Data, para 1).

On June 18, 2015, a formal request was made to the NREMT to obtain de-identified data in Microsoft Excel format for this study. On July 21, the NREMT approved the data release request and then on August 13 sent a spreadsheet containing the list of EMT programs to be coded.

The school data were coded into 11 categories by institution type. The school category codes were assigned as:

1. Post-secondary
2. Hospital, Clinic or Medical Center
3. Governmental education or medical service (fire or EMS agency)
4. Military
5. Other
6. Unknown
7. Individual Instructor

8. High school
9. Technical, career, or adult education
10. Re-registration, refresher or other NREMT administrative
11. Unknown Idaho courses

The Idaho school codes actually represented course codes rather than school codes. Their state EMS office was contacted and provided some of the missing school codes to match with their course codes.

The schools were also assigned codes that identified whether the EMT program was offered at a school that was listed on the Commission on Accreditation of Allied Health Education Programs as having a paramedic program that was either Accredited or had a letter of review (in the process of becoming accredited) at the time the codes were assigned. The school data coding was completed and sent to the NREMT on September 27, 2015.

Remle Crowe, the research intern at the NREMT paired the school data with the individual candidate data. On December 22, 2015, the final de-identified data set was received.

The de-identified data were entered into IBM SPSS Statistics (v22) software. Data were named and classified by type and measure in the variable view, and appropriate variables were dummy coded.

The dependent variable for this study was based on the reattempt status of candidates who failed each attempt at the NREMT-C and either attempted or did not reattempt exams two through six. The group who never reattempted a subsequent

examination was coded zero, while the reattempt group was coded one for each exam attempt.

The independent variables for this study included: prior test theta score, age, school type and whether it was affiliated with an accredited paramedic program, gender, race and ethnicity, employment status (employer type), years of education, and payment type (self-pay or other-pay). Test score and age were continuous variables. Schools were coded as affiliated with a post-secondary institution (1) or not affiliated with a post-secondary institution (0). School names were redacted from the data before this researcher received it. Gender (recorded as sex in the data set) was coded as male (0) and female (1). Initially, race and ethnicity were coded individually to nominal categories as received from the NREMT, however, the number of ethnic minorities within each category did not permit this detailed distinction as noted in Fernandez, Studnek, and Margolis (2008). Because of this, and the fact that candidates could select more than one race or ethnicity choice, this variable was recoded into four groups. The new categories were: white only, Hispanic only, black only and race other (all categories including multiple race choices).

The candidates' employment agency was initially coded into 15 categories (fire department; private; hospital; 3rd service; U.S. Government; Army, Navy, Air Force; Coast Guard; Other; State (Government, non fire-department); local/municipal (government, non-fire department); Homeland Security; Parks Services; and, Tribal. These categories were consolidated to seven categories:

1. Fire
2. Private

3. Hospital
4. 3rd Service
5. Government (U.S. Government, State [Government, non fire-department], local/municipal [government, non-fire department]; Homeland Security; Parks Services; and, Tribal)
6. Military (Army, Navy, Air Force, Coast Guard)
7. Other

Candidates who paid for their own test by credit card or money order were coded as self-pay (0) whereas those whose exam fees were paid by someone else (Army, National Registry, State or Voucher) were coded as Other (1).

Data Analysis

Data were cleaned and assessed for missing values. First, value cleaning was conducted. This was done to assure the values are “within the limits of reasonable expectation” (Meyers, Gamst, & Guarino, 2013, p.38). To determine this, a frequency distribution was run for each variable and each table was analyzed to identify unreasonable values. For example, the age variable was assessed to assure that no value was less than 17 (unable to take the exam at this age) or greater than 90 (very unlikely that a person would license as an EMT at this age). No values less than 16 were identified. The NREMT was queried to determine if age was verified by any other means and they indicated it is not (R. Crowe, personal communication, January 18, 2016).

Missing values were assessed for patterns to determine if they were missing completely at random, missing at random or not missing at random using the Missing Value Analysis function in SPSS for variables with more than 5% missing values

(Meyers, Gamst, & Guarino, 2013). Except as described elsewhere in this section these cases were retained.

Univariate outliers were detected by converting continuous variables to z scores in SPSS. Consistent with the recommendation of Hair, Black, Babin and Anderson (2010) z scores greater than +/-2.5 were categorized as outliers and considered for deletion. Variables with less than 2% of cases representing outliers were left in place. Mahalanobis distance (D^2) was calculated to identify multivariate outliers.

Descriptive statistics were run on each variable. This included calculation of the mean, median and mode for continuous variables. Histograms were run, and skewness and kurtosis evaluated to assess for normal distribution.

Test theta score means and age means (continuous variables) between the reattempt group and the non-attempt group were compared using dependent (paired) *t* tests to assess for a statistically significant difference between the grouping variable mean scores, with an alpha set at $p < 0.05$ (Field, 2009) and effect sizes calculated using an effect-size calculator (Becker, 1998).

Relationships between variables were established by analyzing bivariate correlations using a Pearson product moment correlation coefficient (Pearson *r*) to assess for covariation ($\alpha = p < 0.05$). Pairwise deletion of missing data was selected when necessary to preserve as much data as possible. Because the data were determined not to be missing completely at random, it is possible that this introduced bias into the results producing some inaccuracies in the calculation of standard of errors (Myers, Gamst & Guarino, 2013). The direction of the relationship was assessed and the strength of the relationship determined by evaluating the coefficient of determination (R^2). The

relationships between categorical variables were explored using chi-square analysis (alpha = $p < 0.05$) and effect sizes examined using Cramer's V or for 2x2 tables a phi coefficient.

Independent variables with significant correlations were used to construct the form of the bivariate logistic regression model for each examination attempt (Meyers, Gamst, Guarino, 2103). Using the coded variable attempt or non-reattempt as the dependent variable, independent variables (after coding when needed) identified in the previous step were entered into the bivariate logistic regression function of SPSS to calculate the model using the standard method. Variables that did not achieve an alpha level of $p < 0.05$ were removed from the model. The general form of the model was:

“ $\ln [\text{odds}] = a + b_1X_1 + b_2X_2 + \dots + B_vX_v$ ” where \ln is the natural log; a is a constant; and b represents the change in log odds of membership for any 1 unit change in the independent variable (Meyers, Gamst, Guarino, 2103, p. 535).

The final model was assessed to assure it was an appropriate useful fit for the data using several tests. The Wald χ^2 statistic evaluated the significance of each individual coefficient within the model (Meyers, Gamst, Guarino, 2103). The -2 log likelihood ratio was calculated to assess whether the model improved prediction of each case as compared to chance. An omnibus chi-square test evaluated the model without predictors against the full model. A pseudo R^2 was assessed using the Nagelkerke test. While the Hosmer and Lemeshow test was also calculated, the large sample size in this case may limit its utility when in some cases it produces a significant p value.

A standard selection method was used to perform the binary logistic regression procedure. All of the predictor variables were entered at the same time. This permits the

program to control for the effects of each variable as the procedure was performed (Meyers, Gamst, Guarino, 2013).

Limitations

Some significant limitations are inherently present with a causal-comparative research design. Chiefly this researcher had no ability to control either the independent variables as they had both occurred prior to the research. This posed a threat to the internal validity (Fraenkel & Wallen, 2016). Because of this some authors suggest that causal-comparative research design has limited ability to predict outcomes, but rather merely establishes relationships and may not be superior to “correlational research for establishing causal attributions” (Johnson, 2001, p.5).

Summary

This chapter described the research population and how it was obtained, coded, reviewed and de-identified to protect subject and institutional anonymity. This was conducted after IRB approval.

The following chapter will describe how the data were cleaned and assessed to determine their appropriateness for inclusion in a binary logistic regression model. General descriptive statistics and correlations are reported followed by the results of the binary logistic regression models for NREMT-C EMT examination results two through six.

Chapter 4

Results

Data provided from the NREMT indicated that 131,450 candidates failed their first attempt at the cognitive examination between 2007 and 2012. As of December 31, 2014, this sample had either exhausted all six attempts to pass the examination, or the two-year limit from the time of the first examination had elapsed. The data indicated that 212 (0.002%) of these candidates passed more than one of their six attempts. This occasionally occurred when more than one year elapsed between the date the candidate passed the cognitive exam and when he or she passed the practical examination as exam results expired after one year. These records were eliminated.

There were also 83 age outliers removed. All age groups with <15 candidates were removed. This included 69 candidates who were 67 years of age or greater and 14 cases whose age was reported as less than 18 years. Candidates may not register until they are 18 years.

In addition, 1,647 institution type cases coded as re-registration, refresher, NREMT administration were removed as they did not represent the population of interest as were 2,480 cases where more than 2 years from first test date to any other test attempt had elapsed (Table 3).

Table 3

Cases Removed When More than 731 Days from First Attempt Elapsed

| Attempt | Cases Removed |
|---------|---------------|
| 2 | 903 |
| 3 | 794 |
| 4 | 553 |
| 5 | 157 |
| 6 | 73 |

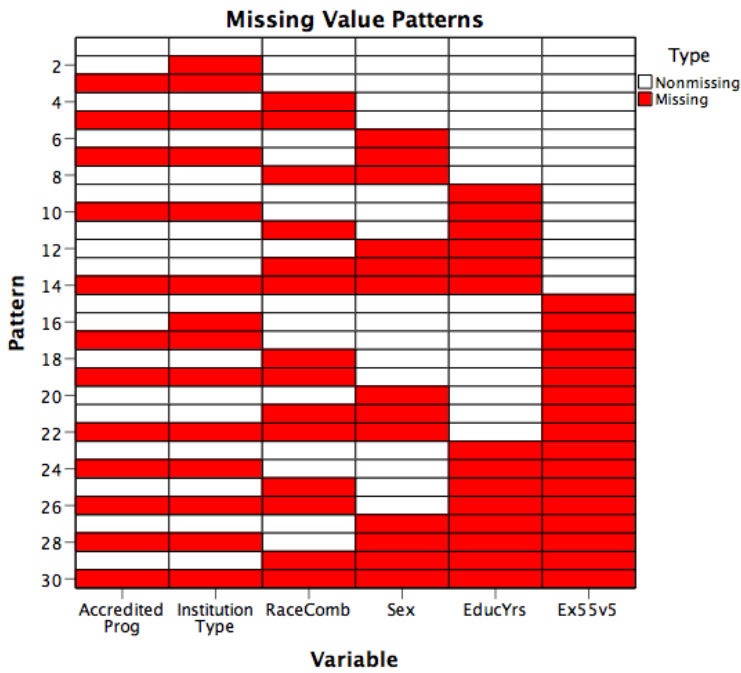
In 6,036 cases, less than the required 15 days had elapsed between candidate first and second test attempts. This is permissible for Army or Air Force candidates so 6,035 of these records were retained (R. Crowe, personal communication, February 25, 2016). One case that indicated a second exam attempt six days earlier than the first exam attempt was deleted. All cases where less than 15 days elapsed between all subsequent attempts were also military. After the data were cleaned 127,027 records remained for the analysis.

Missing value analysis was conducted using variables age (a variable known to have no missing values as it is a mandatory element of the application), education years, gender, work experience, race and accredited versus non-accredited programs to identify patterns of missingness. This showed that 5,779 (4.5%) cases were missing race, gender, education and work experience variables. Little's MCAR test was run on the variables second attempt, education years, sex, race, and work experience to identify whether the data was missing in a pattern or completely at random.

Multiple imputation calculation for attempt one data (set to a 5% minimum missing values to include) revealed that 7 (70%) of the 10 variables analyzed had missing data as did 29,204 (22.99%) of the cases and 53,205 (4.18%) of values in the dataset. The variable summary analysis indicated greater than 5% missing data in five variables: work experience 24,552 (19.3%), education years 10,234 (8.1%), gender 9,654 (7.6%) and race 7,822 (6.2%). Several patterns emerged as seen in Figures 2a and 2b.

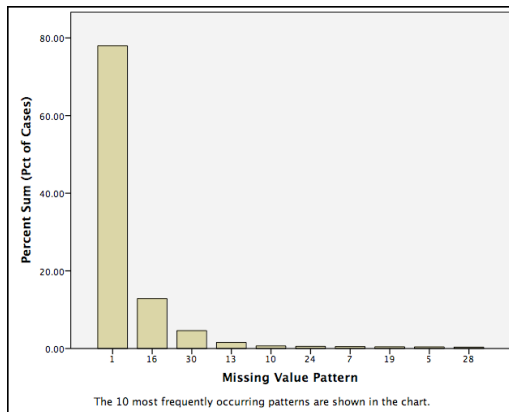
Figure 2a

Missing value patterns (a)



Note. Rows indicate groups of cases with patterns of missing and non-missing values.

Figure 2b

Missing value patterns (b)

Note. Bars indicate % of cases for each missing/non-missing pattern from figure 2a above.

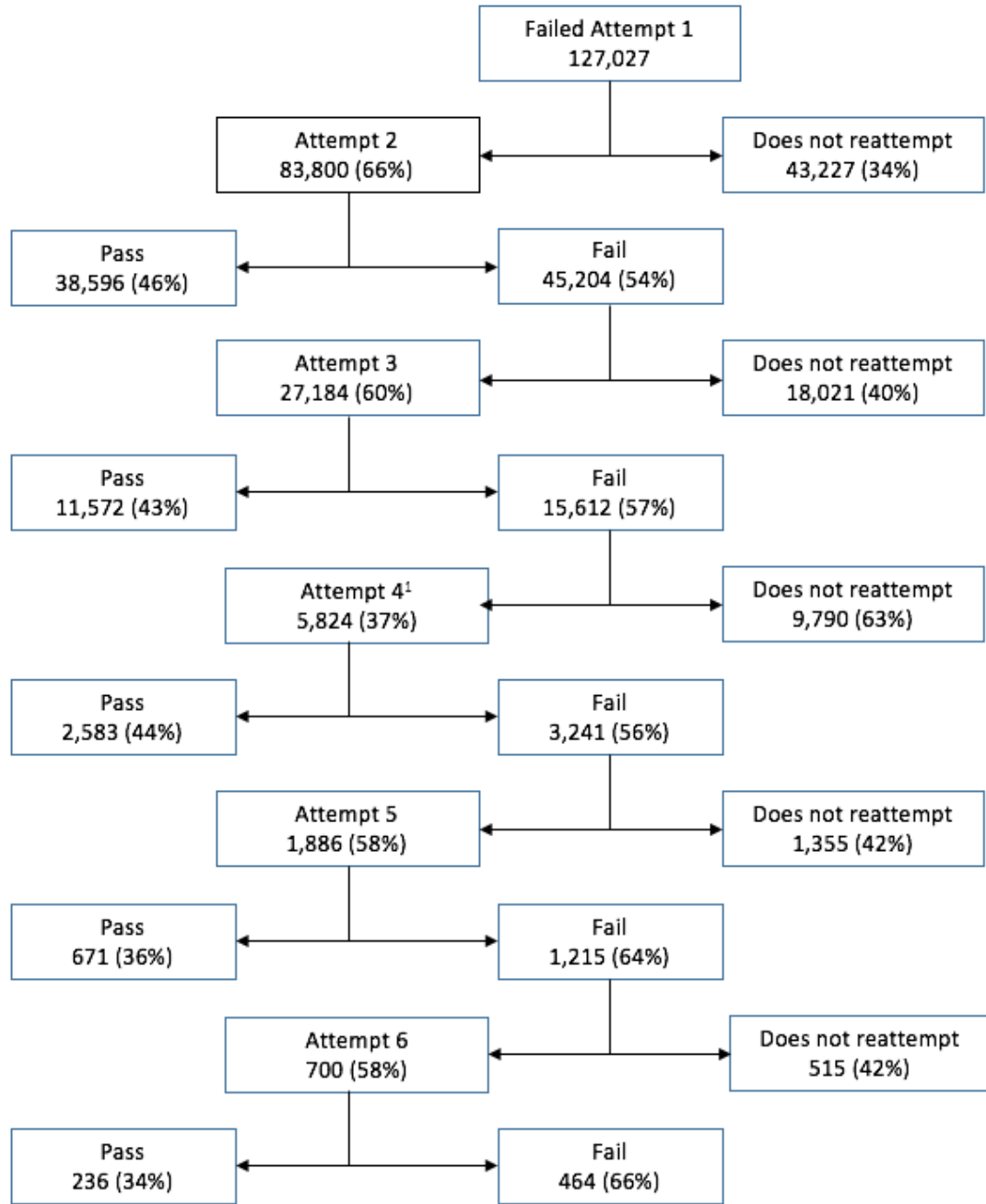
The most common patterns were no missing values (pattern 1) and missing work experience only (pattern 16). The next most frequent pattern (30) included race, sex, education years and work experience.

Of those who failed the first examination attempt, 83,800 (66%) reattempted a second time. A smaller percentage of those failing the second attempt, made a third try (n=27,184, 60%). Candidates wishing to take examinations four through six were required to complete remedial training prior to the fourth attempt. A sharp drop in persistence was seen at exam attempt four, with only 5,824 (37%) of prospective EMTs taking that exam attempt.

Similarly pass rates declined as candidates moved through the testing process. For first quarter 2007 through fourth quarter 2012, the NREMT pass/fail reported a first-attempt pass rate of 67% of the 416,192 who attempted the exam (2016). At the second attempt, only 38,596 (46%) passed and by the sixth attempt only 236 of the 700 attempting (34%) passed. By the end of the sixth attempt, 53,658 (42%) of the original 127,027 candidates who failed their first attempt continued and passed the examination (Figure 3).

Figure 3

Examination Pass/Fail Results and Reattempts



Note¹: Candidates must document remedial education before their fourth attempt.

Theta scores

The theta scores for each attempt were analyzed. They were found to have a normal distribution (Table 4).

Table 4

Theta score frequencies by attempt

| Attempt | Mean | Median | Mode | S.D. | Skewness | Kurtosis |
|---------|--------|--------|----------|-------|----------|----------|
| 1* | .7024 | .7271 | Multiple | .3404 | -1.334 | 3.636 |
| 2 | 1.0627 | 1.0751 | Multiple | .5013 | -.223 | .400 |
| 3 | 1.0276 | 1.0428 | Multiple | .5038 | -0.515 | 2.474 |
| 4 | 1.0500 | 1.0631 | Multiple | .4686 | -.391 | .064 |
| 5 | .9780 | .9874 | Multiple | .4620 | -.096 | .433 |
| 6 | .9635 | .9732 | Multiple | .4369 | -.104 | .266 |

Note: Theta scores for attempt one only represented failed attempts, which likely explains the non-normal distribution. Theta scores for all other attempts include both passing and failing scores.

The theta score means by attempts were compared using t tests and were found to be significantly different. The Pearson r effect sizes for each attempt were calculated using Becker's effect size calculator and ranged from 0.26 to .36. This is judged to be medium (Meyer, Gamst, Guarino, 2013) (Table 5).

Table 5

Theta score t tests and effect size by attempt

| Attempts | t test | | | Effect size | | | |
|-------------------|---------|-------|-------|-------------|--------------------|-----------|------------------|
| | t | df | Sig. | SD | Std. Error Mean | Cohen's d | effect-size r |
| Theta1 to Theta 2 | -203.68 | 83799 | <.001 | 0.62 | 0.001596 | -0.77 | -.36 |
| Theta2 to Theta3 | -100.92 | 27183 | <.001 | 0.48 | 0.002904 | -0.70 | -.33 |
| Theta3 to Theta4 | -52.01 | 5823 | <.001 | 0.45 | 0.005931 | -0.78 | -.36 |
| Theta4 to Theta5 | -21.62 | 1885 | <.001 | 0.44 | 0.010198 | -0.57 | -.27 |
| Theta5 to Theta6 | -13.11 | 699 | <.001 | 0.42 | 0.0157581 | -0.55 | -.27 |

Payment Type

The dataset coded the examination payment type into 10 categories. They were:

1. Army (AR)
2. Credit card (CC)
3. Money order (MO)
4. Move payment from another application (MV)
5. National Registry (NR)
6. Army (PG)
7. Refund (RF)
8. NREMT IT Department (SM)
9. State (ST)
10. Voucher payment (VP)

Credit card and money order are the two ways individuals can pay for the examination themselves so these payment options were combined and coded as self-pay (0). The remaining categories were combined and coded as other (1). Chi-square analyses demonstrated significant differences ($p < .001$) between payment type for each subsequent exam attempt from exam attempt one through attempt six as shown in Table 6. Candidates were more likely to have someone pay for their examinations in the first three attempts than they were in the final three attempts when the other pay declined sharply.

Table 6

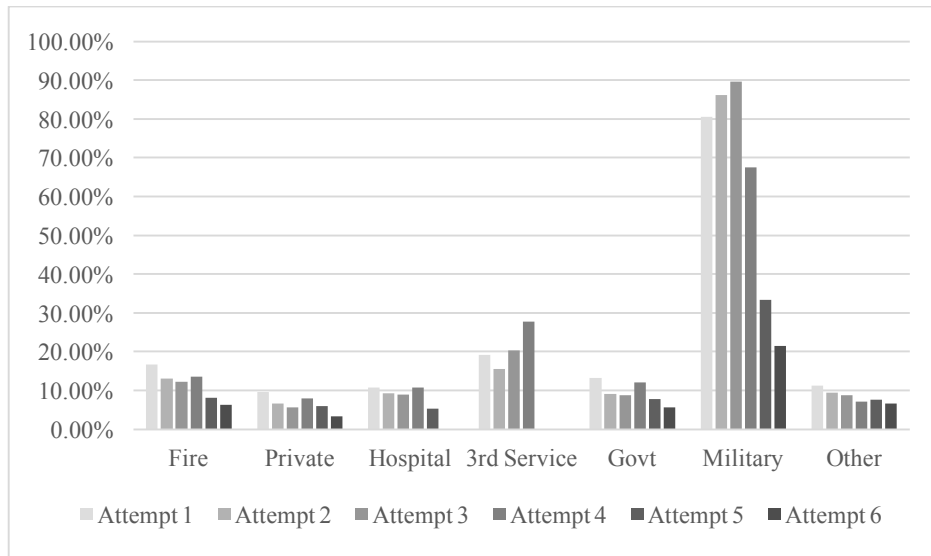
Descriptive Statistics for Payment Type by Attempt

| Attempt | n | Self-Pay n (%) | Other Pay n (%) |
|---------|---------|-------------------|--------------------|
| 1 | 127,027 | 98,196 (77.3) | 28,831(22.7) |
| 2 | 83,799 | 64,306 (76.7) | 19,493 (23.3) |
| 3 | 27,182 | 19,740 (72.6) | 7,442 (27.4) |
| 4 | 5,824 | 4,810 (82.6) | 1,014 (17.4) |
| 5 | 1,886 | 1,729 (92.7) | 15 (8.3) |
| 6 | 700 | 665 (95%) | 35 (5.0) |

Note. Attempt one only includes pay status for those who failed.

Employment was associated with pay status. Candidates who designated military employment were much more likely to have someone else pay for their exams through all attempts whereas candidates who were privately employed were more likely to self-pay (Figure 4).

Figure 4

Other Pay Status by Employment Type for Each Examination Attempt

Pay status when compared to school type, also revealed that military candidates were more likely to have someone else pay for their exams than were candidates who attended other schools. With regard to education institutions, candidates attending a hospital-based school were less likely than others to have someone pay for their exam.

Candidate Demographics

The only mandatory candidate demographic data elements on the application for examination were the candidate age and state of residence. The other categories (gender, race and ethnicity, work experience, and education) were optional. The optional categories were not completed by all candidates and therefore contained varying amounts of missing data.

State of residence. Candidates from all 50 states and the District of Columbia attempted the examination. In addition, there were 17,732 (14%) test-takers representing United States military branches and 5 (0%) from the National Park Service. There were

also 110 (0%) individuals from other countries and US territories, including the Bahamas, Guam, Mariana Islands, Trinidad and Tobago, and the Virgin Islands (Table 7).

Table 7

State Distribution of Candidates Eligible for a Second Attempt

| <i>Region</i> | <i>n</i> | <i>%</i> | <i>Region</i> | <i>n</i> | <i>%</i> |
|----------------------|----------|----------|--------------------------|----------|----------|
| Air Force | 3,595 | 2.8 | Missouri | 3,321 | 2.6 |
| Alabama | 2,444 | 1.9 | Montana | 850 | .7 |
| American Military | 12,509 | 14.7 | National Park Service | 5 | 0 |
| Arizona | 4,118 | 3.2 | National Registry | 134 | .1 |
| Alaska | 83 | .1 | Navy | 1,310 | 1 |
| Arkansas | 1,440 | 1.1 | Nebraska | 1,194 | .9 |
| Bahamas | 22 | .0 | Nevada | 1,485 | 1.2 |
| California | 21,150 | 16.7 | New Hampshire | 1,635 | 1.3 |
| Coast Guard | 318 | 0.3 | New Jersey | 205 | .2 |
| Colorado | 2,204 | 1.7 | New Mexico | 85 | .1 |
| Connecticut | 3,071 | 2.4 | New York | 190 | .1 |
| Delaware | 324 | .3 | North Carolina | 363 | .3 |
| District of Columbia | 670 | .5 | North Dakota | 343 | .3 |
| Florida | 9,370 | 7.4 | Ohio | 5,249 | 4.1 |
| Georgia | 481 | .4 | Oklahoma | 2,139 | 1.7 |
| Guam | 3 | 0 | Oregon | 1,142 | .9 |
| Hawaii | 71 | .1 | Pennsylvania | 262 | .2 |
| Idaho | 1,170 | 1.4 | Rhode Island | 1,084 | .9 |
| Illinois | 2,210 | 1.7 | South Carolina | 1,868 | 1.5 |
| Indiana | 614 | .5 | South Dakota | 893 | .7 |
| Iowa | 1,799 | 1.4 | Tennessee | 2,387 | 1.9 |
| Kansas | 1,736 | 1.4 | Texas | 11,817 | 9.3 |
| Kentucky | 2,777 | 2.2 | Trinidad and Tobago | 51 | .0 |
| Louisiana | 1,853 | 1.5 | Utah | 72 | .1 |
| Maine | 1,067 | .8 | Vermont | 434 | .3 |
| Mariana Islands | 7 | 0 | Virgin Islands | 27 | .0 |
| Maryland | 251 | .2 | Virginia | 364 | .3 |
| Massachusetts | 307 | .2 | Washington | 1,401 | 1.1 |
| Michigan | 4,141 | 3.3 | West Virginia | 910 | .7 |
| Minnesota | 2,246 | 1.8 | Wisconsin | 2,390 | 1.9 |
| Mississippi | 1,252 | 1.0 | Wyoming | 114 | .1 |

Of note, some highly populated states such as New York appear under-represented in this data. In those cases, the state did not require the NREMT-C as a pre-requisite for licensure at the time of the exam so only a few eligible candidates did so.

Age. After data cleaning, of those who failed their first examination attempt, candidates' age ranged from 18 to 66 years. Candidates cannot become registered until they are 18. While the work of an EMT is physically demanding, social media reports many anecdotal stories of older adults who practice in this field particularly in frontier and rural areas that depend on retiree volunteers to help staff their ambulances (Associated Press, 2006; Huffman, 2014). A 2006 report by the HRSA Office of Rural Health Policy with the Frontier Education Center noted that rural areas of many states depend on volunteers to provide their EMS response. They stated that "the average age of rural volunteers tends to be older with 45 percent over the age of 40, compared to 34 percent in urban areas" (p. 7).

Table 8 showed that age had a very small significant negative relationship for attempts two and three with younger candidates more likely to persist. In attempts four and five however, older candidates were significantly more likely to reattempt. Effect sizes were very small in all results (less than .10). There was no statistically significant difference at the sixth attempt (Table 8).

Table 8

Mean Age of Candidates by Attempt

| Attempt | Mean Age | n | Skewness | Kurtosis | Pearson r | Sig. |
|---------|----------|--------|----------|----------|-----------|-------|
| 1 | 25.86 | 127027 | 1.694 | 2.943 | | |
| 2 | 25.56 | 83800 | 1.741 | 3.176 | -0.054 | <.001 |
| 3 | 25.26 | 27184 | 1.784 | 3.28 | -0.45 | <.001 |
| 4 | 25.66 | 5824 | 1.685 | 2.705 | .024 | .003 |
| 5 | 26.59 | 1886 | 1.533 | 2.057 | .066 | <.001 |
| 6 | 27.18 | 700 | 1.374 | 1.36 | .019 | .516 |

Note: Attempt one only represents candidates who failed exam 1.

Gender. Of the candidates who failed their first attempt, 33,973 (28.9%) were female.

This was consistent with the 2009 EMS Workforce Report, in which NHTSA reported that in the 2005 EMS population survey only 29% of the EMTs and paramedics were female.

As candidates progressed through the first through the fifth testing attempt, the proportion of females declined. For attempts two to five, females were significantly less likely than males to retake the exam (Table 9).

Table 9

Proportionate Differences Between Male and Female Candidates by Attempt

| Attempt | N | Male (n%) | Female (n%) | χ^2 |
|---------|----------|-------------|-------------|----------|
| 1 | 117,373* | 83,400 (71) | 33,973 (29) | |
| 2 | 76902 | 56,092 (73) | 20,810 (27) | 384.67 |
| 3 | 24,688 | 18,444 (75) | 6,244 (25) | 216.27 |
| 4 | 5,325 | 4,175 (78) | 1,150 (22) | 109.82 |
| 5 | 1,781 | 1,422 (80) | 359 (20) | 41.88 |
| 6 | 668 | 537 (80) | 131(20) | 1.35 |

Note: 9,655 candidates did not identify a gender. Reported χ^2 value has Df=1, $p<.001$ and includes continuity correction for 2x2 table.

Effect sizes were measured for each attempt using a phi coefficient. The phi coefficients ranged from -0.06 ($p<.001$) in the second attempt to -.12 ($p<0.001$) on the fifth attempt. These represent negligible to small effect sizes (Pallant, 2007).

When females only were examined by attempt, a higher number than expected were found to attempt the second or third exam whereas a smaller number than expected persisted to the fourth exam attempt (Table 10). No significant difference was found on the fifth or sixth attempt.

Table 10

Female Candidate Persistence Through Exam Attempts

| Attempt | | Observed | Expected | Residual | χ^2 | df | Sig. |
|---------|------------|----------|----------|----------|----------|----|-------|
| 2 | No Attempt | 13163 | 16986.5 | -3823.5 | 1721.26a | 1 | <.001 |
| | Attempt | 20810 | 16986.5 | 3823.5 | | | |
| 3 | No Attempt | 5427 | 5835.5 | -408.5 | 57.19b | 1 | <.001 |
| | Attempt | 6244 | 5835.5 | 408.5 | | | |
| 4 | No Attempt | 2632 | 1891 | 741 | 580.73c | 1 | <.001 |
| | Attempt | 1150 | 1891 | -741 | | | |
| 5 | No Attempt | 357 | 358 | -1 | .01d | 1 | 0.94 |
| | Attempt | 359 | 358 | 1 | | | |
| 6 | No Attempt | 109 | 120 | -11 | 2.02 | 1 | 0.156 |
| | Attempt | 131 | 120 | 11 | | | |

Race and ethnicity. The NREMT application asks the following question regarding race and ethnicity. Which of the following categories best describes you? (You may select more than one) (R. Crowe, personal communication, January 18, 2016). Six categories (5 race and 1 ethnicity) were included (Table 11).

Table 11

Race and Ethnicity of Candidates Eligible for a Second Attempt

| Race or Ethnicity | n | % |
|---|--------|------|
| American Indian or Alaskan Native (Not Hispanic or Latino) | 2,731 | 2.1 |
| Asian (Not Hispanic or Latino) | 3,829 | 3.0 |
| Black (Not Hispanic or Latino) | 10,952 | 8.6 |
| Hispanic | 17,598 | 13.9 |
| Native Hawaiian or Other Pacific Islander (Not Hispanic or Latino) | 2,652 | 2.1 |
| White (Not Hispanic or Latino) | 84,737 | 66.7 |
| Missing | 7,822 | 6.2 |

The population n = 127,027. The sum of race or ethnicity selections totaled 130,321.

Of those who selected a race or ethnicity 2.3% identified themselves as more than one race or ethnicity. This included 2,593 (2.2%) who selected 2 races; 256 (.2%) three races; 32 (<.1%) four races; 2 (<.1%) five races; and, 17 (<.1%) six races. Table 12 describes the distribution when two race categories were chosen.

Table 12

Race or Ethnicity when Two Categories Are Chosen

| | AI or AN | Asian | Black | Hispanic | NH or PI |
|----------|----------|-------|-------|----------|----------|
| AI or AN | | 117 | 59 | 99 | 47 |
| Asian | 117 | | 233 | 185 | 66 |
| Black | 59 | 100 | | 233 | 185 |
| Hispanic | 99 | 113 | 233 | | 186 |
| NH or PI | 117 | 66 | 185 | 187 | |
| White | 198 | 391 | 456 | 811 | 766 |

Note: AI or AN = American Indian or American Native. NH or PI = Native Hawaiian or other Pacific Islander. All categories except Hispanic indicate that selection only (Not Hispanic or Latino).

It is difficult to directly compare these results to the U.S. Census, which in 2010 delineated race using more categories and ethnicity as a distinctly separate concept (Jones & Bullock, 2012). However, the Census described those selecting only one race as the race alone population and others as identifying as two or more races. While 2010 Census data notes that 92% of those reporting more than one race selected two races, fewer than 1% reported more than four races and few (<.1%) identifying with six races. Because census data reports included persons identifying with six races, those cases were retained in this data.

For the purpose of this analysis, race was further aggregated and frequency calculations performed for White alone, Hispanic alone, Black alone, Other (Asian [Not Hispanic or Latino], American Indian or Alaskan Native [Not Hispanic or Latino], Native Hawaiian or Other Pacific Islander [Not Hispanic or Latino] or two or more races or ethnicity selected), and missing. A similar proportion of race and ethnicity was

maintained through each subsequent attempt until the final two attempts, when the number of candidates dropped substantially (Table 13).

Table 13

Race and Ethnicity by Examination Attempt

| Attempt | 1 (n,%) | 2 (n,%) | 3 (n,%) | 4 (n,%) | 5 (n,%) | 6 (n,%) |
|-------------|-------------|-----------|------------|------------|------------|----------|
| White alone | 82,460 (65) | 54,661 | 16,977 | 3,770 (65) | 1,277 (68) | 479 (68) |
| Hispanic | 16,412 (13) | 10,512 | 3,466 (13) | 658 (11) | 198 (11) | 72 (10) |
| Black alone | 10,156 (8) | 7,018 (8) | 2,789 (10) | 643 (11) | 216 (12) | 86 (12) |
| Other | 10,177 (8) | 6,603 (8) | 2,109 (8) | 385 (7) | 123 (7) | 43 (6) |
| Missing | 7,822 (6) | 5,006 (6) | 1,843 (7) | 368 (6) | 72 (4) | 20 (3) |

Note: Attempt one includes only candidates who had failed the first exam attempt. Subsequent attempts include all candidates who made that attempt.

Using chi-square analysis, significant differences between attempt were identified for white and black racial groups through attempt five, and for Hispanic candidates through attempt three (Table 14). The utility of these findings is limited by the effect sizes (the highest phi value identified was .043) which were significant but very weak in each case the chi-square was significant (Pallant, 2007).

Table 14

Chi Square Analysis of Race by Examination Attempt

| Attempt | White | | Black | | Hispanic | | Other | |
|---------|----------|-------|----------|-------|----------|-------|----------|-------|
| | χ^2 | Sig. | χ^2 | Sig. | χ^2 | Sig. | χ^2 | Sig. |
| 2 | 10.525 | 0.001 | 48.075 | <.001 | 30.835 | <.001 | | |
| 3 | 64.313 | <.001 | 82.313 | <.001 | 4.418 | 0.036 | 2.484 | 0.111 |
| 4 | 23.05 | <.001 | 5.606 | 0.018 | 6.18 | 0.013 | 6.731 | 0.009 |
| 5 | 22.878 | <.001 | 5.783 | 0.016 | 0.278 | 0.598 | 0.413 | 0.521 |
| 6 | 0.012 | 0.912 | 1.203 | 0.273 | 0.015 | 0.903 | 0.005 | 0.945 |

Note: 0 cells had expected counts of 5. Computed on a 2x2 table. Continuity correction chi-square values reported.

Education. The NREMT application question related to prior education was answered by 92% of candidates. This variable is reported in years and divided into the following categories:

| | |
|------------------------------|----|
| Did not complete high school | 8 |
| Completed high school | 12 |
| Some college | 13 |
| Associate college degree | 14 |
| Bachelor degree | 16 |
| Graduate degree | 18 |

As illustrated in Table 15, the education distribution remained fairly constant across attempts.

Table 15

Years of Education by Examination Attempt

| | Attempts | | | | | |
|---------|-------------|-------------|-------------|--------------|--------------|----------|
| | 1 (n,%) | 2 (n,%) | 3 (n,%) | 4 (n,%) | 5 (n,%) | 6 (n,%) |
| Years | | | | | | |
| 8 | 1,022 (.9) | 546 (.7) | 149 (1) | 31 (.6) | 8 (.5) | 2 (.3) |
| 12 | 73,146 (63) | 47,635 (62) | 15,958 (66) | 3,371 (63.8) | 1,135 (63.9) | 432 (65) |
| 13 | 22,276 (19) | 14,776 (19) | 4,601 (19) | 1,032 (19.5) | 352 (19.8) | 125 (19) |
| 14 | 10,921 (9) | 7,319 (10) | 2,249 (9) | 538 (10.2) | 192 (10.8) | 77 (12) |
| 16 | 8,339 (7) | 5,570 (7) | 1,426 (6) | 271 (5.1) | 74 (4.2) | 22 (3) |
| 18 | 1,089 (.9) | 679 (1) | 193 (1) | 42 (.8) | 16 (.9) | 7 (1.1) |
| Missing | 10,234 | 7,275 | 2,608 | 539 | 109 | 35 |
| Mean | 12.7 | 12.7 | 12.6 | 12.6 | 12.6 | 12.6 |
| S.D. | 1.309 | 1.298 | 1.213 | 1.187 | 1.146 | 1.116 |
| N | 127,027 | 83,800 | 27,184 | 5,824 | 1,886 | 700 |

There were significant positive, but weak, correlations between education years and attempts for exam attempt two ($r=0.17$, $p<.001$), exam attempt three ($r=0.18$, $p<.001$), and exam attempt four ($r=0.033$, $p<.001$). There were no significant correlations at attempts five or six.

Employment. The employment variable was another optional component on the examination application. Only 102,475 (80.7%) of candidates responded to this question. This question asked about EMS-related employment and offered no “none” or “not applicable” option which may account for the large amount of missing data. Some states did not permit employment in EMS until the EMT level of licensure is achieved. There were 24,552 (19.3%) missing values in this variable, the highest for this data set. Of

candidates who responded to this question, for those who failed their first attempt, 38,843 (37.9%) designated employment in fire; 17,553 (17.1%) private; 10,031 (9.8%) hospital; 408 (.4%) third service; 12,311 (12%) government; 15,882 (15.5%) military and 7,447 (7.3%) other EMS roles. The percent of eligible candidates who made the next attempt markedly declined across all employment categories at attempt four which requires proof of remedial training before the exam is scheduled. Of note, the military category was highest for percent making an attempt in exams two and three but then saw the sharpest decline at attempt four, falling to just 15% for that exam. Fire candidates sustained high persistence over all categories through all six attempts (Table 16).

Table 16

Percent of Eligible Candidates by Employment Category Who Made Each Examination

Attempt

| | | Fire | Private | Hospital | 3 rd Service | Govt | Military | Other |
|----------------|---|--------|---------|----------|----------------------------|-------|----------|-------|
| <u>Attempt</u> | | | | | | | | |
| 2 | n | 26,077 | 11,676 | 5,957 | 206 | 8,444 | 12,902 | 3,843 |
| | % | 67 | 67 | 59 | 51 | 69 | 81 | 52 |
| 3 | n | 8,824 | 3,407 | 1,641 | 59 | 2,651 | 5,009 | 1,074 |
| | % | 60 | 57 | 50 | 46 | 59 | 86 | 45 |
| 4 | n | 2,438 | 828 | 352 | 18 | 700 | 354 | 210 |
| | % | 48 | 43 | 37 | 40 | 45 | 15 | 29 |
| 5 | n | 844 | 290 | 114 | 4 | 232 | 60 | 55 |
| | % | 66 | 62 | 58 | 36 | 60 | 38 | 55 |
| 6 | n | 318 | 123 | 43 | 1 | 87 | 14 | 30 |
| | % | 61 | 64 | 59 | 50 | 56 | 44 | 50 |

The respondents who indicated employment in EMS were asked to further categorize their employment into primary and secondary roles. Of the group who indicated employment in EMS only 63,043 selected a primary employment role and 62,767 chose a secondary employment option (Table 17).

Table 17

Candidates' Primary and Secondary Employment Roles in EMS

| | | | | | | |
|----------------------------|-----------------------|------------------|-----------------------------|---------------------------|---------------------|----------------|
| Primary EMS Role (n) | Administrative 290 | Education 244 | Other 6,839 | Patient Care 26,422 | Supervisor 545 | None 28,703 |
| Secondary EMS Role | Education 2,729 | Fire 11,706 | Law Enforcement 1,187 | Patient Care 16,480 | Supervisor 1,554 | None 29,111 |

Note: These roles were identified by candidates who failed their first examination

attempt.

School Characteristics

In the original data set, the schools were assigned 11 codes. They were: post-secondary; hospital, clinic or medical center; governmental education or medical service (fire or EMS agency); military; other; unknown; individual instructor; high school; technical/career/adult; re-registration, refresher or other NREMT admin; and unknown Idaho courses. These 11 codes were consolidated due to the small numbers in some of the groups. The five new groups that were assigned were post-secondary; hospital, clinical or medical center; government (fire or EMS agency); military; and other (which included all other groups except re-registration and refresher). Cases in the re-registration and refresher group were eliminated as they did not represent the population of interest (Table 18).

Table 18

Examination Attempts by School Type

| Attempt | | Post- Sec. | Hospital | Govt. | Military | Other | χ^2 | Sig. |
|---------|-----------|---------------|----------|--------|----------|--------|----------|-------|
| 2 | n | 63,285 | 6,689 | 17,300 | 17,203 | 22,076 | 3340.52 | <.001 |
| | Attempted | 40,408 | 4,059 | 10,873 | 14,654 | 13,504 | | |
| | (%) | (64) | (61) | (63) | (85) | (61) | | |
| 3 | n | 22,111 | 2,161 | 6,237 | 6,785 | 7,723 | 2,791.00 | <.001 |
| | Attempted | 12,257 | 1,127 | 3,538 | 6,037 | 4,126 | | |
| | (%) | (55) | (52) | (57) | (89) | (53) | | |
| 4 | n | 7,204 | 646 | 2,079 | 3,116 | 2,497 | 682.97 | <.001 |
| | Attempted | 3,066 | 222 | 937 | 543 | 1,026 | | |
| | (%) | (43) | (34) | (45) | (17) | (41) | | |
| 5 | n | 1,700 | 117 | 460 | 325 | 620 | 194.39 | <.001 |
| | Attempted | 1,074 | 57 | 297 | 75 | 369 | | |
| | (%) | (63) | (49) | (65) | (23) | (60) | | |
| 6 | n | 688 | 39 | 193 | 42 | 241 | 7.07 | 0.132 |
| | Attempted | 388 | 21 | 121 | 18 | 145 | | |
| | (%) | (56) | (54) | (63) | (43) | (60) | | |

These data show a substantially higher reattempt percentage in the military schools for the second (85%) and third (89%) exam attempts as compared to all other school types which were all just over 60% reattempt rates for the second and between 50 and 60 percent for the third attempt. This trend changed dramatically at the fourth attempt, where military candidate reattempts dropped to 17% and remained below all other school types for the remainder of the examination attempts. While a drop-off to below 50% was seen for all of the other school types at attempt four, by attempts five and six a small uptick was seen in all institutions. After military, post-secondary and government schools showed the highest percentage of persistence through all examination attempts.

Accreditation status of school. The accreditation status of the school was assigned based on whether the academic institution was listed with the Commission on

Accreditation of Allied Health Education Programs (CAAHEP) as being either accredited or having a letter of review (in the accreditation process). The CAAHEP does not accredit EMT programs, but it is possible that the quality assurance elements of accreditation influenced student persistence.

There were 45,568 candidates of the 127,027 (36%) eligible for their second attempt that were affiliated with an accredited program. Of the total cases, 468 (.4%) had no accreditation status assigned (Table 19).

Table 19

Examination Attempt Versus Expected in Candidates Based on School Accreditation Status

| Attempt (n) | Accreditation Status | | χ^2 | Sig. | |
|-------------|---------------------------|-------------------------------|-------------|--------|-------|
| | Accredited n(% within) | Not Accredited n(% within) | | | |
| 2 (83,500) | Attempt | 29,609 (65) | 53,891 (67) | 31.69 | <.001 |
| | Expected | 30,064 (66) | 53,435 (66) | | |
| 3 (27,085) | Attempt | 8,998 (56) | 18,087 (56) | 169.34 | <.001 |
| | Expected | 9,645 (60) | 17,439 (60) | | |
| 4 (5,794) | Attempt | 2,242 (39) | 3,552 (34) | 106.96 | <.001 |
| | Expected | 1,947 (37) | 3,846 (37) | | |
| 5 (1,872) | Attempt | 774 (63) | 1,098 (55) | 18.66 | <.001 |
| | Expected | 715 (58) | 1,156 (58) | | |
| 6 (693) | Attempt | 277 (56) | 416 (59) | 0.58 | 0.450 |
| | Expected | 283 (58) | 410 (58) | | |

Note. df = 1. Accredited indicates the school was associated with an accredited paramedic program. EMT programs are not part of the accreditation process. % within = within accredited or not accredited for that attempt.

Correlations

All independent variables demonstrated significant correlation with the second attempt on the NREMT-C exam. As seen in Table 20, some of the school variables were very strongly correlated with pay type (other pay or self-pay) and employment type.

Because this strong correlation indicated multiple collinearity, the school variables were not included in the regression equation.

Table 20

Independent Variable Correlations Suggesting Collinearity

| Variable | Variable | r | Sig. |
|---------------------|-----------------|------|-------|
| Pay Type 1 | Military school | .607 | <.001 |
| Pay Type 2 | Military school | .726 | <.001 |
| Pay Type 3 | Military school | .781 | <.001 |
| Pay Type 4 | Military school | .508 | <.001 |
| Employment Military | Military school | .816 | <.001 |

Binary Logistic Regression Models

A model was constructed for each of NREMT-C exam attempts two through six using binary logistic regression on the likelihood that the candidates would take their next examination attempt. The frequency and correlation data suggested there might be some variation in each model. In each case the starting point for the model included: theta score and pay status for the previous exam attempt; gender; race; age; years of education; employment; and accreditation status of the education institution. All variables were entered at the same time using the standard selection method as recommended in Meyers et al. (2013).

Model examination attempt two. A total of 113,964 cases (89.7%) of the total eligible to take attempt two were included in the analysis after 13,063 were excluded due to missing data. The original classification table showed that 65.6% made a second attempt with a beta value of 1.903 ($p < .001$). The omnibus tests of model coefficients evaluating the null versus the full model was significant, $\chi^2 = 6128.43$, $df = 17$, $p < .001$, so

the null hypothesis was rejected. The effect, however, was small with the Nagelkerke $R^2 = 7\%$. The Hosmer and Lemeshow Test for goodness of fit was significant $\chi^2 = 194.037$, $df=8$, $p < .001$, which indicated the model did not accurately predict actual probabilities (Myers et al., 2013). The logistic regression coefficient, Wald test, and odds ratio for each predictor are shown in Table 21. Significant ($\alpha < .05$) partial effects were noted for theta one score, pay type for attempt one, gender, education years, race (except Hispanic only), all employment types and age. Using the model, classification accuracy of cases only improved by 0.7% (from 65.6 to 66.3%). The odds ratio for the theta one score indicated that higher scores on this variable more than doubled the odds of reattempting the exam when accounting for the other variables. For the military school category, the odds of reattempting also doubled. Odds increases were also seen in Pay category for attempt; years of education; white, Hispanic, black and other race; and, employment in fire, private, hospital and government. The odds of persisting were less than even in candidates who were female, older, or worked for a third service, or other employer (Table 21).

Table 21

Variables in the Regression Equation for Likelihood to Attempt Examination Two

| Independent variable | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) | |
|----------------------|--------|-------|---------|-------|--------|---------------------|-------|
| | | | | | | Lower | Upper |
| Theta_1 | 0.823 | 0.02 | 1936.20 | 0.000 | 2.278 | 2.196 | 2.363 |
| Pay Type_1 | 0.517 | .02 | 677.99 | <.001 | 1.677 | 1.613 | 1.743 |
| Sex | -0.173 | .064 | 146.4 | <.001 | .841 | 0.817 | 0.865 |
| EducYrs | 0.035 | 0.005 | 47.455 | <.001 | 1.035 | 1.025 | 1.046 |
| WhiteOnly | 0.242 | 0.064 | 14.442 | <.001 | 1.274 | 1.125 | 1.444 |
| HispanicOnly | 0.126 | 0.066 | 3.668 | 0.055 | 1.134 | 0.997 | 1.289 |
| BlackOnly | 0.307 | 0.067 | 20.744 | <.001 | 1.359 | 1.191 | 1.551 |
| RaceOther | 0.134 | 0.067 | 3.986 | 0.046 | 1.143 | 1.002 | 1.303 |
| AccreditedProg | 0.083 | 0.014 | 37.495 | <.001 | 1.086 | 1.058 | 1.116 |
| Age | -0.016 | 0.001 | 349.802 | <.001 | 0.984 | 0.983 | 0.986 |
| Fire | 0.354 | 0.02 | 315.264 | <.001 | 1.424 | 1.37 | 1.481 |
| Private | 0.389 | 0.023 | 283.675 | <.001 | 1.476 | 1.41 | 1.544 |
| Hospital | 0.107 | 0.027 | 16.211 | <.001 | 1.113 | 1.056 | 1.172 |
| ThirdSvc | -0.325 | 0.103 | 9.84 | 0.002 | 0.723 | 0.59 | 0.885 |
| Govt | 0.471 | 0.026 | 332.946 | <.001 | 1.601 | 1.522 | 1.685 |
| Military | 0.695 | 0.03 | 536.833 | <.001 | 2.003 | 1.889 | 2.125 |
| Otheremploy | -0.18 | 0.029 | 38.945 | <.001 | 0.835 | 0.789 | 0.884 |
| Constant | -0.545 | 0.092 | 35.484 | <.001 | 0.58 | | |

Note: n = 113, 964, 13,063 missing.

Model examination attempt three. All of the same variables were entered for examination attempt three except the theta score and pay category which were changed to the previous attempt. A total of 40,604 cases of the 45,204 (89.8%) of the total eligible to take attempt three were included in the analysis. The original classification table predicted 59.3% of those who made a third attempt with a beta value of 1.455 ($p < .001$). The omnibus tests of model coefficients evaluating the null versus the full model was significant, $\chi^2 = 3462.57$, $df = 17$, $p < .001$, so the null hypothesis was rejected. The effect, however, remained small with the Nagelkerke $R^2 = 11\%$. The Hosmer and Lemeshow Test for goodness of fit was also significant for this attempt ($p < .001$) which indicated this model did not accurately predict actual probabilities (Myers et al., 2013). The logistic regression coefficient, Wald test, odds ratio and confidence intervals for each predictor are shown in Table 22. Significant ($\alpha < .05$) partial effects were noted for theta two score, pay type for attempt two, gender, education years, fire, private, hospital, government and military employment types and age. Using the model, classification accuracy of cases improved by 3.1% (from 59.3 to 62.4%). The odds ratio for the theta two score indicated that higher scores on this variable more than doubled the odds of reattempting the exam when accounting for the other variables. For the military school category, the odds of reattempting almost quadrupled a candidate's likelihood of attempting again. Odds increases were also seen in pay category for attempt; years of education; and, employment in fire, private, hospital and government. The odds of persisting were less than even in female and older candidates (Table 22).

Table 22

Variables in the Regression Equation for Likelihood to Attempt Examination Three

| Independent variable | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) | |
|----------------------|--------|-------|---------|-------|--------|---------------------|-------|
| | | | | | | Lower | Upper |
| Theta_2 | 0.78 | 0.032 | 605.265 | <.001 | 2.181 | 2.05 | 2.321 |
| PayDico_2 | 0.65 | 0.037 | 306.553 | <.001 | 1.916 | 1.782 | 2.061 |
| Sex | -0.261 | 0.024 | 117.847 | <.001 | 0.771 | 0.735 | 0.808 |
| EducYrs | 0.044 | 0.009 | 24.978 | <.001 | 1.045 | 1.027 | 1.063 |
| WhiteOnly | 0.055 | 0.119 | 0.212 | 0.645 | 1.056 | 0.837 | 1.333 |
| HispanicOnly | -0.01 | 0.121 | 0.007 | 0.936 | 0.99 | 0.781 | 1.256 |
| BlackOnly | 0.199 | 0.123 | 2.595 | 0.107 | 1.22 | 0.958 | 1.554 |
| RaceOther | 0.03 | 0.124 | 0.06 | 0.807 | 1.031 | 0.809 | 1.314 |
| AccreditedProg | 0.043 | 0.022 | 3.853 | 0.05 | 1.044 | 1.000 | 1.090 |
| Age | -0.008 | 0.001 | 36.871 | <.001 | 0.992 | 0.989 | 0.994 |
| Fire | 0.447 | 0.033 | 184.52 | <.001 | 1.563 | 1.466 | 1.667 |
| Private | 0.389 | 0.038 | 102.467 | <.001 | 1.476 | 1.369 | 1.592 |
| Hospital | 0.16 | 0.046 | 12.249 | <.001 | 1.173 | 1.073 | 1.283 |
| ThirdSvc | -0.057 | 0.186 | 0.096 | 0.757 | 0.944 | 0.656 | 1.358 |
| Govt | 0.437 | 0.042 | 110.399 | <.001 | 1.548 | 1.427 | 1.68 |
| Military | 1.347 | 0.054 | 615.068 | <.001 | 3.845 | 3.456 | 4.276 |
| Otheremploy | -0.06 | 0.05 | 1.423 | 0.233 | 0.942 | 0.853 | 1.039 |
| Constant | -1.015 | 0.166 | 37.582 | <.001 | 0.362 | | |

Note: n = 40,604.

Model examination attempt four. The same independent variables were entered for exam attempt four, with the exception of the theta score and pay category for the previous attempt. A total of 13,837 cases of the 15,612 (88.6%) of the total eligible to take attempt four were included in the analysis. The original classification table predicted 62.5% of those who made a fourth attempt with a beta value of 0.599 ($p < .001$). The omnibus tests of model coefficients evaluating the null versus the full model was significant, $\chi^2 = 1326.62$, $df = 17$, $p < .001$, so the null hypothesis was rejected. The effect, however, remained small with the Nagelkerke $R^2 = 12\%$. The Hosmer and Lemeshow Test for goodness of fit was not significant for this attempt ($p < .251$) which indicated this model would predict actual probabilities (Myers et al., 2013). The logistic regression coefficient, Wald test, odds ratio and confidence intervals for each predictor are shown in Table 23. Significant ($\alpha < .05$) partial effects were noted for theta three score, pay type for attempt three, gender, education years, and fire, private, hospital, government and military employment types. Using the model, classification accuracy of cases improved by just 1.4% (from 62.5% to 63.9%). The odds ratio for the theta three score indicated that higher scores on this variable almost doubled the odds of reattempting the exam when accounting for the other variables. For the military employment category, the odds of reattempting which, in the previous attempt almost quadrupled a candidate's likelihood of attempting again in this attempt cut by more than half the odds a candidate would attempt again. Odds increases were also seen in years of education and in employment in fire, private, hospital and government. Having a pay category of other pay in the previous attempt, which in the previous two models upped the odds of a candidate reattempting, flipped in this attempt. This may suggest that candidates whose

exams were previously paid for by another entity and were faced with paying for their exam on this attempt elected not to reattempt. The odds of persisting remained less than even in female candidates (Table 23).

Table 23

Variables in the Regression Equation for Likelihood to Attempt Examination Four

| Independent variable | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) | |
|----------------------|--------|-------|---------|-------|--------|---------------------|-------|
| | | | | | | Lower | Upper |
| Theta_3 | 0.653 | 0.058 | 128.012 | <.001 | 1.921 | 1.716 | 2.151 |
| PayDico_3 | -0.294 | 0.066 | 19.737 | <.001 | 0.745 | 0.654 | 0.848 |
| Sex | -0.309 | 0.044 | 49.044 | <.001 | 0.734 | 0.674 | 0.801 |
| EducYrs | 0.042 | 0.016 | 6.954 | 0.008 | 1.043 | 1.011 | 1.077 |
| WhiteOnly | 0.063 | 0.224 | 0.079 | 0.779 | 1.065 | 0.687 | 1.65 |
| Hispanic Only | 0.03 | 0.228 | 0.017 | 0.897 | 1.030 | 0.659 | 1.611 |
| Black Only | 0.375 | 0.230 | 2.666 | 0.103 | 1.455 | 0.928 | 2.282 |
| Race Other | 0.113 | 0.233 | 0.237 | 0.626 | 1.120 | 0.71 | 1.767 |
| Accredited Program | 0.088 | 0.039 | 5.169 | 0.023 | 1.092 | 1.012 | 1.178 |
| Age | -0.001 | 0.002 | 0.262 | 0.609 | 0.999 | 0.994 | 1.003 |
| Fire | 0.594 | 0.061 | 95.6 | <.001 | 1.81 | 1.607 | 2.039 |
| Private | 0.448 | 0.071 | 39.899 | <.001 | 1.566 | 1.362 | 1.799 |
| Hospital | 0.211 | 0.087 | 5.859 | 0.015 | 1.235 | 1.041 | 1.464 |
| ThirdSvc | 0.515 | 0.317 | 2.641 | 0.104 | 1.674 | 0.899 | 3.118 |
| Govt | 0.522 | 0.074 | 49.085 | <.001 | 1.685 | 1.456 | 1.95 |
| Military | -1.084 | 0.100 | 117.77 | <.001 | 0.338 | 0.278 | 0.412 |
| Otheremploy | -0.113 | 0.098 | 1.321 | 0.250 | 0.893 | 0.737 | 1.083 |
| Constant | -1.701 | 0.308 | 30.54 | <.001 | 0.183 | | |

Note: n=13,837

Model examination attempt five. The same independent variables were entered as for exam attempt four with the exception of the theta score and pay category for the previous attempt. A total of 2,894 cases of the 3,241 (89%) of the total eligible to take attempt five were included in the analysis. The original classification table predicted 60.4% of those who made a fifth attempt with a beta value of 1.525 ($p < .001$). The omnibus tests of model coefficients evaluating the null versus the full model was significant, $\chi^2 = 121.78$, $df = 13$, $p < .001$, so the null hypothesis was rejected. The effect, however, remained small with the Nagelkerke $R^2 = 6\%$. The Hosmer and Lemeshow Test for goodness of fit was not significant for this attempt ($p = .663$) which indicated this model would predict actual probabilities (Myers et al., 2013). The logistic regression coefficient, Wald test, odds ratio and confidence intervals for each predictor are shown in Table 24. Significant ($\alpha < .05$) partial effects were noted for theta four score, gender, age, and military employment types. Using the model, classification accuracy of cases improved by just 1.9% (from 60.4% to 62.3%). The odds ratio for the theta four score indicated that higher scores on this variable almost doubled the odds of reattempting the exam when accounting for the other variables. For the military school category, the odds of reattempting remained less than half, as in attempt four. For the first time older candidates were more likely to reattempt the exam, although the effect is almost negligible. The odds of persisting continued to be significantly less than even in female candidates. Of note, the constant for this equation was not significant (Table 24).

Table 24

Variables in the Regression Equation for Likelihood to Attempt Examination Five

| Independent variable | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) | |
|----------------------|--------|-------|--------|-------|--------|---------------------|-------|
| | | | | | | Lower | Upper |
| Theta_4 | 0.611 | 0.126 | 23.422 | <.001 | 1.842 | 1.438 | 2.358 |
| PayDico_4 | -0.063 | 0.132 | 0.227 | 0.633 | 0.939 | 0.724 | 1.217 |
| Sex | -0.494 | 0.093 | 28.236 | <.001 | 0.61 | 0.509 | 0.732 |
| EducYrs | -0.026 | 0.034 | 0.575 | 0.448 | 0.974 | 0.911 | 1.042 |
| WhiteOnly | -0.278 | 0.477 | 0.341 | 0.559 | 0.757 | 0.297 | 1.928 |
| Hispanic Only | -0.467 | 0.487 | 0.918 | 0.338 | 0.627 | 0.241 | 1.63 |
| Black Only | -0.115 | 0.489 | 0.055 | 0.814 | 0.891 | 0.342 | 2.324 |
| Race Other | -0.174 | 0.496 | 0.123 | 0.725 | 0.84 | 0.318 | 2.222 |
| Accredited Program | 0.13 | 0.081 | 2.559 | 0.11 | 1.139 | 0.971 | 1.336 |
| Age | 0.012 | 0.005 | 6.489 | 0.011 | 1.013 | 1.003 | 1.022 |
| Fire | 0.248 | 0.131 | 3.551 | 0.06 | 1.281 | 0.99 | 1.658 |
| Private | 0.094 | 0.151 | 0.386 | 0.534 | 1.099 | 0.817 | 1.477 |
| Hospital | -0.044 | 0.188 | 0.055 | 0.814 | 0.957 | 0.662 | 1.382 |
| ThirdSvc | -0.764 | 0.647 | 1.398 | 0.237 | 0.466 | 0.131 | 1.653 |
| Govt | 0.053 | 0.157 | 0.113 | 0.737 | 1.054 | 0.775 | 1.432 |
| Military | -0.818 | 0.22 | 13.805 | <.001 | 0.441 | 0.286 | 0.679 |
| Otheremploy | -0.091 | 0.206 | 0.195 | 0.658 | 0.913 | 0.61 | 1.367 |
| Constant | 0.258 | 0.66 | 0.152 | 0.696 | | | |

Note: n=2,894

Model examination attempt 6. The same independent variables were entered as for exam attempt five with the exception of the theta score and pay category for the previous attempt. A total of 1,115 cases of the 1,215 (91.8%) of the total eligible to take attempt six were included in the analysis. The original classification table predicted 58% of those who made a sixth attempt with a beta value of 1.379 ($p < .001$). The omnibus tests of model coefficients evaluating the null versus the full model was significant, $\chi^2 = 42.71$, $df = 18$, $p = .001$, so the null hypothesis was rejected. The effect, however, remained small with the Nagelkerke $R^2 = 5\%$. The Hosmer and Lemeshow Test for goodness of fit was not significant for this attempt ($p = .319$) which indicated this model would predict actual probabilities (Myers et al., 2013). The logistic regression coefficient, Wald test, odds ratio and confidence intervals for each predictor are shown in Table 25. Significant ($\alpha < .05$) partial effects were only noted for theta five score and employment in fire or private EMS. Using the model, classification accuracy of cases improved by just 3.4% (from 58% to 61.4%). The odds ratio for the theta five score indicated that higher scores on this variable more than doubled the odds of reattempting the exam when accounting for the other variables while private or fire employment signified about a one and one-half odds increase in taking the sixth examination (Table 25).

Table 25

Variables in the Regression Equation for Likelihood to Attempt Examination 6

| Independent variable | B | S.E. | Wald | Sig. | Exp(B) | 95% C.I. for Exp(B) | |
|----------------------|--------|-------|--------|-------|--------|---------------------|-------|
| | | | | | | Lower | Upper |
| Theta_5 | 0.894 | 0.199 | 20.262 | <.001 | 2.445 | 1.656 | 3.608 |
| PayDico_5 | 0.243 | 0.295 | 0.676 | 0.411 | 1.275 | 0.715 | 2.273 |
| Sex | -0.12 | 0.156 | 0.586 | 0.444 | 0.887 | 0.653 | 1.205 |
| EducYrs | 0.083 | 0.058 | 2.037 | 0.154 | 1.086 | 0.97 | 1.217 |
| WhiteOnly | 0.549 | 0.756 | 0.527 | 0.468 | 1.731 | 0.393 | 7.621 |
| Hispanic Only | 0.634 | 0.775 | 0.669 | 0.413 | 1.886 | 0.413 | 8.617 |
| Black Only | 0.746 | 0.777 | 0.922 | 0.337 | 2.108 | 0.46 | 9.66 |
| Race Other | 0.599 | 0.789 | 0.576 | 0.448 | 1.82 | 0.387 | 8.548 |
| Accredited Program | -0.082 | 0.128 | 0.41 | 0.522 | 0.921 | 0.716 | 1.184 |
| Age | 0.002 | 0.007 | 0.104 | 0.747 | 1.002 | 0.988 | 1.016 |
| Fire | 0.41 | 0.208 | 3.872 | 0.049 | 1.507 | 1.002 | 2.268 |
| Private | 0.506 | 0.241 | 4.419 | 0.036 | 1.659 | 1.035 | 2.661 |
| Hospital | 0.265 | 0.307 | 0.748 | 0.387 | 1.304 | 0.714 | 2.38 |
| ThirdSvc | 0.436 | 1.483 | 0.087 | 0.769 | 1.547 | 0.085 | 28.29 |
| Govt | 0.192 | 0.249 | 0.597 | 0.440 | 1.212 | 0.744 | 1.973 |
| Military | -0.522 | 0.443 | 1.392 | 0.238 | 0.593 | 0.249 | 1.412 |
| Other | 0.05 | 0.321 | 0.024 | 0.877 | 1.051 | 0.56 | 1.973 |
| Employment | | | | | | | |
| Constant | -2.24 | 1.098 | 4.165 | 0.041 | 0.106 | | |

Note: n=1,115

Models' Summary

While not all models achieved statistical significance, it is clear from those that did that several factors contribute to a candidate's likelihood of taking another examination attempt. Many of those factors did not remain fixed over all attempts. Chief among them were theta score on the previous attempt which positively influenced the odds of reattempting throughout testing attempts two through six. Candidates have no direct means to ascertain their theta score. Rather, they are told they have failed the attempt, and whether they scored above, below or near the passing standard in each of the five examination categories. It is possible that candidates based part of their decision to either persist or stop attempting based on that feedback. For example, a candidate who received feedback that he or she was below passing in all five categories might be less likely to reattempt than one who passed two categories, failed two categories and was near passing on the final category.

Having someone else pay for their previous exam enhanced a candidate's odds of taking their next examination attempt in the second and third examination attempts. This was negatively but weakly associated to the fourth attempt and not significant for the last two exam attempts.

For attempts two through five female gender, when controlled for other variables, had a significant negative relationship to taking an examination attempt. This is particularly notable because women are under-represented in the profession. While this relationship may, in part, be related to the greater likelihood of persistence in fire and military candidates because both professions are dominated by males, gender did not correlate strongly with either employment types.

Years of education was also statistically significant for attempts two through four, with candidates having more years of education more likely than others to take another attempt, although that effect was very weak. All race designations except for Hispanic only were significantly but weakly associated with the odds of taking a second attempt. None of the race variables played a significant role in in the models for attempts three through six.

Accreditation status of the education institution played a significant, but small role in increasing the odds to predict who would take a second, third or fourth examination attempt. This variable played no significant role in determining who would take their final two attempts.

Age of the candidate at their first attempt had a negative relationship to likelihood of attempting the second, third and fourth exams with younger candidates more inclined to persist. Older candidates were statistically more likely to take attempt five, but the relationship was very weak.

Employment experience in EMS played a significant role in persistence to the next examination attempt in all attempts. Candidates designating military employment had particularly notable results. They had high odds of taking a second or third examination attempt. This trend reversed at the fourth and fifth attempt where military candidates were less than half as likely to reattempt. Fire employment was also a positive predictor in all but the fifth examination attempt.

Summary

The models developed in this research provide a very small contribution to understanding why some candidates persist after failing an initial attempt at the NREMT-

C EMT examination. While this research only minimally illuminated the non-reattempt candidates' rationale for not persisting on the exam, it provided information about them that was previously unknown to assist faculty, programs, and the NREMT to understand factors that influence this decision.

Chapter 5

Summary, Conclusions and Recommendations

This chapter summarizes this study and reflects on the results found in Chapter 4. The implications of these findings are reviewed as are the recommendations for further research.

Summary of the Study

This research was designed to identify demographic and other factors that influence an EMT candidate's decision to reattempt the NREMT-C after failing each of the possible six attempts. Based on a review of the literature, no prior published research had investigated this issue.

In almost all cases, certification as an EMT is the gateway into the EMS and Fire professions. Candidates in most states must pass the NREMT cognitive and psychomotor assessments to be eligible for certification. More than one-third (34%) of EMT candidates did not reattempt after failing their first NREMT-C examination attempt and this lack of persistence is even higher with each subsequent examination attempt. Failure to persist means the candidate cannot continue to become either an EMT or in many cases a firefighter.

This study evaluated the impact of initial test score, demographic features, examination payment type, and school factors on a candidate's likelihood to reattempt the NREMT-C at each examination attempt. Specifically, it addressed these questions:

1. Do higher theta NREMT-C examination scores on the prior examination attempt predict those who would reattempt the exam?

2. Do the demographic characteristics (age, gender, race/ethnicity, employment status, or years of education) of the candidates predict their likelihood to reattempt the examination?
3. Does examination payment type or program accreditation status predict candidates who reattempted the examination?

A causal comparative research design was used to explore the relationship between the independent variables (theta score, demographic features, payment status, school accreditation status) of the group that reattempted versus the group that did not. After data were cleaned and significant correlations identified, binary logistic regression analysis was performed to identify variables that helped predict candidates who were more or less likely to take the next examination attempt.

Major Findings

Significant findings were identified for the models developed for examination attempts two through six, however the predictive power of the models are limited. While the omnibus tests of model coefficients were significant for the models for each attempt, the effect appears to be very small. The Nagelkerke R^2 ranged from a low of .05 (-2 Log likelihood 1485.44) in attempt six, to a high of .12 (-2 Log likelihood 17124.59) in attempt four. It is important to note that the Hosmer and Lemeshow analysis for goodness of fit was significant for examination attempts two and three which suggests the model may not predict actual probabilities. Likewise, for each attempt, the model only marginally improved classification of cases (ranging from a low of 0.7% on the second attempt to a high of 3.4% for the sixth attempt).

Theta score on the prior attempt. The strongest odds of reattempting the examination at each attempt was related to the candidate's theta score on their prior attempt. This is a curious finding as this score is not published by the NREMT so it is not known to either candidates or their instructors. The NREMT reports to candidates that their performance is either above, below or near passing in each of the five examination categories. It is possible that this limited feedback influences candidates' perceptions about their likelihood of succeeding on subsequent examination attempts.

Examination payment status on the prior attempt. Examination payment status for the previous attempt indicating someone other than the student paid for the examination increased the odds that candidates would reattempt examinations two and three, and was weakly but negatively associated with the fourth attempt. Some states and employers pay for candidates to take their examinations. It appears likely that this payment status is often only offered for their first three attempts. Although not specifically assessed in this research, this finding suggests that students who have low socio-economic status and are not funded by the military, state or an employer are less likely to persist on the examination thereby impacting their ability to enter the EMS and fire professions.

Candidate gender. Female candidates were significantly less likely to reattempt examinations two through five. This may be partially accounted for by the gender distribution in military and fire candidates who were more likely to persist. It is possible that other factors contribute to this finding.

It has been suggested that women are more likely than men to experience impostor syndrome (sometimes referred to as impostor phenomenon or perceived

fraudulence) (Clance & Imes, 1978). This individual difference characteristic as described and assessed using the Perceived Fraudulence Scale by Kolligian and Sternberg in 1991, involves “inauthentic and self-deprecatory forms of thinking, with concomitant experiences of attention to one’s behaviors and apprehension in evaluative situations” (p. 323). It appears that individuals who see themselves as impostors are more likely to experience “anxiety in reaction to impending potentially negative outcomes and the subsequent threat of exposure” (Kolligan & Sternberg, 1991, p. 310). This could in part, account for the female’s reluctance to persist through the examination process. For adults, the belief that they can reach their goals is critical to motivation (Goto & Martin, 2004). The fear that they do not deserve those goals and are not worthy to achieve them may be perceived as an insurmountable barrier for some female candidates who are entering a predominantly male occupation.

Resilience is another attribute associated with persistence in higher education. In a 2013 study of Spanish psychology students, de la Fuente, Cardelle-Elawar, Martínez-Vicente, Zapata, & Sánchez found that, in the area of resilience, female students had a lower tolerance for negative stress situations than did their male counterparts.

Years of education. In attempts two through four, the candidates having more years of education were slightly more likely to reattempt the examination. Some degree of academic (college) self-efficacy may have developed in candidates with more years of education as prior academic performance has been shown to influence students’ academic self-efficacy, although the research looks primarily at high school or previous college GPA (Elias & MacDonald, 2007). This attribute has been found to influence persistence in research related to college students (Wright, Jenkins-Guarnieri & Murdock, 2013). It is

possible that having more years of education enhanced candidates' academic self-efficacy, giving them the confidence to take more examination attempts.

Race and ethnicity. When controlling for the other variables, all race and ethnicity designations with the exception of Hispanic only were only found to be significantly predictive of reattempting examination two. In examinations three through six none of race and ethnicity independent variables were significant predictors. This finding was not expected given the literature related to lower persistence, participation and pass rates for racial and ethnic minorities, as compared to Caucasian students.

School accreditation affiliation. Candidates from EMT schools that were affiliated with CAAHEP accredited paramedic programs were more likely to reattempt exams two through four. Paramedic programs with CAAHEP accreditation are monitored for student outcomes with targeted assessment thresholds that include programmatic retention/attrition (CoAEMSP, 2015). Because many EMT programs are housed within departments or agencies that have CAAHEP-accredited paramedic programs it is possible that the quality processes embedded within these organizations contribute to their increased student persistence on the early examination attempts. It is also possible that candidates within these programs are more likely than those in non-accredited schools to aspire to continue to paramedic certification and therefore they are more likely to reattempt.

Candidate age. Younger candidates were more likely to reattempt exams two and three. At the fifth attempt, older candidates were more likely to persist and there was no significant relationship identified for the sixth examination attempt. This increase in early persistence may be related to employment in fire and military where entry-level

candidates tend to be younger. By occupation, in 2005 EMS workers had a lower overall mean age than firefighters, licensed practical/vocational nurses, police, registered nurses and respiratory therapy (NHTSA, 2008). The 2005 LEADS study found that the average age of non-volunteer EMTs and paramedics was 34 as compared to 39 for volunteers. It is also possible that older candidates are more likely to be associated with volunteer affiliations in EMS which could influence their decision to reattempt. That does not, however, explain the increased age of candidates seen in examination attempt five.

Employment experience in EMS. Employment experience in EMS also played a significant role in examination attempts two through six. In particular, military candidates were significantly more likely to reattempt in examination attempts two (OR 2.003) and three (OR 3.845). This trend reversed in subsequent attempts where military were less likely than other candidates to reattempt. It appears that in some military divisions, only three attempts to pass the NREMT examination are permitted. In a military memo dated June, 2016, army candidates were told that they were permitted three attempts to pass the NREMT. Those who failed to do so “are at risk of being separated from military service or reclassified into a different MOS, per the needs of the Army” (Department of the Army, 2006).

Candidates indicating primary employment in fire were also significantly more likely to reattempt in all but the fifth examination attempt. In a study of paramedics (who are typically paid more than EMTs), Russ-Eft and Dickison (2008) found that employment in fire-based organizations was associated with higher earnings. The 2015-2016 Occupational Outlook Handbook confirms this, reporting the median pay of EMTs and paramedics in 2012 as \$31,980 per year as compared to \$46,870 for firefighters

(Bureau of Labor Statistics, 2015). It is possible that the prospect of better wages served as a motivator for those candidates to continue.

Findings Related to the Literature

There was no prior research specifically directed toward participation or persistence of EMS candidates in the certification testing process. The links to the literature are based on these theoretical frameworks. Prior studies related to EMS and nursing high-stakes testing were also considered. While those studies are related to the testing process they predominantly assess factors associated with pass or fail status and therefore do not specifically parallel the examination persistence factors of interest in this research. This discussion is approached from the perspective of the study research questions.

Higher theta scores as predictors. This research demonstrated that higher theta scores on the prior examination attempt predicted those who will reattempt the examination. This finding is consistent with aspects of Tinto's Interactionalist Model of Student Persistence Model (Tinto, 1975) that includes grade performance and intellectual development as key elements of persistence. Tinto suggested that academic ability predicts future performance. Likewise, an individual's decision to continue or leave their educational pursuit occurs when that student weighs the benefits as compared to costs of their choice. In the case of the NREMT-C exam, the candidates who observed they were below passing in many content areas may have felt the cost (of time, dollars and the risk of failing again) involved in taking another attempt outweighed the chance they might pass, based on the indirect feedback about theta score they received from their prior examination attempt. Further, Tinto (1975) suggested this decision to quit is more likely

in students who lack a strong goal commitment – an attribute not directly measured in this research.

The indirect feedback students were given about theta score may have also influenced their self-efficacy, or confidence in their ability to be successful in subsequent attempts. Self-efficacy is known to influence persistence in education (Wolters, Fan & Daugherty, 2013).

Demographic predictors. The EMS workforce is younger in general than other allied health workers such as medical assistants, respiratory therapists and nurses (U.S. Department of Transportation, 2008). This study found that younger EMT candidates were more likely to persist through the first three examination reattempts. This finding flipped at the fifth exam, but by that attempt there was a substantially smaller pool of candidates retesting. This may contribute to the age of the workforce. Darkenwald (1985) found that lack of confidence, one of the deterrents to adult education participation was more prevalent in older adults.

No prior studies have evaluated the impact of gender on testing persistence or participation in EMS or nursing, however, Dickison et al. (2006) found increased pass rates for candidates who were male. In a study of prehospital students, Madigan (2006) also associated male gender with persistence in the program. However, her finding that mature-entry students were more likely to persist in the program after their first year was not consistent with this study's results. The educational literature reports that minority students are more likely to continue in schools that are welcoming, supportive and inclusive (Johnson-Bailey, 2004). In particular, historically females have all success in all female educational institutions (Reason, 2009). Less than one-third of candidates

testing at the EMT level were female. In the past frequent sex discrimination against females in fire organizations (Shih-Yung & Kleiner, 2001) and in medical education (Komaromy, Bindman, Haber & Sande, 1993) has been reported so it is possible this factor is associated with tendency of females to stop testing. However, no scholarly literature related to this topic in EMS education programs was identified so it is unknown whether a hostile teaching environment played a factor in lack of female persistence.

Since screening classes in health professions have been said to disproportionately affect underrepresented minorities (Hurtado, 2009), it came as a surprise that race and ethnicity factors did not appear to play a substantial role in the examination persistence of EMT NREMT-C candidates. Studies related to high stakes examination pass rates in nursing and EMS have noted significant findings in this area (Alameida et al., 2011; Dickison et al., 2006; Fernandez et al., 2008).

Previous education research has demonstrated increased academic persistence based on intellectual development (Tinto, 1975). Madigan (2006) also identified higher post-secondary education as a predictor of persistence in the prehospital students she studied. Years of education have also been associated with examination pass rates as reported in both nursing (Campbell & Dickson, 1996) and EMS (Dickison et. al., 2006).

Other predictors. Cost as a barrier to participation in education has been previously identified (Darkenwald, 1985; Merriam & Cafarella, 1999; Merriam, Cafarella & Baumgartner, 2007). As discussed earlier, these results suggest that this is the case with this population as payment status influenced the likelihood of reattempting.

Association with an accredited education institution appeared to play a small role in persistence and may be related to the institutional commitment referred to by Tinto

(1975). Little other research was identified in support of this concept; however retention is a key indicator for paramedic program accreditation. In one EMS study related to the NREMT-C, paramedic pass rates were positively associated with program accreditation (Dickison et. al., 2006).

Limitations

The number of independent variables in this analysis is small and reflects a limited snapshot of factors that influence a candidate's decision to reattempt the NREMT-C after an initial failed attempt. This limits the utility of the model. Likewise, some of the variables of interest (gender, race, education, and particularly employment status) had a significant amount of missing data as these fields were optional.

Other factors may exert as much, or more, influence on the retest status of each candidate. For example, these variables did not capture the fact that some students take EMT as an elective on their path to another health profession such as medicine, nursing or physician assistant or to occupations such as law enforcement or athletic training. Because these students do not wish to practice in the prehospital setting, it is likely that many will not elect to reattempt if they do not succeed on their first try at the certification examination. Likewise, some students who take an EMT program may do so to explore the profession, and may decide to "give the exam a try" but not persist after failure because they have already concluded that this profession may not suit them.

Cognitive factors such as college science scores, high school GPA, SAT, ACT or entrance exam scores are not considered; nor are non-cognitive learner characteristics such as metacognitive skills, attribution, motivation, self-efficacy or test anxiety assessed

in this model. The absence of these factors represents a major limitation to this work and should be explored in future studies to further expand this model.

Some of the race and ethnicity categories were too small to evaluate individually and were combined into larger groups. This limits the interpretation of the findings. In particular, it restricts the ability of the study to identify whether language factors might play a role in the group's decision about whether to retest. It is known that English-language learners struggle with multiple-choice examinations (Oermann & Gaberson, 2009).

Another variable that might influence a candidate's decision to retest that cannot be directly evaluated in this study is the cost of the exam. While \$70.00 may not be a substantial investment for many students, in some cases it is a barrier and might deter a student from reattempting the examination. A 2015 National Survey of Student Engagement report found that financial stress was common among undergraduates, especially those who were "first generation, women, Black and Hispanic (p.2). For the purpose of this study, cost was assessed indirectly by determining pay status for the candidate's previous exam attempt for each candidate in the model however, particularly at attempt four it is clear the pay status of candidates does not remain fixed throughout all attempts.

Finally, not all states are fully represented in this data. Most candidates take the NREMT-C exam because it is a requirement for licensure by their state. The number of candidates from states that do not mandate the test for licensure is likely to be small and not representative of their entire EMT population.

Recommendations for Future Research

This research could be enhanced by exploring individual factors such as metacognitive skills, attribution, motivation, self-efficacy or test anxiety through either prospective quantitative analysis or qualitative research methodologies. Likewise, knowing the intended career path of the candidates beyond that available for this research would shed understanding on the career motivation of the student which might explain some drop-off in candidates – or the dedication of those who persist until their sixth examination attempt. The presence or absence of institutional emotional and academic support after examination failure might further explain candidate persistence. Combining the independent variables with a survey or qualitative study of registered EMTs who failed one or more attempts could illuminate this topic with greater depth.

Conclusions

While the results of this study demonstrate some of the predictors of persistence through subsequent EMT NREMT-C examination attempts, it is clear that the decisions to continue are far more complex and involve many more variables than were included in this research. With the exception of theta score and employment in fire and private EMS, it was evident that the significance of each variable, and whether it influenced the decision to reattempt was not static and in some cases was dramatically different by attempt. This was particularly notable at examination attempt four when, in order to reattempt, candidates must demonstrate remedial education. It also appeared that the pay status of the examination and military employment shifted significantly in another direction by the time candidates reached this examination attempt.

Much like college attrition, the question of persistence through EMT NREMT-C examination attempts is indeed “an ill-structured problem” (Braxton, 2004, p.2).

Persistence models such as those by Tinto (1975) reveal the complexities involved in decisions to go on, and include individual attributes (age, gender, years of education), goal commitment (employment), grade performance (prior examination score), and institutional commitment (accreditation status). However, many of the features in the persistence models were not available to examine in this research.

The findings of this study should help educators identify students at risk for non-persistence. In particular, female candidates should be targeted for remediation and encouragement given their disproportionately low numbers within the profession.

Alternative sources should be sought to pay for the examination when it is a barrier to students of low socio-economic status.

Focusing on mastery versus performance orientation early in an EMT program might increase persistence through examination attempts. Mastery-orientated students focus on understanding new information, enjoy challenging tasks and tend to persist through failure (Jowkar, Kojuri, Kohoulat & Hayat, 2014; Dweck & Leggett, 1988; Pintrich, 2000). Mastery goal orientation contrasts with performance orientation.

Students motivated by performance tend to avoid challenge, and may falter in the face of obstacles. In her quasi-experimental study of nursing students’ persistence with difficult clinical problems, Gardner (2006) found increased persistence in the experimental group who increased their mastery orientation after specific educational strategies designed to do so, compared to the control group who persisted in performance orientation.

Introducing key interventions to increase students’ awareness of mastery learning may

reframe their view of learning and its relationship to effort, strategies and persistence versus ability and increase the likelihood they will reattempt the examination, particularly in students who are vulnerable to quitting at the first sign of failure. Program directors and faculty should consider introducing these concepts early in the program – perhaps even during the pre-course orientation.

Some EMT programs and many nursing programs use predictive exit examinations to assess students' readiness for high-stakes licensure examinations and to provide clear roadmaps for remediation in low-scoring topic areas. Targeting first-attempt success rates or using such examinations for remediation may enhance persistence. When using the exam to enhance first-attempt examination success rates, Lauer and Yoho (2013) found that requiring remediation as a means to improve predictive examination test scores was associated with higher repeat predictive examination scores than was non-mandatory remediation. For students who have already failed an NREMT-C examination attempt, assigning consequences for failure to complete remediation would not be possible because students are not eligible for the NREMT examination until the program director verifies successful course completion.

Individual strategies to enhance students' critical thinking and application of knowledge throughout the program and during remediation activities may encourage them to reattempt the licensure examination after a failed attempt. According to Cole and Adams (2014), techniques known to help successfully remediate students include standardized tests to assess areas of weak content knowledge followed by specific strategies that depend on the individual student's learning needs. These may include case studies, discussion, simulation role playing and other active-learning techniques. When

content knowledge does not appear to be the primary factor in low exam scores, interventions to improve test-taking and to manage test anxiety may be needed. Developing an individual remediation contract with students increases their investment in the process giving them a structured, tangible pathway to success. While their students experienced increased success on specialty and exit examinations after implementing remediation contracts, Cole and Adams (2014) acknowledge that their process is very time-intensive. Staffing in EMT programs is often limited and at examination attempt two, only one-half of the EMT programs were associated with higher-education institutions. Other than the widely varying state instructor training regulations, there is little assurance that EMT instructors have an understanding of how to develop individualized learning prescriptions nor access to someone who is prepared to do so.

Primary EMT instructors, program directors and school administrators should use the findings from this study to recognize factors that promote examination persistence in EMT candidates. Understanding these factors will allow EMT education programs to integrate strategies early in the program to provide these candidates with motivation and resources to continue if they fail an examination attempt.

States and other stakeholders should consider the need to subsidize examination fees to promote persistence, particularly in under-represented populations. This could help to remove a barrier to persistence on the examination. Further, the NREMT should use this knowledge about the impact of exam payment status on examination persistence when planning examination fee structures.

It appears that predicting the persistence of EMT candidates through the six NREMT-C examination attempts is not an easy puzzle to solve and that some key pieces

were missing in this research. However, it is hoped that these findings begin to shape an outline that can be filled in by further research to create a clearer picture of EMT student certification examination persistence in the future.

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