Triage training, instrument evaluation, and communications: analyzing usability of a 5-level triage system in the pre-hospital care environment.

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Abstract

Purpose: To evaluate a collaborative, cross-discipline and in-depth triage method by comparing the Canadian Triage and Acuity Scale (CTAS) to the Emergency Severity Index (ESI) and to outcomes in the emergency department (ED). Additionally, the study will investigate paramedic self-evaluations of frequency and effectiveness of activities within their professional role using the Six Dimensions of Nursing Competence (6-D) Scale. **Background/Significance**: Currently, first responders do not have an evidence-based, uniform, reliable or valid triage instrument to either guide identification or classification of patients, or to direct handover of care to nurses in the ED. Despite over a decade of requests by the Institute of Medicine (IOM) and the Emergency Nurses Association (ENA) the U.S. still does not have a uniform triage method. Use of the ED has increased over 26% from 1993 to 2003 with recent increases of 3.3% per year since 2009 with over 15% of patients arriving by ambulance. **Methods**: CTAS score upon arrival at the facility were compared to the ESI scores determined by nurses in the emergency department and then to outcomes determined by the primary care provider. Paramedics also completed an online survey that included demographic information, 6-D survey information and a self-evaluation of the CTAS instrument. Data analysis was conducted using SPSS v.21 and included descriptive statistics, a Chi-square and multinomial logistic and hierarchical regression. **Results**: A total of 2,222 patients and 112 paramedics were included in the analysis. The majority of patients were female (53%), not Hispanic or Latino (99.1%) and black (58.8%), with a mean age of 48.97 (SD=18.76). The MLR model explained 32.9% of the admission variance ($p<0.001$; Nagelkerke $R^2 = 0.329$) and correctly predicted 61.5% of the admissions, with an 82%

accuracy rate for all other forms of disposition and an overall model prediction of 73.7%. Specifically, the hierarchical regression model found patient age was statistically significant explaining 14.7% of the admission variance ($p<0.001$; Nagelkerke R^2 0.147; -2LL 624.884). The CTAS was also statistically significant ($p<0.001$; Nagelkerke R^2 0.270, -2LL 569.003) explaining an additional 12.8% of the admission variance. Further analysis of the CTAS demonstrated the following significant factors: CTAS 1 ($p=0.038$; $b=3.110$); CTAS 2 ($p<0.001$; $b=11.187$); CTAS 3 ($p<0.001$; $b=5.991$); and CTAS 4 ($p<0.001$; $b=2.503$). The ESI was a statistically significant factor explaining an additional 6% of the admission variance ($p<0.001$; Nagelkerke R^2 0.330; -2LL 539.255). Further analysis of the ESI demonstrated that ESI 1($p<0.001$; $b=14.453$). Finally, paramedic years of experience were a statistically significant factor and explained an additional 1.5% of the admission variance ($p=0.008$; Nagelkerke R^2 0.345; -2LL 531.889).

Conclusion: Paramedics, with minimal training on the use of the CTAS instrument, can predict ED disposition with equal or better accuracy than nurses using the ESI. However, both instruments demonstrated notable flaws in over-and under-triage rates. Additional research is urgently needed to evaluate existing and unknown factors that impact ED disposition to develop more accurate prediction systems that are feasible for both paramedics and nurses acting in a multidisciplinary approach to ED care. Additionally, the paramedics demonstrate a significant lack of knowledge in relation to their role as members of a complex interdisciplinary and multidisciplinary healthcare system, specifically regarding community and preventative health strategies.

Dedication

The work contained herein as well as my past, present and future life is dedicated to my mother and father, Barbara and Robert. Throughout life's challenges you persevered, kept us safe, encouraged us and gave everything of yourself for us, your children. Your unwavering love, respect and devotion to family was an inspiration and will continue to guide me throughout my life. It is the love, respect and devotion to family and to my professional life that I will continue to grow, nurture and develop. Everything I am, everything I will be is because of you; thank you.

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Chapter 1

Introduction

Triage is a dynamic process that controls access to the healthcare system depending upon the point of entry (Robertson-Steel, 2006). The U.S. does not have a standard triage method for managing day-to-day patient care. Various structured and unstructured systems are currently used. The underlying element of triage is the appropriate identification of those persons needing immediate management, as well as the allocation of resources to persons seeking non-urgent access when not all care-seeking behavior is appropriate or needed in an emergent manner (Aacharya, Gastmans & Denier, 2011). The need for triage is no more evident than during the provision of care by first responders, when the burden for aggressive and appropriate disease identification and management is steadily increasing worldwide. As a result of increasing demands for service, financial pressures for the provision of care and expectations by patients regarding outcomes also are increasing (Robertson-Steel, 2006). Generally speaking, triage processes today attempt to provide the appropriate resources to the appropriate individual in the appropriate time to minimize morbidity, mortality, disfigurement, pain and emotional distress (Kahveci, Demircan, Keles, Bildik & Aygencel, 2012).

Triage in healthcare loosely refers to the allocation of decisions and resources based on the premise that not everyone who needs a particular form of healthcare can gain immediate access to it (Aacharya, Gastmans & Denier, 2011). Throughout the world, emergency departments (ED) and emergency medical service (EMS) systems use triage as a clinical sorting tool to process and prioritize persons presenting for care.

Triage, treatment and transportation decisions are made daily and affect the healthcare of millions of people annually, yet there is no clear definition or agreement as to the expectations of such a frequent decision-making process for first responders.

Characteristics contributing to successful triage are often based on a provider's ability to utilize cognitive skills, intuition, experience and critical thinking to categorize ED patients. These categories imply a level of perceived need directly related to the preservation of function and minimization of loss (Smith & Cone, 2010). Therefore, triage simply implies that systems should do the "greatest good for the greatest number" considering the available resources and the moral consequences of non-maleficence, autonomy and justice (Moskop, Sklar, Geiderman, Schears & Bookman, 2009). Prehospital triage is commonly accepted to occur in three distinct phases: during the dispatch of emergency medical services; during the initial examination by the first responders; and upon arrival at the primary care center ED (Robertson-Steel, 2006; Aacharya, Gastmans & Denier, 2011).

History of Triage

Methods of triage first emerged in the late 1700s when Baron Dominique-Jean Larrey developed an evacuation system that would remove the most critically injured from battle and treat them urgently rather than waiting hours to days for care (Iserson & Moskop, 2007). The need for removal from battle led to the development of the first mobile emergency service process, termed flying ambulances or *ambulance volante* in 1792 (Robertson-Steel, 2006). Triage continues today to be commonly defined according to the French word *trier*, which loosely means the act of sorting (Aacharya, Gastmans & Denier, 2011; Iserson & Moskop, 2007).

Evolving from improvements in outcomes during battle, Larrey derived the idea of attending to those needing the most urgent care without regard to distinction. Building on this early concept, John Wilson, a British naval surgeon, narrowed the focus of triage by focusing care on those who were most likely to benefit successfully from triage efforts and subsequently return to productivity in battle (Iserson & Moskop, 2007). In the U.S., triage was not used until the medical director of the Potomac army Union Medical Corps, Jonathan Letterman, realized the desperate need for triage and front line medical care. The Corps incorporated ambulance transportation and the use of medics on the front lines of battle to evacuate the injured more rapidly to surgeons for definitive care (Mitchell, 2006). During World War I and II, understanding of the potential for mass casualty situations emerged and the realization of the ease at which medical resources could be overwhelmed became apparent, further solidifying the need for effective triage tactics. During the early 1960s, triage first appeared in civilian EDs. It was during this time that rapid change occurred in the prehospital care of ill and injured persons.

In 1966, a white paper titled "Accidental Death and Disability: The Neglected Disease of Modern Society" brought to light the desperate need for EMS to address the lack of ability to manage the rising morbidity and mortality rates related to acute injuries among persons aged 1 to 37. Additionally, this white paper led to the initial infrastructure for development of a nationwide telephone number (911) to be used to request medical assistance. The 1966 Highway Safety Act allocated funds to the Department of Transportation to improve access to care in rural areas and train medical providers to incorporate medical procedures, including triage, in the field. Throughout the 1970s and 1980s, triage saw little change. During the 1990s, three-level triage systems began to emerge globally. These systems used a set of criteria to direct and manage those seeking care in an ED. Until this time, triage was seated in methods of war using the idea of a scarcity of resources to guide care. The terrorist attack of September 11, 2001, re-established the need for triage systems to be capable of managing mass casualty disaster situations through a renewed interest by the Federal government to improve capabilities of front line first responders regarding care management of the population (Mitchell, 2006). Since that time, several “business”-oriented triage systems have been developed, with the most notable change to triage occurring in the evolution of three-level systems to the more in depth five-level systems commonly seen today.

Is it appropriate to assume that resources are actually scarce every minute triage is used? If triage is to assume resources available to a triage nurse are limited at all times, then routine care is implied to occur during times of disaster. This incorrect assumption is the foundation for a skewed view of access to emergency care. How can patients who seek care for a stable medical condition, acute or chronic, be compared to warriors on a battlefield who suffer life-threatening traumatic injuries where time is a central element that impacts outcomes? If those seeking care in the ED can be safely delayed days to weeks, how can medical professionals justify the application of “scarce” resources to an inappropriately (according to the current design and purpose of the ED) perceived need by patients in the ED?

Problem Statement

Currently, first responders do not have an evidence-based, uniform, valid or reliable triage instrument to either guide identification or classification of patients, or to direct handover of care to nurses in the ED for patients with acute or chronic illnesses or injuries. Triage inconsistencies continue to create challenges to effective communication and handover between first responders and emergency nurses, ultimately adversely impacting outcomes. In 2006, the Institute of Medicine (IOM) published a fact sheet focused on the future of emergency care. In this groundbreaking report, the IOM cited several key findings that impact emergency care, which included overcrowding and the fragmentation of EMS systems. A major factor cited was a 26% increase in ED visits from 1993 to 2003. The IOM report further stated that hospitals should focus on improving throughput by maximizing information technologies and operational methods.

Despite its evolutions and strong recommendations by the IOM, triage continues to be an inconsistently applied process with limited understanding of its impacts on outcomes, especially when used by paramedics in the limited role of mass casualty. The primary and secondary aim in this dissertation study will provide new information regarding outcome prediction by two different triage methods, one used by paramedics and the other by nurses. The study will also provide additional information that will help improve understanding of factors involved in day-to-day triage by paramedics specifically the impact paramedic demographics and paramedic perceived ability to perform various tasks as well as their perceived usability of a nursing triage instrument in the field has on patient outcomes. This basic information is necessary so that future studies can further clarify factors necessary to better align paramedic intervention as members of a holistic, collaborative healthcare team.

Chapter 2

Literature Review, Theories and Concepts

A general literature review was conducted to identify various theoretical frameworks used or proposed during evaluating processes involving nurses and first responders performing triage, with a specific focus on identification of the framework or conceptual model. Although a common theory was not readily apparent in recent studies, triage theory was discussed in early evaluations (in the emergency department [ED]), with a specific focus on eight distinct functions: early assessment and determination of need; control of flow; assignment to appropriate location and provider; early initiation of diagnostic measures; application of initial therapeutic measures; control of infection and isolation when necessary; promotion of good public relations by immediate demonstration of concern combined with anxiety reduction measures; and the provision of opportunities for health promotion (Read, George, Westlake, Williams, Glasgow & Potter, 1992).

A proposed conceptual framework using systems theory was identified and found to be largely based on three interdependent components of triage: input (the type and amount of care needed); throughput (the process of care in the ED); and output (the efficient movement of patients from the ED to the appropriate destination for continued care) (Moskop, Sklar, Geiderman, Schears & Bookman, 2009). Another theory that has implications within the performance of triage is the theory of planned behavior. Discussed later in detail, this theory focuses on the impact that perceived behavioral control has, indirectly, on behavioral intention and, directly, on behavior (Madden, Ellen & Ajzen, 1992). Understanding patients' behavioral intentions is a key component in the development of the theoretical approach to and a holistic evaluation of triage by first responders.

Systems Theory

Systems theory, which was originally developed by biologist Ludwig von Bertalanffy in 1936, provides a generalized grand framework on which to improve the view of an organism-based occurrence (Lane, 2002). Systems can be static or dynamic, open (self-regulating, growing and developing interactions with the environment) or closed (fixed relationships with system components without interchange with the environment), with identified boundaries, goals and entropy (development of order and energy over time) (Begley, 1999). Triage is hypothesized to involve many human activity systems including, but not limited to, members of a user's immediate family, his or her social support system, the public safety network and the management systems of healthcare facilities. Each of these elements work with overlapping purposes at three identified levels: the purpose of the system; the purpose of its parts; and the purpose of the system as a part of the supra-system. It is the involvement of multiple agencies, organizations, individuals and disciplines that demands a systems theory approach to the multitude of relationships that present in pursuit of a collaborative and holistic approach to the management of healthcare-seeking behavior (Laszlo & Krippner, 1998).

Triage methods and concepts constitute a multitude of interactions that remain poorly defined. Although the general idea of input, throughput and output is plainly visible in most, if not all, forms of triage, a general lack of understanding regarding the impact human activity systems have on utilization of a triage system continues to exist. Specifically, understanding the complex dynamics of cognitive evolution, human biology, and psychosocial and cultural change remains vague at best. Triage, which is viewed as a soft system or one that characterizes human beings as a principal component, is in direct contradiction to hard systems that have clear aims involving machines or mechanisms (Laszlo & Krippner, 1998).

Considering the extent of the challenge to identify and define triage, it is important to understand the concept of a systems-based approach more accurately. Systems theory is viewed as a process involving situations that are holistic in the involvement of theories of knowledge (epistemology) or the nature of reality, being or becoming (ontology), and consists of "a complex of interacting components together with the relationships among them that permit the identification of a boundary-maintaining entity or process" (Laszlo & Krippner, 1998). These complex systems can lose energy and dissolve into chaos (negentropy), implement activities and processes that adapt and make corrections to action (cybernation or control), or achieve specific goals or objectives in varying manners using multiple inputs (Begley, 1999).

The primary objective of systems theory is not to focus on specific details or direct explorations. Rather, it focuses on the overall environment and how change among individuals can impact the organization and the collective system, with the goal of understanding the interdependence these actions have on outcomes. Boundaries are viewed as permeable and open, yet interrelated (Lane, 2002). A system can be further defined as two or more interrelated entities that function as a divisible whole within an indivisible unity that presents specific characteristics of the system that are not producible by isolated components of the system. Specifically, positive and negative feedback in the presence of a dynamic homeostatic environment within the input, throughput, output-based transformational model functions only in the presence of two emergent properties. If removed, these would cause the system no longer to be identifiable as the original system, indicating that the system is truly greater than the sum of its parts (Lane, 2002; Laszlo & Krippner, 1998). In addition to input, throughput and output, systems often include applications of feedback and control (information that guides or alters performance) given a specific environment with an identified goal (Begley, 1999).

Common to prehospital care is the use of algorithms for situation management. Although these structured, analytical techniques exist, they allow for very little intuitive application of methods or heuristics, which is largely related to an incomplete understanding of care-seeking behavior with regard to an evolving context or environment. Incorporation of an open systems theory approach toward understanding triage is important considering the varying contextual environments in which the process is implemented. Discrete entities, subsystems and supra-systems should be identified and placed in a general framework, with the goal of advancing understanding of each subsystem and entity using a traditional 3-step scientific method. Process inquiry begins with an understanding that the studied system must display some form of predictability using a specific set of objectives and the corresponding relationships and interactions (Begley, 1999). Additionally, the system must be deconstructed; explanations of behaviors or properties must be formulated with these explanations aggregated into a larger understanding of the whole. Finally, the internal and external components of the identified phenomenon can be refocused with the contextually specific perspective into a general system (Laszlo & Krippner, 1998).

In light of the advances in the technology within the prehospital care system, triage may be viewed in the context of multiple systems. Specifically, general systems theory may involve critical systems thinking, which requires five areas of application: (1) critical awareness (analysis of strengths, weaknesses and assumptions of theoretical underpinnings of systems); (2) social awareness (influence of societal or organizational influence at any given time); (3) complementarianism at the methodological level (analysis of sub-methods for attainment of a given goal); (4) complementarianism at the theoretical level (respect for varying theories considering constitutive interests and reconciliation of opposites); and (5) human emancipation (increasing the quality of life with respect for persons involved in the system) (Laszlo & Krippner, 1998).

Finally, a critical attribute of a systems approach to this program of research is the idea of triage as evolutionary. In the context of general evolutionary systems theory, which is identified by the formation of phenomena using flows of energy, information and people that expand existing social boundaries, triage has experienced a revolutionary bifurcation of development within our current society. This transformation has been continuous, explosive and abrupt, depending on geographic location and context of use. The result is a system in chaos striving to identify increasingly efficient systems of application that will lead to development of an equilibrium state through individual empowerment (Laszlo & Krippner, 1998). This new dynamic system will consist of redrawn boundaries; have strong goals that are governed by feedback; invoke adaptability; be able to balance forces within and outside of the system; and be predictable (Begley, 1999).

Theory of Planned Behavior

The theory of reasoned action was initially developed to show that behavioral intentions are a function of salient information (attitudes and subjective norms) that function as variables and/or beliefs that the performance of a specific behavior will yield a specific outcome (Madden, Ellen & Ajzen, 1992). However, the model was significantly flawed, as it did not consider individual intention to perform a specific behavior. This limitation led to the development of the theory of planned behavior, which includes the intention to perform a specific behavior that offers insight into the motivational aspects that impact performance or behavior. Volitional control, or the ability to decide at-will to perform or not perform a specific behavior, interacts with the availability of opportunity and resources to produce a behavior (Ajzen, 1991). Volitional control assumes that behavior is more likely to occur in the presence of increased resources and/or an opportunity, thus indicating that perceived behavioral control has both a direct effect on behavior and an indirect effect on intention (Madden, Ellen & Ajzen, 1992).

Considering the direct link paramedics have with emergency nurses in the input, throughput and output model of ED triage using systems theory, it can be implied that paramedics also are impacted by similar concepts. These include, but are not limited to, intuition (Lyneham, Parkinson & Denholm, 2008; Rew, 1986), clinical reasoning (Simmons, 2010), nurse competence (Smith, 2012), patient acuity (Brennan & Daly, 2009); role stress (Riahi, 2011), compassion fatigue (Jenkins & Warren, 2012), spiritual crisis (Agrimson & Taft, 2008), dignity (Griffin-Heslin, 2005), personal access to health care (Norris & Aiken, 2006), community health (Baisch, 2009), and nurse dose (Brooten & Youngblut, 2006). In addition, environmental, psychological and social attributes are important key factors that may impact the evolution of triage as a concept.

However, for this dissertation the focus was on the several key concepts and hypothesized operational definitions to assess face validity of the instrument. First is clinical reasoning, or the ability of the paramedic to process complex information using cognition and discipline-specific knowledge to gather information, evaluate its significance and weigh actions (Simmons, 2010). Next, competence or the ability of the paramedic to integrate knowledge into practice using critical thinking, communication, motivation and professionalism with consideration of the environment and context of use in relation to the Canadian Triage and Acuity Scale (CTAS) instrument (Smith, 2012). Patient acuity, which is a key component of triage instruments is the ability of the paramedic to accurately apply the [CTAS] score considering the severity and intensity of the illness/injury(Brennan & Daly, 2009). Finally intuition, or the ability of the paramedic to process through the three phases of Benner's expert stage, includes cognitive intuition (subconsciously processing and rationalizing the assessment), transitional intuition (using a physical sensation and behavior to empower awareness), as well as embodied intuition (when the paramedic trusts their intuitive thoughts) (Lyneham, Parkinson & Denholm, 2008).

One of the primary strengths of the theory of planned behavior, as it pertains to prehospital triage, is the perception of the ease or difficulty paramedics have using a triage instrument, specifically as this perception varies with the contextual environment in which the action is implemented. It is important to note that a potential weakness of this theory is the reduction in perceived behavioral control when paramedics have limited information or when the requirements are new or unfamiliar (Ajzen, 1991). The theory of planned behavior is an exceptional theoretical framework on which to base future studies, specifically related to the use of emergency services (EMS). Additionally, Rodgers' evolutionary method of concept analysis supports the definition of triage as a concept, which is necessary to facilitate system development capable of more effective and efficient management of the paradigm shift occurring in ED and EMS use for primary care. Fire and EMS agencies currently do not have a theoretical framework on which to base the empirical analysis of perceived need to aid in the management of increasing demands for service. This situation presents nursing with a tremendous opportunity to collaborate with prehospital providers in the advancement of integrative systems to manage ED input, throughput and output.

The theory of planned behavior, as perceived behavioral control, is a significant component that could have had an impact on the success or failure of the proposed study. Regarding use of secondary data analysis with the theory of planned behavior, there were no specific articles identified within the confines of emergency nursing or prehospital care that referenced the use of this type of analysis. However, this is of little concern given that the CTAS program was implemented throughout the entire CFD. As a result, paramedics were aware that scores would be analyzed and compared to outcomes, which appeared to have created a form of "social pressure" for accuracy and understanding. Additionally, unlike other secondary data analyses, these data were specific to the proposal and, as such, included all specific parameters necessary for analysis, limiting the potential for error in interpretation. Any challenges with training or implementation and/or concerns regarding interpretation and implementation accuracy allowed for a more thorough understanding of the usability of the instrument.

The Evolutionary View of Concept Development

Focusing on the fluid, evolving idea of triage, Rodgers' evolutionary method of concept analysis was used to encompass the central variables necessary for clarification (Appendix A). Concept analysis is a process by which individuals communicate and develop useful knowledge that may ultimately evolve into essential components for the advancement of a science in its attempts to represent images of a phenomenon or experience (Tofthagen, 2009; Duncan, Cloutier & Bailey, 2007; Risjord, 2008; Rodgers, 2000). Simply put, concepts function as "components" of a more broad and abstract idea that create a meshwork of interrelated components, ultimately leading to or becoming part of theory development (LoBiondo-Wood & Haber, 2006). Central to the development of a concept is the impact the philosophical and foundational views of entity and disposition have on the underlying assumptions of the concept (Rodgers, 1989). Entity views hold that a concept is a specific idea or function that is elemental within a system, whereas dispositional views hold that concepts are embedded within the capacity to perform a specific behavior (Rodgers, 1989).

Concept development using Rodgers' evolutionary analysis process occurs in six specific phases in a fluid manner, as each process must fluctuate with the context of the analysis (Rodgers, 2000). The six phases of contextually based concept analysis are: (1) identification and naming of the concept; (2) identification of surrogate terms and relevant uses of the concept; (3) identification and selection of the appropriate realm or context for data analysis; (4) identification of the attributes of the concept; (5) identification of the antecedents and consequences; and (6) identification of related concepts to the concept of interest (Rodgers, 1989). Because triage is a multi-faceted, diverse and continually evolving concept, Rodgers' evolutionary method of concept analysis is reinforced as the supporting conceptual framework that will work in conjunction with the theory of planned behavior.

Identification of the concept and its surrogate and related terms was followed by a systematic review of the literature with a focus on triage and its history, system utilization, implications to nursing and care outcomes and the legal and ethical ideas commonly associated with triage use. From these data, the antecedents, attributes, definitions, and consequences were identified, with the goal of developing an evolving conceptual idea of triage that parallels current healthcare-seeking behavior. This analysis challenges the idea that, according to Cypress (2010), "an ER patient is one who requires immediate or emergency care, specifically the acutely and seriously ill, the injured, and the mentally ill and also those who are admitted for unscheduled urgent and safety net care."

The importance of context when evaluating an idea or concept cannot be lost or brushed aside because, according to contextualism, the meaning of a concept must evolve and fluctuate with the contextual environment or framework in which the concept is to be evaluated or viewed (Risjord, 2008). It is this fluctuating environment that is central to the evolutionary view of concept development. Rodgers' view focuses on the movement of the meaning of a concept as it is impacted by application, use and contextual significance in a manner that is susceptible to both internal and external factors, including social interaction and education, resulting in a vague understanding of an idea (Rodgers, 1989). If a concept analysis occurs independent of a particular context of use, then the concept is weakened and likely unable to describe the desired phenomena adequately (Risjord, 2008). Analysis of a concept, independent of its contextual use, also will adversely impact the praxis of the concept and lead to the creation of knowledge that is flawed and ineffective at advancing the science of nursing (Duncan, Cloutier & Bailey, 2007).

Since its first use on the battlefield in 1792, triage has become a critical component of organized care systems throughout the world. Specifically, these systems have evolved into intricate models with varying phases of delivery, each with its own unique context that impacts the level and quality of care in relation to a specific need (Fitzgerald, Jelinek, Scott & Gerdtz, 2010). Being a dynamic and complex process, triage is hypothesized to exist, in the prehospital environment, in three distinct phases: dispatch of first responder resources; evaluation by first responders at the scene; and evaluation by emergency nurses upon arrival at an ED (Robertson-Steel, 2006). It is the transition of care from first responders to nurses in the ED that functions as a critical interface where a structured, systematic and effective communication system can be implemented to help manage the rising complexities of emergency care-seeking behavior (Iedema, Ball, Daly, Young, Green, Middleton….& Comerford, 2012; Fitzgerald, Jelinek, Scott & Gerdtz, 2010). Because the literature generally lacks a clear conceptual analysis of triage in healthcare, it is important to this dissertation that the concept be more clearly articulated. Therefore, what follows is a focused concept analysis of triage.

Conceptual and operational definition of terms

Naming the concept of interest. The initial and core component of concept analysis is the identification of an area of interest that is significant to the advancement of the science, so as to understand and provide better insight into the characteristics of the phenomenon in question (Tofthagen, 2009). Considering the foundation of the evolutionary process, *Triage* was chosen as the core idea on which mapping of this analysis would develop (Appendix B).

Surrogate terms. Surrogate terms, which can function as manifestations of a concept or unrelated uses of a term, are words or phrases that have something in common with or imply similar meaning to the concept of interest (Rodgers, 1989). Surrogate terms included in the literature in relation to triage include the following: “to sort” (Hartman, R.G., 2003); “to sift” (Webster’s New Online Collegiate Dictionary, 2013); “to select” (Hartman, R.G., 2003); “to prioritize” (Dong, Bullard, Meurer, Colman, Blitz, Holroyd & Rowe, 2005); “to rate” (Farrohknia, N., Castren, M., Ehrenberg, A., Lind, L., Oredsson, S., Jonsson, H. Asplund, K. & Goransson, K.E., 2011); “to ration or allocate” (Iserson, & Moskop, 2007); and “to assess and assign” (Christ, Grossmann, Winter, Bingisser & Platz, 2010).

Relevant uses of triage. *Triage* as a process is used in many areas of healthcare including, but not limited to, the following: EDs; clinics; EMS systems; fire divisions; the military; search and rescue teams (SRTs); advanced life support transport services including rotor wing, fixed wing and ground based systems; law enforcement; the national guard; and the emergency management agency (EMA). Triage also was selected as the foundation on which to evaluate response and transport decisions by dispatchers and EMS personnel at the 2004 Neely Conference, which was a workshop involving thirty-one experts in EMS research. The goal of this workshop was to evaluate the then current literature regarding EMS dispatch and field triage by first responders to identify a standard set of triage criteria and outcome measures against which protocols would be evaluated (Mann, Schmidt & Cone, 2004). This included transport need determination and outcome measure identification against which first responders might be evaluated (Cone, D.C., Benson, R., Schmidt, T.A. & Mann, N.C., 2003). Additionally, as a result of the Neely Conference, a “multi-option decision point” (MODP) model was developed to *triage* patient needs to the appropriate resource during one of two decision points: upon dispatch of first responders; and on scene after evaluation by first responders (Gratton, Ellison, Hunt & Ma, 2003).

Realm or Sample for Data Collection

In 2006, the Institute of Medicine (IOM) published a synopsis of key findings and recommendations, which specifically addressed several impact areas including overcrowded EDs, fragmented prehospital care, unavailability of specialists, an emergency care system ill-prepared for disaster management, and ED boarding and diversion, which directly and indirectly impacts users of the ED for acute or chronic care (IOM, 2006). The primary area of focus here is the idea that care is fragmented and inconsistent, with the potential for ineffective communication among the many collaborating agencies related to ED overcrowding and ambulance diversion. Prehospital providers (paramedics and first responders) are responsible for determining the appropriate destination for care among persons experiencing acute and chronic medical, surgical and traumatic events, as well as those patients with special considerations including transplants, implanted devices, communicable diseases and congenital anomalies (Sasser, Hunt, Faul, Sugerman, Pearson, Dulski …& Galli, 2012).

Additionally, prehospital triage is impacted by recommendations from the IOM for implementation of evidence-based protocols and strengthening of collaborative relationships among first responders and the scientific community (Lang, Spaite, Oliver, Gotschall, Swor, Dawson & Hunt, 2012). The National Registry of Emergency Medical Technicians (NREMT) has focused much attention on the identification and development of guidelines to standardize prehospital triage to improve communication and the level of care. One step in this process was the adoption of triage guidelines by the NRMET developed by the Federal Interagency Committee on Emergency Medical Services (FICEMS). The U.S. Departments of Health and Human Services, Transportation, Homeland Security, and Defense and the Federal Communications Commission support these guidelines (Sasser et. al, 2012).

According to the 2011 Emergency Nurses Association (ENA) position statement on triage qualifications, qualities necessary for successful implementation of triage include the following: (1) a diverse knowledge base; (2) strong interpersonal skills; (3) excellent communication skills; (4) strong critical thinking skills; (5) the ability to conduct a brief, focused interview; (6) strong physical assessment skills; (7) the ability to make rapid, accurate decisions; (8) the ability to focus while multitasking; (9) the ability to work collaboratively with interdisciplinary team members; (10) the ability to work under periods of intense stress; (11) the ability to adjust to fluctuations in workload; (12) the ability to communicate understanding of patient and family needs; and (13) an understanding of cultural and religious concerns that may impact care and outcomes. Considering the strength of the recommendations from a multitude of federal agencies and the IOM, as well as the similar factors that impact triage by nurses and first responders, it seems logical that an analysis of a 5-level nursing triage instrument, that is both valid and reliable, should occur among professional paramedics. Several benefits exist to evaluate the instrument within a large metropolitan fire division, especially one consistently exposed to a wide variety of calls for assistance that include acute and chronic illness or injuries, and special conditions unique to first responders.

References, antecedents, and consequences of triage

Almeida (2004) stresses the importance of nursing care based on the Joint Commission on Hospital Accreditation (TJC) standards according to the ENA idea that the nurse is the appropriate person for triage duties. Maximizing the efficiency of this process requires several key personal and professional attributes among staff charged with the ultimate responsibility for flow direction. These include an understanding of care based on physical, developmental, psychological and access needs while maintaining focus on cost effective strategies that maximize overall clinical outcomes in a safe, efficient and practical fashion.

An important clarification necessary for analyzing triage is an understanding of micro-allocation, including the underlying moral analysis and value guided principles shared by the staff and facility on a macro level. The most critical value in play among care delivery systems is the goal of preserving and protecting endangered life. Use of this value as the core principle driving triage begs the question of fairness, given the varying views on who gets care first, especially in light of a scarcity of resources. Compounding the distress among triage decision-making is the question of fidelity and the existence of a fiduciary relationship. If such a relationship exists, then a primary care provider is challenged by functioning in the best interest of the patient while not favoring one person's interests over another, contrary to the foundational idea of triage. Additionally, the central component of utilitarianism is the goal of maximizing happiness in light of the potential consequences to produce the maximum benefit, not only for the individual, but also for the community as a whole (Moskop & Iserson, 2007). This concept may play a role in decision-making by persons using emergency services for treatment and better clarify the antecedents of triage.

Recommendations are that triage staff has a broad capacity for knowledge, strong professional intuition, heightened stress management skills, and strong collaborative abilities among various facility resources, while focusing on empathetic, comprehensive and compassionate care during the management of disease processes with varying presentations. Triage officers are expected to work during high stress conditions, facing time and risk factors with courage, confidence and rationality. Of significance to the triage process is the determination of urgency (Almeida, 2004). The importance of a standardized, moldable and developing system is imperative to ensure the maximization of resources while maintaining a safe and efficient health care delivery system. Nursing plays a significant role in the cost containment practices necessary to affect the financial status of the health care system significantly as it pertains to care delivery, particularly flow in relation to triage.

Antecedents. Significant to the complexity of flow management during triage is an understanding of the factors that precede the triage process, particularly why and how users of the ED chose to do so. In a study of ED use and overcrowding, it was found that 32% of people visiting the ED did not see their primary care provider (PCP) because of accessibility issues; 20% were referred to the ED when they called their PCP or nurse help line; 11% chose the ED because they were familiar with the process from past experience; 22% felt their condition demanded the ED expertise; 7% trusted the opinion of the ED over that of their PCP; and 7% provided no reason for choosing the ED. Additionally, 62% of non-urgent visits were on the weekend between 4:00 pm and 8:00 am, resulting in an overall non-urgent evaluation rate of 25% (Afilalo, Adrian, Afilalo, Colacone, Leger, Unger & Giguere, 2004). Another contributing factor to ED overcrowding is that 30% of visits characterized as inappropriate or non-urgent constituted the majority of users (48%), who inappropriately felt their situations were urgent (Afilalo et al., 2004).

Consequences. Attributes of triage can be theorized to indicate the provision or application of a service or intervention for a user(s) by a specially trained provider(s). This intervention often occurs in the presence of a patient- defined perceived or actual need in regard to an acute or chronic medical condition. Various primary (internal and external) and secondary modifying factors impact the end goal of mitigating the event while emphasizing protection or enhancement of life (physical, spiritual, psychological or emotional) and/or limb. It can be hypothesized that, when implemented, triage will result in the provision of efficient, accurate, effective and situation-appropriate healthcare over a continuum that changes according to information and contextual evolution.

Regarding ED use, Howard et al., (2007) found the majority of users (48%) inappropriately felt their situation was urgent. Other users cited convenience (20%), the desire for immediate test results (20%), and unavailability of their PCP (28%) as primary reasons for visiting the ED. More than 70% of persons were ultimately discharged, with another 7% leaving against medical advice or eloping. Medicaid and self-pay constituted 36% of users, while over 30% of users received only advice (Howard, Davis, Anderson, Cherry, Koller & Shelton, 2005). A cross-sectional survey of ED users found that 25% of all clients presenting were triaged as non-urgent (Afilalo et al., 2004). A descriptive, qualitative study found that clients "don't want to spend the whole day waiting in the office" (Howard, Goertzen, Hutchison, Kaczorowski & Morris 2007), especially considering they are frustrated with waiting for several hours only to have the physician spend 2 or 3 minutes with them, ultimately expressing a feeling of disrespect for their time. In another qualitative study regarding ED use, 65.6% of participants felt clients used services unnecessarily; however, the patients themselves did not feel as if they were using the service inappropriately (Adamson, Ben-Shlomo, Chaturvedi & Donovan, 2009).

In a retrospective, cross-sectional review of financial records by Ruger, Christopher, Richter, Spitznagel and Lewis in 2004, frequent users of the ED (defined here as 3 or more visits per year) accounted for 12.6% to 27.9% of less urgent and non-urgent clients, with over 62% being discharged and more than 8% left without being seen (LWBS). In terms of self-referred clients, 32.3% were triaged as Emergency Severity Index (ESI) non-urgent (category 5) with a median age of 28 years versus all remaining ESI categories (median age of 40 years). Those with 3 to 5 ED visits had a median cost of $2,437.62; however, that total dropped to $793.12 after 20+ visits. In the 3 to 5 visits per year group, Medicare accounted for 26.9%, Medicaid for 35.3%, self-pay for 14.7% and private insurance for 21.4% of ED users. Among the 6 to 20 visits per year group, Medicare accounted for 29.4%, Medicaid for 45.9%, self-pay for 12.5% and private insurance for 11.6% of ED users.

In a study of Medicaid and the uninsured, it was found that over 27% of Medicaid enrollees visited the ED at least once, compared with only 10% of the uninsured with a predicted probability visitation rate of 0.27 versus 0.10, respectively (Mortensen & Song, 2008). In terms of Medicaid and uninsured enrollee demographics, 66% versus 42% were women; 25% versus 14% were black; 70% versus 33% were unemployed; and 56% versus 24% had incomes less than 100% of the Federal Poverty Level (Mortensen & Song, 2008).

In a cross-sectional survey in Canada regarding use and satisfaction of an ED encounter, 53.2% of ED users reported incomes greater than $45,000, with 80.7% self-reporting their health status as good to excellent (Howard, et al., 2007). A multi-method survey of persons using an urban academic ED evaluating LWBS rates and overcrowding found Medicaid covered 33%, 26% were uninsured and 60% were triaged into the green (non-urgent) or blue (semi-urgent) categories with 21% leaving during times of overcrowding or extreme overcrowding. Additionally, during times of overcrowding, charge nurses felt care was compromised 48% of the time, while physicians felt so 70% of the time (Vieth & Rhodes, 2006).

Concepts Related to Triage

Crowding. Evolving into a hospital-wide problem, ED overcrowding negatively impacts throughput and quality of care, creating a dangerous situation through the inhibition of the surge capacity of a facility during a major catastrophic event (Trzeciak and Rivers, 2003; IOM Fact Sheet, 2006). Statistically, over 50% of all U.S. metropolitan hospitals reported ED wait times over 4 hours before transfer to an inpatient unit (Korn & Mansfield, 2008). This is a major challenge to the input, throughput and output model of ED care. Additionally, ambulance diversion away from the ED during times of overcrowding occurs nearly once every minute (IOM Fact Sheet, 2006). Diversion also delays the return to service time for EMS providers and places those who request service via 911 at greater risk for an adverse event or outcome (Trzeciak and Rivers, 2003). In response to this increasingly dangerous condition, the IOM has called for the creation of a coordinated care system that incorporates nationwide standards for training and certification of prehospital providers, including triage specific protocols and standards, and the subsequent coordination of services with hospitals and trauma centers (IOM Fact Sheet, 2006). This call to action also is supported by FICEMS and the National EMS Advisory Council (NEMSAC) who state that "scientifically rigorous guidelines (for prehospital providers) could significantly increase the quality of EMS care in the future" (Lang, Spaite, Oliver, Gotschall, Swor, Dawson & Hunt, 2012, p. 201).

Regarding those who use the ED, 21-28% included frequent users of 4 or more visits, with the uninsured representing 15% of all visits; 19% had un-met needs and 80% cited a lack of availability of their PCPs as the main reason for visiting the ED (LaCalle & Rabin, 2010). In terms of overcrowding and decreased throughput, LWBS rates increased 1.4 fold during peak afternoon times and 2.4 fold during the evening, with 90% being initially triaged as non-urgent or stable (Vieth & Rhodes, 2006). Among users of telephone based nurse lines, one study found that 50% of calls were placed for persons aged 18-44; 11% for children under 5 years of age; 60% for females; 80% were recommended for services other than the ED. Children aged 13-17 and adults over 45 years of age were more likely to be recommended to visit the ED (12% and 9% respectively versus 7.6% for others); 65% of those recommended for no service followed the advice while 2.7% went to the ED and 31% went to their PCP; and 79% of those recommended to visit the ED did so while 13% chose no care and 7% went to their PCP (O'Connell, Towles, Yin and Malakar, 2002).

According to the National Hospital Ambulatory Medical Care Survey, the U.S. saw an increase of 9.1% in ED visits from 2008 to 2009 with ambulance as the primary mode of transportation remaining constant at 15.8%. Additionally, the survey reported that 30% of persons aged 25-64 and 38% of persons aged 65 and older utilized EMS for transportation to the ED for management of chronic conditions. The top five most common complaints for persons 15 years of age and older were stomach pain, chest pain, back pain, headache and general pain. However, pregnancy concerns, nausea, throat complications, fever, cough, leg pain, vertigo and lacerations also were significant contributors to ED use. In 2008, 68% of admitted patients in metropolitan and 38% of those in non-metropolitan hospitals were boarded 2 or more hours prior to admission. Additionally, this same survey found that 34% of metropolitan hospitals went on EMS diversion in 2008, while only 5.5% of non-metropolitan hospitals did so during the same period.

Communication. One of the key concerns identified by the IOM (IOM Fact Sheet, 2006) is the lack of effective communication between EMS systems and ED's, which often results in the mismanagement of resources. Critical to professional healthcare infrastructure development is an efficient, effective communication system that will prevent or limit the inadvertent omission of any data during handover that are necessary to ensure the safe, efficient and effective transfer of care (Iedema, Ball, Daly, Young, Green, Middleton, Foster-Curry, Jones, Hoy, & Comerford, 2012). This is often a challenge in an ED that is frequently chaotic, with multiple complex and stressful interactions occurring simultaneously, and where the retention and accuracy of information disseminated during handover is often incomplete or ineffective (Talbot & Bleetman, 2007). Although protocols and acronym-based prompts are beginning to be researched, there are very few instruments in use by first responders that focus on non-mass casualty triage or the handover process to ensure the accurate and efficient provision and receipt of care and information (Jenkin, Abelson-Mitchell & Cooper, 2007). During the Neely Conference in 2004, concepts such as communication barriers, age and special conditions were identified as areas to complicate patient assessment in the field. These findings further solidify the need for first responders to develop a system using standardized criteria that determines the most appropriate receiving facility having resources necessary to manage the presenting situation (Sasser, Hunt, Faul, Sugerman, Pearson, Dulski …& Sattin, 2012).

Several studies indicate that first responders are unable, among persons using 911 systems, to determine effectively those who need admission or require additional resources, including laboratory, radiology or specialist referral, or to determine triage category according to acuity or resource need, with reported under-triage rates varying from 5% to 17.9% (Gratton, Ellison, Hunt & Ma, 2002; Silvestri, Rothrock, Kennedy, Ladde, Bryant, M. & Pagane, 2002; Levine, Colwell, Pons, Gravitz, Haukoos & McVaney, 2006). However, first responders are generally able to determine the appropriate destination for critically ill or injured patients effectively (Millin, Brown & Schwartz, 2011). Another study indicated first responders had only a modest ability to predict ICU admission (positive predictive value [PPV] = 50%, negative predictive value [NPV] = 98%), with even less success in determining admission to a ward bed (PPV = 40%, NPV = 89%) (Levine et al., 2005). With the understanding that 15.8% of ED visits arrive by ambulance, it is critically important to be able to identify effectively and efficiently those who do and do not need an immediate intervention, especially considering that as many as 61% of ED transports are not medically necessary (Gratton, Ellison, Hunt & Ma, 2002).

The importance of effective communication among first responders and nurses in the ED remains a topic of concern. Ineffective communication contributes to overcrowding, inhibits throughput, impacts mortality rates and inhibits the continuity of care (Buschhorn, Strout, Sholl & Baumann, 2011). In regard to patient care handoffs, there remains a significant amount of variability in both data and method of transfer, which suggests the lack of a standard and reliable measurement and handoff instrument (Patterson & Wears, 2010). One of the goals cited by the U.S. Department of Health and Human Services (DHHS) is to strengthen the nation's health and human service infrastructure and workforce to ensure it can meet the increased demands of population growth and the implementation of the Affordable Care Act (HHS.gov). One of the key drivers of this goal is that, according to the DHHS, 64 million people live in an area that is deficient in some form of professional health care.

Handover. Particularly concerning within this dynamic, chaotic and noisy environment is the handover of patient information from first responders (paramedics, emergency medical technicians, emergency nurses and physicians) to the emergency nurse in the ED (Bruce & Suserud, 2005). Handover involves either a verbal or written exchange of information about the patient and a transfer of legal responsibility for care of that patient from the first responder to the receiving facility (Bost, Crilly, Wallis, Patterson, & Chaboyer, 2010). The potential for data loss during this process is of great concern and threatens to undermine the patient safety goal of the IOM, as reported in a Health Grades study of patient safety in American Hospitals in 2004. This goal is to keep patients free from accidental injury resulting from medical care or medical errors. Despite this high-risk daily interaction, there are few studies that evaluate the effective communication of data from first responders to emergency nurses (Carter, Davis, Evans & Cone, 2008). This potential for information loss is directly contradictory to the 2013 National Patient Safety Goal NPSG (02.03.01) to improve staff communication by providing important information to the right staff person on time.

Another concern is that the retention and accuracy of information disseminated during handover is often ineffective (Talbot & Bleetman, 2007). The development and implementation of handoff software is likely to improve the consistency of information transferred and the identification and understanding of patient status (Anderson, Leitzsch, & Cunningham, 2010). These data contributed to the development of a national patient safety goal to implement a standard approach to handoff communications that allowed for a question and answer session after data dissemination (The Joint Commission, 2006).

Five-Level Instruments

Responding to growing concerns regarding ED crowding, the American College of Emergency Physicians (ACEP) and the ENA (2003) recommended the use of a 5-level triage system to manage increased demand for services. Although many large facilities rely on one of several 5-level systems that have evolved over the last decade, many smaller community based facilities continue to use obsolete, unproven systems for emergency triage. Systems such as the ESI, the CTAS, the Manchester Triage System (MTS), and the Australasian Triage Scale (ATS) are common 5-level systems used throughout the world. These systems rely on the identification of physiological parameters during the completion of a structured clinical examination. A common shortcoming of these systems is the general lack of consideration of the client's behavioral, psychological, social or environmental circumstances, specifically among non-urgent clients. Systems not mentioned in detail here, because of limited information available in the literature, include the Taiwan Triage Scale, the Cape Triage Scale, and the Geneva Emergency Triage Scale.

Finally, there is a call to action regarding the need for evidence-based instrument development for first responders. A review published by the IOM (2007), stimulated the NEMSAC and the FICEMS to establish an evidence-based guideline development team using funding provided by the National Highway Traffic Safety Administration. This committee developed a model that included eight steps toward guideline development: obtain external input; initiate and review evidence; evidence appraisal; guideline development; model EMS protocol development; guideline dissemination; implementation; and evaluations (Lang et al., 2012). The depth and breadth of this model reinforce the need for a holistic reassessment of the interaction of first responders and ED staff, particularly in the areas of guideline development, communication and language improvements, development and advancement of electronic methods and a team approach that begins with first responders in the field and continually evolves as the client progresses through the system.

Emergency Severity Index (ESI). Commonly used in the U.S. and Europe, the ESI was developed in the 1990s to determine triage category based on anticipated resource need in relation to disease severity (Christ, Grossmann, Winter, Bingisser & Platz, 2010). The ESI uses specific criteria to direct care by first determining if a client is stable or unstable. If unstable, the client is assigned as a category 1 or 2. If stable, then categories 3, 4 or 5 apply. Categories 3 to 5 are determined by the number of resources needed for management of the clinical presentation. An analysis of the ESI shows a strong correlation ($p < 0.01$) with resource utilization and mortality, with an inter-observer reliability rated good to excellent ($\kappa = 0.46 – 0.91$), and good validity and very good inter-observer reliability in children ($\kappa = 0.82$) (Christ, Grossmann, Winter, Bingisser & Platz, 2010). Contrary to other triage systems, the ESI instrument does not establish a specific time limit for evaluation. The instrument simply states those seeking care should be seen as soon as possible depending on the workload of the department and availability of care resources, with re-triage only conducted as needed.

In a review of the literature by Christ and colleagues (2010), 12 analyses of reliability and validity of the ESI were identified, resulting in a significant correlation with hospital mortality and resource utilization and good to excellent interobserver reliability. Specifically, one study found that 85% of patients classified as ESI category 5 and 38% of ESI category 4 patients did not use any resources and had admission rates of 0-1% and 2-5%, respectively (Elshove-Bolk, Mencl, van Rijswijck, Simmons & van Vugt, 2007). However, a study by van der Wulp and Sturms in 2010 identified concern with the ESI system in relation to age and the increasing number of co-morbidities, as well as challenges with atypical complaints. The ACEP/ENA position paper on triage scale standardization was revised in 2010 to include a recommendation to use the ESI or a similar 5-level instrument (ACEP, 2012).

In one study overall concordance, or inter-rater reliability, in ESI level designation by first responders and nurses was moderate at 0.409 (95% CI, 0.256-0.562). For first responders with 10 or more years of experience, the weighted kappa statistic improved but remained moderate at 0.519 (95% CI, 0.258-0.780) while those with less than 10 years of experience decreased to fair at 0.348 (95% CI, 0.160-0.536), suggesting that first responders are unable to use the ESI instrument effectively (Buschhorn et al., 2011). Limitations to successful implementation of this instrument were hypothesized to relate largely to the lack of a common language, differences in training and differences in purpose and understanding of triage, including the depth and breadth of the very ill or injured and the need to limit under-triage (Buschhorn et al., 2011).

Regarding triage acuity, ESI category 5 saw an average of 0.5 mean laboratory orders (SD = 1.6) with 0.2 radiology orders (SD = 0.6), compared with the ESI category 4 with 1.2 mean laboratory orders (SD = 2.8), 0.5 radiology orders (SD = 0.9), and a moderate correlation to throughput ($r = 0.42$, $p < 0.01$). Throughput times began to decrease around midnight, with peak times from 04:00 until 11:00. Radiology and laboratory orders peaked at 13:00 and remained high through midnight (00:00), directly correlating with peak census and arrival times of 13:00 until 01:00 (Welch, Jones & Allen, 2007). In terms of self-referred clients, 32.3% were triaged as ESI category 5, with a median age of 28 years versus all remaining ESI categories (median age of 40 years).

Among ESI category 5 clients, 83.9% were discharged and 10.3% were referred to their PCP or an outside agency while 1.9% was admitted; 56.8% of ESI category 5 clients sought care between 9:00 am and 4:00 pm (van der Wulp, Sturms, Schrijvers & van Stel, 2010). In an observational study of a convenience sample regarding ESI triage, it was found that 85% of ESI category 5 and 38% of category 4 clients did not use any resources, with only 1-2% admitted, none of whom went to the intensive care unit (ICU). Also, 69% of ESI categories 4 and/or 5 patients received no follow up recommendations, while 23% were advised to follow up with their general practitioner (Elshove-Bolk, Mencl, van Rijswijck, Simmons & van Vugt, 2007).

Canadian Triage and Acuity Scale (CTAS). A second system, the CTAS, uses an extensive list of clinical complaints, symptoms and modifiers, in a spiral bound color-coded booklet format, to direct users toward a specific classification (Christ et al., 2010) (Appendix C). Also developed in the 1990s, CTAS has undergone several revisions to become the national triage system for Canada and many other countries (Lee, Oh, Peck, Lee, Park, Kim, & Youn, 2011). Contrary to the challenges faced by the ESI instrument, the CTAS instrument, in addition to demonstrating strong reliability and validity among pediatric and adult populations (Bergeron, Gouin, Bailey, Amre & Patel, 2004), also demonstrates a strong correlation with severity and resource need among the elderly (quadratic $\kappa = 0.69$; 95% CI=0.68-0.71). Regarding discharge rates, 95% of CTAS category 5 and 81% of category 4 patients were discharged. Of those admitted in the CTAS categories 4 or 5, none were to the ICU and all were ultimately discharged alive (Lee et al., 2011). Additionally, CTAS categories 3, 2, and 1 had alive at discharge rates of 97.1%, 81.6% and 78.8%, respectively ($p < 0.01$). Significant here is the un-weighted or raw agreement level of 0.74 (95% CI, 0.68-0.80) in comparison with the quadratic value of 0.75 (95% CI, 0.68-0.81) (Grafstein, Innes, Westman, Christenson & Thorne, 2003).

The primary method of CTAS use in the field involves a 4" x 5" flip-style spiral bound booklet. The booklet is color coded based upon the body system involved with the chief complaint. Once the complaint is identified, the user then flips the page to reveal specific modifiers. At that point, the user moves to the first and second order modifiers section, also color coded, to determine the final score. The booklet is designed to be a fluid process to determine the most critical score possible for the presenting situation. Additionally, the CTAS instrument is available in an electronic format. The electronic CTAS, eTRIAGE, is a web-based decision algorithm that uses a list of complaints and relevant discriminators to assign a triage score. The instrument has demonstrated an excellent predictive validity measure for all categories. When compared to CTAS category 3, CTAS category 1 severity determination was 4.45 (95% CI = 3.45-5.73) and CTAS category 5 was 0.16 (95% CI = 0.13-0.20) (Dong, S., Bullard, Meurer, Blitz, Akhmetshin, Ohinmaa, Holroyd, & Rowe, 2007). According to Lee and colleagues in 2011, the CTAS system has an 86% interrater reliability ($\kappa = 0.69$; 95% CI = 0.68 to 0.71) for category determination. Regarding the need for immediate intervention, CTAS levels 4 and 5 received none, whereas CTAS category 1, 2 and 3 received 46 (48.9%), 46 (48.9%), and category 2 (2.1%) of the ED interventions, respectively ($p < 0.01$). This study demonstrated that use of the CTAS among persons over 65 years of age had a high predictability for life saving intervention, producing a sensitivity/specificity rating of 97.9%/89.2%. A significant benefit of the eTRIAGE instrument is the ability to track users' methods of score determination. This allows the system to guide training and implementation practices.

Both the ESI and the CTAS triage instruments use a 5-level scale representing a deterioration of health condition as the score decreases (Grierson, 2011). The patient's final disposition does not have a specific direction of scaling. It will be used to identify common disposition locations in relation to triage categorization to improve identification of patients who are critically ill and likely to require surgery or admission to a critical care unit.

Australasian Triage Scale (ATS) and Manchester Triage System (MTS). The two remaining 5-level systems discussed in this review are the ATS and the MTS, both of which have limited reliability and validity. According to the Australasian College of Emergency Medicine policy for implementation, the ATS primarily focuses on the relative urgency and time when a client should be evaluated by a physician while considering the anticipated length of stay (LOS), mortality rate, ICU admission, staff time, and cost in relation to ED outcome measures, such as effectiveness, cost and efficiency. Based on six analyses, the ATS has fair to moderate reliability ($\kappa = 0.25$–0.56), with a 60% reliability rating among psychiatric clients (Christ et al., 2006). The MTS uses 52 flow charts considering the chief complaint in which a presenting client is placed using key discriminators to determine a triage category. Four analyses show fair to substantial reliability ($\kappa = 0.31$–0.62), with satisfactory ratings in use with children (Christ et al., 2006).

Psychometrics and Measurement in the Social Sciences

Quantification of observed phenomenon in social science is of critical importance to understanding situational relationships and promoting change. These methods, derived from direct observation, must accurately convey knowledge of a specific action, activity or outcome in relation to their contextual environment (DeVellis, 2003). Modern psychometric methods are considered to be derived from E.L. Thornkike in 1913 when he published *An Introduction to the Theory of Mental and Social Measurement*. Although some historians believe psychometrics dates to 1860 with the publication of *Elemente der Psychophysik by* Gustav Fechner, others suggest astronomer Nevil Maskelyne's dismissal of variation in time measurement of stellar transit by his assistant, David Kinnebrok in 1796 is the first historical mention of observational testing (Jones & Thissen, 2007). *Psychometric Theory*, published in 1978 by Jum Nunnally, has become the foundational publication on which psychometric testing is measured today. Psychometrics generally refers to a group of statistical models and methods that involve psychological scaling, factor analysis and test theory from the fields of psychological and behavioral research (Jones & Thissen, 2007). The focus of psychometric theory is not centered on the depth of understanding of a particular phenomenon rather it focuses on the breadth of information impacting the concept (Nunnally & Bernstein, 1994). Reliance on theoretical models in social sciences is challenged by the tremendous numbers of theories and the relative immaturity of the field of study (DeVellis, 2003).

Generally speaking, there are three primary principles of measurement in psychometric testing: feasibility, reliability and validity. The primary goal of feasibility testing is to determine if the proposed intervention can work, does work and will work in the contextual environment in which it is proposed (Bowen, Kreuter, Spring, Cofta-Woerpel, Linnan, Weiner… & Fernandez, 2009). Feasibility assessments are used when development of community partnerships is required, there is an absence of intervention-specific existing data or if existing studies did not adhere to rigorous scientific methods. According to Bowen et al (2009), feasibility is comprised of eight general ideas: (1) acceptability; (2) demand; (3) implementation; (4) practicality; (5) adaptation; (6) integration; (7) expansion; and (8) limited-efficacy testing.

Reliability is the extent to which a measure produces the same result consistently over time. There are three specific psychometric properties of reliability: stability; internal consistency and equivalence (Frost, Reeve, Liepa, Stauffer, & Hays, 2007). *Stability* is assessed testing then re-testing the same group at two different times where the time delay is contextually specific and defined by the investigating team in relation to the goal of the measure (short- term such as assessing a state or symptoms or long term to assess a syndrome or trait). It is important to clarify the time measure so that the time chosen neither allows memorization of original responses nor is extensive enough to be altered by new knowledge (DeVon, Block, Moyle-Wright, Ernst, Hayden, Lazzara… & Kostas-Polston, 2007). *Internal consistency* is a common form of reliability testing in nursing journals today which examines each item in relation to the whole measure. The most preferred method of internal consistency testing, which was developed by Lee Cronbach in 1951, is called Cronbach's alpha. *Alpha*, which is the proportion of variation attributable to the items being evaluated, measures the extent to which the items on a particular measure conceptually fit together using all measures of variance (disagreement) and covariance (agreement) (Ferketich, 1990; DeVellis, 2003). The value of alpha can be increased or reduced by adding or removing items that are similar or dissimilar. The accepted guideline for reliability is that of Nunnally and Bernstein (1994), which suggests a minimum alpha of 0.70 for new measures and 0.80 for established measures as well as 0.90 for measures for an individual that may have serious consequences (such as IQ testing).

Equivalence, or equality at one or more time points, is assessed by interrater and/or intrarater reliability and parallel and alternate forms (Landis & Koch, 1977; DeVon et al, 2007). *Interrater reliability* generally uses a kappa statistic to estimate equivalence between or among raters of equal status across and within locations or sites to measure the degree of agreement. Landis and Koch (1977) suggest the following agreement levels: 0.00 – 0.20 (slight agreement); 0.21 – 0.40 (fair agreement); 0.41 – 0.60 (moderate agreement); 0.61 – 0.80 (substantial agreement); and 0.81 – 1.00 (almost perfect agreement). *Intrarater reliability* evaluates the extent to which a single rater agrees with prior assessment of the same construct over time, thus, not straying from interpretation of items halfway through a study. Agreement between two different measures of a construct can be calculated using varying and randomly selected (parallel and alternate) forms or samples from the same population to quantify the correlation of either form with itself (DeVellis, 2003); however, health care measures seldom use this method due to limiting the number of items to reduce patient burden. Examples of factors that have an impact on reliability that need to be considered include the number of items, a practical length due to participant burden, and whether the measure captures a state or trait (Knapp, 1985; Knapp & Brown, 1995).

Validity, which is a correlation between test scores or a specific criterion measure, indicates how successful the instrument measures what it purports to measure while not measuring some other concept (Anastasi & Urbina, 1997). Validity is used to determine if item co-variation is attributable to the true score of a phenomenon or a casual influence of all the items (Frost et al., 2007). The accepted guideline for validity testing assumes multiple procedures employed sequentially over time throughout the evaluation process (Anastasi, 1988). There are three primary types of validity used today: content validity, construct validity, and criterion-related validity (Frost et al., 2007; DeVellis, 2003). Validation begins with conceptual identification of the construct of concern and includes norms based on demographic variables (Anastasi, 1988).

Content validity is an assessment used to demonstrate that test items identify the construct of interest or the instrument measures the specific attributes of a concept (Cronbach & Meehl, 1955; Frost et al., 2007). *Construct validity* evaluates the extent at which the instrument identifies or captures the theoretical concepts of a specific phenomenon (Frost et al., 2007; DeVellis, 2003). The primary methods to establish support for construct validity include contrasted groups approach, relationship testing, and factor analysis (Cronbach & Meehl, 1955); the multitrait-multimethod approach is used less often due to the difficulty in finding convergent and divergent measures for this approach (Campbell & Fiske, 1959). *Criterion-related validity* evaluates the extent to which the instrument agrees or correlates with a measures that measures the same concept but is identified as being superior to the study instrument (Frost et al., 2007); but, there must be a clear rationale why a new form is needed in place of the "gold standard" measure. There are two forms of criterion-related validity, concurrent validity and predictive validity. *Concurrent validity* is used to evaluate scores of similar instruments at the same point in time, whereas predictive *validity* is used to determine the correlation with a criterion involved at some point in the future (Cronbach & Meehl, 1955; DeVon et al., 2007).

Need for the study

National strategies for emergency service improvement, common among the ENA, IOM and ACEP include a focus on improving demand management, communications and collaboration while reducing costs and improving outcomes. In its report on the future of emergency care in 2006, the IOM recommended the creation of a fully coordinated, regionalized and accountable emergency care system that included integrated communications among first responders and paramedics in the field with nurses in EDs and trauma centers to reducing overcrowding. To achieve this goal, the IOM (2006) recommended the development of national standards for emergency care and categorization of health care facilities, which included the development of evidence-based operational protocols for the triage, treatment and transport of patients. The Joint Commission in its 2006 National Patient Safety Goals recommended the development and implementation of a standardized approach to handoff communications to ensure accurate and up to date information is exchanged in the promotion of outcome improvement.

It is the existence of these recommendations, in conjunction with a tremendous knowledge gap in the current literature regarding national, evidence-based standards for triage that creates a tremendous opportunity for the development of a program of research. Another aspect that supports this research trajectory is the increasing use of the

ED and 911 services for primary care, especially considering that the idea of medical necessity or medically appropriate use of emergency services remains a challenge to define (Brown et al., 2009). Regarding scope of practice, the complex and technically advanced electronics involved in paramedic care are pushing the envelope for the development of a new, advanced role that places first responders and paramedics in a unique and challenging position to ensure accurate prehospital assessments in an attempt to guarantee patients are provided a seamless clinical pathway to holistic care (Hagiwara, Henricson, Jonsson, & Suserud, 2011).

Patient care will benefit from further understanding of the many components involved in communications among paramedics and ED nurses, especially considering the extensive number of patients who arrive by ambulance, a number that has continually risen over the past 10 years (CDC, 2010). A focus on creating a common language for triage categorization will improve a charge nurse's ability to place patients accurately and appropriately, based on anticipated resource need and clinical condition, in the appropriate geographic region of the ED to ensure the availability of the appropriate resource in the appropriate amount of time. The literature demonstrates a clear knowledge gap in evidence-based systems and methods to improve triage and communications.

Nurses are actively involved in prehospital care operations, including rotor and fixed wing transportation services, mobile ICU transportation and 911-based emergency response systems. Considering the dramatic evolution of paramedic and nursing based prehospital services, the expansion of acceptance of the advanced practice nurse and the increasing acceptance of nursing as a science, it stands to reason that nursing is perfectly positioned to take the lead in the research and development of reliable and valid triage and treatment protocols, including development of instruments to meet one of the many key recommendations of the IOM's future of emergency care.

Prehospital patient assessment often occurs in extreme situations within volatile and uncertain environments (Hagiwara, Henricson, Jonsson & Suserud, 2011). Paramedic field assessment involves an extensive understanding of anatomy and physiology as it relates to the mechanism of injury, patterns of illness or special population needs (Sasser, Hunt, Faul, Sugerman, Pearson, Dulski…& Galli, 2012). Several factors impact field triage and place a tremendous strain on the decision-making process: season and weather; threat to safety or security; the varying type of patient and the environment in which they are assessed; and the time of day and the amount of time before additional resources arrive to offer assistance. These factors indicate that as prehospital patient care increases in complexity, so does the demand for a decision-support tool that offers advice or information to aid in the management of increasingly complex patients (Hagiwara, Henricson, Jonsson & Suserud, 2011).

In 2001, the EMS National Research Agenda released a report that highlighted the need for prehospital providers to change their operational protocols from one of physician discretion based on opinion to one that is based on scientific research, with the goal of strengthening EMS systems and improving overall care (Lang, Spaite, Oliver, Gotschall, Swor, Dawson & Hunt, 2012). A report released by the IOM in 2007 identified two specific recommendations on the future of emergency care in an attempt to thwart specifically the over-reliance on "expert based" opinion protocols. Part one recommended that the DHHS and the National Highway Traffic and Safety

Administration form a collaborative and multidisciplinary team to develop evidence-based categorization systems for EMS systems and first responder agencies with regard to their capabilities. Secondly, they sought to develop evidence-based triage, treatment and transport models for prehospital systems. Additionally, the 2006 Joint Commission Patient Safety Goal 2E brought to light the extreme need to implement a standardized approach to the handover process from first responders and paramedics to ED nurses to reduce the high error rates within ED settings (Buschhorn, Strout, Sholl & Baumann, 2012). In light of these recommendations, it is clear that an understanding of field triage, paramedic and first responder decision-making, communication methods, and the expansion of evidence to aid in the development of a field categorization and triage instrument are critical.

Chapter 3

Methods

Specific Aims

The goal of this dissertation study was to challenge an existing thought process that paramedics cannot effectively predict triage score categorization. Additionally, the study sought to lay the groundwork necessary to develop a more collaborative and holistic working relationship among paramedics and first responders in the field with nurses in the emergency department (ED). Accordingly, the research used a dual-phase methodological study, incorporating a correlational design and a descriptive written survey, conducted in a naturalistic setting within the City of Columbus Division of Fire (CFD) in Ohio. The aims of the study were as follows:

Aim 1: To determine, using secondary data analysis from a patient database, if triage score categorization by paramedics in the pre-hospital environment (as measured by the Canadian Triage and Acuity Scale [CTAS] system on a 1-5 scale) positively correlates with the triage score categorization determined by the ED nurses (using the well-established "Silver Standard" Emergency Severity Index [ESI] system) and/or is positively correlated with the patient's final disposition as determined by the emergency care provider (physician, nurse practitioner, or physician assistant).

Hypothesis 1: Paramedic triage categorization using the CTAS triage system among five categories [Resuscitation (Category 1), Emergent (Category 2), Urgent (Category 3), Semi-urgent (Category 4), and Non-urgent (Category 5)] will, after instrument training, positively correlate with the triage categorization as determined by nurses using the ESI triage system among five categories [Resuscitation (Category 1), Emergent (Category 2), Urgent (Category 3), Semi-urgent (Category 4), and Non-urgent (Category 5)] and the patient's final disposition (admission, discharge, eloped, left without being seen, left against medical advice, ED observation, died or transferred) as determined by the emergency care provider [physician, nurse practitioner (NP), or physician assistant (PA)].

Aim 2: To evaluate the feasibility and usability of the CTAS by paramedics in the field using a written survey, and to present a descriptive profile of the participants (Appendix D and E).

Hypothesis 2: Paramedics within the CFD will indicate that use of the CTAS instrument is feasible and acceptable.

Design/Setting

This dual-phase methodological study with correlational and descriptive aims was conducted in cooperation with the CFD and the Ohio State University (OSU). The CFD operates a full-time combined Fire and EMS division using a 24-hour on/48-hour off schedule. Paramedics and firefighters report for duty at 8am and remain at the station until the following day at 8am when their shift is completed. This schedule allows each paramedic an opportunity to participate in the patient portion of the study for 24-hours once every three days. The city is divided into seven Battalions with 5-7 fire stations that house medic, engine, ladder and rescue companies. Each Battalion has a Chief and an EMS coordinator who function as supervisors. Each station has a Lieutenant or Captain, some of whom are paramedics. The CFD responds, on average, to over sixty thousand calls for assistance each year (CFD, 2012). Serial enrollment for the study included all paramedics operating on an engine company or transport medic company within the CFD.

The strength of the study is increased knowing that the demographics of the CFD and the Winnipeg Fire Paramedic Services (WFPS) are nearly identical with similar call volumes, numbers of certified paramedic's and training level. The medical director of the Winnipeg Fire Paramedic Services (WFPS) functioned as a consultant for this study as an expert in the use of the CTAS instrument. The WFPS uses the CTAS as a form of triage on all EMS requests for service and is a full time fire service agency serving the city of Winnipeg, Manitoba Canada. The city is home to over 700 thousand residents, has 31 fire stations and 27 transport ambulances that handle nearly 70 thousand transports per year.

Sample and inclusion and exclusion criteria

Using a patient database for Aim 1, all paramedic responses that involved the following were excluded: (1) persons who were not transported; (2) persons who denied a need for assistance; (3) persons who were transported by means other than the CFD; or (4) persons who were pronounced dead on the scene. All other persons, using a serial enrollment process, including children, pregnant women, prisoners and special populations, were included in the study.

Potential Risks

The only identified potential risk to any participant of the proposed study was loss of confidentiality. Subject confidentiality was held strictly in trust by the participating investigators and their staff. This confidentiality was extended to cover the clinical information related to participating subjects including hemodynamics, demographics, time factors and outcomes measures, as well as destination and diagnosis. The study protocol, documentation, data and all other information generated were held in strict confidence.

No information concerning the study or the data was released to any unauthorized third party without prior written approval. The clinical study site permitted access to all documents and records that required inspection including, but not limited to, hospital data provided by participating healthcare systems and/or facilities and fire division records, including surveys, paramedic response demographics and data for the subjects in this study.

The assessed risk was minimal for several reasons. First, only the specific healthcare system responsible for the patient's ED record had access to patient specific identifiers. At no point did the patient record with identifying information leave the specific healthcare system in which the data were housed. The only data to leave the system were de-identified by the participating research physician, or his designee, with only the paramedic specific fire depart employee identification number (FDID) being used as an identifier to insure accuracy of data interpretation when combined with the paramedic specific surveys. Second, the principal investigator (PI) did not collect data that described a specific medication or medical history, other than a final diagnosis for analysis. Third, the paramedic specific FDID, which was replaced by a randomly generated 5-digit number, was not tied to any specifically identifiable health information other than age in years.

The FDID number was not used during any form of data dissemination, so the likelihood of identifying the specific paramedic involved in a particular case is remote. All data collected were for this specific dissertation study; however, because of the potentially significant impact such a large study may have on prehospital care, the final de-identified database will be maintained by the PI for potential future use. No alternative data collection methods exist on such a scale capable of providing such a vast amount of data.

Sources of Materials

The research materials obtained during this study were broken into three components: paramedic specific patient data; ED specific patient data; and paramedic interpretation of instrument use. For the paramedic specific patient data component, the following data were collected from the safetypad electronic patient care record (ePCR) system and shared only with the receiving facility for data verification purposes only: patient name and patient birthdate (used specifically to match records, then deleted); medic specific FDID; FD response number (deleted after accuracy confirmation); CTAS scores (where 1 = resuscitation, 2 = emergent, 3 = urgent, 4 = semi-urgent, and 5 = non-urgent); the diagnostic impression; age in years; gender; and ethnicity. Only the research physician and ePCR managing battalion chief within the CFD had access to the initial database including all HIPPA identifiers. The database was queried bi-weekly during the study period to create a healthcare system specific database based on patient name, birthdate, and paramedic specific FDID and ED destination. The new database, sorted by the CFD in accordance with the specific facility to which the patient was transported, was then disseminated to the respective facilities for ED record identification. Once the ED records were identified, all HIPPA data and electronic links to the patients' names and birthdates were severed and replaced with the paramedic specific FDID for the paramedic in charge of the transport. This new dataset became the new de-identified database that was made available electronically for analysis.

For the ED specific patient data component of the study, the following data were collected from the ED specific ePCR system: the paramedic specific FDID; the ESI at handoff (1 = resuscitation, 2 = emergent, 3 = urgent, 4 = semi-urgent, and 5 = non-urgent) and final disposition (0 = discharge; 1 = admit; 2 = transfer; 3 = deceased; 4 = left without being seen; 5 = against medical advice; 6 = eloped; 7 = labor/delivery; and 8 = observation), including the specialty service for accurate identification and differentiation between admission and critical care admission.

Paramedic interpretation of CTAS instrument usability was assessed using paper survey packets (Appendix E and F) which included one Six Dimension of Nursing Performance Scale survey, one paramedic demographic survey, one usability assessment survey and one self-addressed stamped envelope. The survey packets were mailed in bulk to the CFD headquarters where they were disseminated via the CFD interdivisional mail system. The surveys included a one-page description of the goals of the study, contact information if users requested additional details and an IRB statement indicating the survey was strictly voluntary (Appendix G).

Instruments to analyze prehospital triage

The CTAS is a 5-level measure that is generally designed to prioritize patient care requirements according to type and severity of their illness/injury, specifically with regard to the anticipated care needs and workload relating to the overall acuity and availability of resources of the department. The five levels of the measure are as follows: Level 1, resuscitation, where patients need to be evaluated 98% of the time by a physician and nurse immediately; Level 2, emergent, where patients need to be seen by a nurse immediately and a physician within 15 minutes 95% of the time; Level 3, urgent, where patients need to be seen by a physician and nurse within 30 minutes 90% of the time; Level 4, semi-urgent, where patients need to be seen by a physician and nurse within 60 minutes 85% of the time; and Level 5, non-urgent, where patients need to be seen by a physician and nurse within 120 minutes 80% of the time.

Several factors are involved in determining a final score. Initially, the presenting chief complaint or injury is identified and located within the scoring system, which is color coded according to body system. First and second order modifiers are then evaluated to determine the impact on the final score. These modifiers include temperature, heart rate, respiratory rate, white blood cell count, immune system status and presence of a bleeding disorder, while complaint specific modifiers include factors related to the specific presenting complaint. Finally, a mental health modifier, which includes an evaluation for depression, anxiety, hallucinations, insomnia, violence and social and behavioral changes, is available to use as indicated (Appendix C).

The ESI is a 5-level measure used by nurses and designed to determine category stratification of presenting patients based on categorical acuity and anticipated resource need. ESI categories are as follows: Category 1, resuscitation; category 2, emergent; category 3, urgent; category 4, semi-urgent; and category 5, non-urgent. Resources include labs, radiology examinations, intravenous fluid and medication administration, and simple and complex procedures such as suturing or conscious sedation. Four primary decision points are used as the focus of the measure: (1) determination of need for immediate life-saving intervention; (2) determination of the presence of a high risk situation or severe pain or distress; (3) determination of resource need (none, one or many); and (4) determination and analysis of vital signs, including blood pressure, heart rate, respiratory rate and pulse-oximetry (ESI, 2012; Appendix D).

Study Procedures

Paramedics were notified of the study, the components of the CTAS instrument training program and the post-study surveys using the CentreLearn internet-based interdivisional training system. All fire division personnel are required to use the CentreLearn system to monitor division announcements, training and changes in standard operating procedures. The CentreLearn system was used to maximize participant exposure to the CTAS education, and to offer a consistent and efficient means of communicating study-related information to all participants.

The current CTAS PowerPoint training system used in Canada was re-formatted for CentreLearn and used to track individual participation and successful completion of the required initial training. The training module was designed using material from the same program that nurses and paramedics in Canada are required to complete prior to use of the instrument in the field. The training included post-testing for verification of accuracy of use and an opportunity to direct questions, via email, to "super users" within the CFD. The super users were EMS coordinators and senior paramedics who were directly trained by CTAS instructors in a "train the trainer" program prior to the launch of the study. The training created a super user for each Battalion on each unit day, with back-up support from the EMS coordinators. Completion of the CentreLearn modules was required of all paramedics prior to study inception. Paramedics who were off work were required to complete the CentreLearn training prior to completing an electronic ePCR in the safetypad system. The training process took approximately 2 weeks. Paramedics who did not complete the training did not have access to the CTAS portion of the division's ePCR system. Three specific time points for measurement of the CTAS were required: upon arrival at the scene; upon initiation of transportation; and upon arrival at the ED. It was critical that the triage instrument training sessions provide as much information as possible, including clarification of dimensions and application to increase the familiarity and perceived ease of use of the system, maximizing participation and accuracy.

Additional challenges with implementation were embedded within the three determinants of intention: attitude toward the behavior; social factor or subjective norm; and the degree of perceived behavioral control (Ajzen, 1991). A major weakness with the method of implementation of the present study was the challenge that if paramedics did not feel a form of social or operational pressure to perform the triage process, then there was likely to be extensive missing data. It was imperative for the research team to encourage understanding of the importance of the study and the need to gather the data by making the implementation process as easily understandable as possible. Electronic mail, telephone conversations and in-person meetings were conducted with the study team on multiple occasions to maximize participation.

Chart Review. For the chart review component of the study, participating sites received a HIPAA authorization waiver of consent as part of the IRB submissions because this portion of the study involved only review of medical records. Data were collected both retrospectively and prospectively. Patients were not contacted by any method to obtain additional information for this study. Patients were identified through CFD records and information was obtained from chart reviews of the identified patients. Information from psychotherapy notes was not used. Prior to data collection, an Excel spreadsheet was constructed to accommodate the necessary data management specifications to avoid data transformation errors.

Data Analysis. Data analysis was conducted using multiple statistical methods within the SPSS v.21 statistical software package. Descriptive statistics were evaluated to describe and document known elements of participants in the study: (1) paramedic's age; (2) paramedic's years of experience; (3) paramedic's gender; (4) patient's age; (5) CTAS scores at three time points; (6) frequencies of disposition status from the ED; and (7) paramedic's years of education. Prevalence studies also were conducted to determine the prevalence of dispositions based on CTAS and ESI score presentation using the following formula: number of dispositions (admit, discharge, observation) per CTAS or ESI categories (1, 2, 3, 4 and 5) upon arrival at the ED divided by the overall number of CTAS or ESI category (1, 2, 3, 4 and 5) presentations multiplied by 100. Prevalence studies were evaluated for on scene and on arrival at the treatment facility CTAS categories, as well as the arrival ESI categories.

A multinomial hierarchical logistic regression (MLR), with a minimum sample size goal of 30 participants per independent variable (IV), was conducted using the following variables: (1) disposition status as the dependent variable (DV) (admission, discharge, eloped, left without being seen, left against medical advice, ED observation, died or transferred); (2) CTAS score (IV); (3) ESI score (IV); (4) paramedic's years of experience (IV); (5) paramedic's age (IV); (6) patient's age (IV); and (7) paramedic's years of education (IV). The MLR was conducted to determine group membership and correlation to or the significance of the IVs with the DV, with an explanation of the variance explained by each variable. Chi-square analyses focused on determination of differences in CTAS categories by disposition status (admit or discharge). A missing values analysis was conducted to determine if any one variable was missing more than 5% of its data. Because the level of missing transport data was not more than 5%, no imputation of data was necessary. However, when the transport data was combined with the survey data there were 1,709 cases with missing variables. Diagnostics for normality and multicollinearity were conducted and included an evaluation of the collinearity statistics (tolerance and VIF) and variance proportions against case number as the dependent variable. During data evaluation, it was found that total years of fire experience (condition index 33.72, variance proportions 0.90/0.92) significantly correlated with total years of medic experience; therefore, these variables were removed from the analysis. The following skewness statistics were noted: patient age (1.301); paramedic age (3.53); total paramedic education in years (minor skew at 5.00); years of full time paramedic service (minor skew at 5.13) and total years of fire service experience (minor skew at 5.85). The skewed data was not transformed as the skewness was minimal and an even minor transformation of the data presented greater risk to conclusions than using the data in its skewed format.

Assumptions

Multinomial logistic regression predicts a probability of a particular outcome using an odds ratio such that a change in the DV is/is not identified by a 1-unit change in the IV. There are no specific assumptions necessary however MLR can be conducted on a categorical DV with two or more categories. Additionally multicollinearity, multivariate outliers and inadequate sample sizes are important factors to analyze as their presence may impact the conclusion. Cohen's kappa dictates that all response categories must be mutually exclusive and their responses must be paired observations of the same phenomenon with the same number of categories. There must be a symmetric crosstabulation with two independent, fixed raters.

A chi square distribution can be used to test the significance of the MLR model specifically to determine if one of the IV's is statistically different from zero. If significant then the variable(s) in the model improve the prediction of the model. The negative two log likelihood (-2LL), which has a chi square distribution, indicates the probability that the estimated model represents the observed data where a smaller number indicates a better fit or an increased likelihood of the observed results. Used in this analysis, the Akaike's Information Criteria (AIC) is a more accurate measure to describe the model fit in the MLR than the -2LL. A smaller AIC indicates a better model fit. Finally, the Nagelkerke R^2 indicates the percent of the variance explained by discriminating among groups. Here a confidence interval is reported as an adjusted odds ratio due to multiple variables in the equation and, if significant, should not include 1. If the beta variable is greater than 1 the event being predicted is more likely to occur whereas if the beta variable is less than 1 the event being predicted is less likely to occur.

Power analysis and sample size

In a 2011 statement to the U.S. Senate subcommittee on primary health and aging, Cunningham found that trends in the use of 5-level triage instruments in EDs varied extensively among the five categories of the instrument (Non-urgent Use of Hospital Emergency Departments, 2011). According to the National Hospital Ambulatory Medical Care Survey, the following percentages was observed using a 5-level triage system in 2008 and 2009: Category 1, 4% in 2008 and 1.9% in 2009; Category 2, 12% in 2008 and 10.2% in 2009; Category 3, 39% in 2008 and 41.6% in 2009; Category 4, 21% in 2008 and 35.1% in 2009; Category 5, 8% in 2008 and 7.7% in 2009; and unknown category, 18% in 2008 and 3.5% in 2009. These statistics varied slightly from those found in a Canadian study using the CTAS where 1% were category 1, 12% were category 2, 33% were category 3, 36% were category 4, and 18 % were category 5 (Bullard, Unger, Spence, & Grafstein, 2008).

Considering the prevalence rates in the Senate report, it is plausible to hypothesize estimated sample sizes available based on 2011 EMS transport statistics from the CFD for the participating treatment facilities of the study. Among the four participating facilities, approximately 11,000 patients (2,200/month average) were transported between the months of September 2012 and January 2013, which created the potential for 440 category 1 patients, 1320 category 2 patients, 4290 category 3 patients, 2310 category 4 patients, and 880 category 5 patients, with 1760 potential unknowns.

Despite suggestions of a needed ratio of cases to predictors of 40:1, this study used a more common sample size calculation based on a logistic regression analysis of 30 combined participants per predictor, considering large sample sizes are commonly required to obtain high (95%) confidence intervals (Rotondi & Donner, 2012; Polit & Beck, 2008). A ratio of 30:1 was chosen because of challenges in obtaining data resulting from limitations on time for data collection. Because of an unforeseen human error, data collection within the CFD failed to begin as proposed in September 2013, resulting in a loss of access to an estimated 6600 participants. Therefore, data collection only occurred from December 1, 2013 through February 28, 2014. It is important to note that the chosen ratio exceeds a minimum 20:1 recommendation for hierarchical regression analysis (Rotondi & Donner, 2012; Polit & Beck, 2008).

A total of six predictor variables were identified for the dissertation study, yielding a total necessary participant sample of 180 per CTAS category, or 900 overall. However, prevalence estimates play a role in sample calculations, specifically in regard to goodness of fit statistics (Rotondi & Donner, 2012). By combining categories 1 and 2, this reduced the overall total sample size required to 720 while maintaining 180 in each category. Another method of sample size estimation considers multiple regression analysis, understanding sample size estimations are based on an effect size convention of small ($R^2 = 0.02$), moderate ($R^2 = 0.13$) and large ($R^2 = 0.30$) using the formula $N=(L/\Upsilon)+k+1$, where: $L = 11.94$ based on an $\alpha = 0.05$ and power ($1-\beta$) of 0.80; Υ = estimated effect size (here moderate, 0.13); and k = number of predictors (7). This formula yields a needed sample size estimate for the MLR of 96.85 or 97 per CTAS category, for a total sample size of 485. However, if CTAS categories 1 and 2 are combined, the overall sample size needed is 388 (Polit & Beck, 2008, pp. 623).

Calculation of survey sample size included the following variables: (1) a population size of 360; (2) an estimated variance of 0.5; (3) a desired precision analyzed at 5% (0.05); and (4) a confidence interval of 95% (1.96) with an estimated response rate of 60% (58% for physicians and 68% for non-physicians) (Kellerman & Herold, 2001). Surprisingly, in a study by Asch, Jedrziewski and Christakis in1997, surveys with extended page lengths had higher response rates with no residual or compounding effect in response rates based on the number of questions. That study also found that survey response rates for healthcare workers, other than nurses or physicians, had a mean response rate of 56% (Asch, Jedrziewski & Christakis, 1997).

A general needed sample size estimate can be derived from a table developed by Krejcie & Morgan (1970) using the formula: $s = X^2NP(1-P)/d^2(N-1)+X^2P(1-P)$, where: s = the required sample size; X^2 = the table value of chi-square for 1 degree of freedom at alpha of 0.05 (3.841); N = the population size; P = the population proportion (assumed at 0.50 indicating maximum sample size); and d = the degree of accuracy as a proportion (0.05). This formula yields an estimated sample size of 151, whereas a chart of general estimates for a population sample size of 360 is 186. Therefore, a range of needed sample sizes of 151 to 186 was used for the survey portion of the analysis.

Survey Analysis

Item generation. First, paramedics completed the Six-Dimension Scale of Nursing Performance (6-D scale; Appendix E). Dr. Patricia Schwirian at the OSU developed the 6-D scale in 1978 in cooperation with the OSU Research Foundation. This instrument seeks to measure self-appraisals and/or quality of nursing performance and perceptions of their functional abilities based on the following parameters: leadership; critical care; teaching/collaboration; planning/evaluation; communications; and professional development. According to Schwirian (1978), a principal component analysis using an oblique rotation with a factor analysis of involved components was conducted to six behavioral constructs (parameters) which produced a Cronbach's alpha coefficient for the six parameters ranging from 0.844 (leadership) to 0.978 (professional development). In a meta-analysis to measure nurse competence, the 6-D scale was found to have been used repeatedly and in varying settings in the literature, with tests for reliability and validity well-documented (Meretoja & Leino-Kilpi, 2001). Permission to alter the instrument only by replacing 'nurse' or 'nursing' with 'paramedic', with all remaining constructs and layouts, was obtained directly from Dr. Schwirian for study purposes.

Next, paramedics completed a written survey consisting of two specific categories: 'Demographic Factors' and 'Instrument Factors.' Instrument factor items were analyzed on a 5-point Likert scale ranging from 5 (strongly agree) to 1 (strongly disagree). The theory of planned behavior (TPB) postulates that by increasing resources and opportunities for individuals, their perceived behavioral control over the expected behavior increases (Madden, Ellen & Ajzen, 1992). Therefore, the intent of the chosen survey questions was to identify factors that inhibited or promoted users perceived level of control. Additionally, the aim of the survey was to identify any demographic correlations that existed in regard to the identified perceived level of control (Appendix F).

Section two of the survey focused on paramedics' interpretations of the instrument. Although current studies are underway, the CTAS instrument has not been validated when used by paramedics in the prehospital environment (Manos, Petrie, Beveridge, Walter & Ducharme, 2002; Lee, Oh, Peck, Lee, Park, Kim & Youn, 2011; Worster, Gilboy, Fernandes, Eitel, Eva, Geisler, & Tanabe, 2004; Rankin, Then & Atack, 2011; Christ et al., 2010). Therefore, it is important to gain paramedics' perspectives of the usability of the instrument. Because conducting focused interviews on such a large and diverse sample would be well beyond the scope of a dissertation study, the survey offered quantitative insight into an otherwise qualitative set of questions to obtain data that may guide future qualitative investigations.

The second component of the survey was designed to understand better the technical aspects of the instrument, including verbiage, complexity, usability, and acceptability. For the survey phase of data collection, all paramedics who used the CTAS instrument were included, with a potential sample size of 120 per duty day and 360 in total (Figure 2). Survey questions sought to understand the perceived usability of the CTAS instrument in regard to the user's training and education, as well as his/her interpretations of the overall layout and length of the instrument. Additionally, the survey sought to understand the user's understanding of how well the CTAS instrument predicted the outcome of medical or trauma patients, and if the instrument had any impact on handover communications or patient care. Responses were evaluated on a five-point Likert scale, where 1 indicated strong disagreement with the statement, 3 indicated neither agreement nor disagreement with the statement and 5 indicated strong agreement with the statement (Appendix F).

For the survey portion of the study, participating sites obtained a waiver of documentation of consent under 45CFR46.117(c) (DHHS) as part of their IRB submissions. The research presented no more than minimal risk of harm to subjects and involved no procedures for which written consent was required outside of the research context. A written statement regarding the research was provided to potential paramedic subjects as the first item in the survey packet. Prospective paramedic participants to whom the CFD survey was provided were notified via the CFD CentreLearn interdivisional training system and the CFD interdivisional mail system.

Feasibility. The primary goal of feasibility testing is to determine if the proposed intervention can, does and will work in the contextual environment in which it is proposed. To evaluate the feasibility or usability of the CTAS instrument by paramedics a multinomial logistic regression and chi-square analysis was conducted. Additionally information contained in the paramedic surveys will provide additional details of the CTAS feasibility.

Reliability. Reliability is commonly referred to as the extent to which an instrument consistently yields or produces the same results or score each time it is administered or utilized (LoBiondo-Wood & Haber, 2006; Frost, Reeve, Liepa, Stauffer & Hays, 2007). Because only the in–charge (I/C) paramedic assesses and documents the condition of the client, we were unable to evaluate reliability of the CTAS in the current study. Future studies should consider requiring the second paramedic to determine and document scores to allow for reliability assessment.

Criterion-related validity. Criterion-related validity using concurrent validity, which seeks to determine relationships between an instrument and an external criterion, was tested using Cohen's kappa. Cohen's kappa (κ) is a measure of how well one independent rater using the CTAS agrees with another independent rater using the ESI, which is presumed to be the superior instrument (Frost, Reeve, Liepa, Stauffer & Hays, 2007). Assumptions include responses made using a nominal or ordinal variable; the response data are paired observations (here CTAS at the hospital with the ESI); each variable has the same number of categories (here both are rated 1-5); the two raters are independent; and the two raters are specifically involved in the study. Cohen's kappa was evaluated considering the following six levels of goodness of fit: <0 poor; 0-0.20 slight; 0.21-0.40 fair; 0.41-0.60 moderate; 0.61-0.80 substantial; and 0.81–1 almost perfect (Polit & Beck, 2008). Predictive validity, which measures the degree of correlation between the measure on an instrument and some future measure of the external criterion, was not evaluated (Lo-Biondo-Wood & Haber, 2006; Polit & Beck, 2008).

Content validity. Instrument content validity determination consists of multiple factors broadly grouped under the idea of construct validity. Construct validity indicates how accurately the instrument measures what is intended (including all associated attributes), whereas reliability indicates the ability of the instrument to consistently replicate the theoretical and/or construct attributes it purports to measure (DeVon, Block, Moyle-Wright, Ernst, Hayden, Lazzara, Savoy & Kostas-Polston, 2007; Polit & Beck, 2008; Frost, Reeve, Liepa, Stauffer & Hays, 2007). This dissertation study did not seek to identify content validity, given that the complete range of attributes that define triage as a concept are not clearly defined in the literature. However, face validity was of interest, specifically in terms of the usability of the CTAS instrument and the perceived interpretation of the items by participants. The MLR analysis, using positive and negative predictive values, sensitivity and specificity and over and under triage rates, helped form a general impression (face validity) of the extent to which the CTAS measure was perceived to measure what each category was expected to measure (Frost, Reeve, Liepa, Stauffer & Hays, 2007). To assess the ease of understanding and the application of an instrument, specifically the speed at which the instrument is applied, face validity and content validity are indicated. However, considering the lack of empiric evidence indicating the complete range of attributes of triage, significant numbers of expert reviewers will be required to obtain a Content Validity Index (CVI) and, therefore, were not evaluated during this study (CVI >0.05 level of significance) (DeVon et al., 2007).

Construct validity. Construct validity is inferential from observations to the constructs in question, here CTAS scores to disposition, which indicates the extent to which the CTAS instrument agrees, behaves or indicates a specific outcome based on an underlying theory, hypothesis or body of knowledge (Frost, Reeve, Liepa, Stauffer & Hays, 2007). Because determination of construct validity is a complex task outside the scope of this initial evaluation, we chose to use the results as a means to identify important evidence toward eventual construct validation and to exclude the evaluation of convergent and discriminant validity at this time. Our hypothesis was that construct validity would indicate a lower CTAS score represents a less stable patient, with an increased likelihood of the need for more admissions or intensive care (specifically where category 1 and possibly categories 2 or 3 patients go to intensive care units (ICUs) or step-down units, while categories 4 and 3, and possibly category 2, go to general medicine or specialty services). Additionally instrument feasibility, using survey response rates as determinants, was also assessed (Frost, Reeve, Liepa, Stauffer & Hays, 2007; Lo-Biondo-Wood & Haber, 2006).

Cronbach's alpha. Reliability is a measure of internal consistency and, by itself, is not sufficient to move forward testing the validity of an instrument. However, the coefficient, or Cronbach's alpha, is frequently used in the nursing literature to show how reliably the instrument identifies the concept of interest, with a value ≥0.90 required for clinical instruments (DeVon et al., 2007; Polit & Beck, 2008). Unfortunately, neither of these criteria was reported in studies summarized by Christ et al. (2010) regarding triage using the CTAS or ESI. In fact, the only statistic reported was Cohen's kappa statistic. Therefore, based on the psychometric guidelines by Landis and Koch (1977), six levels of goodness of agreement were used to evaluate the triage instruments. These arbitrary boundaries differ slightly, by name only, from those reported by Christ et al. (2010) and include the following ranges: 0-0.2 = slight; 0.21-0.4 = fair; 0.41-0.6 = moderate; 0.61-0.8 = substantial; and 0.81-1 = almost perfect.

Considering these values, the CTAS showed the most reliability, with kappa scores ranging from 0.68 to 0.89 among eight different studies, indicating substantial to almost perfect reliability. The ESI demonstrated the second most reliability, with kappa scores ranging from 0.46 to 0.91 among twelve studies, indicating moderate to almost perfect reliability. To gauge predictability of outcomes, specifically the CTAS score to patient disposition, predictive criterion-related validity is the appropriate method to identify the presence of a predictive correlation within the instrument (DeVon et al., 2007).

When comparing scores of related criteria at the same time, such as when paramedics compare their CTAS scores to those of triage nurses using the same scale, a concurrent criterion-related validity is indicated using a high Pearson Product Moment correlation with an acceptable standard of $r \geq 0.45$. Because this study compares the CTAS to the ESI, a discriminant criterion is indicated using a low Pearson Product Moment with an accepted standard of $r \leq 0.45$. However, because the measures are categorical, these violate the assumptions necessary to perform a Pearson analysis;

therefore, the PI used the MLR data to analyze associations or relationships between the CTAS, the ESI and outcomes.

Ethics, Characteristics and Risks to Human Subjects' Involvement

Human subject involvement in this proposal was limited to the study paramedics and the patients transported. Study paramedics were offered participation on two levels. All paramedics participated in the online training session for the CTAS instrument and data were tracked according to FDIDs. All CFD division paramedics participated in a non-voluntary manner because the CFD elected to make the CTAS a requirement for continuing education outside of the scope of this study. Each paramedic's success or failure and the number of attempts for the CTAS post-test were recorded.

The de-identified dataset was forwarded to the PI for management according to the study parameters. The doctoral student had sole responsibility for combining the specific paramedic demographic data from the surveys with the appropriate treatment records provided by the health systems. The new dataset was then stripped of the paramedics' FDIDs and replaced with paramedics' ages in years and years of experience. Once removed from the database, the doctoral student no longer had access to the FDIDs, thereby creating a totally de-identified dataset. In a similar fashion, the CFD research physician created a database with all participating paramedics and their associated survey responses. The surveys were anonymous and only included paramedics' ages, FDIDs and paramedics' years of experience as identifying information.

Estimations for participants in the study included the following special classes: pregnant women; prisoners; institutionalized persons; cognitively impaired persons; traumatized and comatose patients; terminally ill patients; elderly, children and aged persons; students; and employees of the CFD where applicable. These protected health classes were included without concern because the only risk to those classes is the same as unprotected classes (i.e., the loss of confidentiality). The use of protected classes provided a greater depth to the study, specifically with regard to those persons unable to effectively communicate. Additionally, patients aged 89 and older were labeled as 89 to protect the limited number of patients in that specific age range. No patient involvement was necessary and the use of the CTAS instrument in no way changed care at any level. Each collaborating health care system was responsible for medical record review only. No patient interaction, treatment or care change occurred related to the study by any of the participating healthcare systems.

Chapter 4

Results

Dataset Construction

Sample estimates before data collection began anticipated a total potential of 11,000 patients and 360 paramedics in the sample. However, data collection was not initiated when anticipated because of the inadvertent programming failure within the ePCR system necessary to generate the hard stop that required recording of the CTAS scores before closing the report. The overall reduction in sample size was estimated to be 6,600. Additionally, patient data were received from only one of the two participating health systems, thus reducing the available sample size by approximately 2,500. Finally, a total of 16 cases were eliminated because of either missing CTAS score or ESI score. Combined, these unforeseen circumstances reduced the study sample to 2,222. Analysis of the reduced sample set demonstrated that CTAS categories 3 (339), 4 (605) and 5 (1139) met the minimum sample size of 180 necessary to statistically power the study. However, CTAS category 1 had only 39 cases, while category 2 only 100 cases. Similar impacts were noted among the ESI demographics. ESI category 1 had only 52 cases, while ESI category 5 only 7 cases. Therefore, ESI categories 1 and 2 (748) were combined to produce a new recoded ESI category 2 with 800 cases. ESI category 5 was combined with category 4 cases (273) to produce a new ESI category 4 with 280 cases. Finally, CTAS categories 1 (39) and 2 (100) were combined to produce a new CTAS category 2 (139). The Cohen's kappa for the CTAS to ESI comparison was not significant; however, it demonstrated a moderate relationship with the ESI upon arrival at the hospital ($p = 0.599$; $\kappa = -0.003$).

A total of 31.1% (112) of 360 paramedic surveys were returned. Surveys were entered into an Excel spreadsheet and verified two different times to ensure data accuracy. After each survey or group of surveys was added to the spreadsheet, the data were re-verified. Additionally, 25% (33) of the surveys were randomly selected from the sample set and re-verified a second time with no data entry errors detected. Because so few female paramedics participated in the surveys, an analysis of the effects of paramedic gender on CTAS use was eliminated to protect the confidentiality of the participants. Finally, because response times and length of stay times were unable to be separated by the research physician, the decision was made to delete the times from the database to ensure protection of sensitive health information. Because of this, all time related factors were eliminated from the analysis, which reduced the list of predictors as follows: (1) patient age, (2) paramedic age, (3) paramedic years of experience, (4) CTAS at the facility, (5) the ESI and (6) paramedic years of education.

To evaluate paramedic demographics a separate database was created so that each participant was only evaluated once, thus providing a more exact picture of the participants. At the time of data analysis, a total of 112 paramedics had responded to the survey; however, additional surveys, which were not included in the analysis, have continued to arrive and will be evaluated during future studies.

One combined dataset was created consisting of all 2,222 transports. Paramedics who completed the survey had their data matched to their transports, creating a combined dataset with 2,222 transports and 530 total transports having combined paramedic data. This produced 1,692 cases that were missing paramedic data because of missing surveys.

Demographics

Males comprised 46.9% (1050) of the patients transported while females comprised 53% (1187). Additionally, 37.4% (837) were white, 58.8% (1315) were black and 3.5% (85) were of mixed or other races. Ninety-nine percent (2218) were not of Hispanic or Latino ethnicity, while 1% (4) either refused to answer or were of other ethnicities. The mean patient age was 48.97 (SD = 18.76) with a range of 15 to 89 years.

The majority of paramedics (97.3%, 109) were male and not of Hispanic or Latino decent. Twenty-five percent (28) of the paramedics had volunteer experience of 1.85 (SD = 4.28) mean years; however, only 12.5% (14) of those who had volunteered in the past continued to volunteer. Mean paramedic age was 42.46 (SD = 8.18) with a range of 18 to 59 years. Paramedics mean years of experience was 11.33 (SD = 6.01) with a range of 1 to 27 years, while their mean years of education was 13.99 (SD = 1.66) with a range of 12 to 19 years.

Paramedic Response Data

Disposition statuses were as follows: 55.6% (1245) discharged; 36.8% (823) admitted; 3.8% (84) admitted to ED observation; 2.4% (48) eloped, left against medical advice (AMA) or left without being seen (LWBS); 1.5% (33) transferred; and 0.2% (4) died in the ED. A total of 14 different admission categories were identified: 25.9% (579) general medicine; 3.6% (81) critical care; 4.1% (92) ED observation; 1.9% (43) surgery; 1.4% (31) nephrology/urology; 1.3% (29) oncology; 1.2% (26) inpatient psychology; 0.5% (12) transplant; 0.3% (6) neurovascular; 0.3% (6) obstetrics/gynecology; 0.2% (5)

neurology; and 0.2% (4) adult trauma/burn, with 1 case each admitted to hematology and ENT. A total of 145 different independent or combinations of diagnostic impressions (DI) were identified. The ten most frequent DIs, the overall percent of transports involved, and CTAS and ESI categories are presented in Table 1.

A chi-square analysis demonstrated significant variation between the CTAS at the hospital and ESI score at the hospital (Table 2. Descriptive statistics of re-coded CTAS and ESI scores are displayed in Table 3. Differences in CTAS and ESI category frequencies by admission type are presented in Table 4 Further analysis of the admission rates were conducted by analyzing specialty admissions (nephrology, cardiology, neurology, psychology, etc.), critical care admissions (intensive care unit, coronary care unit, surgery, etc.) and general medicine admissions. The ESI measure produced the following critical *care admission* rates: 21.2% (11) category 1; 10.4% (79) category 2; 2.4% (28) category 3; 2.2% (6) category 4; and 0% category 5. The CTAS measure produced the following *critical care* admission rates: 10.3% (4) category 1; 17% (17) category 2; 9.1% (31) category 3; 6% (36) category 4; and 3.1% (35) category 5. Lastly, a Cohen's κ statistic was calculated to assess the agreement of judgment between raters within and across different locations. Neither the CTAS on the scene (κ= 0.006) nor the CTAS at the receiving facility (κ= -0.003) had statistical significance; however, the kappa statistic did show moderate agreement (κ=0.599), with the ESI at the receiving facility based upon benchmarks established by Landis & Koch (1977).

Regression Analysis

To understand the impact of each variable on admission likelihood, a hierarchical multinomial logistic regression was performed. In the first block, patient age was significant and explained 14.7% of the admission variance. The data indicated that as the patient age increased by 1 year the likelihood of admission decreased 3.3% ($p < 0.001$, OR=0.967, 95% CI 0.961-0.972). In the second block, paramedic age was not a significant predictor ($p = 0.727$). In the third block, the CTAS score determined by paramedics upon arrival at the hospital was significant ($p < 0.001$), explaining an additional 12.8% of the admission variance. This data indicates that as patients in CTAS category 2 (emergent) improve to CTAS category 3 (urgent) their likelihood of admission decreases 60.3% (p<0.001, OR=0.397, 95% CI 0.241 – 0.653). When their triage category changed from CTAS 3 (urgent) to CTAS 4 (semi-urgent) their likelihood of admission decreased 51.1% (p<0.001, OR=0.489, 95% CI 0.368 – 0.652). Finally, when their triage category changed from CTAS 4 (semi-urgent) to CTAS 5 (non-urgent) their likelihood of admission decreased 35.7% (p<0.001, OR=0.643, 95% CI 0.511 – 0.809).

In the fourth block, the ESI was added to the model and explained an additional 6% of the admission variance ($p < 0.001$). Further analysis of the ESI demonstrated that ESI 1 (p<0.001; b=14.453) and ESI 2 (p=0.009; b=6.048) were significant variables. This data indicates that as patients in ESI category 1 (resuscitation) improved to ESI category 2 (emergent) their likelihood of admission decreased 95.9% (p<0.001, OR=0.041, 95% CI 0.004 – 0.443). ESI category 3 and 4 were not significant predictors of admission. In the fifth block, total paramedic years of experience were added to the model, explaining an additional 1.5% of the admission variance ($p = 0.008$). Finally, paramedic years of education were added to the model and explained an additional 0.4% of the admission variance. However; years of education was found not to be a significant predictor (p =

0.149). The overall model correctly predicted 61.5% of admissions and 82% of all other ED dispositions for an overall model prediction rate of 73.7% (Table 5).

Six Dimensions of Nursing Performance Scale (6-D)

The majority of paramedics (77.7% [87]) indicated that they participated in leadership activities such as guiding other team members occasionally or frequently, while 21.4% (24) indicated guidance of others either was not expected of them or occurred rarely. Additionally, 27.7% (31) felt that giving praise and recognition was either not expected or provided infrequently or seldom. Regarding factors that impact leadership, 37.5% (42) indicated they were not able to provide praise and recognition very well, while 84% (94) indicated they were quite willing to remain open to suggestions (Table 6). With regard to critical care, 87.1% (93) of paramedics felt they performed technical procedures occasionally or frequently; however, 32.1% (36) felt the recognition of patients' emotional needs was either not required or occurred infrequently.

Despite the relative frequency of performing technical procedures, 14.3% (16) felt they were only, at most, satisfactory at performing those procedures, while 20.6% (23) of paramedics indicated they had difficulty providing emotional support during the application of care (Table 7). Paramedics overwhelmingly felt that teaching and collaboration occurred infrequently. Specifically, 59.8% (67) felt planning and integration of the needs of the patient was either not expected or occurred infrequently. Paramedics also felt the promotion of an interdisciplinary team was either not expected or occurred infrequently (57.1%; 64). Paramedics also indicated they did not use teaching aids well or only did so satisfactorily (57.1%; 64). Additional factors cited by paramedics as performed not well or satisfactorily include: encouraged family participation (37.6%; 42) communicated facts and ideas (53.6%; 60) or plan an integration of the patients' needs (48.2%, 54) (Table 8). Regarding communications, 32.1% (36) of paramedics felt using opportunities for teaching was either not required or occurred infrequently. However, 88.4% (99) felt they occasionally or frequently promoted the rights of the patient. Interestingly, 30.4% of paramedics were only, at best, satisfactory in the promotion of inclusion of the patient in care decision-making, while 26.8% (30) indicated they struggled to help a patient communicate (Table 9). In the category of professional development, 82.2% (90) felt they used opportunities for professional growth. However, 23.3% (26) of paramedics felt they did not demonstrate knowledge of the legal components of their job very well or satisfactorily (Table 10). Finally, 43.8% (49) of paramedics indicated they were not expected to or rarely coordinated a patient's plan of care, with 19.7% (22) indicating they were not expected to or rarely developed a plan of care. Paramedics indicated that they struggled with coordinating the plan of care, with 51% (57) citing they did so satisfactorily at best. Interestingly, 36.6% (41) struggled to identify changes in a patient's condition (Table 11).

Another aspect of the study sought to obtain a general impression of the CTAS instrument from the paramedics who participated in the study. The first question asked if the CTAS and its methods and factors related specifically to paramedics' training. Over 43.7% of paramedics indicated that they disagreed with the relationship of the CTAS instrument to their training; however, 25.1% (28) indicated that they felt the CTAS did relate specifically to their training and 29.5% (33) were neutral on the question. Twenty-two percent (25) of paramedics felt the amount of time needed to use the CTAS was too short, while 44.7% (50) felt the time was too long. When asked about ease of use, 50.9% (57) felt the instrument was not easy to use compared with 19.7% (22) who felt it was easy to use. In addition, 42.8% (48) felt the color-coding was helpful while 31.3% (35) did not. Furthermore, regarding layout of the CTAS instrument, 25% (28) felt the instrument sections were not labeled appropriately, while 35.8% (40) felt the sections were labeled appropriately (Table 12).

Psychometric Evaluations

Five psychometric properties were evaluated. Descriptive statistics were used to assess feasibility (acceptability of the CTAS instrument by paramedics) and face validity (does the CTAS logically appear to measure the concept it intends to measure). Although paramedics strongly indicated they did not want to see the CTAS instrument as standard of care and the time to use the instrument was too long, the identified relationship of CTAS category to outcomes suggests that the instrument is usable (Table 12). A Cronbach's alpha was evaluated to assess unidimensionality (internal consistency) between the CTAS and the ESI. According to Nunnally (1967, p206), "reliability is the extent to which measurements are repeatable and that any random influence which tends to make measurements different from occasion to occasion is a source of measurement error." Therefore, although the Cronbach's alpha is one estimate of reliability, the estimates of reliability used depend entirely upon the source of variance or error included in the analysis (Cortina, 1993). According to Landis and Koch (1977) six levels of goodness of agreement, a Cohen's kappa of -0.003 indicated poor agreement between the CTAS and the ESI. This is contradictory to the hypothesis of the study that the two instruments would agree with each other and outcomes. However this data supports the idea that paramedics can use the CTAS instrument with some level of accuracy since the ESI did not correlate as well as the CTAS with outcomes. The lack of correlation of the two instruments provides strength to the relationship of the CTAS to outcomes. Multivariate regression tables were assessed to determine support for convergent validity, which is a form of construct validity that identifies the degree of relationship with another measure of the same construct, while sensitivity and specificity tables were used to assess concurrent criterion-related validity, which evaluates the extent the CTAS agrees with the ESI, which is the reported superior instrument.

Six psychometric properties were NOT evaluated with this study: reliability or the reproducibility of results across patient presentations; specifically intra-rater which assesses the ability of the same triagist to evaluate patient categories accurately over time or inter-rater reliability which assesses variability among different triagists of the same patient at one time. Content validity, or the extent the CTAS represents the variety of attributes that define the construct of triage, was not assessed. Finally, neither Factor analysis, which is a method of data reduction to identify underlying latent and manifest variables of a concept, NOR support for divergent validity, which is a form of construct validity that assesses the lack of correlation among dissimilar instruments, was conducted.

Chapter 5

Discussion

Paramedics are an integral component of the modern U.S. healthcare delivery system. They are responsible for the treatment and/or transportation of thousands of patients on a daily basis. The foundational goal of this frequent interaction is to transition the patient from a place where they feel unsafe or unwell to the emergency department (ED) where they can receive, in a timely fashion, the care their specific situation warrants. During this transition, paramedics have tremendous opportunities to provide emergent and lifesaving interventions, alleviate pain, reduce emotional distress provide a safe environment, offer professional guidance regarding community resource availability, and promote healthy living and wellness. Additionally, paramedics have the chance to prepare the patient and the receiving facility, to their fullest potential, so that the transition from an external, unstable environment to the internal safety of the healthcare system is free of error and inefficiency, promoting optimal outcomes.

Paramedics often work in some of the most extreme situations imaginable including harsh weather, violence, threats to personal safety, fire, weapons of mass destruction, chemical and biological warfare, fast moving traffic, extremes of elevation, threats of collapse and many others. They also are responsible for the provision of care in these extreme situations to any person of any age at any time or location in which it is requested. To be successful, paramedics must have significant confidence, trust and critical thinking skills, using strong interpersonal and intra-professional communication to protect life, limit loss and improve outcomes as they transition care of patients to nursing and medical staff in the ED. This collaborative yet complex, inter-professional and intra-professional relationship is of paramount importance to ensure a smooth transition of care to the nursing and medical staff. This transition of care must be efficient, while at the same time provide accurate information regarding the evolution of the patient's situation from the initial point of contact to the point of transition, including all aspects of care and related changes in condition. The amount of data to be processed by paramedics in a short amount of time is substantial.

In a majority of states, paramedics are part of the department of transportation. All states use some form of certification that includes didactic and hands-on components designed to prepare the individual for a career as a professional paramedic. The IOM, in 2007, affirmed its position that paramedic protocols must move from a design that is primarily based on physician interpretation or opinion to one that is based on scientific evidence. The IOM is specifically interested in prehospital triage of patients by paramedics. Many studies suggest that paramedics are unable to triage patients, often citing limited training or inability to think critically independently or when using a nurse-based 3- or 5-level instrument (Levine, Colwell, Pons, Gravitz, Haukoos & McVaney, 2006; Brown, Hubble, Cone, Millin, Schwartz, Patterson, Greenberg & Richards, 2009; Buschhorn, Strout, Sholl & Baumann, 2012; Cone, Benson, Schmidt & Mann, 2003; Kaveci, Demircam, Keles, Bildik & Aygencel, 2012).

The findings from the current study strongly indicate that paramedics can triage emergency patients; in fact, they can use the CTAS instrument quite well. Considering the evolution in paramedic training programs and the breadth and depth of skills necessary to perform their role, it is imperative that future studies more thoroughly evaluate triage in the pre-hospital environment to understand better the many factors that impact paramedics' abilities to evolve and succeed as active team members in one area of entrance to a complex healthcare system.

Considering the demands by the IOM and a lack of understanding in the current literature of paramedics' abilities to triage, it is important to critically analyze the results of the current study in relation to care delivery as a holistic, system-based model. First, the instruments used were the two most comparable available. Both used a 5-level measurement method, shared similar category definitions and had been proven extensively in the literature to be both reliable and valid when performed by nurses. Paramedic exposure to nearly 150 different diagnostic impressions during this study speaks to the wide range of situations in which they are expected to function. It is likely that the number of diagnostic impressions would have been much larger if data were provided by the second hospital system, as the demographics of paramedics and patients differ geographically.

Model Analysis

The first specific aim of this dissertation study was to determine, using a hierarchical multinomial logistic regression analysis, if the CTAS system, when used by paramedics in the prehospital environment, positively correlated with the ESI system used by nurses in the ED or if the CTAS was able to predict disposition status. The model chosen for analysis included patient age, years of full time paramedic experience, paramedics' total years of education, the CTAS system and the ESI system. The overall model was significant in that it predicted 61.5% of all admissions and 82% of remaining outcomes with an overall predictability of 73.7%. Individually, patient age was a significant predictor of admission. For every one-year increase in patient age the likelihood of admission decreased 3.3%. This suggests that as patients age they are more likely to use emergency services, possible for inappropriate reasons including: fear, increased number of comorbid factors, social inequalities, financial burdens, the lack of a PCP or inadequate education in regard to the progression of their chronic disease state. The results demonstrate that paramedics, with training, can adequately use the CTAS instrument.

The first MLR analysis for the CTAS and ESI in which the categories were not recoded, but included paramedic demographics, demonstrated a correlation of the CTAS to the ESI; however the CTAS was more predictive of outcomes than was the ESI. When used by paramedics the CTAS instrument demonstrated slight correlations with the 'silver standard' ESI instrument however the data further indicates the CTAS was more predictive of outcomes than the ESI. Therefore, the hypothesis for aim 1 that the CTAS was able to be used by paramedics and is predictive of outcomes was proven true. The MLR model, which analyzed the full CTAS and ESI without paramedic factors found similar results demonstrating CTAS categories 2, 3 and 4 and ESI categories 1 and 2 were significant predictors of admission while CTAS 1 and ESI 3 and 4 were not. Interestingly, paramedic factors, when applied to the model increased the accuracy of the CTAS measure while decreasing the accuracy of the ESI measure.

Another factor in the model that impacted admission prediction was the total years of experience by the primary paramedic. For each year of paramedic experience the likelihood of admission decreased by 5.9%. This data indicates experience increases the paramedics' ability to more accurately assess and manage patients' acute or chronic needs. Further analysis in regard to this revelation is warranted to determine if the training programs differed in relation to any recent system wide changes at the state or federal level or if simply more patient contact equates to improved practice. Paramedic training systems must evaluate an increased focus on clinical experience. The elderly population in the U.S. continues to expand with increasing reliance on emergency services for care. This dramatic increase in the elderly population will create a significant challenge to paramedics in regard to the multitude of comorbid factors for which patients are managed. Additionally, the aging population will further strain the emergency response system as evidenced by increased reliance on and use of the ED and emergency services. Public safety and paramedic training systems are facing an evolution in demands for care. Further studies in varying regions and systems should be conducted to further evaluate how age, comorbid conditions, experience and training impact outcomes.

Interestingly, paramedic total years of education were not a significant predictor of admission. This suggests that hands-on experience is more important than extensive post-secondary education in the provision of prehospital care. The need for increased hands-on experience creates the potential for a collaborative training program where paramedics and nurses work and train together in reciprocal environments. Education programs may need to evolve to create these opportunities. Another strategy to evolve paramedic experience is to scientifically evaluate benefits of a blended nurse/paramedic training program where paramedics have increased patient care time during their initial training while nurses have exposure to paramedic training and working environments to improve situational understanding. The hierarchical model correctly predicted 61.5% of admission with all remaining dispositions predicted with 82% accuracy. The overall model correctly predicted 73.7% of the admission variance.

Additional factors were noted that further described the impact the ESI and the CTAS had on disposition. The ESI category 3 discharge rate was nearly 73% suggesting there is an extensive amount of over triage that occurs. Comparatively CTAS category 3 had a more balanced admit/discharge rate of 44.8% and 55.2% respectfully. The ESI system was more predictive of discharge in category 4 and 5 than was the CTAS system as the ESI saw 94% of category 4 and 87.5% of category 5 patients discharged while only 57.9% of CTAS category 4 patients and 74.8% of category 5 patients were discharged. These data suggest that the ESI system performs better than the CTAS among category 4 and 5 patients however both are highly predictive of outcomes. It is important to note that no patients in either the CTAS or the ESI system categorized as emergent, urgent, semi-urgent or non-urgent died. Overall, the model explained 34.9% of the admission variance with patient age explaining 14.7%, the CTAS system explaining 12.3%, the ESI system explaining 6%, paramedic years of experience explaining 1.5% and paramedic years of education explaining 0.4%. These data suggest significant other factors remain that impact outcomes thus supporting the need for further research in an attempt to more accurately predict outcomes.

Survey Evaluation

The goal of the second specific aim was to evaluate the usability of the CTAS instrument using a written survey and demographics data provided by the paramedics. Although paramedics strongly indicated that they did not feel the CTAS instrument was related to their training, was not easy to use and did not want it to be a part of the standard of care, the success of the instrument's predictability of disposition status strongly suggests further studies are indicated to evaluate the usability of the CTAS instrument in the prehospital environment. These studies should evaluate if paramedics became certified willingly or were forced as a job requirement within the fire service. Secondly, the information from the 6-D survey demonstrated a significant knowledge gap among paramedics in relation to the role they play within a collaborative, holistic and intra-professional team based system of care.

The surveys also produced several interesting points of data that are likely related to a previous relationship the PI had with the CFD. Participants had the opportunity to write on the surveys, some of which included negative comments possibly related to previous relationships with specific division employee(s). These few comments suggested the paramedics were angry at the researcher's departure from the division. Several of the surveys returned had all negative remarks for the survey component; however, it appeared they answered the 6D questions more accurately as evidenced by the variation of responses. It also was noted during the on-site training that many past co-workers were disappointed with the PI's career change. It stands to reason that these feelings may have had an impact on response rates and the responses themselves. Future studies should be evaluated in a fire or EMS division in which the PIs involved have no employment history or relationship.

Despite the hidden challenges to the survey, the 6-D data provided a unique view of paramedics' opinions of their job expectations and abilities, which has not been evaluated previously. This critical analysis sets a strong foundation on which future studies can focus so that researchers and administrators can better understand the dynamics involved that impact daily operations of EMS services, including the use of instruments to improve care. It is well known that paramedics are involved in extreme situations and are required to provide care to critically ill and injured persons; however, until now, researchers did not have a clear picture of how often or how well paramedics felt they performed job-related tasks. For example, this study produced very interesting results regarding paramedics' interpretations of their roles in the provision of emotional support. Over 32% of paramedics in this study felt they were not expected to or rarely recognized the emotional needs of their patients. In addition, nearly 20% felt they were not expected to or rarely provided emotional support. Emotional support is a major factor in healthcare today and is often included on post-care surveys by healthcare systems in an effort to improve the provision of customer service.

Should EMS delivery systems be concerned about customer satisfaction? It is rare that competition exists for 911 services, so the question becomes one of a moral and ethical consequence, not one of a need for users to generate revenue. Interestingly, despite the data challenging the provision of emotional support, over 75% of paramedics felt that when they provided emotional support they did it well or very well. Additionally, paramedics felt that over 69% of the time they performed well or very well in the recognition of the emotional needs of their patients. Should public safety systems dedicate a component of their job performance reviews to meeting customer satisfaction? The data suggest that there exists an opportunity for public safety systems to dedicate components of their training systems to the provision of customer service, including the provision and analysis of methods, divisional expectations and the impact satisfaction has on outcomes.

In support of the paramedics involved in this study, over 93% indicated that they occasionally or frequently performed emergency procedures which is the backbone of paramedic training programs and system expectations, with 84% indicating they used mechanical devices well or very well and 82% indicating they performed care for critically ill patients well or very well. The obvious reported strength in critical care assessment and management is one of the core foundations necessary for a safe and effective public safety healthcare system. These data support the common idea that paramedics are very good critical thinkers who have an extreme passion for the extremes, but often lose focus on more personal aspects of the provision of professional care.

Paramedics are a group of professionals operating within the grand system of healthcare. First responders have a strong sense of pride in their profession. Accordingly, the data from this study demonstrate strong interpretations of paramedics' self-reported professional development activities. For instance, 84% reported displaying a positive attitude, 86% that they demonstrate a strong knowledge of the ethical factors related to their job, 87% that they accept responsibility for their actions, and 82% that they maintain a high standard of performance. Considering many of these professionals during the course of a standard 24-hour shift often miss meals, rarely get more than 3 or 4 hours of sleep and are frequently berated verbally, their ability to maintain this strong sense of self-respect and pride speaks volumes regarding their levels of professionalism.

Leadership qualities are a central component common among paramedics and first responders. Leadership is a quality necessary to maintain control of extreme situations often encountered during the provision of care. Patients who call 911 when something in their life is out of control expect paramedics to assert some form of control over the situation. Whether it is to control patients' levels of pain, restart their stopped hearts or make their breathing easier, patients simply want and expect a strong intervention by paramedics. This idea was supported by findings from the current dissertation study. Over 70% of paramedics indicated, either occasionally or frequently, that they gave praise and recognition to those with whom they interacted. Additionally, 77% occasionally or frequently provided guidance to other team members, while 87% remained open to suggestions from others. Supporting the presence of leadership qualities, paramedics indicated they performed several components of leadership well or very well, including giving praise and recognition (58%), delegating responsibility (82%) and remaining open to suggestions (83%). These data support the idea that paramedics are professional leaders who demonstrate acts of delegation, recognition and openness, all of which are qualities of a professional.

A central component of leadership is efficient and effective communications. Although paramedics indicated that they occasionally or frequently promoted inclusion of the patient (80%), promoted patient rights (88%), helped patients meet their needs (75%) and communicated their feelings (81%), paramedics seemed to have some difficulty with how well they performed those tasks. Over 27% of paramedics indicated they were only satisfactory at best in communicating a feeling or emotion. This limitation may play a role during the provision of care, especially if the paramedic has feelings of inadequacy or lacks confidence. Additional self-reported factors that were not performed well by paramedics included using opportunities for personal or professional interaction (20%), explaining procedures to patients (25%), promoting inclusion of the patient (30%) and using opportunities for teaching (23%). These data suggest that there exists a tremendous opportunity for public safety systems and administrators to provide staff education regarding the importance of communication. These strategies go hand in hand with the delivery of customer service. Educational opportunities in one component may have a positive impact on the other.

Planning and evaluation strategies are another central component to the provision of safe and effective care. The ability to develop a plan of care, based loosely on standard protocols, in an emergent situation is a critical skill necessary for paramedics in the prehospital environment. The plan of care is initiated in the field by paramedics and continued by nursing and medical staff upon arrival at the hospital. Bringing together the application of critical care with strategic planning and evaluation strategies are essential in the promotion of improved outcomes.

Interestingly, paramedics indicated they were not expected to, seldom or not very well able to coordinate a plan of care, identify changes in patient conditions, initiate planning with others or evaluate the results of the care they provided. These results suggest a tremendous knowledge gap in the understanding of the role paramedics play in the global healthcare system. These data support the idea that paramedics often believe they are separate from the hospital system and their interaction has no impact on the overall outcome of the patient, other than those outcomes involving a critical intervention. It is imperative that paramedic training systems further analyze programs to ensure future paramedics are made aware of their roles in the entire healthcare system. Paramedics are the first step in the systems theory approach to emergency care. An analysis of both nursing and paramedic training programs should be conducted to identify similarities and differences. This analysis may identify significant overlap that will allow for the implementation of cross-training in each curriculum to improve the efficiency and effectiveness of both professions.

Teaching and collaboration are major components of nursing. Each patient interaction is an opportunity to improve a patient's situation using a collaborative team approach to health promotion. Paramedics have incredible opportunities to interact with patients in their homes. Paramedics see patients' living conditions more frequently and better understand the living situation and appreciate the social challenges simply by being in the patients' homes. It stands to reason that nursing should investigate ways to promote and improve these interactions, especially from a health promotion viewpoint. This approach might maximize compliance with PCP guidelines and outcomes in relation to their acute or chronic condition while reducing admission rates. Unfortunately, data from this study indicate that paramedics do not appreciate teaching opportunities that they may experience on a daily basis. For example, 34% of paramedics indicated that they were not expected to or seldom provided preventative health information. This is a lost opportunity to improve overall health. Additional factors that paramedics indicated were not expected of them or that they rarely performed included developing innovative methods, encouraging family participation, planning an integration of needs, identification of community resources and adapting teaching methods to a patients' specific need. Further hindering the opportunity to deliver daily preventative care through teaching and collaboration, paramedics felt they either not very well or only satisfactorily taught patients' families, adapted a teaching method to meet a patient need, encouraged family participation, planned an integration of needs or communicated facts and ideas. These data suggest that there is a tremendous gap in paramedic training programs. Further research is indicated to identify paramedics' interpretations of their role as promoters of preventative health more clearly.

Significance to nursing

The ED is frequently chaotic, with multiple complex and stressful interactions occurring simultaneously. Of particular concern within this environment is the handover of patient information from paramedics to the emergency nurse in the ED (Bruce & Suserud, 2005). The 2013 ENA position statement on patient handover and transfer suggests the development and utilization of standardized approaches to facilitate safe and effective handover are necessary to reduce or prevent medical errors directly and indirectly related to communication. It is important to note that, considering in excess of 15% of all patients treated in the ED arrive by ambulance, the ENA also states that handoff/transfers should occur between caregivers of equal or higher levels of knowledge, skills and clinical judgment, indicating the recognition of the level of training of paramedics to some degree.

Triage as a system for managing the health care needs of clients in the emergency department has become tremendously inefficient. Triage systems can no longer take the position that all clients presenting for care should be compared to wounded soldiers in times of war. Except during times of mass casualty or disaster, EDs and paramedics infrequently have a scarcity of resources when actual need and urgency are applied to those seeking healthcare in the ED. This is because a large portion of persons seeking emergency care are not medically appropriate for the delivery method chosen. Reassurance as the simplest form of care is often overlooked all while a tremendous financial burden is being inappropriately applied to a struggling economy by misuse of medical services by the insured and uninsured alike. Simply put, an individually perceived emergency does not equate with or demand the need for emergency care. Health care professionals have a moral and ethical obligation to address the challenges facing resource use appropriately. Confusion within the system itself regarding the identification of the most critical and unstable clients, in contrast with the most common reasons for actually seeking care, has created a tremendous gap wherein nurses and clients alike find themselves confused, frustrated, angry and disappointed. Over-reliance on the ESI system may be creating gridlock in the ED, something with which healthcare systems regularly struggle. Excessive over-triage rates are a hindrance to throughput, create tension-filled environments, inhibit positive customer experiences and adversely impact outcomes. Further studies are warranted to evaluate changes to both the CTAS and the ESI system to develop more accurate methods of triage.

Paramedics play an integral role in the systems model of healthcare delivery, specifically within the input component of the ED. Accurate early recognition of the potential for admission may help nurse managers improve throughput efficiency, customer satisfaction and outcomes. Despite past concerns regarding paramedics' inabilities to use nurse-based 5-level triage systems accurately, this dissertation study shows that paramedics, with minimal instrument training, are capable of not only using the instrument, but also using it with significant accuracy. Nursing is at a critical juncture in the delivery of emergency care. It is imperative for professional nurses and professional paramedics to work collaboratively in the delivery of emergency care. The data in this study indicate an evolution in paramedic training programs is desperately needed. Who better to lead the evolution than emergency nurses? Transitioning paramedics from curricula designed by the department of transportation or the department of public safety to one that is more centered on the provision of emergency nursing and medical care will function as the cornerstone in the necessary evolution of prehospital care.

Limitations

Several limitations may have had an impact on the results of this study. The study used written surveys instead of an electronic format. Although the literature indicates paper surveys often generate increased participation, it stands to reason that the electronic format option may have increased the response rate (Asch, Jedrziewski and Christakis, 1997). Additionally, the sample size was reduced dramatically as a result of delayed IRB approval at participating sites, ultimately causing one participating site to completely drop from the study. This delay caused the omission of an estimated 2,500 cases. These missing cases, which would have included vastly different patient and paramedic demographics for analysis, may have produced alternative results that may have impacted conclusions. The omission of two months of data because of the delayed installation of the hard stop that required CTAS scores in the paramedic ePCR Toughbook computing system also caused a significant reduction in sample size (estimated 6,600).
Paramedics indicated, by writing on the paper surveys, that they were frustrated with the initiation of the study without requesting input from them before starting data collection or training. The frustration voiced in writing by paramedics suggests they may have portrayed their frustration to their opinion of the instrument, possibly causing an inaccurate assessment of perceived CTAS instrument usability. In addition, some of the comments on the surveys suggested disappointment and frustration among paramedics in

relation to the PI, who was once a member of the CFD and chose to leave the division to pursue scholarly research. This frustration also may be related to paramedic status within the CFD. Many current CFD participants were forced to become paramedics to meet the demand for staffing guidelines. Future analyses should attempt to involve a more diverse fire division that involved willing participants with positive interest in the provision of prehospital care. Also, the number of surveys received did not meet the minimum sample size necessary to power the study appropriately. In addition, the CTAS instrument did not have enough category 1 patients while the ESI did not have enough patients in categories 1 and 5.

This study was conducted within one career fire division in central Ohio. Data were only provided by two of the nine total hospitals in the geographic region. The majority of paramedic respondents may have come from a small geographic region near the two participating facilities. Combined, these data may have an impact on outcome and usability analysis. Study results may differ among geographically different agencies, independent EMS agencies, combined volunteer and career fire divisions, and all volunteer divisions. Another factor that may have had an impact on the results is the strength or weakness of the fire or EMS division medical protocol. Because protocols vary among agencies, it is possible that treatment and transport guidelines may impact the use of the CTAS instrument. Concurrently, as protocol content varies, so too may the behavioral norms and expectations of the paramedic participants who may or may not feel they have a role in a holistic healthcare system. Further studies are indicated to develop a better understanding of how behavior impacts prehospital management.

Finally, despite the proposed inclusion of children, very few were included in the sample. The cause of the reduced sample of children is likely related to non-involvement of the primary children's hospital located geographically near the participating facilities. The influence of transport protocols for children to go to the children's hospital likely reduced the sample size. Future studies should seek to include a tertiary pediatric care center.

Summary

Despite the data showing a strong push back regarding the perceived use of the CTAS instrument, the data suggest a moderate correlation with the ESI instrument, although notable variation between the instruments exists. The CTAS also was a significant predictor of disposition, with a 4% larger impact than the ESI in the overall regression model. Further studies are necessary to understand better the impact early application of the CTAS instrument may have on throughput and, ultimately, outcomes. Future studies should focus on implementation of the study within agencies and communities having varying populations of service type, patients and paramedics.

In addition to the significant CTAS results, the results of the 6-D scale strongly indicate there is a knowledge gap among paramedics regarding the purpose and significance of paramedics in the overall systems model of healthcare delivery. Despite feeling quite efficient and effective at performing technical skills and participating in leadership activities, paramedics indicated they were inefficient and rarely provided emotional support, evaluated a plan of care for the patient, included the family or promoted a collaborative interdisciplinary team. These data indicate that further studies are necessary to understand better this tremendous knowledge gap in performance expectations. Paramedic training programs should take note of these results and, in collaboration with state and federal agencies, make adjustments to their standard training curricula. Understanding their roles as collaborative team members in a holistic approach to care will potentially improve paramedics' performance and patient outcomes.

Conclusion

Triage, in emergency care, is a vital component of the health care delivery system. History has demonstrated and the IOM has demanded the ED has and should continue to function as a "safety net" and primary entry point for primary care, which ultimately increases use rates. Because of this and other causes outside the scope of this research, health care facilities will continue to write off millions of dollars annually as a result of unreimbursed care in the ED. It is imperative for health care systems as a whole to look outside the standard areas of practice to identify new systems of care management in an attempt to manage care seeking behavior effectively.

This study demonstrates usability of the CTAS 5-level triage system by paramedics, with comparable or better accuracy than ESI instrument in terms of disposition status of the patient. There exists additional potential to expand the use of paramedics through restructured training programs that include an emphasis of the role paramedics play within the overall care delivery system. Although further studies are warranted, paramedics may be able to use nurse-based triage instruments accurately with only minimal training. Increasing awareness of the impact paramedics' interventions have on outcomes, while providing the methods and training necessary to adjust their practice, creates a significant opportunity to improve community health. The data within this dissertation study indicate a significant education gap exists within paramedic training that vaguely addresses the importance of collaborative and holistic care planning, as well as an emphasis on prevention and education. Nurses are at the front line of this paradigm shift and have an excellent opportunity to change the way professional, evidence-based emergency care is provided. It is important for the profession of nursing to evaluate scientifically care delivery models that incorporate advanced practice nurses and paramedics, working collaboratively in the field, to promote wellness, prevent illness and maximize throughput in the ED.

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