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Level 2 and Level 3 Patients in a 5-Level Triage System: Factors Related to Acuity Assignment and Trajectory of the Emergency Department Experience

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Level 2 and Level 3 Patients in a 5-Level Triage System: Factors Related to Acuity Assignment and Trajectory of the Emergency Department Experience

by

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DISSERTATION

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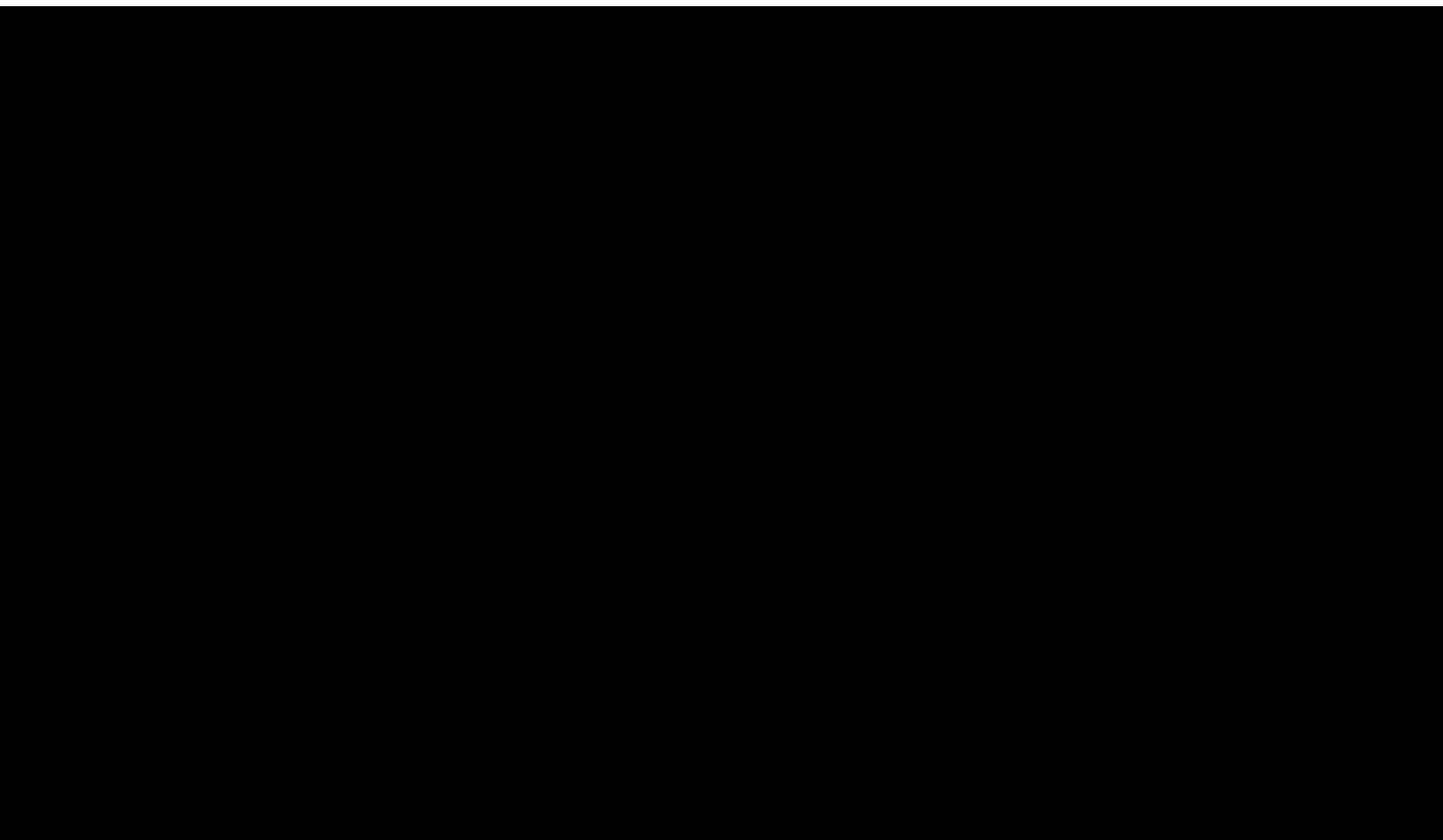

ABSTRACT

Level 2 and Level 3 Patients in a 5-Level Triage System: Factors Related to Acuity Assignment and Trajectory of the Emergency Department Experience

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Clinical decision making in the emergency department (ED) can have a significant impact on patient safety and health care outcomes. One type of clinical decision making is the process of emergency department triage. Within the context of the 5-level Emergency Severity Index triage system, it is not known what factors influence patient assignment by the triage nurse to ESI acuity levels 2 and 3. To increase the validity of patient assignment to levels 2 and 3, more explicit criteria are needed.

Purposes: 1) Describe factors that influence triage nurse assignment of patients to level 2 and level 3; 2) Examine the relationship between group membership (level 2 and Level 3) and specific patient factors; and 3) Describe the emergency department trajectory for patients assigned at triage to level 2 or level 3.

Methods: This prospective study used a convenience sample of 18 nurses from two large emergency departments. During the triage process, if the patient was assigned to level 2 or level 3, the nurse completed a Triage Questionnaire. The PI then continued data collection on these patients as they progressed through the emergency department experience to final diagnosis and disposition.

Results: A total of 334 Triage Questionnaires and patient charts were used for data analysis. Nurses rated patient age, vital signs, and the need for a timely intervention as significant factors influencing patient assignment to level 2, and number of expected resources as a significant factor influencing patient assignment to level 3. Influencing factors that did not reach statistical significance, but were nonetheless clinically important, included patient chief complaint, past medical history, additional symptoms other than patient chief complaint, and patient presentation. Resource use was significantly different for patients assigned to level 2 compared to level 3.

Conclusions: This study was able to identify specific, objective factors that are important in clinical decision making when determining patient severity of illness and time to treatment. Those factors could be used by less experienced nurses to assist in differentiating which patients could potentially be in a high risk situation, and should therefore be assigned to level 2 rather than level 3.

Advisor and Chair of Dissertation Committee:

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CHAPTER ONE: PROBLEM AND SIGNIFICANCE

Introduction

Clinical decision making (CDM) is a form of inquiry that includes the thought processes involved in making decisions within a clinical setting (Kovacs, et. al., 1999). The major goal of the clinical decision making process should be accuracy; however, clinical decision making involves probabilistic judgments that are at risk for being inaccurate (Dowding & Thompson, 2004; Lunney, 2003). Accuracy is defined as having no errors, being correct, and deviating only slightly while staying within acceptable limits from a standard (Hastie & Rasinski, 1988). In a study of clinical decision making, accuracy refers to a patient's condition or situation as determined by the quality of information gathered (Patel, et al., 1991). Accuracy of clinical decision making in the emergency department (ED) is critical to quality care and patient safety and has a significant impact on health care outcomes and patient experiences (Cioffi, 1998; Cooper, 2004; Cosby & Croskerry, 2003; Croskerry, 2003). Clinical decision making specific to the ED setting has the unique characteristics of time constraints and lack of previous exposure to the patients presenting for treatment. These characteristics create situational complexity and uncertainty in the decision-making process.

One type of clinical decision making in the ED is the process of triage. Triage is defined as a sorting process for the purpose of prioritizing treatments for multiple patients seeking care simultaneously, while placing emphasis on expediting time critical treatments (Wuerz, Fernandez & Alarcon, 1998). The primary goal of triage is to decrease morbidity and mortality for all ED patients by ensuring that patients with life-threatening conditions are quickly identified and treatment is started (Emergency Nurses

Association, 2001). The expert nurse relies on his or her individual subjective judgments, called intuition or heuristics, to decide on the appropriate action for a specific clinical situation (Benner, 1984). Intuition and heuristics incorporate strategies for dealing with large amounts of information by using constructs such as past experience, insight, and experiential knowledge to recall patterns of information and gain understanding of specific situations. Expert nurses tend to view algorithms and protocols as decreasing their options and suppressing their ability to accurately assess patients (Cone & Murray, 2002; Zimmerman, 2002).

In contrast to an intuition approach to the clinical decision making process of triage, more recently, instrument driven triage systems have been developed and tested. For example, the Emergency Severity Index (ESI) is an analytic approach meant to provide a standardized algorithm for the triage process and provide knowledge and/or expertise for less experienced nurses. Algorithms or protocols use a systematic approach that seek to maximize the quality of decisions by critically evaluating the known options or choices utilizing probabilities and utility estimates, then using these data to choose the best outcome. This approach is particularly useful for situations where critical thinking involves complex, unique situations that are value laden, as is true in clinical decision making in the ED (Doubilet & McNeil, 1988).

Analytic and intuitive approaches to decision making are effective as long as they are utilized in situations that maximize their strengths and minimize their weaknesses. Analytic processes are more efficient in controlled, well-structured, “scientific” situations where time is not a limiting factor and a more linear, logical thought process is in order. Intuitive processes are better in situations of uncertainty where decision making reflects a

more non-linear process, tasks are ill-structured, decision making must be quick and decisive, and individual expertise would be the most efficient method for resolution (Croskerry, 2000). However, analytical and intuitive approaches to decision making only describe how clinical decision making processes can be structured. It is essential that the healthcare provider come to the clinical situation with a firm grounding in experiential knowledge to facilitate the formulation of hypotheses or judgments that will allow the best decision to be made. The current emphasis on evidence-based practice for decision making is reflective of the present day thinking that healthcare providers are expected to combine individual clinical expertise acquired through experience practice (intuitive approach) with the best available external evidence derived from systematic research (analytical approach) (Thompson, 2003).

Significance

Increasing use of emergency departments nationwide has created overcrowding in most hospitals in the US, a phenomenon that is an emerging threat to public health and patient safety (Lambe, et al., 2003; Trzeciak & Rivers, 2003). Contributing factors to ED overcrowding, such as lack of available in-hospital beds and variable turn around times for diagnostic testing, are complex and not easily managed because they tend to be interrelated within the hospital setting, as well as influenced by external factors such as lack of patient access to primary medical care that leaves the patient no other avenue for medical care (Derlet & Richards, 2000; Lambe, et al., 2002). Between 1990 and 2000, ED visits by “critical” or “emergent” patients increased 59%, while visits by “urgent” patients increased 36%, the urgent category accounting for the largest proportion of total ED visits (Derlet, et al, 2001; Lambe, et al., 2002). Emergent is defined as a patient who

needs immediate medical intervention due to severe threat to life or limb (ENA, 2001). Urgent is defined as a patient with a medical condition that would not be expected to deteriorate or harm that patient if medical intervention was delayed up to 10-15 minutes (Travers, et al, 2002).

As the United States population ages, ED patient volume and acuity increases, with persons age 75 and older having the highest rate of ED visits (McCaig & Burt, 2004). In 1990 there were approximately 10 million US citizens age 75 and older, and this number is projected to increase to 23 million by 2030 (US Census Bureau, 1996). Newly arrived ED patients whose condition is consistent with evaluation and intervention within a short time frame may be at risk for an adverse event if the ED lacks capacity or resources to provide it within a timely fashion. In addition, more patients are using ED resources for extended periods of time, and even "admitted" patients continue to utilize ED beds and resources when there are no available beds in the hospital.

The effects of ED crowding include the potential for inaccuracy in decision making due to limited time frames for clinician-patient contact, delay in patients receiving appropriate treatment in a timely manner, decreased quality of care with increased risk to patient safety and the occurrence of poor health outcomes, increased patient and family dissatisfaction, and frustration among the medical and nursing staff (Derlet, Richards & Kravitz, 2001). Although it may be difficult in an overcrowded ED setting, it remains essential that patients are assessed and assigned triage scores that accurately reflect their severity of illness in order to assure they receive safe, quality care.

Statement of the Problem

Research literature specific to the ED triage setting describes a challenging environment that has lacked consistency and reliability related to the clinical decision making process. Although models exist for clinical decision making in nursing, a framework specific to ED triage has not been well conceptualized in the literature. One of the major obstacles is a lack of consensus on what relevant outcomes need to be measured (Cooper, 2004; Fernandez, et al., 2005a).

Over the last 10 years, much ED triage research has focused on the outcome measure of "triage score", defined as the ranked priority for treatment, and how this score affects the subsequent patient disposition and patient satisfaction with the ED experience. One of the factors affecting that score is the expertise and ability of the nurse to perform CDM. Guidelines for practice from the American College of Emergency Physicians (ACEP) and the Emergency Nurses Association (ENA) indicate that triage assessment should be performed by experienced registered nurses with proven clinical judgment and decision making skills. The nurse's expertise in CDM is crucial to the accuracy of the triage process, yet the majority of studies related to triage scoring do not adequately describe the qualifications or clinical decision making ability of the personnel studied making the validity and reliability of the study findings problematic. In addition, research findings have shown a lack of adequate training and/or variability in educational requirements for healthcare providers performing triage (Chung, 2005; Gerdtz & Bucknall, 2000; Goransson, Ehnfors & Ehrenberg, 2005; Keough, Schlomer & Bollengerg, 2003). If the nurse lacks the CDM skills necessary to recognize that a patient may be experiencing a serious medical problem within a momentary presentation of

stability in triage, the patient may experience a significant delay in treatment, ultimately creating a potential for acute deterioration and adverse outcome. Finally, the nursing shortage has limited the availability of mentoring and the ability to have resource nurses readily available who can answer questions and provide clinical expertise (Simmons, Lanuza, Fonteyn, Hicks & Holm, 2003).

The Emergency Nurse's Association (ENA) (2001) has published a Triage Curriculum Module that contains education material and recommendations for nursing triage. ENA recommends a "comprehensive" triage taking 2-5 minutes, however Travers (1999) found only 22% of triage assessments (57/260 patients) met the ENA standard for a time to completion of less than 5 minutes. Another significant finding of Travers' study was that the length of triage time from start to completion was related to patient age. As expected, older adults were more likely to have complex medical conditions, take multiple medications, and the severity of their illness was difficult to assess within a brief interaction time frame. Gerdtz & Bucknall (2001) examined the impact of patient and nurse variables on the duration of triage nurse decision-making, and found triage times (the outcome measure) consistent with Travers' study.

The American College of Emergency Physicians (ACEP) and the Emergency Nurses Association (ENA) state that triage assessment should be performed by experienced registered nurses with proven clinical judgment and decision-making skills. Little is known about the actual process of how clinical decision making during triage is performed (Goranssen, Ehrenberg, Marklund & Ehnfors, 2006). Research findings from studies with retrospective designs, simulations and scenarios have not translated well to real time clinical settings. Clinical decision making using simulations or patient paper

scenarios do not accurately reflect the real time clinical situation that may include interruptions, inability to obtain important information from the patient, or patient visual cues that may aid in the decision making process. In addition, retrospective and scenario designs are limited in the type and amount of information that can be obtained from the patient, with no ability to gather additional information if it is deemed important for making an accurate decision. Therefore, prospective, real time study designs that take place within the ED setting should be the focus for research related to the triage process.

There are available instruments that have been tested that measure real time clinical decision making situations. These are convenient, practical, and applicable to the ED setting, as well as having usefulness related to the decision making process. One of these instruments is the 5-level Emergency Severity Index (ESI) triage system (Fernandes, et al., 2005). The ESI uses acuity as a proxy variable for severity of illness, severity of illness defined as the risk of mortality or survival (Marcin & Pollack, 2002). Acuity is defined as the degree to which a patient's condition is life or limb threatened and how soon the patient requires treatment to alleviate symptoms (NCIPC, 1997). The ESI stratifies acuity into 5 levels ranging from near death to referral for evaluation at a later time: 1=Resuscitation, 2=Emergent, 3=Urgent, 4=Nonurgent, and 5=Referred. The ESI instrument has demonstrated content validity and predictive validity with the finding that it can predict patient hospital admission and utilization of ED resources (Wuerz, Milne, Eitel, Travers, & Gilboy, 2000). Inter-rater reliability is strong between triage nurses (n=386) (kappa 0.69 to 0.87, Pearson r = 0.83) regarding patient assignment to ESI acuity levels (Eitel, Travers, Rosenau, Gilboy & Wuerz, 2003).

Patients assigned a level 1 acuity require immediate intervention to preserve life or limb, while levels 4 and 5 acuity assignment is decided based on the number of resources the patient will require while in the ED. Resource categories include continuous cardiac monitoring, EKG, laboratory studies, plain xrays, special radiological studies, parenteral fluids or medications, blood administration, mechanical ventilation and specialty consultation. Assignment to level 4 indicates the patient will use one resource, and level 5 none. Factors that have influenced patient assignment to levels 1, 4 and 5 have been studied as part of the ESI validation process (Wuerz, et. al., 2000).

There is a lack of research related to the factors that discriminate between and influence patient assignment by the triage nurse to ESI acuity levels 2 and 3. Level 2 focuses on identifying the high risk patient that needs time sensitive treatment or meets pre-determined criteria, and requires the highest level of clinical decision making within the 5-level system. Patients are assigned to level 3 when it is determined by the triage nurse that they are not at high risk however will require two or more ED resources. The major gap in the testing of the ESI is that factors which may influence clinical decision making and acuity assignment by triage nurses, such as, nurse education or experience, patient characteristics, or the clinical environment, have not been studied. These factors are directly relevant to the nurse-patient interaction, which is the foundation of the triage process.

Information guiding the decision of the triage nurse for patient assignment to ESI levels 2 or 3 includes pre-established criteria by consensus opinion of the ESI Triage Group (Table 1) and the nurse's clinical experience. Currently there is no other information available to guide the nurse in the determination of acuity level. The stated

ESI criteria are not specific enough to be useful to less experienced nurses and determination of acuity level is open to individual interpretation by the triage nurse. To increase the validity of nurse assignments to levels 2 and 3 the ESI criteria need to be more explicit and be drawn from actual practice patterns and patient characteristics.

Building on the concept of clarifying and defining criteria used for patient assignment, the major aim of the present study is to examine the factors used by triage nurses to differentiate level 2 high risk patients from level 3 lower risk patients, while more clearly defining the overall characteristics and trajectory of level 2 and level 3 patients. This study will address gaps in knowledge regarding the actual use of triage criteria by nurses. Of special interest is a description by the triage nurse of subjective and objective observations related to triage acuity assignment. These components may impact patient safety by providing new information specific to knowledge of factors that can be used to better predict patient severity of illness and thus increase accuracy of triage acuity assignment. Describing the trajectory of level 2 and level 3 patients identifies unique characteristics related to resource needs, times to treatment and/or interventions, and common final diagnoses categories for patients at each level. A secondary aim is to describe the characteristics of patient who experience deterioration in their medical condition or death while in the emergency department. Within the trajectory of the ED experience deterioration in patient condition is not expected, so it is imperative to examine patient characteristics for possible contributing factors to morbidity that could be monitored by the staff.

Findings from this study will be used as the foundation for an educational triage program that teaches nurses different clinical decision making strategies during triage,

especially the process of differential diagnosis, in an attempt to increase the validity of the ESI. Gaining insight into the processes by which healthcare providers make decisions is essential for creating the ability to measure comparable concepts and constructs, as well as providing a transparency that makes the decision making processes visible to other members of the healthcare team, (Buckingham & Adams, 2000a; Cook, Gerrish & Clarke, 2001).

Purpose of the Study

The primary aims of this study are to 1) identify factors that influence the triage nurse's assignment to level 2 and level 3 acuity; 2) examine the relationship between group membership (level 2 and Level 3) and specific patient factors; 3) describe those patients assigned to level 2 or level 3 who experience deterioration in their medical condition during their time in the emergency department; and 4) describe the emergency department trajectory for patients assigned at triage to level 2 or level 3 based on a 5-level Emergency Severity Index (ESI) triage system. A secondary aim is to validate the ESI criteria for patients assigned to level 2 and level 3.

Research Aims and Research Questions

Nurse Characteristics Related to the Triage Process

Research Aim #1: Describe the factors that influence triage nurse assignment of patients to acuity level 2 and level 3.

1a. Are there specific factors that nurses identify as influencing patient assignment to level 2 or level 3?

1b. Do environmental factors influence patient assignment to level 2 or level 3?

1c. Do nurses with less than 4 years of triage experience identify the same factors as influencing patient assignment to level 2 or level 3 as nurses with 4 or more years of triage experience?

Patient Characteristics Related to the Triage Process

Research Aim #2: Examine the relationship between group membership (level 2 or level 3) and specific patient factors.

2a. Is there a difference in assignment of patients to level 2 or level 3 based on patient age?

2b. Is there a difference in assignment of patients to level 2 or level 3 based patient chief complaint?

2c. Is there a difference in assignment of patients to level 2 or level 3 based patient past medical history?

2d. Is there a difference in assignment of patients to level 2 or level 3 based patient medication history?

2e. Is there a difference in assignment of patients to level 2 or level 3 based on vital signs?

2f. Is there a difference in assignment of patients to level 2 and level 3 based on whether they were discharged from the hospital or emergency department within the last seven days?

2g. Is there a difference in assignment of patients to level 2 or level 3 based on the source used to gather patient information?

2h. Is there a difference in assignment of patients to level 2 or level 3 based on the patient's level of pain or distress?

2i. Is there a difference in final disposition for patients assigned to level 2 vs. level 3?

Research Aim #3: Describe the characteristics of patients assigned to acuity level 2 or 3 who experience deterioration in their medical condition or die while in the ED.

3a. Did any patients assigned to level 2 or level 3 experience a deterioration in medical condition or die prior to physician evaluation?

3b. Did any patient assigned to level 2 or level 3 experience a deterioration in medical condition or die prior to final disposition?

3c. Which characteristics as most frequently identified with a patient who experienced a deterioration in medical condition or died prior to final disposition?

Clinical Environment Characteristics Related to the Triage Process

Research Aim #4: Describe the trajectory of patients assigned in the emergency department to acuity level 2 or level 3.

4a. Is there a difference in the average number of minutes from triage to physician exam for patients assigned to level 2 vs. level 3?

4b. Is there a difference in the average number of minutes from triage to first intervention for patients assigned to level 2 vs. level 3?

4c. Is there a difference in the average number of minutes from triage to opioid pain medicine for patients assigned to level 2 vs. level 3?

4d. Is there a difference in types of ED resources used by patients assigned to level 2 vs. level 3?

4e. Is there a difference in number of resources used by patients assigned to level 2 vs. level 3?

CHAPTER TWO: THEORETICAL MODELS AND REVIEW OF THE LITERATURE

Critical thinking and decision making skills are viewed as essential for all healthcare professionals. The ability to engage in critical thinking when providing patient care is considered to be the key component in positive or deleterious outcomes (Thurmond, 2001). The exact relationship between critical thinking and decision making has yet to be clearly delineated; however critical thinking and decision making possess many similar constructs and components, and critical thinking tends to be conceptualized as informing decision making. The thinking process of how decision making occurs can be viewed from an analytical perspective, from an intuitive perspective, or as a shared experience utilizing both analysis and intuition. Decision making involves assessment of a situation utilizing data gathering, formulating judgments based on those data, testing and refining those judgments, and making a decision.

Clinical decision making (CDM) is one aspect of decision making, and within the emergency department (ED) environment, clinical decision making takes on unique characteristics due to the addition of high levels of uncertainty, situational complexity and time constraints. Accuracy is a major goal of the clinical decision making process (Dowding & Thompson, 2003). Triage is the CDM process used in the ED for the purpose of identifying life or limb threatening conditions and prioritizing patient treatment (Wuerz, et. al., 1998). Within the time frame of brief clinical encounters, triage nurses are required to make a large number of decisions about multiple patients not previously known to them while potentially faced with a multitude of competing demands and distractions. Additional factors influencing the decision making process

include patient characteristics such as chief complaint, age, medical history, visual cues, vital signs and communication barriers, nurse characteristics such as education, training and experience, and the method of information collection (Cooper, 2004). Although models exist for clinical decision making in nursing, a model specific to ED triage has not been well conceptualized in the literature. The purpose of this paper is to describe clinical decision making within the emergency department setting, with a specific focus on triage. Theoretical models of decision making will discussed along with relevant review of the triage literature, organized and presented in accordance with the conceptual model of the triage process presented later in this paper.

Critical Thinking and Decision Making

Critical Thinking

The essence of critical thinking, its conceptual framework and constructs, have been debated by philosophers for centuries. According to Cody (2002) critical thinking was envisioned as an isolated activity, with a lone individual utilizing analytical reasoning and logic to gain knowledge and truth. This image perpetuates the unrealistic expectation for attainment of perfect knowledge, the critical thinker striving to possess the ability to deal correctly and effectively with any situation. Cody goes on to define critical thinking on a philosophical level as "the application of reasoning and reflection to a variety of situations and discourses, along with the ability to identify evidence for one's beliefs, evaluate its significance, and change one's thinking accordingly" (p. 184).

By the second half of the 20th century, the concept of critical thinking was contextualized more often within the realm of educational philosophy, the movement

conceived to announce the arrival of a new era in education (Cody, 2002). As the foundation for educational reform, CT was widely regarded as a process that could be generalized across subjects and disciplines, with a deliberate emphasis on the processes of inquiry, logical reasoning and reflection, as opposed to rote memorization of facts or theories (Thurmond, 2001). Literature examining critical thinking can be found in a wide variety of disciplines; however it is not clear whether critical thinking is envisioned as ability, attitude or skill (Edwards, 1998). Consequently there is a plethora of definitions for the concept of critical thinking, most either incorporating large, complex constructs, or definitions using terms embedded within domain specific knowledge. Paul (1995) defined critical thinking as purposeful thinking, a systematic way to forming and shaping one's thinking, which is the definition chosen by this author for this paper. Defining attributes of critical thinking include: 1) recognition that a unique situation exists that requires critical thinking to arrive at the best solution (Thurmond, 2001); 2) the use of reasoned judgment based on previous knowledge and experience (Paul, 1995); 3) the need to be flexible and open-minded with the ability to see situations from various angles (Kyzer, 1996); 4) the combination of understanding of one's frame of reference, assumptions, and bias with a willingness to alter opinion based on new information (Hansten & Washburn, 2000); 5) willingness to implement a course of action and take the risk of making a wrong decision (Lenburg, 1997); and 6) the desire to excel (Alfaro-Lefevre, 1999). The consequences of engaging in critical thinking include expansion of knowledge, improvement in skill level, and/or the making of a decision.

It is also important to understand what critical thinking is not. It is not one single defining construct, not singularly problem solving, reflective thinking, diagnostic

reasoning, reflective judgment, intuition, clinical decision making or creative thinking (Thurmond, 2001). It is not traditional thinking that relies primarily on past practice to answer questions, but seeks to examine the present and possibilities for the future. Critical thinking asks the important question of "Why?" (Stark, 1995). Finally, it does not involve a linear line of thinking; rather critical thinking expects one to consider multiple different elements and contingencies at the same time.

In nursing, measurement of critical thinking skills has most commonly been in regards to learning outcomes, for example the Model for Evaluation of Critical Thinking Skills in Bacclaureate Nursing Students (Colucciello, 1997), the Transactional Model of Critical Thinking (Gendrop & Eisenhauer, 1996), and the Critical Thinking Model for Nursing Judgment (Kataoka-Yahiro & Saylor, 1995). There is a lack of empirical data regarding the relationship between critical thinking and clinical decision making (Hicks, Merritt, & Elstein, 2003), and critical thinking and patient outcomes (Fesler-Birch, 2005). In addition, there is a lack of agreement in the literature on the relationship between improving clinical practice through critical thinking and patient outcomes (Brunt, 2005).

Decision Making

Decision making is one of multiple constructs associated with the concept of critical thinking, with critical thinking conceptualized as informing decision making. Decision making is defined as the process of making a selective intellectual judgment when presented with several complex alternatives consisting of several variables, and usually defines a course of action or an idea (Thompson, 1999). An assessment of a situation is performed, followed by formulation of one or more judgments, and finally the making of a decision (Carnevali, Mitchell, Woods & Tanner, 1984). A hallmark of

decision making is that it only occurs when there is uncertainty about the choices of decisions to be made (Muir, 2004). Decision making is performed in a diverse variety of settings and situations, for example business meetings, social interactions, and building construction, however clinical decision making (CDM) in healthcare, specifically CDM in emergency department triage in the United States, will be the focus of this paper.

Terms such as problem solving and judgment have also been used in the literature synonymously and interchangeable when discussing decision making (Facione & Facione, 1996; Hamers, Abu-Saad, & Halfens, 1994; Rashotte & Carnevale, 2004; Thompson, 1999). However, decision making must be differentiated from the concepts of problem solving or judgment. Researchers argue that problem solving is a narrower, linear process while CDM involves complex, non-linear processes (Taylor, 2000). Decision making and judgment are used in the literature as though they were the same, when in truth judgment informs decision-making. Judgments can be considered assessments, estimates, or predictors of an entity (Harvey, 2001), while decisions can be considered a choice between alternatives (Dowie, 1993). The use of judgment within the healthcare environment would be the process of using different aspects of clinical information about a patient such as appearance, vital signs, or behavior to make an assessment or estimate of health status. Lamond and Thompson (2000) report that two main reasons for inconsistency and inaccuracy in judgment may be 1) the use of information that has no utility for the judgment in question, and 2) placing too much emphasis on particular information at the expense of other information.

Clinical Decision Making

Clinical decision making is contained within decision making and describes a form of inquiry that examines the thought processes involved in making decisions within the clinical setting (Kovacs, et al., 1999). It is closely aligned to the concept of critical thinking; however, as described earlier in this paper, the exact relationship between the two terms remains unclear. Components of CDM as it relates to emergency department, and specifically the triage setting, include provider personal experience, education and expertise, as well as patient characteristics, task complexity and possible environmental conflicts such as interruptions or in ability to obtain necessary information (Croskerry, 2002; Cone & Murray, 2002).

The spectrum of clinical decision making has been described as a continuum from simple to complex, and involves varying degrees of uncertainty (Croskerry, 2005; Kovacs, et al., 1999; Thompson & Dowding, 2001). Uncertainty is defined as the level of confidence expressed by an individual about the decision, and is influenced by factors such as incomplete or imperfect knowledge on a personal level, and limitations in current empirical knowledge (Thompson, et al. 2001). Because of this, different decision makers may find similar tasks as having differing levels of complexity. In the emergency department, the large number of decisions that must be made, combined with the need for high quality decisions, is also complicated by time constraints and the potential for cognitive bias by the physician and nurse (Croskerry, 2002).

The process of information gathering that precedes decision making by the provider evokes such cognitive functions as pattern recognition, task complexity, availability, and anchoring and adjustment (Cioffi, 1998). Pattern recognition involves

the ability to make a judgment based on a few critical pieces of information where the presenting symptoms of a patient are categorized based on the decision maker's previous experience with a similar patient, and therefore given the same diagnosis (Benner & Tanner, 1987). Cioffi (1998) defines task complexity as a function of the experience of the decision maker as well as the complexity of the patient's presenting condition. Availability is the ease by which the nurse can recall a similar patient condition or event. Anchoring and adjustment involve starting from a baseline or anchor point, then adjusting the decision making process to take into account individual patient characteristics. A common failure in the process of anchoring and adjustment is lack of adjustment, such that, a clinician making a decision about a patient fails to later consider alternative decisions when presented with conflicting information (Croskerry, 2002; Kovacs, et al, 1999). All of these processes are components of a risk assessment, a secondary purpose of the triage process, to determine which patients have a high potential for an adverse outcome if not seen immediately (Cioffi, 1998). The outcome of performing the risk assessment is the determination as to how long the patient can wait safety for further medical evaluation or intervention.

It is suggested that there are similarities in the strategies used by nurses and physicians for CDM, however the purpose of the information search appears to be different (Crow, Chase, & Lamond, 1995). Nursing literature tends to use the concepts of "critical thinking" and "decision making" interchangeably in reference to clinical decision making, and many of the components related to critical thinking can be found within the framework of clinical decision making (Tanner, 2006). Physicians tends to use "clinical decision making" to describe the critical thinking components that comprise

the decision making process. In nursing, the goal of CDM is to create a picture of the patient's current condition or situation, while for physicians the goal is to use information regarding the patient's medical condition to establish an explanation. Brillman and colleagues (1997) in a descriptive, correlational study of 4725 patients, found little agreement between nurses and physicians when they simultaneously triaged the same patient (k=0.21). The physician more often upgraded the severity of the patient condition as compared to the nurse. The authors suggested that similar patient information is interpreted differently by physicians and nurses.

Clinical Decision Making in the Emergency Department

The following is a discussion of four models of clinical decision making. The most widely studied clinical decision making model is the Hypothetico-Deductive (Croskerry, 2000). This model is used to generate and evaluate hypotheses using a logical and rational approach. The majority of remaining critical thinking models in healthcare fall into one of three broad categories: information processing, intuition and heuristics, and decision theory. Information processing theory focuses on the cognitive processes of diagnostic reasoning and problem solving, where relevant information gained from education and experience is stored throughout life in short term and long term memory, and retrieval of information is performed for the purpose of decision making (Fonteyn & Ritter, 2000; Kovacs, et. al., 1999). Intuition and heuristics incorporate strategies for dealing with large amounts of information by using constructs, such as, past experience, insight, and experiential knowledge to recall patterns of information and gain understanding of specific situations (Buckingham & Adams, 2006b).

Decision theory models, such as algorithms or protocols, use a systematic approach that seeks to maximize the quality of decisions by critically evaluating the known options or choices utilizing probabilities and utility estimates, then using this information to choose the best outcome (Harbison, 2001).

Hypothetico-Deductive

The Hypothetico-Deductive model, illustrates a systematic, rational process of decision making, and represents the "expert" practice most frequently studied in research related to physician clinical decision making (Kovacs, et al., 1999). Patient information is collected for the purpose of formulating hypotheses which are then tested and re-formulated until a decision or plan of action is reached (Carnevali, et al., 1984). Stages of the HD process include hypothesis generation, hypothesis evaluation, hypothesis refinement, and hypothesis verification. During hypothesis generation one or more hypothesis is generated based on patient presentation. Expert clinicians try to organize their information into meaningful groups in an effort to focus and be selective, then use strategies such as heuristics to link key features of a patient's presentation to a known clinical situation. It is important to note that new hypotheses can be generated at any stage in the clinical decision making process.

During hypothesis evaluation, a context is created by the clinician to be used as a framework for gathering additional information. Two strategies used at this stage are confirmation and elimination. Hypothesis refinement may occur at the same time as hypothesis evaluation. As information is collected the previously considered hypotheses are refined and prioritized in terms of likelihood or prevalence. Finally, hypothesis verification is considered the final check, when the hypothesis is retrospectively

considered for adequacy, coherency (appropriateness) and parsimony (simplest possible explanation). HD has been shown to be affected by cognitive bias such as "anchoring" where decision maker tends to continue to favor initial hypothesis despite incoming contradictory evidence (Croskerry, 2002).

Clinical decision making related to HD requires domain-specific cognitive strategies for gathering and organizing information, and incorporate both inductive and deductive methods of reasoning (Norman, Brooks, Smith & Henry, 1987; Parrino & Mitchell, 1989). Expert clinicians typically are able to utilize this kind of knowledge due to their extensive knowledge and developed expertise. Domain-specific knowledge refers to cognitive strategies that organize problems into broad groups or categories either by the use of core concepts or a set of procedural rules (Crow, et al., 1995). Core concepts can be used for recognizing what kind of problem exists, while procedural rules provide a framework for gathering and combining information, facilitating the ability to then weigh and combine patient cues and synthesize them for significance.

Domain specific knowledge structures are also useful as a thinking strategy by allowing clinicians the ability to filter out irrelevant material as well as limit the amount of information they need to extract from the patient (Patel, et. al., 1991). Inductive reasoning, the process of drawing a conclusion or judgment based on a limited set of observations, predominates during the information gathering phase for the purpose of organizing specific, relevant cues to formulate a decision about a patient's condition or situation, while deductive reasoning is used for deriving predictions about specific cases from general knowledge of clinical condition.

Information Processing Theory

Information processing (IP) conceptualizes problem solving as an interaction between the information processing system (person) and the task environment, and incorporates the constructs of short term and long term memory (Thompson, 1999). According to Newell and Simon (1972), the problem solving process can be analyzed as two simultaneously occurring sub-processes of "understanding" and "search". A person, presented with a problem, translates it into his or her own internal representation and looks for a pathway to reach the desired goal. The individual then goes through a series of sequential steps to make a decision. Different phases have been suggested in the literature, however common features include: 1) gathering preliminary information and organizing cues into patterns; 2) generating tentative hypotheses; 3) interpreting the cues and confirming or refuting the hypotheses; and 4) making the judgment based on evaluation of each possible explanation and choosing the one with the best evidence (Thompson, 1999).

IP is comparable to the theory of "Bounded Rationality" which emphasizes the limits of information processing secondary to limited amount of short term memory available for use. Short term memory is the central storage area for information, however due to a limited capacity the person will often store similar, relevant information as "chunks" and can normally hold five to seven "chunks". Long term memory can be conceptualized as a library in which knowledge and experience is stored for retrieval later when needed as additional input for short term memory. All thinking processes get their input from short term memory and leave their output in short term memory. It is interesting to note that the linear and sequential steps used in IP have not been

consistently identified in the clinical decision making activities of expert clinicians (Benner & Tanner, 1987; Offredy, 1998, 2002). Nevertheless, IP continues to be used by researchers to gain cognitive insights into clinical decision making behaviors (Taylor, 2000).

Intuition and Heuristics

The use of intuition as a conceptual framework for clinical decision making has had a significant influence on all healthcare disciplines, intuitive thought processes related to CDM considered the mark of an expert and foundation of experiential knowledge (Benner, Hooper-Kyriakidis & Stannard, 1999; Cone & Murray, 2002). Dreyfus and Dreyfus (1985) identified five stages of decision making development which they labeled novice, advanced beginner, competent, proficient and expert. This conceptual model has been applied to both medicine (Schoen, 1988) and nursing (Benner, 1984). The model hypothesizes that novices tend to govern their practice using best practice evidence and rule-oriented behaviors such as algorithms to guide decision making, basically using more of an analytical or scientific approach. In contrast, Benner (1984) describes the expert as having an intuitive grasp of the situation with the ability to zero in on the accurate region of the problem without wasteful consideration of a large range of unfruitful problem situations. The expert no longer relies on analytical principles, but instead on his or her individual subjective judgments, to decide on the appropriate action for a specific clinical situation. Experts have demonstrated the use of more focused information acquisition strategies as compared to novices; they gather less extraneous information, and synthesize information more quickly (Cioffi, 1998). This was validated in qualitative studies by Cioffi (1998) and Cone & Murray (2002) utilizing triage nurses

who self identified themselves as expert. Findings from the studies demonstrated that expert ED triage nurses include the use of intuition, heuristics, and past experience for clinical decision making.

It is argued that intuition is an essential part of clinical judgment and decision making, however researchers acknowledges that it is seldom granted legitimacy as a sound approach to decision making because it is not congruent with rationalism and empirism, two concepts considered to be the foundation of scientific knowledge (Benner, et al., 1987; Rashotte, et al., 2004). In addition, intuition is characterized by a lack of ability for individuals to explain or understand how or why judgments or decisions are made (Hamm, 1988). Therefore it is difficult to measure if the constructs implied by the use of intuition are actually being used, or be able to reproduce the decision making process beyond that individual. Finally, there is the need for a "gold standard" or analytically derived algorithm or rule for which judgments and decisions of the clinician can be measured and compared for accuracy (Dowding, et al., 2004). Many times the gold standard is either an "expert" clinician who utilizes their own individual subjective experiences and knowledge as the benchmark, or the creation of a criterion standard by a consensus of experts. The use of experts or criterion standards as the standard of accuracy requires choosing one from among many available. The choice of any one criterion standard is therefore always subject to dispute regarding the validity of the criterion. Research investigating the use of intuitive decision making has found large variations in clinical practice and the outcomes associated with it (Hammond, 2000; Harbison, 2001).

An alternative approach to the process of intuition is the use of heuristics, also known as subjective probability judgments (Croskerry, 2002). The successful use of heuristics is considered to be within the domain of the expert clinician (Kovacs, et al., 1999). The heuristic model of learning encourages individual exploration, investigation and discovering, then organizing the information into meaningful parts. This process results in experiential learning and the development of rules learned on the job, or "rules of thumb". Heuristics are frequently described as "short cuts" for problem solving and decision making. They provide clinicians working in situations of uncertainty a time efficient method for streamlining the decision making process by creating individual expertise from past learning experiences (Cioffi, 2001). Using a qualitative study design, Cioffi (2001) interviewed 32 registered nurses who had five or more years of nursing experience. Findings demonstrated that the majority of nurses used three "classic" types of heuristics: representativeness, availability, and anchoring and adjustment and Cioffi concluded that the use of heuristics is intrinsic to decision making. However, the use of heuristics can be a double edged sword, in that when its application to decision making is successful it can be considered economical, resourceful and efficient. When the process fails, it is looked upon as cognitive bias. The utility of heuristics is limited by the numerous variables and unknowns in clinical situations that do not allow for a quantitative approach to guide clinical decisions, as well as the individuality of learning experiences and knowledge acquisition over time.

Decision Theory

Decision theory (DT) focuses on the decision to be made rather than the process used in making it. DT models are associated with statistical constructs such as accuracy,

precision, prevalence, likelihood ratios and positive predictive values whereby a patient's signs and symptoms are treated as independent variables that predict a corresponding dependent variable (diagnosis) within a certain range of confidence (Rashotte, et al., 2004). Research related to clinical decision making has been conducted primarily to identify, theoretically, how a person should make a decision by describing mathematically how the person should: 1) weigh cues to create a diagnosis; and 2) choose an action which has the highest probability of achieving the most highly valued outcome. The outcome is typically then tested for validity by comparing it to the judgment of an expert clinician. DT can be used to tell researchers a great deal about what is wrong with CDM by making the decision making process explicit and transparent.

Computerized decision support systems (DSS) are an emerging focus of DT triage research as a model for rational decision making. Under conditions of uncertainty, decision analysis is a systematic approach to decision making that seeks to maximize the quality of decisions by breaking the decision into a number of actions (Offredy, 1998). Evidenced based research has led to the development and wide acceptance of standardized algorithms or protocols that provide a framework for clinical decision making. The use of standardized algorithms has been shown to improve patient care and outcomes in the emergency department (Aslanian-Engoren & Engoren, 2007; Castro, et. al., 2008). Within the ED triage setting, the Emergency Severity Index (ESI) 5-level triage system is a standardized algorithm that is gaining wide acceptance in the United States due to its ability to generate reliable, reproducible acuity assignments, also known as triage scores, between nurses by providing a systematic approach to patient assessment and clinical decision making. The ESI is based on a conceptual model that considers not

only *when* a patient presenting to triage should be seen, but also *what* resources that patient will need (Wuerz, et. al., 2000).

However, one must consider that there are human behavior patterns, specifically within decision making, that limit the ability of support systems such as algorithms to capitalize on tacit knowledge, the "intuitive knowing" influences clinicians bring to the decision making process (Taylor, 1999). The use of algorithms does not capture the reality of many clinical decisions in healthcare, which are characterized by incomplete knowledge of all available alternatives and lack of reliable probabilistic data related to consequences of the alternatives (Thompson, et al., 2001). Analytic models tend to focus on one correct solution or pathway without consideration of acceptable, albeit less desirable, alternatives. Finally, analytic processing skills of humans, when compared to analytic computation models, are vulnerable to substantive inaccuracies, such as insufficient or incorrect information, and thus comparisons between individual decision making and decision making using support devices or algorithms can be problematic.

Clinical Decision Making During ED Triage

Triage in the Emergency Department

Triage is the initial clinical decision making process used in emergency departments (ED) for the purpose of "prioritizing treatments for multiple patients seeking care simultaneously while placing emphasis on expediting time critical treatments" (Wuerz, Fernandez & Alarcon, 1998). The primary goal of triage is to ensure that patients with life-threatening conditions are quickly identified and treatment is started, and to decrease morbidity and mortality for all ED patients (Emergency Nurses

Association, 2001). Clinical decision making is the foundation of the triage process, involving complex interactions between the provider and patient where subjective and objective patient information is gathered by the triage nurse. Information gathering and risk assessment are used by the triage nurse to formulate a determination of severity of medical condition and assignment of an acuity score, designating how long the patient can safely wait before receiving either an initial intervention or further evaluation.

Triage is commonly placed within the context of supply and demand when there is a need for allocation of limited resources. According to Fernandes, Wuerz, Clarke & Djurdjev (1999), an explicit assumption of triage is that patients are seen according to the urgency of their complaints, not in the order in which they arrive to the health care setting. Another assumption is that triage will facilitate patient flow and efficiency of treatment and disposition (Travers, et. al., 2002). Implicit assumptions are: 1) the outcomes of some patients will be improved if the patients are seen sooner; 2) patients who wait for treatment will not experience adverse outcomes secondary to a delay in treatment; 3) patients will not utilize beds and emergency department resources for long periods of time; and 4) triage will be reliable and reproducible (Partovi, Nelson, Bryan & Walsh, 2001).

Triage Process

The triage process involves a complex interaction between the patient, triage nurse, and triage environment. This section will begin with a discussion of the components of the triage process. The components can change across triage settings, and include the type of clinical decision making used, timing, and the method by which the severity of patient illness or injury is communicated to others. Types of clinical decision

making models have been discussed earlier in this paper, and in ED triage setting the models commonly utilized by nurses include intuition, heuristics, and algorithms or protocols. Specific factors influencing clinical decision making during the triage process will be discussed in depth later in this paper.

The concept of timing is two fold, incorporating how long a healthcare provider actually spends evaluating a patient, and how long the patient can safely wait for further evaluation or interventions. In the military, triage happens in a matter of seconds for individual patients since the goal is to divide out the dying so resources can be used on the salvageable patients. In emergency department settings in the United States, the process of triage can be minimal in situations where there is recognition by a healthcare provider that a patient is dying and must be immediately transported to a hospital bed for further evaluation, or if there is an available patient bed to receive a patient for further evaluation regardless of the severity of the complaint. However, in the modern day hospital, when there are more patients to be seen than beds available, the triage process is focused on the severity of patient illness and time to treatment. The prioritization of patients related to the time-to-be-seen is an essential component of triage since the time of intervention and treatment many times is a factor in determining if a safe outcome occurs.

The most common method of communicating the severity of a patient's medical condition and estimate of how long the patient can safely wait to for further care is the acuity level, typically assigned as a number or score (Cooper, 2004). This triage score is usually a scale of levels related to perceived patient severity of illness or injury, ranging from life threatening emergent to non-urgent and is based on factors that include 1) risk

of the patients' clinical condition deteriorating within the next 30-60 minutes; 2) emergency department waiting time to be seen. Early treatment has been found to effect patient safety and clinical outcomes, examples being time to reperfusion in acute myocardial infarction or stroke, and early goal directed therapy for sepsis (Cooper, 2004). Clinical outcomes include patient harm due to delay in further evaluation; improved health due to timely intervention and treatment; and patient satisfaction with the ED experience. In the literature, and in this paper, the words acuity level, acuity rating, and triage score are used interchangeably.

If the patient condition is not considered life threatening on presentation to triage, the next step has been to decide how long the patient can wait before being seen by a physician. This is a crucial decision, in that if the healthcare provider lacks the experience or clinical judgment to recognize that a patient may be experiencing a serious medical problem, the patient may be under-triaged and/or experience a significant delay in treatment. Under-triage is defined as assigning a patient a lower or less acute triage score than is appropriate for the severity of their illness or injury (Fernandes, et al., 2005b; Travers, et. al., 2002). Under-triage is considered to be more serious than over-triage, the assignment of triage acuity associated with a more severe illness or injury that the patient is experiencing. Under-triage may increase the potential risk for clinical deterioration due to the patient waiting longer to be seen and receive definitive treatment (Fernandes, et al., 2005a).

Accuracy is a major goal of the clinical decision making process since triage scores are probabilistic judgments and, as such, are at risk of being inaccurate (Dowding, et. al., 2004; Lunney, 2003). Hastie & Rasinski (1988) define accuracy as having no

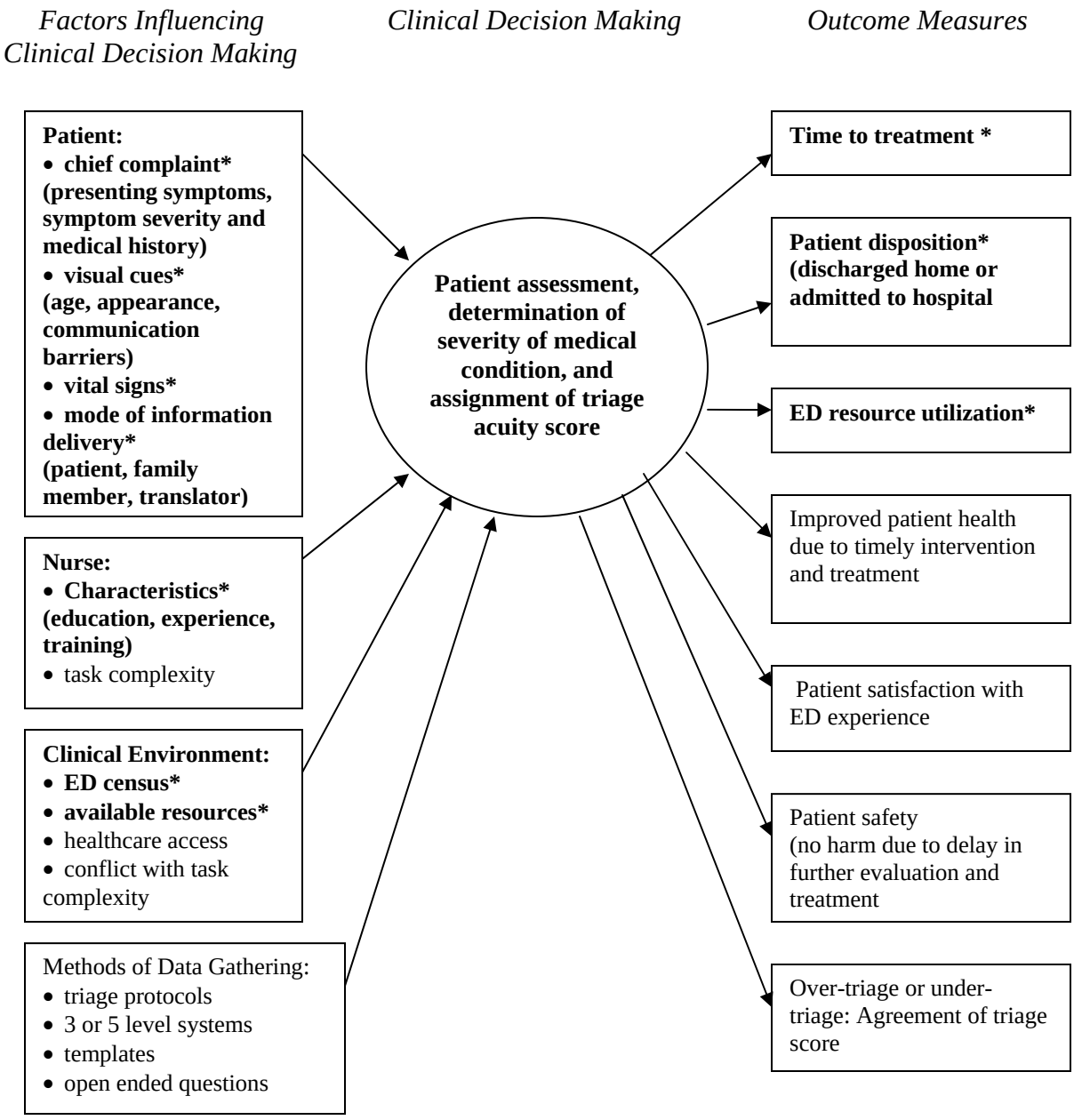
errors, being correct, and deviating only slightly while staying within acceptable limits from a standard. Attributes related to accuracy include types of information available to the clinician, types of information utilized, and the factors and method used to make the decision (Dowding, et. al., 2004; Lunney, 2003).

In an overcrowded emergency department setting where beds may not be available within the assigned time allotment for waiting patients, an inaccurate triage score, and specifically under-triage, may cause a patient to experience a delay in further evaluation and treatment resulting in an increased risk of deterioration in the patient's clinical condition and potentially impacting patient safety (Cooper, 2004). Triage scores, and thus accuracy regarding estimation of severity of illness and acceptable patient wait times, are influenced by multiple factors, including an individual nurse's clinical expertise, patient characteristics, clinical environment, and the pre-established triage guidelines and/or a standardized triage protocol utilized (Zimmerman, 2001).

Factors Influencing the Triage Process

A conceptual model for the process of clinical decision making and assignment of a triage score requires a framework that incorporates multiple nurse, patient and environmental factors (Figure 1). These include 1) triage nurse characteristics such as education, experience, training; 2) patient characteristics including presenting symptoms and history, visual cues such as age and appearance, vital signs, communication barriers; 3) clinical environment such as limited access to health care, ED census, ED and hospital resource availability, conflicts with task completion; and 4) method of information

Figure 1. Conceptual Model of the Triage Process



The following variables have been measured in this study:

Factors influencing decision making:
Patient: chief complaint, visual cues, vital signs, and mode of information delivery
Nurse: characteristics
Clinical environment: ED census, available resources

Outcomes:
Time to treatment, Patient disposition, ED resource utilization

gathering. For clinical decision making in the ED, it is the method of information gathering and interpretation of that data that changes, while nurse characteristics, patient characteristics and clinical environments tend to be similar across settings.

Nurse Characteristics

Several studies have looked inside the triage process at the characteristics of triage nurses and their relationship to the triage decision making process. It has been commonly accepted that level of education and number of years of nursing experience will influence the development of clinical decision making skills. However, examination of the relationship between nursing characteristics, such as education or experience, and accuracy of triage rating found no correlation, while the nurse's interpretation of patient characteristics, mode of delivery of patient information, independent clinical decision making strategies and a limited time frame with which to gather information, have been shown to influence triage nurse clinical decision making (Arslanian-Engoren, 2000; Considine, LeVasseur and Villanueva, 2004; Gerdtz, et. al., 2000; Goransson, et. al., 2006, Travers, 1999). Many of studies related to triage research also do not adequately describe the qualifications or clinical decision making ability of the personnel used for the study, making the validity and reliability of study findings problematic.

Goranssen and colleagues (2006), performed a descriptive study with a sample of 423 ED nurses using the Canadian Triage Acuity Scale (CTAS) and 18 scripted patient scenarios for the purpose of determining if there was a relationship between personal characteristics of the nurses (triage education, clinical nursing experience) and accuracy of CTAS ratings and triage decisions. Two independent groups of ED nurses and physicians were utilized, one group to develop the scenarios and the other group to create

a triage score using a criterion standard, or expected utility rating, for assignment to the eighteen scenarios based on the CTAS. Validity of the expected utility rating was established by pre-test inter-rater reliability of greater than 80% between the two physician/nurse groups for each scenario. The triage nurses' percentage of accuracy of triage scores averaged only 58% when compared to the expected utility rating, i.e. triage score, with a range of 22% to 89%. No relationship was found between personal characteristics of the nurses and their triage ability. The authors concluded that, because education and clinical experience did not explain the dispersion of acuity and triage decisions, there must be other determining factors, such as independent clinical decision making strategies, used by ED nurses in the triage process.

Seaberg & MacLeod (1998), using a two phase pre-test/post-test experimental design, examined the ability of nurses, during the triage process, to accurately order diagnostic tests, such as blood samples, EKGs, and xrays, as compared to what physicians ordered when evaluating the same patient. The physician was considered the "gold standard" for accuracy. The physician was not aware of what the nurse had ordered in triage when the time came for the physician to order tests. During the first phase, full agreement between nurses and physicians was 41%, 35% of nurses ordering more tests compared to physicians, and 37% of nurses ordering fewer tests as compared to physicians. An education in-service was then provided to the nurses halfway through the study regarding the use of guidelines and protocols for ordering tests at triage based on physician recommendations. After the education, during the second phase, there was little improvement in the agreement of nurses and physicians when comparing diagnostic test ordering. The authors hypothesized that, because the nurses had no input into the

development of the diagnostic guidelines and protocols, they did not understand the rationale and instead choose to continue using their own expertise. In contrast, Hay, Beckerman, Rosenberg & Peled (2001) and Washington, et. al. (2000) demonstrated both accuracy and agreement with regard to triage acuity categories and triage score after nurses participated in education training classes.

Twelve nurses participated in Arslanian-Engoren's (2000) qualitative study to investigate factors influencing nursing triage decisions for patients presenting with symptoms suggestive of a myocardial infarction (MI). Patient presentation, nursing knowledge and experience, practice environment, intuition, fear of liability, and gender specific behaviors were all factors triage nurses used in their decision making process. However, there was no discussion of how much each of these factors influenced the decision making process. Additional findings based on nursing characteristics indicated that MI was not the primary diagnosis considered for middle aged women with symptoms suggestive of an MI as compared to their male counterparts, and the author concluded that the inability of the triage nurse to associate middle aged women's presenting symptoms with MI may contribute to increased morbidity and mortality for this patient population.

Arslanian-Engoren (2005) performed a follow-up descriptive study for the purpose of determining if patient cues used by ED nurses to make clinical inferences varied by patient gender or nursing demographic characteristics. Eight hundred forty nurses (28% response) returned a survey questionnaire of two scripted vignettes. The content validity of the vignettes was established by consensus of three self identified "experts" and the vignettes were pilot tested prior to the study. The findings

demonstrated that men and women were equally likely to be given an ACS triage decision and the decision making process was not affected by nursing characteristics. The study also found that nurses use different patient cues when triaging men and women with complaints suggestive of ACS. Men were less likely to be considered for an ACS triage decision if the chest pain was associated with exertional stress, and one subgroup of women was more likely than males to be considered for a triage decision of cholecystitis rather than ACS.

Considine, LeVasseur and Villanueva (2004) conducted a large, multi-center study of 4611 adult and pediatric patients and 178 RNs in 26 EDs for the purpose of comparing the accuracy of triage acuity rating to nursing characteristics (number of years of ED experience and triage education). Two methods of information gathering were utilized; paper based scripted scenarios and computer-based scripted scenarios that included a photograph of the patient. The Australian Triage Scale (ATS) was utilized as the triage instrument to determine triage score, and content validity of the scripted scenarios was established by a consensus of a panel of experts in emergency medicine. Higher inter-rater reliability for the triage nurses was demonstrated with the computer based scripts (k=0.56) compared to the paper based scripts (k=0.42), although both only had a moderate level of agreement. The authors found no correlation between accuracy of acuity ratings and nursing experience or triage education, and concluded that mode of delivery of information appears to have an effect on RN triage performance. However, it was unclear whether it was the mode of delivery or the use of photos included in the computer scenario that resulted in the discrepancies in the decision making process. Additionally, the study design was confounded by the use of different scenarios for the

computer and paper scripts. Differences in the triage decision making process may have been related to differences in patient information contained in the scenarios rather than the addition of photos.

A prospective, qualitative study by Leprohon and Patel (1995) investigated 34 nurses performing telephone triage for the purpose of evaluating decision making strategies related to task urgency and patient problem complexity in a real time clinical setting. Transcripts of 50 nurse-patient interactions and 50 explanations of the decision making process were analyzed. In situations of high urgency, when decisions must be made quickly, decision making performed prospectively by the telephone triage nurses was determined to be based on patient symptoms and heuristics, or "rules of thumb", personal knowledge acquired by the nurses through years of clinical experience. Comparison showed that the triage decisions by the telephone triage nurses were similar to the decisions made retrospectively by expert nurses. However, in contrast to task urgency, increases in patient problem complexity were reflected by telephone triage decisions that used more causal explanations, and decision making was found to be less accurate as compared retrospectively to the expert nurse. Furthermore, the explanations used by the telephone triage nurses to support and explain the decision making process for situations of high patient problem complexity were often inaccurate when compared to the expert nurse.

Patient Characteristics

The influence of patient characteristics on triage nurse clinical decision making has most often been investigated within the context of prediction of patient admission based on specific patient criteria. A prospective study by Arslanian-Engoren (2004),

using 13 ED nurses, investigated the ability of the nurses to predict a patient hospital admission diagnosis of ACS at the time of triage. Findings demonstrated that factors predictive of an ACS decision by the nurse included patient complaint of chest pain, a past medical history of coronary artery disease and MI, and history of smoking. However, accuracy for predicting, at the time of triage, a hospital admitting diagnosis of ACS was low (sensitivity 57% and specificity 59%), and the context of real time triage clinical decision making situations strengthens the validity of the results.

Kosowsky, Shindel, Liu, Hamilton and Panciloi (2001), in a prospective study of 521 patients and 39 RNs, investigated the ability of the triage nurse to predict hospital admission and which area of the hospital (non-telemetry, telemetry or ICU) the patient would be admitted. Triage nurses correctly anticipated only 66 of 107 admissions (positive predictive value (PPV) (61.7%), and PPVs for non-telemetry, telemetry and ICU admission locations were 34.7%, 48.3% and 66.7% respectively. Limitations to the study include the lack of formal training provided to the nurses and no discussion of a demonstrated ability by the RNs to have the expertise needed to accurately predict patient admission based on the patient's chief complaint.

Triage nurse clinical decision making that incorporated both patient and nursing characteristics was examined in a descriptive, observational study by Gerdtz, et al. (2000). The study was conducted using 404 patients and 26 nurses for the purposes of: 1) describing the various decision tasks performed by triage nurses when making triage acuity or priority assignments; and 2) exploring the impact of patient and nurse variables on the duration of triage decision making in a real time clinical setting. Data was collected using a 20-item instrument that recorded the performance frequencies of a range

of decision tasks by triage nurses as well as a number of observable patient, nurse, and environmental variables. Findings indicated limited use of objective physiological data by the triage nurses when making decisions regarding acuity assignments for patients, and large variability in triage durations and final decisions by triage nurses for patients presenting with similar complaints. The authors suggest that triage nurses are strongly influenced by subjective individual and patient factors and recommend further evaluation of the patient-nurse interactive process.

Two additional studies examined factors related patient characteristics and duration of triage time. The Emergency Nurses Association recommends a comprehensive triage taking 2-5 minutes, however Travers (1999) found only 22% of triage assessments (57/260 patients) met the ENA standard for a time to completion of less than 5 minutes. The significant finding of Travers' study was that the length of triage time from start to completion was related to patient age. Older adults were more likely to have complex medical conditions, take multiple medications, and the severity of their illness was difficult to assess in a short interaction time frame. Gerdtz & Bucknall (2001) examined the impact of patient and nurse variables on the duration of triage nurse decision-making, and found triage times (the outcome measure) consistent with Travers' study. One conclusion that may be drawn from both studies is that the use of designated time frames for triage durations may have little value within the context of developing practice standards or triage education.

Clinical Environment

Whether clinical environment, and specifically overcrowding, has an influence on clinical decision making was investigated by Dong, et. al. (2006). A prospective study

was performed for the purpose of assessing whether the level of agreement between triage nurses and a computer decision support system was affected by various measures of ED overcrowding. Findings demonstrated that agreement did not significantly differ during periods of ambulance diversion, or with respect to the number of admitted hospital patients still occupying an ED bed, number of patients in the waiting room, or nurse perception of activity level in the ED.

Method of Data Gathering

There are multiple methods of obtaining and documenting information from patients, including the use of algorithms or protocols, 3 or 5 level triage systems, telephone or in-person interviews, computer-aided systems, and open-ended or closed ended questioning. Salk, Schriger, Hubbell & Schwartz (1998) performed a 2 phase randomized controlled trial (RCT) with 34 nurses and 409 patients for the purpose of comparing triage assignment derived from in-person and telephone patient interviews, while at the same time examining the effects of patient visual cues, vital signs and complaint-based protocols on the triage process. The authors found inter-rater reliability poor (k=.19 to .26) when comparing telephone and in-person triage designations by the triage nurses. The telephone vs. in-person triage nurses chose to use the same complaint-based protocol only 56% of the time, and there was little evidence of learning and increasing agreement over the length of the study. Knowledge of the patient's vital signs and use of complaint-based protocols did not improve agreement or increase the nurse's ability to correctly identify patients requiring hospital admission. The authors concluded that it would be hard to discern whether poor disagreement by the nurses was caused by

the lack of visual cues inherent in phone interviews, or lack of agreement related to situational complexity inherent in the triage process.

Dong and colleagues (2005) investigated agreement between a computer decision tool and memory based triage by nurses in a prospective observational study of 693 patients and 37 nurses. Consecutive patients were assessed using subjective questioning by the triage nurse, and then a study nurse interviewed the same patient using a computerized decision support tool. No description of the computerized triage tool was provided. An expert panel created a standardized triage score to be used as the reference for comparison. Agreement between the triage nurse and expert panel was poor (k= 0.202; 95% CI=0.150 to 0.254). Agreement between the expert panel and nurse triage showed lower agreement (k=0.263; 95% CI=0.133 to 0.394) than agreement between the expert panel and the triage tool (k=0.426; 95% CI=0.289 to 0.564). The study design was confounded by the sequencing of interviews, the triage nurse talking to the patient under a time constraint in a real time clinical setting, while the second interview with the research nurse was performed immediately afterward in a quiet area where that nurse was allowed more time to interview the patient. The findings indicate that there was a substantial lack of agreement between the expert panel and nurses who utilized subjective questioning, and the authors conclude that the greater agreement demonstrated between the expert panel and the computer tool suggests that the use of a computer support system for triage decision making would improve the decision making process.

The Brillman, et al. (1996) study discussed earlier in this paper compared triage decisions and examined the ability of physicians, nurses, and a computer system to predict patient hospital admission for 5106 patients. The computer system generated

algorithms based on patient chief complaints in triage, and had pre-established validity in a military medical setting. It was later modified for use in a civilian setting. The authors found great variability between the three groups with respect to triage decisions and prediction of hospital admission. The variability in agreement was seen, although the nurses and physicians had attended education training sessions meant to foster consensus and standardize responses. The authors concluded that: 1) physicians may interpret the same patient information differently than the nurses, most probably due to differing educational and experiential backgrounds, and 2) computers do not understand subtleties associated with subjective context or clinical relevance. Variability may have been due to differing thresholds used by physicians, nurses, and the computer for determining which patients required specific types of care or hospital admission.

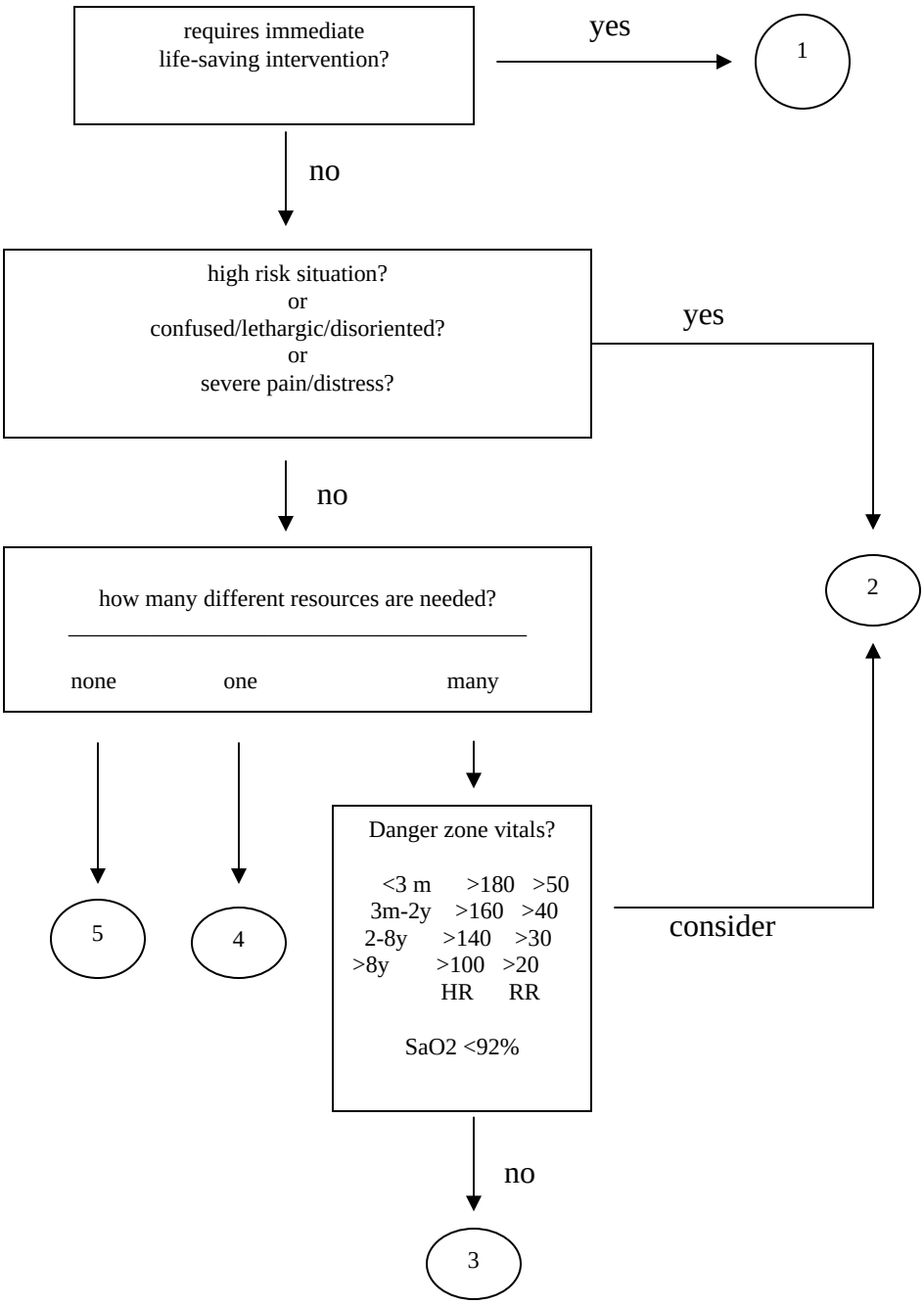
Outcome Measures

Outcome measures relevant to the triage process in this study's conceptual model of the triage process include both short term and long term measures. Short term outcome measures include time to treatment, number of ED resources utilized, patient safety, and over- and under-triage. Long term measures include patient disposition, patient satisfaction with the ED experience, and improved patient health and outcome. Triage research has shown that improved patient assessment and appropriate assignment of triage acuity score can shorten wait times and time to treatment (Richardson, Braitberg & Yeoh, 2004; Travers & Lee, 2006), increase patient satisfaction (Ekwall, Gerdtz & Manias, 2008) and reduce patient morbidity (Cooper, 2004; Molyneux, Ahmad & Robertson, 2006).

A report from the American College of Emergency Physicians/Emergency Nurses Association (ACEP/ENA) Task Force stresses the need for ED planners and policy makers to have triage outcome measures that create comparative, operationalized data (Fernandes, et al., 2005a). The use of prediction of ED resources utilized, patient disposition (specifically hospital admission), and ED length of stay, and reliability of triage score agreement between nurses, are outcome measures that have been designated to create that quantifiable data (Eitel, et. al., 2003; Fernandes, et. al., 1999; Salk, et al., 1998; Tanabe, Gimbel, Yarnold & Adams, 2004a; Tanabe, Gimbel, Yarnold, Kyriacou, & Adams, 2004b; Wuerz, et al., 2001). Reliability of inter-rater agreement related to triage score and prediction of patient admission was discussed earlier in this paper within the context of nurse and patient characteristics and method of data gathering. Study findings have generally been inconsistent prior to development of the Emergency Severity Index (ESI).

In the US, research has focused on the development of the Emergency Severity Index (ESI) (Figure 2), a 5-level triage tool designed to stratify patients based on the acuity of their illness and intensity of their ED resource needs. A flowchart-based algorithm stratifies patients presenting to triage into five explicitly defined, mutually exclusive categories or levels. Definitions of the categories were based on patient acuity (stability of vital signs, severity of distress), resource intensity, and timeliness (expected staff response, time to disposition) (Table 1). Triage levels range from 1-5 with level 1 representing patients with the highest or most severe acuity, and level 5 representing patients with the lowest acuity. Multiple studies have been published to establish the validity and reliability of the ESI instrument as it has been revised and improved, and a

Figure 2. Emergency Severity Index Triage Algorithm Version 4



Gilboy, N., Tanabe, P., Travers, DA., Rosenau, AM. & Eitel, DR. *Emergency Severity Index, Version 4: Implementation Handbook.* AHRQ Publication No. 05-0046-2. Rockville, MD: Agency for Healthcare Research and Quality. May 2005.

majority of the literature on the ESI was written by members of the original ESI research team (Eitel, et al., 2003; Gilboy, Tanabe & Travers, 2005a; Tanabe, et al., 2004a; Tanabe, et al., 2004b; Tanabe, et. al., 2005; Travers, et al., 2002; Wuerz, et al., 2000).

The initial prospective, correlational study of the ESI version 1 by Wuerz, et al. (2000) was conducted using a sample of 493 patients in a single ED triage setting, and findings demonstrated validity and reliability of the triage instrument, as well as correlation of the levels of patient groups with resource use and hospitalization rates. Inter-rater reliability between physician and research nurse, the physician used as the gold standard, compared the level of assignments of 351 patients and was found to be adequate (weighted k=0.8, 95% CI=0.76-0.84). Results also demonstrated that use of the ESI version 1 improved discrimination between patient chief complaints. The study findings resulted in revision of the ESI version 1, which was then tested in a multi-site, prospective validation study of the ESI version 2 performed to further refine the instrument. The study correlated triage nurse assigned ESI levels with ED resource consumption, the need for patient admission, ED length of stay and 60-day all cause mortality (Eitel, et al., 2003). The study did not examine the nurses performing triage for their clinical decision making skills. The "good" level of inter-rater agreement instead was associated with the triage nurse assignment of patients to one of five priority levels and prediction of the number of ED resources the patient required, ED length of stay, or hospital admission. Study findings again demonstrated validity and reliability of the instrument and resulted in creation of ESI Version 3 which incorporate consideration of pediatric patients and focus more attention on resource utilization rather than acceptable

waiting times for physician evaluation or length of ED stay (Baumann & Strout, 2005; Tanabe, et al., 2004a; Tanabe, et al., 2004b).

Tanabe, et al. (2005), using ESI version 3, addressed the need to more clearly define the distinction between level 1 and level 2 criteria by looking at predictors of need by triage patients for immediate, life saving interventions. Seventeen predictors of the need for immediate intervention were identified, the strongest predictor (OR 10.2, CI: 3.3 to 31.8) being the triage nurse's clinical judgment of the need for immediate intervention. This study emphasized the importance of incorporating individual clinical judgment and decision making into the triage process. Based on these findings, the ESI version 4 was developed and is the version currently in use (Gilboy, Tanabe, Travers, Rosenau & Eitel, 2005) (Figure 2). ESI version 4 criterion for level 1 is "Does the patient require immediate life-saving intervention?". Level 2 focuses on identifying the high risk patient that requires time sensitive treatment or meets pre-determined criteria.

The key components of ESI level 2 criteria are expected to be obtained using the following questions: 1) Is this a high risk situation? 2) Is the patient experiencing new onset confusion, lethargy, or disorientation? and 3) Is the patient experiencing severe pain or distress?. Severe pain and distress are conceptually different, with a general definition of pain being an unpleasant feeling caused by injury or disease of the body, while a general definition of distress being suffering caused by pain, worry, illness or exhaustion (Ehrlich, Flexner, Carruth & Hawkins, 1980). Pain is considered to have both physical and emotional components, while distress is primarily emotional, but can also be a manifestation of the pain experience. Therefore it is appropriate for the ESI Working Group to combine pain and distress into a single component of the level 2 criteria.

The triage nurse is not expected to document a medical diagnosis while triaging a patient; however it is not outside the purview of the experienced nurse to formulate a possible medical diagnosis while gathering and synthesizing patient information (Gilboy, et. al., 2005). The study by Arslanian-Engoran (2005) demonstrated that triage nurses can formulate possible medical diagnosis for patients presenting with symptoms suggestive of Acute Coronary Syndrome. When triage nurses assess patients to see if they meet level 2 criteria, the ESI handbook states "While the purpose of nurse triage is not to make a medical diagnosis, these situations are based on the experienced nurse's knowledge of possible medical diagnoses that are associated with specific chief complaints" (p.27). In contrast, novice nurses are expected to use symptom clusters they have been exposed to in the past, for example difficulty breathing and fever, and use that information to determine if a high risk situation exists (Gilboy, et. al., 2005). There is a lack of triage studies looking at accuracy of prediction of patient final diagnosis for all types of patient complaints presenting for treatment. Further research is needed to validate that, in fact, triage nurses do formulate accurate medical diagnosis for patients, using physician final diagnosis as the gold standard. Also, it is important to determine if there are specific patient populations that demonstrate a higher level of agreement between the triage nurse and physician.

The ESI 5-level triage system has significant advantages and limitations. It is useful in the ability to quantify results, thus finally creating a tool that easily lends itself easily to statistical analysis (Fernandes, et al., 2005a). The ACEP/ENA task force that supports the use of the ESI states that, ideally, triage assessment should be performed by experienced registered nurses with proven clinical judgment and decision-making skills.

However, none of their published studies have prospectively evaluated nurses for their actual level of expertise or clinical decision making skills, and a definition of experienced nurse is not provided. Information guiding the decision of the triage nurse for patient assignment to ESI levels 2 (high risk) or 3 (lower risk) includes pre-established criteria by consensus opinion of the ESI Triage Group and the nurse's clinical experience. Currently there is no other real time information available to guide the nurse in the determination of acuity level.

Ultimately, the stated ESI criteria are not specific enough to be useful to less experienced nurses and determination of acuity level is open to individual interpretation by the triage nurse. Few studies in the literature have examined the validity of the actual ESI triage categories and none have examined the clinical distinctions between those patients assigned to level 2 (high risk category) or level 3 (lower risk category). In addition, no studies in the literature have looked at the characteristics or trajectory of the patients placed in triage levels 2 and 3 other than resource consumption, ED length of stay, or hospitalization rate. To increase the validity of patient assignment to levels 2 and 3 there needs to be more explicit criteria, and the criteria need to be drawn from actual nurse practice patterns and patient characteristics. Environmental factors such as wait time, patient census and time of day also need to be evaluated to understand if they influence the triage nurse decision making process. With the knowledge that the strongest predictor of patient risk assessment is the nurse's own clinical judgment, further research should focus on what subjective and objective criteria triage nurses are using to determine level of risk for their patients, and subsequent triage score, as it relates to use of the ESI instrument.

CHAPTER THREE: METHODS

Design

A descriptive, correlational design was used for the purpose of investigating specific factors that determine a patient's assignment by the triage nurse to Emergency Severity Index (ESI) level 2 or level 3, as well as tracking the trajectory of patients assigned to these categories as they progress through the emergency department experience to final diagnosis and disposition. Of special interest was a description by the triage nurse of subjective and objective observations related to triage acuity assignment. Specific variables measured included factors related to triage nurses, patients, and the Emergency Department (ED) clinical environment, and data was collected using the Triage Nurse Demographic Form (Table 2), Triage Questionnaire (Table 3) and Patient Demographic Form (Table 4).

Setting

Two sites, the University of California, San Francisco (UCSF) Emergency Department and San Francisco General Hospital Medical Center (SFGH) Emergency Department, were used to study the triage process of nurses. Depending on the availability of the nurses data was collected at the same time in these two sites. Data for this study were collected between February 2008 and May 2008.

Sample

The study was conducted after approval was obtained from the University of California, San Francisco Investigational Review Board (IRB). A convenience sample of triage nurses was recruited from the two Emergency Department sites. Triage nurses

were recruited directly by the Principal Investigator (PI). The PI attended 1-2 ED staff meetings at each site at which time a short in-service was conducted regarding the purpose and description of the study.

Inclusion critierion

The following inclusion criteria were applied:

1. ED triage nurses who successfully completed the ESI training program at UCSF or SFGH in the last 12 months and are certified by the institution to perform triage.
2. All patients assigned by the triage nurse to an acuity level 2 or 3 were included in the study.

Exclusion criterion

The following exclusion criteria were applied:

1. A patient who had already been included in the study from a previous ED visit.

Interested triage nurses were encouraged to contact the PI directly to arrange a specific day and time for data collection. ED management at both study sites were included in the scheduling discussion to facilitate the process. All triage nurses who agreed to be in the study provided written consent prior to the start of their participation in the study. All data has been analyzed and protected in accordance with Health Insurance Personal and Accountability Act (HIPPA) requirements. All identifying information has been removed from the data set and reported results are free of any type of identifier. Research records were handled as confidentially as possible within the law. Names of the nurses will not be used in any published reports and unique identification numbers are assigned to each nurse and patient information data sheet. All collected data from datasheet forms were downloaded to a research computer that is password protected

and accessible only to the PI. The datasheet forms were locked in a secure cabinet that is accessible only to the PI. Approximately six months after completion of data collection the PI will provide the two ED managers a summary of the findings for dissemination in their emergency department.

Instruments Used to Measure Variables

The conceptual model of the triage process guiding this study was used as the framework for development of the following data collection instruments.

Triage nurse

The Triage Nurse Demographic and Triage Questionnaire instruments were developed by the PI to measure nurse characteristics related to the ED triage setting. Variables related to nurse sociodemographic and clinical characteristics included age, gender, level of education, number of years of nursing experience, whether or not the nurse had earned a Certified Emergency Nurse (CEN) certification, number of years of triage experience, and type(s) of triage training. These items were measured using the Triage Nurse Demographic Form.

Correlates of Triage

The Triage Questionnaire measured factors that triage nurses might use in their clinical decision making to determine patient assignment to acuity level 2 or 3 and determine patient severity of illness. The choice of variables included patient factors, clinical environmental factors, and an opportunity to write in additional factor(s) not already described on the questionnaire that the triage nurse felt was important in decision making for a particular patient. The decision of which factors to measure was guided by the conceptual model for the study after a thorough review of the literature related to ED

nurse triage, the use of experiential knowledge, criteria in the standardized ESI criteria, and the Emergency Nurse Association (ENA) Triage Curriculum. Triage task complexity was not measured.

The Triage Questionnaire was reviewed by three expert triage nurses and two experienced ED physicians for face validity and content validity, and modifications were made based on their recommendations. The instrument was then pilot tested by one triage nurse to obtain an average time for completion. Based on ten patient triages the average time for completion was one minute.

Patient characteristics

The Patient Demographic Form included variables from both the ED triage record and ED main medical chart relevant to the patient's current medical complaint and trajectory while in the ED. Examples of variables include patient chief complaint, past medical history, vital signs, level of pain, time to physician evaluation, final diagnosis, and number and type of resources utilized by the patient while in the emergency department. The ED record is generated as the patient's permanent medical record for that visit. The ED triage record is documentation of subjective and objective information elicited from the patient by the triage nurse, as well as the overall determination of severity of patient illness by the triage nurse as reflected by assignment of an ESI acuity score. The ED main medical record contains documentation regarding patient condition, diagnostic testing and therapeutic interventions, and diagnosis and final disposition. The PI collected the above data about the patient and recorded it on the Patient Demographic Form. Additional data were collected if any patient in the study experienced deterioration in medical condition or died while in the ED.

Clinical environment

The Triage Questionnaire included variables such as time of day, high ED census and long wait times that measure environmental factors that could potentially influence assignment of an acuity score by the triage nurse. Concurrent with each session of data collection, every four hours the PI collected overall ED department information that included total number of patients in the ED, number of patients in the waiting room, number of beds occupied by patients, number of nursing staff, and if the ED was on diversion. These data were used as validation if the triage nurse indicated on the Triage Questionnaire that environment was a factor.

Procedure

On the day of data collection, written informed consent was obtained from the triage nurse by the PI, and the triage nurse completed the Triage Nurse Demographic Form (Table 2). The triage nurse then performed one-time triage interactions with patients who presented to the ED setting. The PI did not observe the nurse-patient interaction. At the completion of the patient-nurse interaction, the triage nurse assigned each patient to one of five acuity levels using the ESI. If the triage nurse assigned the patient to either level 2 or level 3, the triage nurse then completed a brief Triage Questionnaire (Table 3) regarding their perceptions of that patient. Completion of this questionnaire took approximately one minute. Each triage nurse was asked to complete a minimum of 20 Triage Questionnaires for the study.

Although completion of the questionnaire had the potential to increase the time needed for each patient episode this effect did not impact the ability of the triage nurse to

provide timely interactions with patients presenting to triage for evaluation. Also, in the event that a patient presented to the triage nurse with a medical condition that required immediate intervention, the patient received appropriate medical management and the triage nurse completed the questionnaire at a later time during the same data collection time period.

The nurse then placed the completed Triage Questionnaire in a pre-determined area for pickup by the PI. This action initiated inclusion of the patient in the study and identified that further patient information would then be collected by the PI during the time that patient was in the ED setting. The PI was in the main ED area and would periodically go to the pre-determined pickup area to collect newly completed nurse questionnaires. The PI obtained the Triage Questionnaire, and then began prospective data collection on the patient using the Patient Demographic Form (Table 4). During the course of the study the PI did not come into direct contact with the triage nurse or patient in the triage area nurse and did not come in contact with the patient during later data collection in the ED.

The PI completed the Patient Demographic Form by transcribing data obtained from the emergency department medical record onto the Patient Demographic Form. Data collection concluded with death of the patient or discharge of the patient from the ED to hospitalization, transport to another facility, or home. In the event the medical record was not immediately available, or incomplete upon patient discharge, the PI obtained the patient information at a later time using a retrospective chart review.

Data Analysis

Data was analyzed using SPSS for Windows software (version 15.0). Descriptive statistics such as frequencies, mean, median, SD, and range were used to present demographic and clinical characteristics of the nurses and patients. Due to the non-independent nature of the triage interactions, i.e. each triage nurse contributing more than one patient interaction, statistical analysis using General Estimating Equations (GEE) and Logistic Regression was used to identify predictive factors influencing patient assignment in relationship to nurse age, level of nursing education, years of ED nursing experience, and years of triage experience. GEE was able to account for the clustering of triage nurses, i.e. a small number of nurses (n = 18) and many patient interactions (n=334). Estimation of differences between two groups (group membership in level 2 or level 3) for age, chief complaint, past medical history, and number and type of intervention and final diagnosis was analyzed with comparisons by t-test used for continuous variables and chi-square for categorical variables.

Power Analysis

No previous studies have been reported estimating effect size related to factors influencing patient assignment to level 2 or 3 acuity. For the proposed study, a sample size of approximately 250 for level 2 patients and 250 for level 3 patients was estimated to have an 80% power to detect an effect size of 0.251 using a two-group t-test with a 0.05 two sided significance level. A two group continuity corrected chi-square test with a 0.05 two sided significance level was estimated to have 80% power to detect the difference between a Group 1 proportion of 0.40 and a Group 2 proportion of .053 (odds ratio of 1.69) when the sample size in each group (level 2 and level 3) is 246.

To account for being nested within study site and nurse, each nurse needed to perform at least 20 triages.

CHAPTER FOUR: RESULTS

Sample

Potential triage nurse participants were recruited from two emergency departments, ED-A and ED-B, between February 2008 and May 2008. A total of 22 triage nurses expressed interest and were screened for participation in the research study. Due to scheduling conflicts a sample of 18 triage nurses was used for the study, 13 women and 5 men. The mean age of the triage nurses was 38.33 +/- 8.38 (range 27-55) with a mean number of years of ED triage experience being 7.22 +/- 5.54 (range 1-23). The mean number of months they had used the ESI 5-level triage system was 5.28 +/- 1.99 (range 0-7). The types and levels of nursing education were an Associate Degree (n=2), Baccalaureate (n=7), currently in a Graduate Nursing program (n=5), and a Masters degree (n=4). Three of the 18 triage nurses had obtained triage education (continuing education class or additional education at previous employment) in addition to the triage education all 18 nurses received at their current employment. See Table 5 for a summary of baseline demographic data.

Data for this study were collected during all shifts (day = 9, overlap =5, night =4) to obtain a time representative sample of nurse-patient interactions. A total of 334 separate nurse-patient triage interactions were collected and analyzed, with 94 patients being assigned to level 2 and 240 to level 3.

At one of the emergency departments (ED-A) a total of 152 nurse-patient interactions (45.2%) were collected and used for analysis, while at the other emergency department (ED-B) a total of 182 nurse-patient interactions (54.8%) were collected and analyzed. Within the subset of 152 nurse-patient interactions used for analysis from ED

A, a total of 31 patients (20.4%) were assigned to level 2, and 121 patients (79.6%) to level 3. Within the subset of 182 nurse-patient interactions used for analysis from ED B, a total of 63 patients (34.6%) were assigned to level 2, and 119 patients (65.4%) to level 3. When comparing the two emergency departments, there was a statistically significant difference between the number of level 2 and level 3 patients for each ED ($F = 8.28$, $df = 1$, $p = .004$). There were a higher percentage of patients assigned by the triage nurse to level 2 at ED-B as compared to the percentage of patients at ED-A assigned by the triage nurse to level 2 (63/182, 34.6% vs. 31/152, 20.4% respectively). Consequently, there was a lower percentage of patients assigned by the triage nurse to level 3 at ED-B as compared to the percentage of patients at ED-A assigned by the triage nurse to level 3 (119/182, 65.4% vs. 121/152, 79.6%). This finding indicates that there were a higher percentage of patients at ED-B that the triage nurses assessed as meeting the criteria for a greater severity of illness.

The research aims and research questions will be used to categorize the results in this chapter.

Research Aim #1: Describe the factors that influence triage nurse assignment of patients to acuity level 2 and level 3.

Factors Important to the Nurses When Assigning the Level of Acuity

Research Question 1a. Are there specific factors that nurses identify as influencing patient assignment to level 2 or level 3?

The triage nurses used the Triage Questionnaire to select 3-4 factors from a pre-determined list of 20 factors that he/she considered important when assigning that particular patient to level 2 or level 3. One of the choices was “other” to provide the

opportunity for the triage nurse to qualitatively document a factor not on the list. For 67% of patients (n=223) the triage nurse rated the patient chief complaint as an important factor that influenced patient assignment to level 2 or level 3. Additional patient factors the triage nurse chose were vital signs (40.7%, n=136), patient past medical history (35%, n=117), and expected number of resources utilized while in the ED (31.7%, 106). For 32.9% of patients (n=110) their triage nurse chose the "other" category as one of the important factors. Within that "other" category a total of 95 qualitative responses were documented, of which patient clinical presentation was the most frequently documented factor (67/95 = 71%). Other factors included mechanism of injury (6%, n=6), multiple visits for same (5%, n=5), history of hospitalization for same (3%, n=3) and family states change in patient status (2%, n=2).

A Chi-square analysis was used to determine if there were significant differences in number or frequency of factors chosen by the nurse for those patients assigned to level 2 or level 3. Statistically significant differences between factors selected for level 2 and level 3 patients were found for the following: patient vital signs ($F = 7.054$, $df = 1$, $p = .009$), expected number of resources ($F = 5.331$, $df = 1$, $p = .026$), required timely intervention ($F = 4.105$, $df = 1$, $p = 0.047$), and patient age ($F = 6.650$, $df = 1$, $p = 0.013$). Overall, 136 of 334 patients in the study (40.7%) had triage nurses rate vital signs as an important factor influencing the patient assignment. Of those 136 patients, nurses assigned 49 to level 2 (49/94, 52%), and 87 patients to level 3 (87/240, 36%), the difference between the percentage of patients assigned to level 2 and level 3 assignment being statistically significant ($p = .009$). This indicates vital signs were rated by the triage nurse as an important factor used to discriminate between level 2 and level 3

assignment. Likewise, 106 of 334 patients (31.7%) had triage nurses who rated the expected number of resources an important factor influencing patient assignment for those patients. Within that subset of patients, of the patients whose nurses assigned them to level 2, 22% (21/94) had expected number of resources selected as an important factor for that patient; whereas, of the patients assigned to level 3, 35% (85/240) had expected number of resources selected rated by the nurse as an important factor. The difference between 22% (Level 2) and 35% (Level 3) for expected number of resources was statistically significant ($p = .026$) indicating that expected number of resources was rated an important factor for level 3 assignment. The percentage of patients in level 2 whose triage nurse indicated that patient age was an important factor in their decision making was 24% (23/94) whereas the corresponding percentage for level 3 patients was 13% (31/240), the difference between being statistically significant ($p = .013$). It is interesting that the mean age of patients assigned to level 2 was approximately 2 years older than the mean age of patients assigned to level 3; however this difference was not significant (50.2 vs. 48.2, $p = .444$). In the sample, for patients assigned to level 2, the triage nurse indicated that patient age, vital signs, and need for a timely intervention were important factors, while for patients assigned to level 3, the triage nurse indicated that expected number of resources was an important factor. See Figures 3 and 4 and Table 6 for a summary of these results.

Research question 1b. Do environmental factors influence patient assignment to level 2 or level 3?

ED census or a long wait time was indicated by a triage nurse on the Triage Questionnaire as an important factor only once during the course of the study, and was

Figure 3: Frequency of Factors Influencing Patient Assignment: A Comparison of Level 2 and Level 3 Patients

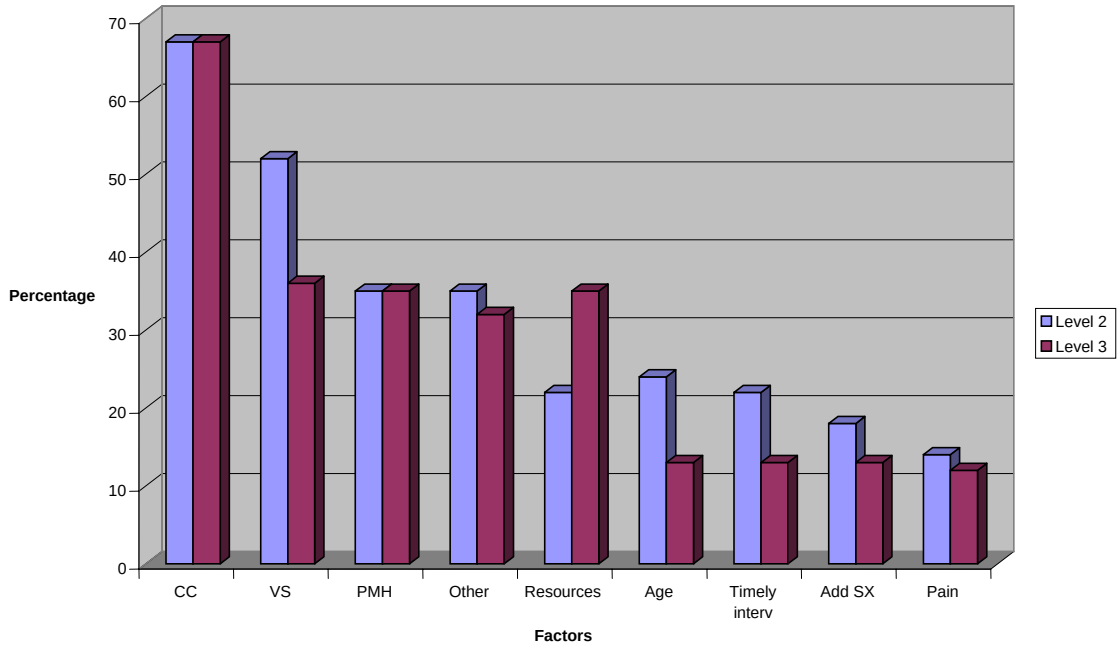
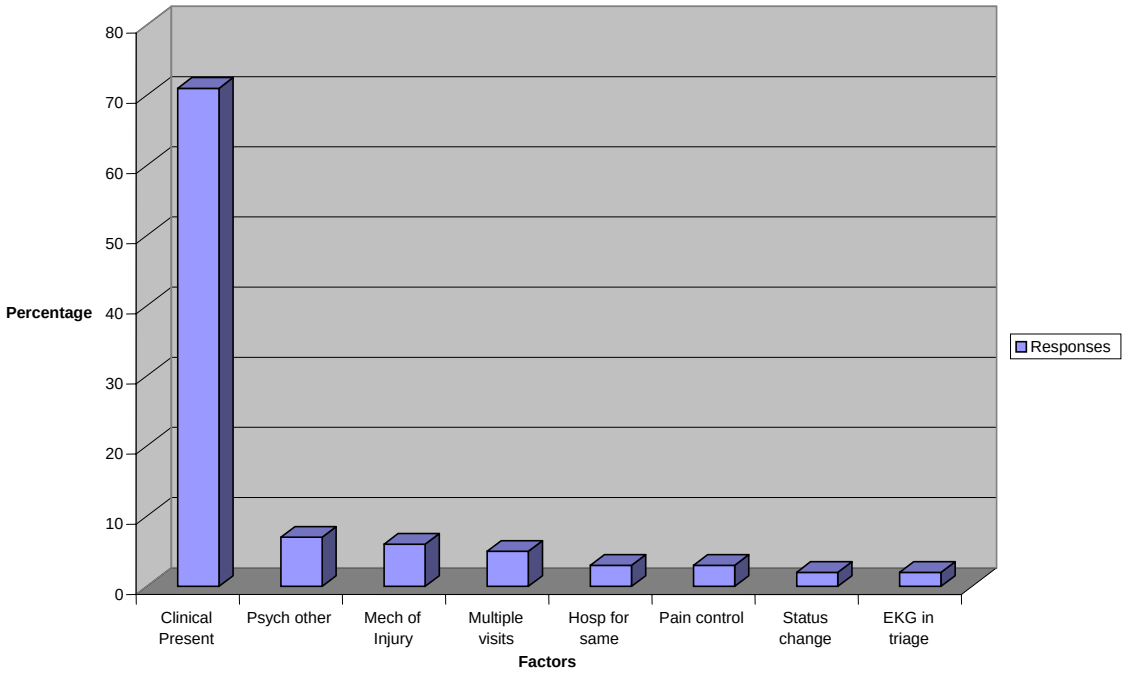


Figure 4: Other Factors Influencing Patient Assignment to Level 2 and Level 3



selected for a level 3 patient. Time of day was never selected by a triage nurse as an important factor influencing patient assignment. These findings are important because they indicate triage nurses were not making clinical decisions based on transient external factors.

Comparison of Nurse Experience in the Choice of Factors Influencing Assignment to Level of Acuity

***Research question 1c*.** Do nurses with less than 4 years of triage experience identify the same factors as influencing patient assignment to level 2 or level 3 as nurses with 4 or more years of triage experience?

Statistical analysis using General Estimating Equations and Logistic Regression was used to answer the question due to the non-independent nature of the triage interactions. Each triage nurse contributed more than one patient interaction and logistic regression was able to account for the clustering of triage nurses, i.e. a small number of nurses (n = 18) and many patient interactions (n=334). A comparison was made between years of triage nursing experience and selected factor(s) the triage nurses rated important when deciding if a patient would be assigned to level 2 or level 3. For this sample, nurses with four or more years of triage experience rated “patient past medical history” to be an important factor (OR 2.27, p = .019). The more experienced triage nurses were 2.27 times more likely to select patient past medical history as an important factor when making a decision than triage nurses with less than 4 years of experience. Also, nurses with more experience rated “additional symptoms other than the patient chief complaint” to be an important factor (OR 4.62, p = .018) more times than less experienced nurses. More experienced triage nurses were 4.62 times more likely to select additional

symptoms other than chief complaint as an important factor than those with less experience.

Research Aim #2: Examine the relationship between group membership (level 2 or level 3) and specific patient factors.

Patient Characteristics Related to the Triage Process

Research question 2a. Is there a difference in assignment of patients to level 2 or level 3 based on patient age?

An independent samples t-test was used to compare the age of patients assigned to level 2 and level 3. The average age for the 334 patients included the study was 48.75 +/- 21.17 with a range of 1–98 years. The average age of patients assigned to level 2 was approximately 2 years older than the average age of patients assigned to level 3 (50.17 vs. 48.2 respectively), however this difference was not statistically significant ($t = .766$, $df = 332$, $p = .444$).

Research question 2b. Is there a difference in assignment of patients to level 2 or level 3 based on the patient's chief complaint?

The patient's chief complaint at triage, described either as a complaint or as one or more symptoms, was extracted from the patient's triage record and placed within 20 pre-determined categories created by the PI covering a broad range of common ED patient complaints and symptoms. These categories included chest pain, shortness of breath, abdominal pain, fever, neck/back pain, extremity pain, extremity swelling, trauma, stroke symptoms, altered level of consciousness, headache, vaginal bleeding, vaginal discharge, dysuria, nausea/vomiting, diarrhea, bleeding, psych/depression, weak/fatigue,

or other. If a patient had multiple symptoms then each symptom was placed within the appropriate category for data analysis. Chi-square analysis was then performed comparing chief complaint and level 2 or level 3 assignment to ascertain if certain chief complaints were more likely to be associated with level 2 or level 3 assignment. For a total of 334 triage records, only two chief complaints were found to be significantly associated with assigned triage level. Patients with a chief complaint of nausea and vomiting were more often assigned to level 2 (20/94, 21%) than level 3 (28/240, 12%), the difference being statistically significant (Fisher's exact test, $p = .036$). The second was a chief complaint related to a psychiatric illness, depression or suicidal ideation. There were more patients with these complaints assigned to level 3 (17/240, 7%) than level 2 (1/94, 1%), the difference being statistically significant (Fisher's exact test, $p = .030$). However, the overall number of patients with this chief complaint (18/334) was too small to find a meaningful comparison. See Table 7 for a summary of findings.

Research question 2c. Is there a difference in assignment of patients to level 2 or level 3 based on the patient's past medical history?

The patient's past medical history, described as one or more chronic medical conditions, was extracted from the patient's triage record and placed within 15 pre-determined categories created by the PI covering a broad range of common chronic conditions. These categories were coronary artery disease (CAD)/myocardial infarction (MI), Thyroid, Congestive Heart Failure (CHF), Hypertension (HTN), Chronic Obstructive Pulmonary Disorder (COPD), Asthma, Diabetes (DM), Cerebral Vascular Accident (CVA), Renal Insufficiency/Failure, Seizures, HIV, Immunocompromised, Cancer, Pain, Psychiatric/Anxiety, Gastointestinal, Other conditions, and None. If a

patient had more than one chronic condition then each condition was placed within the appropriate category for data analysis. Chi-square analysis was performed comparing patient past medical history and level 2 or level 3 assignment to determine if certain chronic conditions were more likely to be associated with level 2 or level 3 assignment. Of 334 patient charts available, data were available for 320 patients. Data were not available from 14 charts due to the inability of the patient to provide the information, or the information was not available. Only one chronic medical condition was significantly associated with assigned triage level. Patients with a past medical history of renal insufficiency/failure were more often assigned to level 2 (12/89, 13%) than level 3 (11/231, 5%), the difference being statistically significant (Fisher's Exact Test, $p = .013$). See Table 8 for a summary of results.

Research question 2d. Is there a difference in assignment of patients to level 2 or level 3 based on the patient's medication history?

The patient's list of medications was extracted from the triage record and placed within 14 pre-determined categories created by the PI covering a broad range of common medications associated with specific chronic medical conditions. These medication categories were coronary artery disease (CAD), Thyroid, Hypertension (HTN), Pulmonary, Diabetes (DM), Cerebral Vascular Accident (CVA), Renal Insufficiency/Failure, Seizures, HIV, Immunocompromised, Cancer, Pain, Psychiatric/Anxiety, other medications, none, and unknown. If a patient was on multiple medications then each was placed within the appropriate category for data analysis. Chi-square analysis was performed comparing patient past medication history and level 2 or level 3 assignment to ascertain if certain medications were more likely to be associated

with level 2 or level 3 assignment. Of 334 patient charts available, data were available for 311. Data were not available from 23 charts due to the inability of the patient to provide the information, or the information was not available. No relationship was found between specific medications associated with chronic medical conditions and patient assignment to level 2 or level 3. See Table 9 for a summary of findings.

Research question 2e. Is there a difference in assignment of patients to level 2 or level 3 based on vital signs?

The ESI 5-level triage algorithm provides a list of "danger zone" vital sign parameters to be used as a reference by the triage nurse when making the decision whether to assign a patient to level 3. The vital signs are listed based on age and include heart rate, respiratory rate and oxygen saturation. Vital signs within the parameters are considered stable, while vital signs outside the parameters are to be considered in the "danger zone". If the patient's vital signs are outside the parameters it is left to the discretion of the triage nurse to decide, considering patient chief complaint and presentation, if the patient should be assigned to a higher triage level, with level 2 being the appropriate higher level. This is considered "up-triage". Triage nurses are not required to assign the patient to the higher triage level if the vital signs fall outside the parameters if, as part of their clinical decision making, the triage nurse determines that assignment to level 3 is appropriate. Vital sign measurements were extracted from the patient triage record and recorded whether the vital sign measurements were within or outside the parameters. A total of 334 charts were used for analysis, with 94 patient assigned to level 2 and 240 patients assigned to level 3. For the 94 patients assigned to level 2 there were 72 patients (76.6%) who had vital signs within the parameters and 22

patients (23.4%) who had vital signs outside the parameters. For the 240 patients assigned to level 3 there were 208 patients (87%) who had vital signs within the parameters and 32 patients (13%) who had vital signs outside the parameters. In this sample, for patients with vital signs outside the parameters, patients were more often assigned to level 2 than level 3, the difference being statistically significant (Fisher's Exact Test, $p = .031$). However, 13% of patients assigned to level 3 had vital signs in the "danger zone" but their condition was still considered appropriate by the triage nurse for assignment to level 3, while 22% of patients considered by the triage nurse to be high risk had normal vital signs. For the 13% of patients assigned to level 3 who had vital signs outside the normal parameters, this indicates that, in addition to vital signs, other criteria, such as patient presentation, was influencing the triage nurse's clinical decision to place them at a certain level.

Research question 2f. Is there a difference in assignment of patients to level 2 and level 3 based on whether they were discharged from the hospital or emergency department within the last seven days?

Information from the ED triage record was examined to determine if, within the last seven days, the patient had been seen in an ED setting or physician's office, or recently released after a hospital admission, and if there was a difference in level 2 or level assignment for these patients based on these criteria. For 334 patient charts, a total of 53 patients met the criteria, with 15 patients assigned to level 2 (15/94, 16%) and 38 patients assigned to level 3 (38/240, 15.8%). In this sample, there was no statistically significant difference between assignment to level 2 and level 3 (Fisher's Exact Test, p

= .554) for patients recently seen in an ED setting, physician's office or discharged after a hospital admission.

Research question 2g. Is there a difference in assignment of patients to level 2 or level 3 based on the source used to gather patient information?

Information from the ED triage record was examined to determine how the patient information was provided to the triage nurse. Information sources included the patient, relative, use of a translator, paramedic, or other source. For 334 patient records, the patient was the most frequent information source (n=234, 70%), followed by paramedic (n=60, 18%), relative (n=27, 8%), use of a translator (n=9, 3%) and other (n=3, 1%). For this sample, a comparison of triage levels 2 and 3 with sources used to gather patient information, there was no statistically significant difference with relation to information source and assignment of the patient to level 2 or level 3 ($F = 5.115$, $df = 4$, $p = .276$.)

Research question 2h. Is there a difference in assignment of patients to level 2 or level 3 based on the patient's level of pain or distress?

An independent samples t-test was used to compare the level of patient pain or distress while at triage as documented by the triage nurse using a universal pain scale ranging from 0 = no pain to 10 = severe pain. With 94 patients assigned to level 2 and 240 patients assigned to level 3, the average pain/distress rating for level 2 patients was 4.46 +/- 4.1, while the average pain/distress rating for level 3 patients was 4.22 +/- 3.9, the difference being not statistically significant ($t = .487$, $df = 332$, $p = .627$). For this sample, there was no significant difference in level of pain or distress between patients assigned to level 2 vs. level 3.

Research question 2i. Is there a difference in final disposition for patients assigned to level 2 vs. level 3?

The final disposition of the patient was categorized as left without being seen (LWBS), discharged home, admit to medical floor, telemetry or ICU, death, transfer to another facility, or other. The categories were then compressed into three categories of home, admitted or other. For the 93 patients assigned to level 2, 49 patients were discharged home (53%), 40 patients were admitted (43%) and 4 were categorized as other (4%). For the 237 patients assigned to level 3, 141 patients were discharged home (60%), 62 patients were admitted (26%) and 34 were categorized as other (14%). The difference in final disposition between level 2 and level 3 patients was statistically significant ($f = 12.525$, $df = 2$, $p = .002$). Overall, the biggest difference between level 2 and level 3 patients is admission rate, with the trend being toward a higher percentage of level 2 patients being admitted than level 3. However, there was a relatively small level of association between admission and level 2 or level 3 assignment (Cramer's $V = .002$).

Research Aim #3: Describe the characteristics of patients assigned to acuity level 2 or 3 who experience deterioration in their medical condition or die while in the ED.

Research question 3a. Did any patients assigned to level 2 or level 3 experience a deterioration in medical condition or die prior to physician evaluation?

Examination of the patient medical records indicated that no patient in the sample experienced deterioration in medical condition, specifically an unexpected, detrimental change in heart rate, blood pressure, temperature, respiratory rate, oxygen saturation, pain

level or level of consciousness, that required immediate evaluation and intervention, prior to physician evaluation.

Research question 3b. Did any patient assigned to level 2 or level 3 experience a deterioration in medical condition or die prior to final disposition?

One patient experienced deterioration in medical condition and death after physician evaluation. A 94 year old patient with a history of multiple co-morbid medical conditions was brought by ambulance to the emergency department after exhibiting a decreased level of consciousness. The patient was given a level 2 assignment by the triage nurse, however due to the fact the patient has been transported to the ED via ambulance the patient was placed in an ED treatment room rather than the waiting room. During the course of the patient's ED stay the patient's blood pressure and heart rate became unstable and the patient required mechanical ventilation. It was determined by the physician that the patient had a life-threatening condition, most likely sepsis. After the physician discussed this information with the patient's family the family decided to make the patient a "do not rescusitate". The patient was provided supportive care and expired several hours later while in the ED.

***Research question 3c*.** Which characteristics as most frequently identified with a patient who experienced deterioration in medical condition or died prior to final disposition?

Unable to answer this question due to lack of patients fitting criteria for data collection.

Research Aim #4: Describe the trajectory of patients assigned in the emergency department to acuity level 2 or level 3.

Clinical Environment Characteristics Related to the Triage Process

Research question 4a. Is there a difference in the average number of minutes from triage to physician exam for patients assigned to level 2 vs. level 3?

An independent samples t-test was used to compare average time from triage to physician exam for level 2 and level 3 patients. One of the two emergency departments used in this study had the waiting room set up so that the patient had to approach the triage nurse immediately upon entering the department. At that time a small amount of specific patient information was gathered by the triage nurse and a triage score was assigned by the triage nurse. If needed, the patient received immediate intervention, otherwise the patient was referred to registration and a comprehensive exam was performed by the triage nurse a short time later. The initial brief patient contact, when a triage score was assigned, was used for the triage time at this institution. At the other emergency department, patients were initially screened by a triage nurse on arrival, and then had a comprehensive exam by the triage nurse a short time later with assignment of a triage score. This second patient contact time, when the triage score was assigned, was used for the triage time at this institution. The average time from triage to physician examination for patients assigned to level 2 was 75.29 +/- 70.72 minutes, while the average time from triage to physician for level 3 patients was 103.03 +/- 87.8 minutes, the difference between level 2 and level 3 being statistically significant ($t = -2.67$, $df = 317$, $p = .004$). After triage was completed, level 2 patients were examined by a physician an average of 27.74 minutes sooner than level 3 patients.

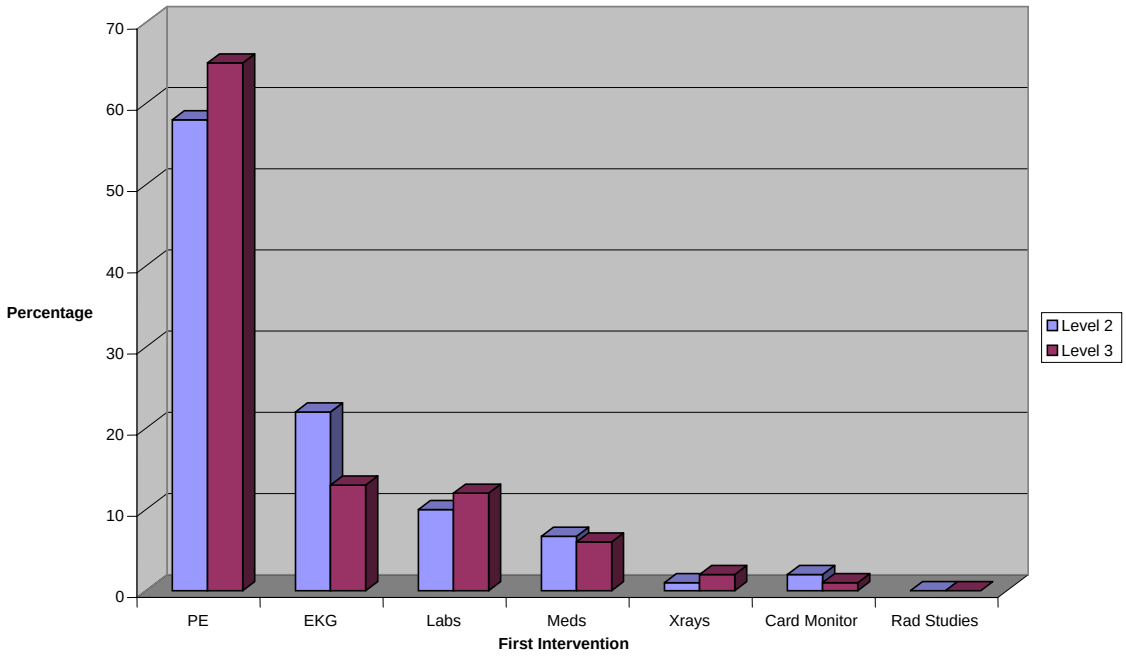
Research question 4b. Is there a difference in the average number of minutes from triage to first intervention for patients assigned to level 2 vs. level 3?

First intervention was defined as providing a diagnostic test or treatment, such as, nebulized breathing treatment, pain medication, obtaining blood for accucheck or other labwork, an x-ray, or an electrocardiogram prior to the patient being seen and examined by a physician. If no intervention took place prior to the physician examination, then physician exam was coded as the first intervention. From a total of 334 patient charts, 320 charts were used for analysis, with 90 patients assigned to level 2 and 230 patients assigned to level 3. Patients who left prior to physician evaluation, patients referred by the triage nurse to labor and delivery, or patients sent to on-site clinic setting by triage nurse accounted for missing data on 14 triaged patients. The average time from triage to first intervention for patients assigned to level 2 was 60.16 +/- 70.32 minutes, while the average time from triage to first intervention was 85.69 +/- 86.78 minutes for patients assigned to level 3, the difference being statistically significant ($t = -2.49$, $df = 318$, $p = .007$) In this sample, after the triage was completed, level 2 patients received a first intervention an average of 25.53 minutes sooner than level 3 patients. Overall, the most frequent first intervention was physician exam (n = 202, 63.1%), followed by electrocardiogram (n = 50, 15.6%) and laboratory studies (n = 36, 11.3%), and the difference between level 2 and level 3 for type of first intervention was not significant ($F = 5.39$, $df = 6$, $p = .494$). See Figure 5 for a summary of results.

Research question 4c. Is there a difference in the average number of minutes from triage to opioid pain medicine for patients assigned to level 2 vs. level 3?

An independent samples t-test was used to compare average time from triage to

Figure 5: Comparison of Level 2 and Level 3 by First Intervention



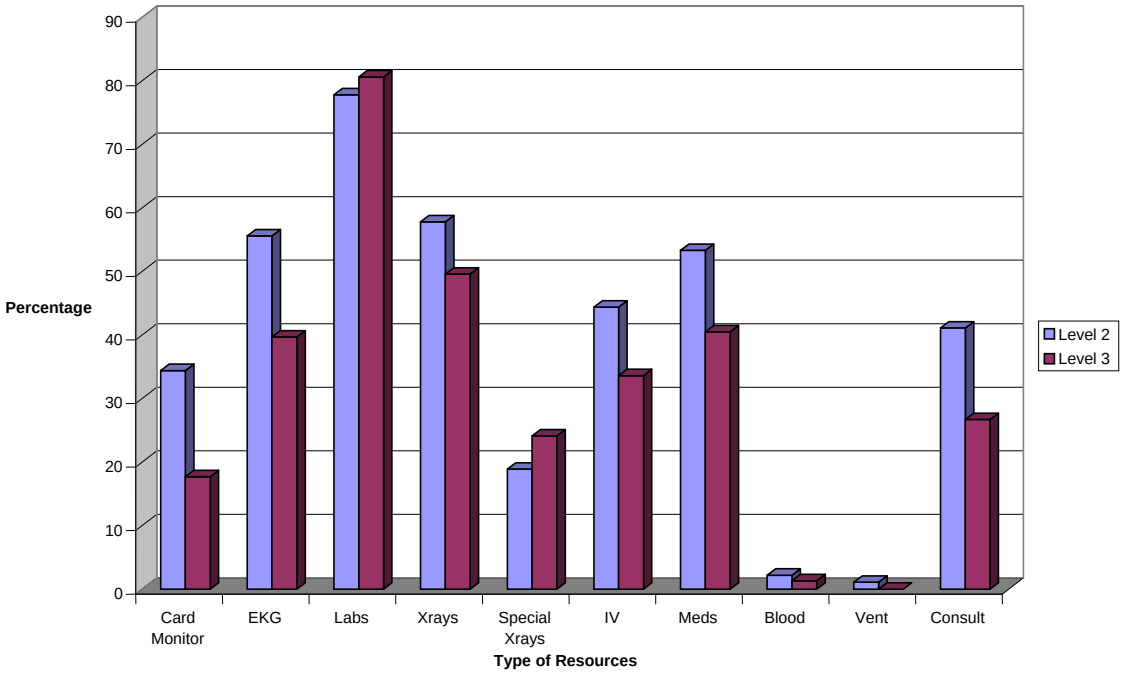
time of opioid pain medication for level 2 and level 3 patients. For consistency, the time used in the study as time to opioid pain medicine was the time the physician documented on the patient's medical chart that opioid pain medicine was to be administered to the patient, not the time documented on the chart that the opioid pain medicine was administered. During the course of the study a total of 97 patients had opioid pain medicine ordered by the physician, 29 patients from level 2 and 68 patients from level 3. The average time from triage to opioid pain medicine for level 2 patients was 117.03 +/- 96.98 minutes, while the average time from triage to opioid pain medicine for level 3 patients was 142.63 +/- 108.17 minutes, the difference between level 2 and level 3 patients not statistically significant ($t = -1.099$, $df = 95$, $p = .274$).

Research question 4d. Is there a difference in types of ED resources used by patients assigned to level 2 vs. level 3?

The types of interventions the patient received after physician evaluation was completed were coded based on the resource utilization categories described by the Emergency Severity Index 5-level triage system, and include cardiac monitoring, electrocardiogram, laboratory studies, plain xrays, special radiological studies (such as CT or ultrasound), parenteral (intravenous) fluids or medications, blood administration, mechanical ventilation and specialty consultation. Frequencies were obtained for each resource category and Chi-square analysis was performed comparing each resource utilization category with level 2 or level 3 assignment to ascertain if certain resources were more likely to be associated with level 2 or level 3 assignment. Types of resources was documented for 322 of the 334 patient medical records used in the study (96%), with patients who left prior to physician evaluation, patients referred by the triage nurse to labor and delivery, or patients sent to on-site clinic setting by triage nurse accounting for missing resource documentation on 12 triaged patients. Overall, for a total of 322 patient charts, the most frequent resource category utilized was laboratory (n=257), followed by plain x-rays (n=167), electrocardiogram (n=142), medications (n=142), parenteral fluids (n=116), special radiological studies (n=73), cardiac monitoring (n=72), blood administration (n=5) and mechanical ventilation (n=1). Comparison of resource utilization showed a statistically significant difference between patients assigned to level 2 and level 3 for cardiac monitoring (Fisher's Exact Test, $p = .002$), electrocardiogram (Fisher's Exact Test, $p = .012$), medications (Fisher's Exact Test, $p = .045$) and specialty consultation (Fisher's Exact Test, $p = .015$). In this sample, for patients utilizing

emergency department resources, patients assigned to level 2 were more likely to receive cardiac monitoring, electrocardiogram, medications and a specialty consultation, than patients assigned to level 3. See Figure 6 for a summary of findings.

Figure 6: Comparison of Level 2 and Level 3 by Type of Resources Utilized

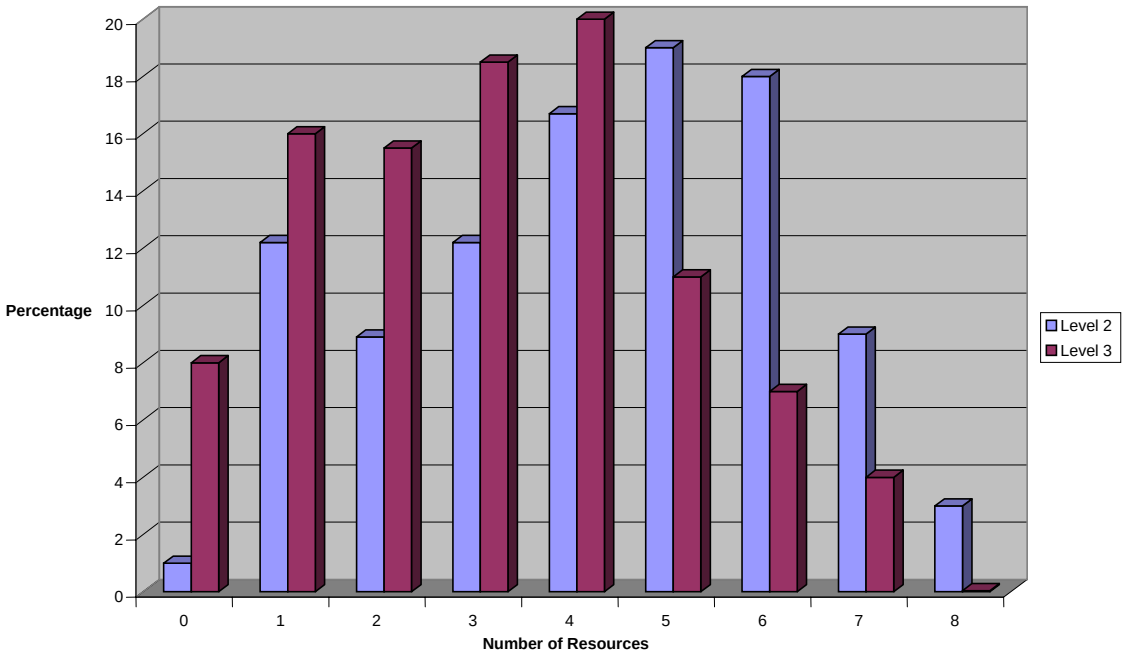


Research question 4e. Is there a difference in number of resources used by patients assigned to level 2 vs. level 3?

The total number of resources utilized by each patient was extracted from the patient medical record. Number of resources was documented for 322 of the 334 patient medical records used in the study (96%), with patients who left prior to physician evaluation, patients referred by the triage nurse to labor and delivery, or patients sent to on-site clinic setting by triage nurse accounting for missing resource utilization on 12

triaged patients. A comparison using Chi-square was performed to determine if there was a difference in total number of resources used by level 2 and level 3 patients. Resource categories were defined using established ESI definitions of resource categories and include cardiac monitoring, electrocardiogram, laboratory studies, plain xrays, special radiological studies (such as CT or ultrasound), parenteral (intravenous) fluids or medications, blood administration, mechanical ventilation and specialty consultation. Number of resources was documented for 322 of the 334 patient medical records used in the study (96%), with patients who left prior to physician evaluation, patients referred by the triage nurse to labor and delivery, or patients sent to on-site clinic setting by triage nurse accounting for missing resource documentation on 12 triaged patients. Overall, the number of resources used by patients in level 2 and level 3 ranged from 0 (n = 19) to 8 (n = 4). In a comparison of patients assigned to levels 2 and 3 and number of resources utilized at each level, level 2 patients used a average of 3.7 resources while the level 3 patients used an average of 3.05 resources, the difference being statistically significant ($F = 5.869$, $df = 151$, $p = .015$). In this sample, patients assigned to level 2 used a significantly greater number of ED resources than patients assigned to level 3. See Figure 7 for a summary of findings.

Figure 7: Number of Resources for Level 2 and Level 3



CHAPTER FIVE: DISCUSSION

Significance of Findings

Research related to the 5-level ESI triage system has examined characteristics that differentiate patients assigned to level 1 vs. level 2, and patients assigned to levels 3, 4 and 5. To this author's knowledge, prospectively assessing factors that influence triage nurse assignment of patients to the high risk level 2 and lower risk level 3 within the 5-level ESI triage system, and detailing the differences between patients assigned to level 2 and level 3 as they progress through their emergency department experience, has not previously been explored.

Considering the large amount of information available about the patient, less experienced triage nurses often struggle in deciding what patient information is truly relevant when assessing if a high risk situation exists (Tanner, 2006). In the current environment of emergency department overcrowding, maintaining patient safety and quality of care is absolutely essential, and this can be facilitated by assigning patients to the appropriate triage level. Utilizing, on average, experienced triage nurses, this study identified specific, objective factors which could be used by less experienced triage nurses during clinical decision making at triage. These factors provide additional discrimination regarding which patients could potentially be in a high risk situation or require timely intervention, and should therefore be assigned to level 2 rather than level 3. These study findings are consistent with the information provided in the ESI Version 4: Implementation Handbook; therefore this study can be seen as validating the ESI criteria for level 2 and level 3.

Previous ESI research has utilized mostly retrospective study designs (Baumann, et. al., 2007; Tanabe, et. al., 2004a, Tanabe, et. al., 2004b; Travers, et. al., 2002) and case scenarios (Baumann, et. al., 2005; Eitel, et. al., 2003) with only a limited number of real-time clinical studies (Elshove, et. al., 2007; Tanabe, et. al., 2005; Wuerz, et. al., 2000). The prospective design of this study allowed the triage nurses to provide immediate feedback regarding variables they considered important in decision making, and data were collected within the confines of a real-time clinical setting. Therefore, one can be more confident that the findings are reflective of actual decision making that occurs in triage than retrospective studies or case scenarios. In fact, almost every triage nurse made a similar comment at the completion of their participation in the study. They stated that having to designate 3-4 important factors that they considered in their decision making "really made me think about what I was doing and was a good learning experience".

The conceptual model of the triage process created by the author illustrates components the author has determined are relevant to decision making and assignment of a triage acuity level or score. The components include nurse characteristics, patient characteristics, clinical environment, and outcome measures that include accuracy of medical diagnosis. The model provides a framework from which to begin investigation into the decision making process, the findings used to inform the relationship between those factors and outcomes. By more clearly delineating specific factors that influence triage nurse assignment of patients to acuity levels, specifically level 2 and level 3, this model has the potential to make clinical decision making more transparent, and thus easier to understand, measure, and reproduce.

Factors Important to the Nurses When Assigning the Level of Acuity

Three research questions within Research Aim #1 examined patient factors that influenced the triage nurse to assign a patient to level 2 or level 3. There was a statistically significant difference in assignment of patients to level 2 and level 3 by the triage nurse based on patient age, vital signs, the need for a timely intervention and expected number of resources. Triage nurses rated patient age, vital signs and need for a timely intervention as significantly important factors influencing assignment to level 2, while expected number of resources was a significantly important factor related to patient assignment to level 3. In the study, the age range for patients was 1-98, with 13 patients under the age of 18 and 48 patients age 75 years and older. The average age of patients assigned to level 2 was approximately 2 years older than the average age of patients assigned to level 3, however the difference was not significant. It is possible that the triage nurses decided that particular patient ages, specifically the very young or very old, were an influencing factor. The very young and very old are known to be vulnerable patient populations, and thus have the potential to influence decision making regarding how long a patient can wait to be seen or receive an intervention (Baumann & Strout, 2007; Baumann & Strout, 2005). In a study of 929 patients aged 65 years and older, Baumann and Strout (2007) found a significant association between rate of hospitalization and ESI triage assignment. This finding validates the information presented in the Emergency Severity Index Version 4: Implementation Handbook (Gilboy, et. al., 2005), where the example is given of a frail elderly man with abdominal pain being assigned to level 2 because he is seen as a high risk patient, while a 20 year man with abdominal pain and stable vital signs would be assigned to level 3.

Triage nurses also identified vital signs and need for a timely intervention as significantly important factors influencing patient assignment to level 2 rather than level 3. This judgment is theoretically and clinically sound, as patients who had vital signs outside the normal parameters, or required a timely intervention, would most likely benefit from being assigned a higher triage level, thus decreasing the patient's wait time to intervention or physician evaluation compared to assignment to level 3. It is possible that, for the nurses that choose vital signs as an important factor for level 3, it was the stability of the vital signs that influenced assignment to level 3.

Expected number of resources was also identified by triage nurses as a significantly important factor when assigning patients to level 3 compared to level 2. The ESI algorithm places determination of expected number of resources at the level 3 decision point, thus expected number of resources is not considered in the decision making process for level 2 patients. At the level 3 decision point the determination is made as to whether the patient will require 2 or more resources. If the triage nurse anticipates that the patient will require less than 2 resources then the patient is placed in a lower level, either 4 or 5. In this study, level 2 and level 3 patients used, on average, 3 or more resources, so they did use a similar number of resources. This finding is consistent with previous ESI studies investigating the amount of resource consumption (Tanabe, et. al., 2004a; Wuertz, et al., 2000). Both studies found there was no difference in level 2 and level 3 based on the number of resources used. It is possible that the triage nurse, when indicating that expected number of resources was a very important factor, had to decide on the number of resources, i.e. none, one or many resources, to discriminate

whether the patient would be placed in level 3 (many), rather than levels 4 (one) or 5 (none), based on anticipated resource utilization.

Four patient factors, patient chief complaint, past medical history, additional symptoms other than patient chief complaint, and "other", did not reach statistical significance for discriminating between level 2 and level 3 patients, but may nonetheless be clinically significant. For 67% of patients, the triage nurse rated chief complaint as an important factor when making level 2 or level 3 assignment. However, overall, the difference between level 2 and level 3 was not significant as patient chief complaint had an equally high frequency of selection between the two levels (67.1% vs. 67% respectively).

Past medical history was also selected frequently by triage nurses as an important factor, with 35.9 % of patients in level 2 and 35% of patients in level 3. However, based on number of years of triage experience, nurses with four or more years of triage experience were 2.27 times more likely to rate past medical history as an important factor compared to nurses with less than four years of triage experience (2.27, p=.019). Similarly, additional symptoms other than chief complaint did not reach statistical significance as an important factor. However, again based on number of years of triage experience, nurses with four or more years of triage experience were 4.62 times more likely to rate additional symptoms other than the patient chief complaint as an important factor, compared to nurses with less than four years of triage experience (OR 4.62, p=.018). This could be interpreted that more experienced triage nurses felt that patient past medical history and additional symptoms other than the patient chief complaint assisted in the determination of severity of illness and assignment of acuity level and, for

a majority of triage nurses in the study, patient chief complaint was an important factor when assigning an acuity level.

The “other” category was the fourth most frequent factor chosen, with a similar percentage of level 2 and level 3 patients having the triage nurse rate it was important to their decision making. The most frequent qualitative answer for the “other” category was clinical presentation (71%), and based on this information, it would have been very informative to then have the triage nurse provide additional explanation as to what it was about the patient’s clinical presentation that the triage nurse felt was important. Additional answers within this category included mechanism of injury, multiple visits for same, hospitalized for same in past, family states change in patient status, and pain control. These responses all indicate circumstances specific to a particular patient, and all are relevant factors that would influence decision making.

In this study environmental factors were not rated by the triage nurses as important in the patient assignment to level 2 or level 3. This finding validates that triage nurses are incorporating patient safety into clinical decision making, and triage level was being assigned based on patient chief complaint and available information, and not being assigned based on transient variables such as time of day, emergency department census, or waiting time to receive an intervention or physician evaluation.

It was surprising that severe pain or distress did not reach statistical significance as an important factor influencing patient assignment to level 2 or level 3. However, this finding could be explained by the fact that the average pain rating documented by the triage nurses for patients assigned to level 2 and level 3 in this study was similar, 4.6 vs. 4.22 respectively, the difference not being statistically significant. Another sample of

patients may yield significantly different results. All other factors on the Triage questionnaire received 10% or less of total number of responses and none were found to be statistically significant for influencing triage nurse assignment of patients to level 2 vs. level 3.

In summary, the findings that patient age, past medical history, and vital signs were rated by triage nurses to be important when assigning a patient to level 2, and expected number of resources was important when assigning a patient to level 3, validates the information presented in the ESI Version 4: Implementation Handbook for Level 2 criteria (Gilboy, et. al., 2005). According to the Handbook patient age, past medical history, and medications will often assist the triage nurse in determining the severity of the patient's chief complaint, however in this study medications did not help differentiate between patients assigned to level 2 and level 3. Severe pain or distress, also one of the criteria used for consideration of assignment to level 2, was not found to be statistically significant for assignment to level 2 vs. level 3.

Patient Characteristics Related to the Triage Process

Research Aim #2 contained nine research questions examined the relationship between patient assignment to level 2 and level 3 and the following patient factors: age, chief complaint, past medical history, patient medications, vital signs, level of pain or distress, whether the patient had been seen by a physician, or discharged from a hospital or emergency department, within the last seven days, the source used to gather patient information, and the patient's final disposition after evaluation in the ED. The average age for the 334 patients included in this study was 48.8 +/- 21.17. This average age is

older than found in some previous ESI research studies, where average patient ages were 40 years (range 29-57) (Wuertz, et. al., 2000), and 44.8 +/- 20.6 (range 3 months to 102 years) (Tanabe, et. al., 2004). However, the average age of 50.2 for level 2 patients in this study is consistent with an ESI study conducted by Tanabe, et. al. (2005) where the average patient age was 50. Finally, in this study, patients assigned by the triage nurse to level 2 were on average only 2 years older than the patients assigned to level 3 (50.2 vs. 48.2), which was not statistically significant. However, as previously stated, triage nurses rated patient age as an important factor influencing patient assignment to level 2. One explanation could be that the very young or very old were seen by the triage nurse as vulnerable patient populations.

Patients with a chief complaint of nausea and vomiting were more likely to be assigned by triage nurses to level 2 than level 3, while patients with psychiatric illness, depression or suicidal ideation were more likely to be assigned by triage nurses to level 3 than level 2. Patients presenting to triage actively vomiting often appear to be in moderate to severe distress, which could influence the triage nurse to assign them to a level that allows the patient to be seen by a physician, while not immediately, as soon as possible. Patients presenting with a psychiatric illness may be otherwise communicating with the triage nurse in a thoughtful, organized manner, thus providing a stable presentation. The patient would need to be seen in a timely manner, but could potentially wait a little longer than a level 2 patient if he/she does not appear to be a danger to self or others, or if the waiting room is being closely monitored by the triage nurse or security.

A surprising finding was that, for chief complaints typically associated with more severe illness, such as shortness of breath, chest pain, stroke symptoms, and altered level

of consciousness, no significant differences were found between chief complaint and assignment of patients to level 2 and level 3 acuity. This could be explained if the patient's chief complaint was similar for level 2 and level 3; however, the severity of the complaint was different, for example mild vs. moderate shortness of breath, chest pain that is not consistent with ACS symptoms, stroke symptoms that occurred more than 6 hours prior to patient arrival in the ED, or dizziness/feeling faint due to anxiety rather than decreased level of consciousness. This would validate the importance of visual inspection of the patient, i.e. patient presentation, where a patient presenting with complaint of shortness of breath, but who is otherwise speaking in complete sentences and has stable vital signs, may have been assigned a different triage score than a patient presenting with complaint of shortness of breath and obvious difficulty breathing.

Comparison of patient past medical history, or vital signs, to level 2 and 3 assignment demonstrated statistically significant findings. Of the 15 pre-determined categories of past medical history, patients with a history of renal insufficiency/failure were significantly more likely to be assigned by the triage nurse to level 2 than level 3. It would be reasonable for the experienced triage nurse to view patients with moderate to severe renal problems as already sufficiently ill, and, with the addition of perhaps another problem, the patient should be further evaluated sooner rather than later. It is surprising that no other past medical history category was found to be an important factor in differentiating patient assignment to level 2 or level 3. For patients whose vital signs, specifically heart rate, respiratory rate and oxygen saturation, were outside the normal parameters listed on the ESI algorithm, patients were significantly more likely to be assigned by the triage nurse to level 2 rather than level 3. This finding would be expected,

as abnormal vital signs can be associated with high risk situations. It is interesting to note that 13% (n=32) of patients assigned to level 3 had one or more abnormal vital signs, however their condition was still considered appropriate for assignment to level 3 by the triage nurse, while 76.6% (n=72) of patients assigned to level 2 had vital signs within normal parameters. This indicates that other factors, in addition to vital signs, were influencing the triage nurse's decision making.

A difference was found between patients assigned to level 2 or level 3 in relationship to patient disposition. Three patient disposition categories were analyzed: Discharged home, Admitted to the hospital, or Other. The category "Other" included the patient being sent to another hospital, clinic, or to a psychiatric facility, transported to jail, or left without being seen. The difference in final disposition between level 2 and level 3 patients was statistically significant ($p = .002$), the largest difference being the higher rate of admission for patients assigned to level 2 compared to level 3. However, due to the relatively small level of association between admission and level 2 or level 3 assignment (Cramer's $V = .002$) statistical significance is likely due to the large patient sample size and is not clinical significant.

The percentage of patient admissions for level 2 and level 3 patients in this study is much different than the percentage of level 2 and level 3 admissions in previous ESI studies, with L2 = 67% and L3 = 42% (Eitel, et. al., 2003); L2 = 72.7% (n=125) and L3 = 50.8% (n=70) (Tanabe, et al., 2004b) and L2 = 61% (n=80) and L3 = 36% (n=56) (Wuerz, et al., 2000). It is possible that the patient sample used in this study contained, on average, a lesser number of patients with medical conditions that required hospitalization, or the patient case-mix was significantly different as compared to

previous studies. It is also possible that, during years between the previous ESI studies and this study, management of specific patient medical conditions had improved to the point where patients were able to be medically managed at home. In summary, what can be taken from the past and present studies is that there is a significant difference in admission rate for level 2 and level 3 patients, with level 2 patients more likely to be admitted when compared to level 3 patients.

No significant difference in patient assignment to level 2 or level 3 was found based on patient medication, source used to gather initial patient information in triage, or whether the patient was seen recently in a physician's office, or discharged from a hospital or emergency department within the last seven days. It was interesting to this author that, for patients who had a recent history of physician evaluation, and who were now presenting to the emergency department for physician evaluation, there was no difference between level 2 and level 3 assignments. It would have been informative to have obtained information on each patient who fit these criteria regarding whether the patient came to the ED for the same complaint because it had not resolved as expected, or the previous symptoms or complaint was getting worse, or whether the patient was presenting for a completely different problem.

Research Aim #3 contained three questions meant to describe the characteristics of patients assigned to acuity level 2 or 3 who experience deterioration in their medical condition or die while in the ED. No patient in this study experienced deterioration in medical condition that required immediate evaluation and intervention, or died prior to physician evaluation. One patient, subsequent to physician evaluation, experienced deterioration in medical condition and eventual death after the physician evaluation.

Death was due to the patient being designated “do not resuscitate” by the family after a discussion with the ED physician regarding the severity of the patient’s medical condition.

This lack of deterioration of health status for the patients in this sample is not surprising, as the investigator’s clinical experience is that unexpected deterioration in a patient’s medical condition in the ED is rare. The ED physicians and nurses associated with the two emergency departments used in this study were highly skilled in patient assessment and management. This study demonstrated that the nurses triaged patients appropriately, thus impacting patient safety. Patients were sorted so they could receive intervention or evaluation in a timely manner based on their risk of experiencing an adverse outcome. No patient experienced an adverse outcome secondary to waiting for an intervention and/or physician evaluation. In the future, larger samples should be followed to accurately analyze relevant variables related to deterioration in patient’s medical conditions and/or deaths. In addition, information regarding adverse events at any hospital, especially patients dying in the ED waiting room while awaiting physician evaluation, is diligently collected but not made routinely available outside of a hospital’s risk management department.

Clinical Environment Characteristics Related to the Triage Process

Research Aim #4 described the overall trajectory of patients assigned in the emergency department to acuity level 2 or level 3. Three research questions examined if there was a difference between level 2 and level 3 assignment and average number of minutes from triage to physician exam, first intervention, and treatment with opioid pain medication. The average number of minutes from triage to physician exam for patients assigned to level 2 was approximately 28 minutes less than for patients assigned to level

3, and the average number of minutes from triage to first intervention for patients assigned to level 2 was approximately 26 minutes less than patients assigned to level 3. These findings are expected. Based on criteria for level 2 and level 3, patients assigned to level 2 would have been perceived by the triage nurse to have a higher severity of illness or injury, and this would account for the patients receiving a physician examination or interventions sooner than level 3 patients.

A review of the patient medical records demonstrated that, for targeted patient presenting complaints, symptoms or medical histories, triage nurses initiated specific interventions, such as, electrocardiogram for patients with suspected cardiac chest pain, accucheck for patients with diabetes, and breathing treatments for patients with a history of Asthma/COPD and presenting with shortness of breath. Interventions initiated in triage could have the potential to impact the difference in time to intervention for level 2 and level 3 patients. Anecdotally, it is assumed that patients assigned to level 2 would be evaluated sooner than patients assigned to level 3; however, this has not so far been documented in the research literature. Total amount of time in the emergency department (length of stay or LOS) for patients assigned to ESI levels 2 and 3 has been documented as part of multiple ESI studies, and LOS had not been shown to be significantly associated with assigned ESI Level. This is the first study within the ESl literature to document actual minutes from triage to physician examination or first intervention.

In this study, the average time to physician evaluation for level 2 patients was over one hour. The standard deviation was wide, indicating that some level 2 patients were seen within a few minutes, while other level 2 patients waited more than 2 hours. In the past, studies addressing appropriate time to treatment, “what it should be”, place the

expectation of wait time for level 2 patients to be between 15 and 30 minutes (Zimmerman, 2001). The ESI does not define time intervals to physician evaluation, recommending that level 2 patients be seen in a timely manner consistent with their medical complaint. A more detailed review of the patient charts in this study might determine, for patients assigned to level 2, if there were specific patient complaints that were "moved to the front". In addition, the average time from triage to first intervention for patients assigned to level 2 was approximately 26 minutes sooner than patients assigned to level 3. The ability of the triage nurse to order targeted tests and treatments prior to physician evaluation provides additional information to the physician during evaluation, improves overall efficiency of patient care, and could have contributed to formulation of an "evidence-based" medical diagnosis by the triage nurse. An analysis examining if the tests and treatments initiated by the triage nurses were appropriate for each patient who received them was not performed as part of this study.

No significant difference was found for minutes from triage to opioid pain medication and assignment to level 2 and level 3 (117.03 vs. 142.63 respectively, p=.274). Typically one would think that patients presenting with painful conditions would, most likely, receive pain medicine such as opioids. This finding could be explained by referring back to the average patient level of pain or distress documented in triage, the pain scale ranging from 0-10, which showed no significant difference between level 2 and level 3. The findings showed there were extremes in pain complaints and time to medication. Patients presenting with suspected cardiac chest pain or broken bones received an opioid pain medicine within a few minutes of triage, whereas patients with less severe complaints may not have received opioid pain medicine until close to the end

of their emergency department stay. It is interesting to note that multiple types of medications other than opioid were prescribed to patients for pain control, including Tylenol, NSAIDS, Pepcid, Maalox, Protonix, and Nitroglycerin. In addition, procedures such as incision and drainage of a wound, or irrigation of a foley catheter, could have been the method utilized to reduce a patient's pain or discomfort. This suggests the use of targeted treatments for specific pain problems, and potentially validates the use of opioid pain medicine only in patients for whom opioids would be the best choice (Ducharme, 2000).

Two research questions compared level 2 and level 3 patients and the number and type of resources they used during the time they were in the emergency department. Level 2 patients used, on average, 3.7 resources, while the patient assigned to level 3 used, on average, 3.05 resources. Patients assigned to level 2 were more likely to use cardiac monitoring, electrocardiogram, medications, and specialty consultation than patients assigned to level 3. It is not unexpected that the patients assigned to level 2 would receive a more extensive diagnostic workup and higher number of therapeutic interventions than patients assigned to level 3. Specialty consultation in this study was mainly used when patients required hospital admission, with patients assigned to level 2 significantly more likely to be admitted to the hospital than level 3 patients. However, other types of specialty consultation, such as psychiatric evaluation, were used by both level 2 and level 3 patients. There were several level 3 patients who received a specialty consultation prior to discharge as a way to facilitate outpatient management and follow-up.

The findings of a difference in resources used by Level 2 and Level 3 patients in this study are similar to those of other investigations. Tanabe, et al., (2004a), in a retrospective study of 403 patients, found that patients assigned to level 2 used, on average, 3.9 resources, while patients assigned to level 3 used, on average, 3.3 resources. Wuerz, et. al. (2000) and Eitel, et. al. (2003) documented that patients assigned to level 2 and level 3 used "many" resources, "many" defined as using more than one resource. Eitel, et. al. (2003) stated that level 2 and level 3 patients require more diagnostic tests and consultations than level 4 and level 5 patients because the diagnostic process is more difficult. It is difficult to compare the findings of this study with those of others. None of these authors reported the actual number or type of resources used by level 2 and level 3 patients, or if there was a significant difference between level 2 and level 3, most likely because the criteria for measuring resources was none, one or many. Also, none of the previous ESI studies investigated if there was a difference between level 2 and level 3 regarding resource use.

This is the first study to discriminate between level 2 and level 3 patients based on actual number and type of resources used by the patients. Patients assigned to level 2 were more likely to receive cardiac monitoring, electrocardiogram, medications, and specialty consultation during their time in the ED. Patients on both levels used, on average, 3 or more interventions. Laboratory testing was the most frequent resource used between all level 2 and level 3 patients, followed by plain xrays, electrocardiogram, medications, and parenteral fluid administration. This information is very helpful to predict what resources are more frequently utilized, allowing the emergency department

staff to plan staffing and coordinate with ancillary departments according to department needs.

Summary of findings

Triage nurses identified patient age, vital signs, and need for a timely intervention as factors that influenced patient assignment to level 2, while expected number of resources was identified as the factor that influenced patient assignment to level 3. Influencing factors that did not reach statistical significance, but were nonetheless clinically important, included patient chief complaint, past medical history, additional symptoms other than patient chief complaint, and patient presentation. Thus, triage nurses used multiple pieces of patient information in their decision making to create a complete assessment of the patient. While other factors were identified by triage nurses based on individual patient situations, overall no other factors reached statistical significance. No patient experienced deterioration in medical condition between the time they were assigned by the triage nurse to triage level 2 or 3 and when they received an intervention or physician evaluation.

The findings also provide insight into the trajectory of patients assigned to level 2 and level 3 by determining that there is a significant difference in resource utilization between patients assigned to level 2 and level 3. The Emergency Severity Index 5-level triage system was designed to stratify patients based on the intensity of their ED resource needs for levels 3, 4 and 5. The knowledge that there is a difference in resource needs between patients assigned to level 2 and level 3 is beneficial because it provides further discrimination regarding the number and types of resources the emergency department

and ancillary services must be prepared to supply to the higher acuity patients presenting to the emergency department.

Limitations

There are several limitations to this descriptive and correlational study. The convenience sample of five nurses with less than 4 years of triage experience and 13 nurses with four or more years of triage experience was heavily weighted with experienced nurses. Participation in the study was voluntary, and at each of the two emergency departments there were a significant number of triage nurses who chose not to participate in the study. This has the potential for selection bias as the sample of triage nurses may not be representative of emergency departments nationwide, and thus the study results may not be generalizable. The triage nurses in this study had been trained to use the ESI system within the last 6 months. This new knowledge may have influenced their decision making process to focus on the algorithm they had recently learned rather than relying on previous experiences or expertise. With regard to a convenience sample of patients, the triage nurses assigned a higher percentage of patients in this study to level 3 than level 2 (240 vs. 94). This is consistent with other investigations using convenience samples of patients from emergency departments associated with large teaching hospitals (Bauman & Strout, 2005; Wuerz, 2000) and is likely to be reflective of the actual percentage of patient assigned to level 2 and level 3, however a larger study sample is necessary to validate this finding.

The lack of examining reliability and agreement of patient assignment to level 2 and level 3 is a limitation of this study. No attempt was made to assess for inter-rater reliability of patient assignment to ESI level 2 or level 3 due to previously documented

good to excellent inter-rater reliability for ESI validation studies. In addition, there was no assessment of intra-rater reliability, whereby the triage nurse assigns the same triage level to patients presenting with similar symptoms or chief complaints. Accuracy of patient assignment to level 2 and level 3 was not assessed. This could have been measured using an established gold standard, such as, established criteria currently in use for patients suspected of having an MI or stroke where treatment is time sensitive. Another method of measurement would be to assess for deterioration in a patient's medical condition after assignment to level 2 or level 3. This study used patient deterioration as the outcome measure for assessing accuracy of patient assignment to level 2 and level 3; however lack of sufficient patients who met this criterion made examination of this issue not feasible.

Collecting patient information from the chart has limitations typically associated with a retrospective chart review. Only information that has been charted can be used, therefore there is a threat of lack of adequate documentation and/or of loss of information. However, the majority of patient data collection was completed using chart review within three to four hours after completion of the Triage Questionnaire and while the patient was still in the ED. The fact that the nurses were aware they were being studied may have influenced the completeness and validity of their triage process. However, the PI did not observe the nurse-patient interaction in an effort to maintain a realistic clinical environment and minimize a possible Hawthorne effect.

Implications for Nursing

With the aging of the US population and improvements in health care that allow people to living longer with multiple co-morbid conditions, it is clear that patient acuity

will only become higher over time. Accuracy of patient assessment is critical to patient safety and quality care, and assigning a patient to an inappropriate triage level could have a significant impact on patient healthcare outcomes and patient satisfaction with their ED experience. Given the variety and complexity of the patients routinely presenting to the emergency department for evaluation, it is easy to understand why there is a lack of standardized criteria that can be applied to every patient. The Emergency Severity Index has been shown to be a valid triage system for standardizing collection of patient data and stratifying patients based on priority of treatment and ED resource utilization, and is therefore a valuable tool for nurses wanting to provide effective and efficient patient care at triage.

Many of the criteria set forth in the ESI Version 4: Implementation Handbook have been validated in this study and therefore need to be reinforced within triage education programs. However, the ESI 5-level triage system is, by definition, a tool meant to assist in the triage process, with the expectation that the nurse bring an advanced level of experience and expertise that supplements the use of the ESI system. The level 2 criteria questions (is this a high risk situation, is the patient experiencing new onset confusion, lethargy, or disorientation, and is the patient experiencing severe pain or distress) do not provide enough guidance for less experienced nurses. Triage nurses can assess if the patient is experiencing new onset confusion, lethargy or disorientation, or severe pain or distress, however only experience and expertise can answer the question "Is this a high risk situation?". For example, results from this study demonstrate that, for patients presenting to triage with some type of altered level of consciousness, 14 patients were assigned by the triage nurses to level 2, and 21 patients were assigned by

the triage nurse to level 3. Altered level of consciousness is a broad symptom that can multiple different presentations and levels of risk. Patients in severe pain or distress would most likely be assigned to level 2, such as patients in this study who were experiencing nausea and vomiting. However, patients assigned to level 2 had an overall pain or distress level equivalent to patients assigned to level 3, so there must have been other important factors that influenced the triage nurse to assign the patient to the high risk category of level 2. Therefore, identifying important factors that experienced triage nurses use to discriminate between level 2 and level 3 assignment, in addition to the factors already delineated in the ESI Version 4 Implementation Manual, have useful implications for less experienced triage nurses by providing a more comprehensive and relevant foundation for data gathering and decision making.

Implications for Research

Very little is known about nurse clinical decision making relative to the triage setting, the triage process, or its impact on patient care and outcomes. The sample was small, with 18 triage nurses from two emergency departments. Larger studies utilizing triage nurses from multiple types of ED settings would assist in further discriminating what is truly the most relevant information to use for clinical decision making, as well as refining a theoretical framework specific to the triage process. Further research should also be performed using nurses from emergency departments where the ESI has been in place for several years, as well as in emergency departments that require the nurse to rely primarily on experiential knowledge, to investigate if the findings are consistent.

Research using both experienced and inexperienced triage nurses is necessary to validate that triage nurses do formulate accurate medical diagnosis for patients, and to

determine what if there are specific patient populations where triage nurses have a very high level of accuracy in prediction. Findings from this and future studies could be used as the foundation for an educational triage program that teaches nurses different clinical decision making strategies during triage, especially the process of differential diagnosis. The educational program would be followed by a study of the effects of the program on patient outcomes, especially patient safety.

It is crucial that all nurses functioning in the triage setting, regardless of their number of years of triage experience, be capable of identifying patients at risk so that timely interventions can be initiated in triage. Many emergency departments currently use protocols for initiating interventions and treatments prior to the patient being examined by the physician, however, they are institution specific. Future triage research could look at developing a universal algorithm that could be the standard for all emergency departments.

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APPENDICES

Table 1: Description of Category Criteria for the Emergency Severity Index.

	ESI level 1	ESI level 2	ESI level 3	ESI level 4	ESI level 5
Stability of vital functions (ABCs)	Unstable	Threatened	Stable	Stable	Stable
Life threat or organ threat	Obvious	Reasonably likely	Unlikely	No	No
Requires resuscitation	Immediately	Sometimes	Seldom	No	No
Severe pain or severe distress	Yes	Yes (sufficient but not necessary for this category)	No	No	No
Expected resource intensity	Maximum: staff at bedside continuously; mobilization or outside resources	High: multiple, often complex diagnostic studies, frequent consultation; ontinuous (remote) monitoring	Medium: multiple diagnostic studies; or brief period of observation; or complex procedure	Low: one simple diagnostic study; or one simple procedure	Low: exam only
Physician/staff response	Immediate	Minutes	Up to 1 hour	Could be delayed	Could be delayed
Expected time to disposition	1.5 hours	4 hours	6 hours	2 hours	1 hour
Examples	Cardiac arrest, intubated trauma patient, severe drug overdose	Most chest pain, stable trauma with concerning mechanism, elder pneumonia, altered mental status, behavioral disturbance	Most abdominal pain, dehydration, esophageal food impaction, hip fracture	Closed extremity trauma, simple laceration, cystitis, typical migraine	Sore throat, minor burn, recheck

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Table 2: Emergency Department Triage Nurse Demographic Form

_____	_____	_____
Nurse ID #	**UCSF/SFGH**	**Date**

Emergency Department Triage Nurse Demographic Form

Please circle the appropriate response

1. Gender: Male Female

2. Age: _____

3. Number of years in Nursing: _____

4. Highest level of Education (circle one): ADN BSN Graduate program MSN

5. Certification in Emergency Nursing: Yes No

6. Total number of years working as a nurse in an ED setting: _____

7. Total number of years functioning as a nurse in the ED triage setting: _____

8. Total time as a triage nurse using the 5-level ESI system: _____

9. Have you participated in any classes, in-services, or education programs, in addition to the program offered by this emergency department, for nurses transitioning into the ED triage setting? Yes No

If you answered "yes" to the question above please list what additional training you have received. Examples would be CE classes such as *TriageFirst*, institution specific classes by previous employer, or precepting with an experienced nurse.

_____

_____

_____

Table 3: Triage Questionnaire

_____	_____	_____	_____
Nurse ID #	**Date/Triage time**	**Site**	**Patient ID #**

Nurse Questionnaire

This patient was assigned to (circle): Level 2 Level 3 Patient MR #: _____

Section I. Please mark 3-4 factors from the list below you considered important when assigning the patient to Level 2 or Level 3. If you used another factor not listed below please describe. Factors may be present or absent when determining importance, for example presence of cardiac history or absence of cardiac history may influence importance of past medical history.

_____ Patient referred to ED from outside

_____ ED census/long wait time

_____ Age

_____ Medications

_____ Chief complaint

_____ Additional symptoms than chief complaint
___ present ___absent

_____ Required timely intervention

_____ Hospital or ED discharge <3 days ago

_____ Alcohol/Illicit Drug use

_____ Time of day

_____ Hx by relative or translator

_____ Gender

_____ Immunocompromised

_____ Severe pain or distress

_____ Past medical history
___ present ___absent

_____ Vital signs

_____ Behavioral or psych issue

_____ Expected # of resources

_____ Other (describe) _____

Table 4: Patient Demographic Form

_____	_____	_____
Nurse ID #	**Date**	**Patient ID #**

Patient Demographic Form

Patient ED sign-in time: _____

RN Triage Time: _____

Type of First Intervention: _____
Time _____

Physician Contact Time: _____

Final Diagnosis _____
Time_____

Disposition/Where _____

Age _____

Chief Complaint _____

Vital signs stable Yes No

Pain level _____

Time first dose pain med administered _____

Associated Symptoms Yes No _____

Past Medical Hx CAD Diabetes COPD Renal CVA HIV

Pain Other _____

Family Hx _____

Medications CAD Diabetes COPD Renal CVA HIV

Pain Other _____

Discharged <3 days ago Yes No

Information Source Patient Relative Translator Other_____

Resource Utilization Categories:
Cardiac Monitoring
EKG
Laboratory studies
Plain x-rays
Special radiological studies
Parenteral fluids or Medications
Blood administration
Mechanical ventilation
Specialty consultation _____

List additional interventions: _____

_____

_____

Deterioration in Condition during ED stay: Yes No

If yes, which patient factors changed? Circle the change(s) in patient condition and describe.

BP _____

HR _____

Temperature _____

RR/O2 Sat _____

Pain level _____

Level of consciousness _____

Death _____

Other _____

Table 5: Nurse Demographics

	Mean (SD)	Range
Age	38.33 +/- 8.38	27-55
Number of years ED Nursing	11.14 +/- 8.45	3-33
Number of years in ED setting	8.33 +/- 5.39	1-23
Number of years in ED triage	7.22 +/- 5.54	1-23
Number of months using ESI	5.28 +/- 1.99	0-7

Table 6: Triage Questionnaire - Frequency of Factors Influencing Patient Assignment: A Comparison of Level 2 and Level 3 Patients

	N = 334 (%)	L2 (%)	L3 (%)	χ^2 p value
Patient chief complaint (CC)	224 (67.1)	63/94 (67)	161/240 (67)	p = 1.000
Vital signs	136 (40.7)	49/94 (52)	87/240 (36)	p = .009
Past medical history	120 (35.9)	33/94 (35)	87/240 (35)	p = .899
Other factor	110 (32.9)	33/94 (35)	77/240 (32)	p = .607
Expected number of resources	106 (31.7)	21/94 (22)	85/240 (35)	p = .026
Patient age	54 (16.2)	23/94 (24)	31/240 (13)	p = .013
Required timely intervention	53 (15.9)	21/94 (22)	32/240 (13)	p = .047
Additional symptoms other than CC	49 (14.7)	17/94 (18)	32/240 (13)	p = .303
Severe pain or distress	42 (12.6)	13/94 (14)	29/240 (12)	p = .714
Patient referred to ED from outside	29 (8.7)	5/94 (5)	24/240 (10)	p = .200
Behavioral or Psych issue	25 (7.5)	5/94 (5)	20/240 (8)	p = .488
No additional symptoms to CC	18 (5.4)	3/94 (3)	15/240 (6)	p = .419
Absence of past medical history	18 (5.4)	6/94 (6)	12/240 (5)	p = .598
Patient medications	17 (5.1)	7/94 (7)	10/240 (4)	p = .267
Hospital or ED discharge < 3 days	15 (4.5)	5/94 (5)	10/240 (4)	p = .769
Patient Immunocompromised	14 (4.2)	9/94 (7)	7/240 (3)	p = .074
Alcohol or illicit drug use	13 (3.9)	1/94 (1)	12/240 (5)	p = .121
Hx by relative or use of translator	10 (3.0)	3/94 (3)	7/240 (3)	p = 1.000
Patient gender	4 (1.2)	0/94 (0)	4/240 (0.1)	p = .580
ED census or long wait time	1 (0.3)	0/94 (0)	1/240 (0)	p = 1.000
Time of day	0 (0)			

Other Category (95 responses)	N (%)
Clinical Presentation	67 (71)
Psych (other)	7 (7)
Mechanism of injury	6 (6)
Multiple visits for same	5 (5)
Hx hospitalized for same in past	3 (3)
Pain control	3 (3)
Family states change in patient status	2 (2)
Warrants EKG in triage	2 (2)

Table 7: Comparison of Level 2 and Level 3 by Chief Complaint

	Level 2 N=94	Level 3 N=240	Fisher's Exact p-value
Chest Pain	13 (13.8%)	28 (11.7%)	.582
Shortness of breath	22 (23.4%)	36 (15 %)	.078
Abdominal pain	16 (17%)	59 (24.6%)	.147
Fever	12 (12.8%)	31 (12.9%)	1.00
Neck/Back pain	6 (6.4%)	18 (7.5%)	.818
Extremity pain	10 (10.6%)	28 (11.7%)	.851
Extremity swelling	7 (7.4%)	11 (4.6%)	.292
Trauma	10 (10.6%)	21 (8.8%)	.675
Stroke	0 (0)	5 (2.1%)	.327
Altered LOC	14 (14.9%)	21 (8.8%)	.118
Headache	6 (6.4%)	11 (4.6%)	.580
Vaginal bleeding	2 (2.1%)	2 (0.8%)	.315
Vaginal discharge	0 (0)	1 (0.4%)	.719
Dysuria	2 (2.1%)	10 (4.2%)	.521
Nausea/Vomiting	20 (21.3%)	28 (11.7%)	.036
Diarrhea	6 (6.4%)	9 (3.8%)	.377
Bleeding	4 (4.3%)	7 (2.9%)	.511
Psych/Depression	1 (1.1%)	17 (7.1%)	.030
Weakness/Fatigue	9 (9.6%)	19 (7.9%)	.662
Other	42 (44.7%)	104 (43.3%)	.902

Table 8: Comparison of Level 2 and Level 3 by Past Medical History

	Level 2 N=89	Level 3 N=231	Fisher's Exact p-value
CAD/MI	25 (28.1%)	45 (19.6%)	.131
Thyroid	3 (3.4%)	11 (4.8%)	.765
CHF	3 (3.4%)	6 (2.6%)	.713
Hypertension	33 (37.1%)	63 (27.3%)	.102
COPD	6 (6.7%)	18 (7.8%)	1.00
Asthma	8 (9.0%)	19 (8.2%)	.824
Diabetes	12 (13.5%)	21 (13.4%)	1.00
CVA	4 (4.5%)	11 (4.8%)	1.00
Renal	12 (13.5%)	11 (4.8%)	.013
Seizure	2 (2.2%)	10 (4.3%)	.521
HIV	4 (4.5%)	7 (3.0%)	.506
Immunocompromised	7 (7.9%)	12 (5.2%)	.428
Cancer	5 (5.6%)	16 (6.9%)	.804
Pain	4 (4.5%)	16 (6.9%)	.607
Psych/Anxiety	14 (15.7%)	39 (16.9%)	.868
Gastrointestinal	8 (9.0%)	34 (14.7%)	.200
Other	28 (31.8%)	68 (29.4%)	.684
None	13 (14.6%)	42 (18.1%)	.511

Table 9: Comparison of Level 2 and Level 3 by Medications

	Level 2 N=87	Level 3 N=224	Fisher's Exact p-value
Thyroid	4 (4.6%)	9 (4.0%)	.761
Cardiac	20 (23%)	42 (18.8%)	.430
Hypertension	32 (36.8%)	62 (27.7%)	.121
Pulmonary	12 (13.8%)	30 (13.4%)	1.00
Diabetes	11 (12.6%)	27 (12.1%)	.850
Renal	7 (8%)	10 (4.5%)	.265
CVA	3 (3.4%)	6 (2.7%)	.714
HIV	3 (3.4%)	7 (3.1%)	1.00
Cancer	2 (2.3%)	8 (3.6%)	.731
Pain	15 (17.2%)	47 (21%)	.529
Psych/Anxiety	10 (11.5%)	36 (16.1%)	.375
Seizure	3 (3.4%)	11 (4.9%)	.764
Other	32 (36.8%)	75 (33.5%)	.597
Unknown	8 (8.5)	17 (7.1)	.648

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Roxanne Garbez

October 1, 2008