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## Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital

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## ABSTRACT

In 2017, several hospitals in Ontario implemented the Electronic Canadian Triage and Acuity Scale (eCTAS). This new technology affects a critical area of the Emergency Department: triage. There is no research on Registered Nurses' (RNs) perceptions of eCTAS. A quantitative non-experimental descriptive survey obtained and quantified RN perceptions of eCTAS at a hospital with a 23 bed Emergency Department. The Diffusion of Innovation Theory was used as the theoretical framework to help guide study development. Results indicate both positive and negative perceptions of eCTAS and that younger RNs are more likely to think eCTAS cues them to collect the relevant patient information required at triage ( $P=0.008$ ). The findings suggest that eCTAS is easy to use and is organized logically. eCTAS needs to be further studied ideally using a larger sample size with control groups and with a focus on RNs who are learning how to triage.

*Keywords:* Diffusion of Innovation Theory, registered nurses, new technology, emergency department, triage, CTAS, eCTAS

## SUMMARY FOR LAY AUDIENCE

Emergency Departments (ED) typically deal with large numbers of patients every day, including many with severe health problems. To help ensure the sickest patients are prioritized, all people entering an ED are first triaged. Triage is a short process where a Registered Nurse (RN) assesses how critical the patient is and how long they can safely wait to see a doctor. If an RN makes a mistake at triage, it can be detrimental to a patient's outcome. In Canada, the triage process is based on the Canadian Triage and Acuity Scale (CTAS), which is a set of guidelines to use when assessing patients that helps to define a patient's level of urgency. Recently, at a hospital in Ontario, RNs transitioned from a paper-based triage document to an online platform that provided decision support, called the Electronic Canadian Triage and Acuity Scale (eCTAS). This was a major change in practice for the RNs in an already high stress and critical environment.

Many hospitals within Ontario are transitioning to eCTAS with minimal understanding of RNs' perceptions of the new online program, highlighting a knowledge gap which was explored in the current study. Using a questionnaire, a quantitative descriptive study was conducted to examine and quantify RNs' perceptions of eCTAS after one year of use at a community hospital.

The results indicated both positive and negative perceptions of eCTAS. RNs suggested eCTAS was easy to learn, organized logically, and they liked that the document was a typed legible printout. Additionally, younger RNs were more likely to feel that eCTAS cued them to collect the relevant patient information required at triage. RNs expressed concerns that they might be more likely to make a triage mistake with

eCTAS, that it may negatively impact critical thinking, and that there were difficulties relating to slow computers and a slow logon process.

Future research needs to focus on how eCTAS is impacting RNs who are learning triage for the first time and how eCTAS impacts critical thinking. Additionally, a larger sample size and multicenter study will allow for more robust and powerful results.

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## CHAPTER 1: INTRODUCTION

Hospital Emergency Departments (EDs) are experiencing increased pressure. The population of Canada is growing and aging, which leads to a high volume of ED visits and extended wait times (Bullard et al., 2017). In Ontario, this issue is further exacerbated as the growth in ED visits is outpacing the rate of population growth (Health Quality Ontario, 2016). Health Quality Ontario reported that over the last seven years, the population growth in Ontario has increased by 6.2%, however, the number of annual visits to an ED increased by 13.4%, more than double the population growth.

Furthermore, the patients coming to an ED are now presenting sicker than in previous years (Health Quality Ontario, 2016). In the last seven years, the number of high acuity patients increased 44.1% and the number of ED visits that led to a hospital admission rose by 17.5% (Health Quality Ontario, 2016). In Canada, the patients who are admitted to hospital from the ED are more likely to be older, sicker, and have multiple or more severe conditions or diseases than patients admitted through other processes in the hospital (Canadian Institute for Health Information (CIHI), 2007). Despite the increased volume and acuity of patients, all patients presenting to an ED must first be triaged.

Triage is an essential process in the ED as it sorts the patients who need to be seen first (Farrohknia et al., 2011). This sorting is based on the severity of the patient's presenting medical condition with the goal of reducing the negative impact that the delay to treatment may have on their prognosis (Farrohknia et al., 2011). Triage is a challenging and complex process requiring decision making skills (Farrohknia et al., 2011). The College of Nurses of Ontario (CNO) (2018) states that this task requires the skill of a Registered Nurse (RN) due to the complex situations, range of care required, and the dynamic environment of triage. The triage RN must be able to rapidly identify

critical patients, determine who needs care first, and where the most appropriate location in the ED is for each patient (Canadian Association of Emergency Physicians (CAEP, 2018a). Furthermore, the triage RN must have strong communication skills, organization, discretion, patience, and be able to work in a hectic environment (CAEP, 2018a).

Triage is not a new process as it dates back to the 1840s where Baron Dominique Jean Larre first prioritized the medical needs of military casualties (Fry & Burr, 2002). In the 1970s and 1980s, EDs started to build, implement, and evaluate their own triage systems (Fry & Burr, 2002). Following that, in the 1990s several countries began to develop and introduce ED triage standards (Farrohknia et al., 2011). As previously described, the triage process is highly complex and challenging. To help with these challenges, several triage scales have been developed to aid with the decision-making that is required at triage and to help the triage nurse make a correct decision (Farrohknia et al., 2011). In Farrohknia et al.'s (2011) review of triage scales, they list the most widely used triage scales, including: Emergency Severity Index (ESI), Manchester Triage Scale (MTS), Canadian Emergency Department Triage and Acuity Scale (CTAS), and the Australian Triage Scale (ATS). Experts have worked to design algorithms that incorporate clinical risk assessments and predictions that help to define the level of acuity (Dippenaar & Bruijns, 2016).

In Canada, the CTAS guidelines have been in use since 1999 (Bullard et al., 2017). These guidelines have been promoted by multiple stakeholders who formed the CTAS National Working Group, including CAEP, National Emergency Nurses Association (NENA), l'Association des médecins d'urgence du Québec (AMUQ), and the Society of Rural Physicians of Canada (SRPC) (Bullard et al., 2017). Since the

CTAS guidelines are complex, an overview will be given that outlines the main components.

The goal of the CTAS guidelines are to ensure the sickest patients are seen first (CAEP, 2013). The triage RN must start with a critical first look, which is a rapid visual assessment that is required to look for the seriously ill or injured (CAEP, 2014). If the patient is stable enough, the triage RN will then complete a screening for communicable diseases (CAEP, 2014). Following that screen, the triage RN chooses the most applicable and appropriate presenting complaint using the Canadian Emergency Department Information System (CEDIS) (CAEP 2014, 2018b). A CEDIS is required for data collection (CEDIS, 2014). The triage RN must choose between 167 different CEDIS options (CAEP, 2017). The triage RN then applies the applicable first and second order modifiers (CAEP, 2013a). The purpose of the modifiers are to provide additional acuity information to the chosen CEDIS complaint and to help inform the CTAS level (CAEP, 2013b). When the modifiers are applied to the CEDIS list, there are over 650 variations with corresponding CTAS levels (CAEP, 2013b). Once this is complete, the triage RN must select the CTAS level which signifies how long the patient can safely wait to see a physician (CAEP, 2018a). Patients will be assigned a CTAS level from one to five based on the triage RNs assessment, with one representing the most urgent and five representing the least urgent (CAEP, 2018a). Throughout this entire process, the triage RN must consider the presenting complaint, symptoms, including onset and duration, physical appearance, degree of distress, emotional response, vital signs, physical assessment, medical history, medications, and allergies (CAEP, 2018a).

From the description of the CTAS guidelines, it is evident that this is a complex and challenging process for the triage RN to complete effectively. When considering the

pressure on EDs in Ontario with increased patient volumes and acuity (Health Quality Ontario, 2016), it is apparent that triage can be a highly stressful area to work in and that the triage RN has tremendous responsibility. In addition, the accuracy of the patient assessment at triage is impacted by the competence of the triage RN, which then can affect patient safety and quality of care (Hitchcock, Gillespie, Crilly, & Chaboyer, 2013). The morbidity and mortality rates in the ED can be impacted by the accuracy and duration of triage (Gerdtz & Bucknall, 2001). If the triage RN underestimates the severity of a triage score, it can lead to a delay in a time sensitive intervention (Gertz and Bucknall, 2001).

Access to Care (2018a) stated that studies have demonstrated that the CTAS guidelines are used, interpreted, and applied differently. In 2015, the Ontario Ministry of Health and Long-Term Care announced an electronic solution would be developed by Cancer Care Ontario that would improve quality of care and patient safety by creating a standardized process for how the CTAS guidelines are applied (Access to Care, 2018a). This program, called the Electronic Canadian Triage and Acuity Scale (eCTAS), is a decision support tool that RNs use to enter patient information into and a CTAS score is calculated based on what they input (Access to Care, 2018b). RNs have the ability to change the suggested CTAS score using their clinical judgment if they believe the patient's signs and symptoms suggest a different level of acuity. Additionally, eCTAS helps with timely collection and analysis of triage data (Access to Care, 2018b).

The move to eCTAS coincides with the trends in health care becoming more digitally based. There has been rapid development and use of electronic medical records and electronic health records (CIHI, 2013). Billions of dollars are being utilized on a wide variety of information technologies to help support the coordination and provision

of health care to patients in Canada (CIHI, 2013). Thus, it is understandable that an electronic solution to help with decision making at triage was created. However, it is important to note that it is not the first electronic triage program to be used as previous programs have been used in Ontario with mixed results (Health Quality Ontario, 2016). eCTAS is expected to be used by over 120 hospitals in Ontario, meaning approximately 400,000 people will be triaged using eCTAS each month (Access to Care, 2018b).

As previously described, triage is a complex and challenging area to work. There are multiple eCTAS implementation options for hospitals so they can choose the option that best fits their ED (Access to Care, 2018a). This means there are a variety of transitions that triage RNs are experiencing. Some hospitals are transitioning from a completely paper based system to an electronic system and others are moving from a different electronic platform to eCTAS. As triage is a critical moment in the point of care with a patient, it is essential that triage RNs are supported through the transition process to eCTAS. Furthermore, now that many hospitals have adopted eCTAS, it is important to understand what triage RNs think about the program. The purpose of this study is to gain an understanding of RN perceptions of eCTAS. Understanding RN perceptions will help to inform future information technology development, specifically in the critical care environments. In addition, this research will help to inform hospitals that currently utilize eCTAS and hospitals that may be planning to transition in the near future. It is important that all stakeholders understand the RNs' perceptions of this new technology.

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## CHAPTER 2: MANUSCRIPT

### Background and Significance

The National Emergency Nurses Association (NENA) (2014) states that patients need to be rapidly assessed when they arrive at an Emergency Department (ED). This sorting process is called triage (NENA, 2014). The Canadian Association of Emergency Physicians (CAEP) (2018a) describes the Canadian Triage and Acuity Scale (CTAS) as a tool to be used by EDs to prioritize patients based on their presentation. CTAS has been in use in Canada since 1999 (CAEP, 2012). CTAS considers the patients' type and severity of signs and symptoms when they present to the ED (CAEP, 2018a). Since EDs experience high volumes and have limited capacity, proper use of CTAS guidelines ensures that the most urgent patients are seen first (CAEP, 2018a). CTAS guidelines provide a five-level triage system where each patient presenting to an ED will be assigned a number from one to five, with one representing the highest priority and needing immediate intervention and five being the least urgent and able to safely wait for at least two hours for physician assessment (CAEP, 2018b). The decisions that the triage Registered Nurse (RN) makes can significantly impact mortality and morbidity rates within the ED (Gerdtz & Bucknall, 2001). If the RN's decision leads them to underestimate a patient's level of acuity, it might impede an essential time-sensitive intervention (Gerdtz & Bucknall, 2001).

Since CTAS guidelines help to define how long a patient can wait to see a physician (Access to Care, 2018), it is imperative that they are applied appropriately. Access to Care (2018) presented evidence to suggest there are differences in how the CTAS guidelines are being applied and interpreted. In 2015, the Ministry of Health and Long-Term Care announced a plan to develop an electronic program called the Electronic

Canadian Triage and Acuity Scale (eCTAS) (Access to Care, 2018). Access to Care (2018) states that this tool will improve safety and quality of care as eCTAS provides decision support that will help to standardize the use of CTAS scores across Ontario. Furthermore, eCTAS will improve the collection and analysis of triage data (Access to Care, 2018). Access to Care (2018) states that "Province-wide implementation of eCTAS will ensure that no matter where patients are they will receive consistent, high-quality triage care". RNs enter the patient's information into eCTAS and then a CTAS score will be generated (Access to Care, 2018). RNs can adjust the CTAS score using their clinical judgment if they believe the patient's signs and symptoms suggest a different level of acuity. Different hospitals have been able to implement various versions of eCTAS based on their facility's unique needs and processes (Access to Care, 2018). The goal is to have over 120 participating hospitals in Ontario, which would equate to 90% of all ED patients province wide, representing over 400,000 ED visits per month (Access to Care, 2018).

A tertiary acute care hospital in Ontario that services approximately 62,000 ED visits each year is the focus of this research. The hospital's ED has 23 total beds in rooms plus six hallway stretchers and multiple seated patient areas. At this hospital, RNs previously triaged using a paper-based system, which utilized the CTAS guidelines. The previous paper-based triage system did not provide any decision support functions as it was a basic paper document that RNs used to record the patient's presenting complaint, patient assessment, allergies, infection control assessment, medical history, and medications, and then they chose the CTAS score they felt was most appropriate. In October 2017, this hospital began using eCTAS, which was an enormous culture shift for the RNs. There is currently no research on RNs' perception of this tool once it has been

implemented that could help to determine whether RNs support continued adoption of eCTAS. This knowledge gap needs to be addressed in order to understand RNs' perceptions of eCTAS. Rogers (2003) Diffusion of Innovation (DOI) theory has been used multiple times to study the adoption of an array of health information systems (Rahimi, Timpka, Vimarlund, Uppugunduri, & Svensson, 2009). The DOI theory was used as a framework to develop the questionnaire for this study.

### **Research Questions**

What are the RNs' perceptions of eCTAS at a community hospital in Ontario?

Does age impact a triage RN's perception of eCTAS?

Does triaging experience in years impact perceptions of eCTAS?

How do the RNs' perceptions of eCTAS compare to the previous paper-based system?

### **Theoretical Framework**

The Diffusion of Innovation theory explains how innovations are diffused and whether they are adopted or rejected within specific social networks (Rogers, 2003). Diffusion is, "the process by which an innovation is communicated through certain channels over time among the members of a social network" (Rogers, 2003, p. 11). An innovation is, "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (Rogers, 2003, p.12). A decision to either adopt or reject an innovation is based mostly on whether the individual develops a favourable attitude toward it (Rogers, 2003). DOI describes the innovation-decision process, which looks at a series of actions and choices by which an individual is introduced to an innovation, forms their perception of it, and makes a decision to adopt or reject (Rogers, 2003). There are five stages to the process: (1) knowledge is where individuals are exposed to

the innovation and informed of its function, (2) persuasion is where individuals form attitudes toward the attributes of the innovation, (3) decision is where individuals choose to adopt or reject the innovation, (4) implementation is where the innovation is put to use, and (5) confirmation is where the individual re-evaluates the decision already made (Rogers, 2003). The outcome at each of these stages has an impact on whether the individual adopts or rejects an innovation (Rogers, 2003).

It is the second stage of the innovation-decision process, persuasion, which is primarily used in this research as it contains the perceived attributes of an innovation (Rogers, 2003). DOI has five main attributes of innovation: relative advantage, compatibility, complexity, trialability, and observability (Rogers, 2003). Rogers (2003) states, “Subjective evaluations of an innovation, derived from individuals’ personal experiences and perceptions and conveyed by interpersonal networks, drives the diffusion process and thus determines an innovation’s rate of adoption” (p. 223). This means that an innovation’s adoption can be further explained by the individual’s perception of the specific attributes listed above (Rogers, 2003). By examining adopters’ perceptions of attributes of an innovation and how they impact the innovation-decision process, one can determine if an innovation will be adopted and if it can be sustained. This study employs three of the five attributes, including relative advantage, compatibility, and complexity, to guide the questionnaire and to assess the triaging RNs’ perceptions of eCTAS. Attention will also be given to the knowledge stage as a question was included in the survey that reflects the training received for eCTAS. Within this study, since the innovation is currently in use, the focus is on how these aspects support continued adoption of eCTAS.

### **Literature Review**

This literature review section will cover a review of the primary constructs being

utilized in this study and the population of interest. The use of the DOI theory within the evaluation of technology innovations in health care will be discussed, which will include an overview of the knowledge stage, relative advantage, complexity, compatibility, and continued adoption of eCTAS. The function of triage will be explained, along with nurse's adoption of electronic medical records. A summary will be included that indicates how these aspects are connected, the relevance for the current study, and the gaps in the literature that the study will target.

### **Diffusion of Innovation Theory**

The DOI theory has been used multiple times to study the adoption of health information systems (Rahimi et al., 2009). For example, in a questionnaire based study Rahimi et al. (2009) used three attributes of the DOI theory, relative advantage, complexity and compatibility, to examine factors related to the adoption of a computerized provider order entry system. Kapoor, Dwivedi, and Williams (2014) completed a systemic review and synthesis on the five attributes of the DOI theory. Within their review of 226 studies using the DOI theory, they found that relative advantage, complexity, and compatibility, were used retrospectively 78.24%, 77.33%, 77.51% of the time, respectively (Kapoor et al., 2014), which is consistent with how the attributes will be assessed in this study. Furthermore, these three attributes were more commonly used than the other two attributes of observability and trialability (Kapoor et al., 2014).

One of the three attributes being assessed is relative advantage. Relative advantage is the perception of potential benefits or improvements that the innovation can bring (Rogers, 2003). It focuses on whether this innovation is better than the previous

system/idea (Rogers, 2003). Relative advantage is operationalized as RNs' perceptions of eCTAS as an improvement over the paper-based CTAS system.

The second attribute being assessed is complexity. Complexity refers to how difficult the new technology is to use and understand (Rogers, 2003). Complexity is negatively related to the decision to adopt an innovation (Kapoor et al., 2014). This construct is operationalized to understand whether RNs feel that eCTAS is user-friendly and easy to understand. For example, if eCTAS is too complex and causing the perception of increased errors, a decision to reject the program will result.

The third and last attribute being assessed is compatibility, which considers how the innovation aligns with the experiences, needs, and values of the adopters (Rogers, 2003). The more an innovation is recognized as familiar, the better the compatibility, and the more meaning the adopter can give to the new idea (Rogers, 2003). Past experiences with the previous innovation were used when judging the latest innovation (Rogers, 2003). Compatibility is operationalized as whether RNs believe that eCTAS fits the needs of the triage process, and is perceived as guiding a decision for an appropriate CTAS score, capturing necessary patient information, and improving quality of care at triage.

The knowledge stage is not one of the five attributes, but is a stage within the innovation-decision process in the DOI theory and is assessed within this study. Prior to implementing eCTAS, the study hospital provided all users with a two-hour training session. The session involved an overview of the purpose of the program and went through multiple case exemplars. The training on eCTAS fits into the knowledge stage of the innovation-decision process, where the user gains an understanding of the necessary functions of the innovation (Rogers, 2003). Training adequacy refers to



whether the user of eCTAS found the education successfully prepared them on how to use the program in real-time. The questions in this survey assessed whether the two-hour session provided the RNs with an understanding of how eCTAS fit a need in the triage process, aligning with the knowledge stage in the DOI theory (Rogers, 2003).

Lastly, there will be a question in the survey aimed at assessing continued adoption. Adoption refers to, “the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as each year” (Rogers, 2003, p.221). Adoption is most frequently used as the dependent variable in DOI research (Kapoor et al., 2014). The continued adoption construct was measured by assessing whether RNs would prefer to keep using eCTAS, thus supporting continued adoption, or if they had the choice, they would revert to the previous paper-based system.

### **Triage**

CTAS guidelines are used in EDs all across Canada (CAEP, 2013). CAEP (2018b) states that the first goal of triage is to “rapidly identify patients with urgent, life-threatening conditions”. Other goals of triage are to select the most appropriate treatment area for the presenting patients, maintain ongoing assessment of patients, reduce the congestion in the critical treatment areas, provide information to patients and their families regarding the wait times and expected care, and to contribute to the information that helps to define the acuity of the department (CAEP, 2018b). It is vital that EDs have teams who can identify patients’ needs while setting priorities and providing necessary treatment (CAEP, 2018b).

RNs are expected to start the triage process by conducting a critical first look at the people waiting to be triaged to see if any people need immediate intervention (CAEP,

2013). The triage RN's assessment of the patient will cover the main complaint of why the patient presented to the ED, which is the patient's statement of the problem (CAEP, 2018b). Following that, a subjective assessment will be completed, which includes asking questions such as when the symptoms started, where the problem is, and does it come and go (CAEP, 2018b). Next is the objective assessment, which involves assessing the patient's physical appearance, level of distress, emotional response, and vital signs (CAEP, 2018b). Other information that is collected includes: medical history, medications, allergies, and an infection control screen (CAEP, 2013, 2018b). Once the triaging RN has obtained this information, they assign the patient a CTAS score of one, two, three, four, or five depending on their level of acuity and how quickly they require an intervention (CAEP, 2018b).

### **Triaging RNs**

The target population in this study is triaging RNs as they are the users of eCTAS. The process of triage requires RNs to possess strong communication skills, discretion, patience, organization, and the ability to work in a hectic environment (CAEP, 2018a). Triaging RNs must be able to rapidly identify critical patients and determine which treatment area in the ED is most appropriate for each presenting patient (CAEP, 2018a). Due to the complex situations, the dynamic environment, and the requirement of the ability to provide a full range of care, the triage role must be filled with RNs, rather than a Registered Practical Nurse (College of Nurses of Ontario, 2018).

### **Nurses and Electronic Medical Records**

The use of technology, specifically electronic medical records (EMRs), in health care is continually increasing for many reasons, including cost efficiency, performance development, and quality improvement (Top et al., 2015). Despite the promise of health

information technology (IT) improving health outcomes, research shows that the potential users of the IT systems avoid using it, attempt to work around it, or may only use partial features (Holden, 2010). Unfortunately, there is limited research on nurses' views of EMRs (Likourezos et al., 2004; Top, Yilmaz, & Gider, 2013).

A study completed by Kossman and Scheidenhelm (2008) looked at the nurse's use of electronic health records in a community hospital and the impact on patient outcomes and job performance. The results demonstrated that nurses preferred the electronic health records over the paper charts, and found they improved access to information, organization, efficiency, and also provided useful alert screens (Kossman & Scheidenhelm, 2008). However, the research also found that the nurses thought the technology reduced interdisciplinary communication, created an increased demand on work time, and negatively impacted their critical thinking (Kossman & Scheidenhelm, 2008). In addition, the results demonstrated the electronic health records decreased the quality of care provided, although they did promote safer care (Kossman & Scheidenhelm, 2008).

A quantitative and descriptive questionnaire based study conducted in four hospitals in Turkey focused on nurses' perceptions of the use, user satisfaction, and quality of EMR systems (Top et al., 2013). Top et al. (2013) found that nurses considered EMRs to be helpful in their daily work within the hospital and that the use of the EMR was relatively easy. The nurses reported that the EMRs decreased their workload and improved their ability to assess their patient's progress (Top et al., 2013). Likourezos et al. (2004) conducted a questionnaire based study in an ED in the United States which looked into nurses' and physicians' perceptions of EMRs. Similar to the results of Top et al.'s (2013) study, the results indicated that the clinicians felt EMRs are

helpful in their daily work, the use of the program was easy, and improved the ability to monitor the progress of the patient. However the results demonstrated that both nurses and physicians found EMRs to have little impact on patient care and that they do not believe that EMRs will improve quality of care (Likourezos et al., 2004).

### **Summary of the Literature (also referred to as Statement of the Problem)**

According to Chaudhry et al. (2006), stakeholders who are interested in the promotion of the adoption of IT need information that allows them to best implement the system to maximize its benefit. With eCTAS being mandatory, continued support from the users will help make it more sustainable. The problem is that the perceptions of the RNs using eCTAS have not yet been examined. When an organization sets a goal of increased productivity from an innovation, the innovation needs to be accepted by the employees of the organization (Kapoor et al., 2014). Research findings demonstrate that previous health IT interventions, such as EMRs, may improve the daily work of the users and improve nurses' ability to monitor their patients; however, it is not clear that it improves quality of care (Likourezos et al., 2004; Top et al., 2013). In order to maximize the potential benefits, there needs to be an understanding of the RNs' perceptions of eCTAS to address this knowledge gap. By using the DOI theory as a framework for this research, it will help to understand RNs' perceptions of eCTAS, specifically in regards to if they find eCTAS is better than the previous paper-based system, if it is easy to understand, and if it fits with the needs of the ED (Kapoor et al., 2014).

### **Methodology**

#### **Design**

A quantitative descriptive non-experimental design was used for the study. Data were collected using a cross-sectional approach with a researcher-developed questionnaire.

## **Sample and Setting**

The non-probability method of convenience sampling was used to obtain the study subjects. The research was conducted at one acute care tertiary hospital in Ontario. The inclusion criteria were met if the participant was an RN at the recruiting hospital who used the paper-based system for more than two months prior to eCTAS introduction and has used eCTAS for more than two months. Sample size calculation was not applicable to this study because it was a descriptive analysis, however the goal was to have a minimum of 25 responses.

## **Instrument**

A questionnaire was developed for this study (see Appendix A). A majority of the questions were in the form of a five-point Likert Scale design. Multiple items are expected to generate an analysis that is more reliable and valid than a single item, while also having less random measurement error (Willits, Theodori, & Luloff, 2016). The Likert Scale questions were presented as a declarative statement with the following options for the response: disagree, somewhat disagree, neither agree or disagree, somewhat agree, and agree (DeVellis, 2012). Five response options were chosen as they are known to be user-friendly while providing appropriate levels of reliability (Dillman, Smyth, & Christain, 2014). "Neither agree or disagree" was included as respondents may have no opinion or knowledge on a question, and without this option, they would be forced not to answer or choose an incorrect answer (Willits et al., 2016). In addition, the responses were selected as they have a roughly equal interval between each option (DeVellis, 2012). The declarative statements were phrased both positively and negatively to help avoid agreement bias (DeVellis, 2012). DeVellis (2012) does caution that having oppositely worded statements can cause confusion, especially in lengthy

questionnaires. The Likert Scale portion was kept short at 16 questions to help reduce this confusion. Some of the Likert Scale questions were influenced by a questionnaire developed by Ntemana & Olatokun (2012), who used the five attributes of the DOI Theory to study the influence of information and communications technology. The questionnaire developed by Carper, McHugh, Murray, and Barlow (2014) which looked into Perceptions of Computerized Therapy using the DOI theory also influenced several Likert Scale questions. The Likert scale questions were created according to the three DOI attributes: relative advantage, compatibility, and complexity.

There were two questions designed to understand how satisfied triaging RNs were with the previous paper-based system and how satisfied they are with eCTAS. The word “satisfied” was chosen as this word is used within the DOI theory to explain the relative advantage of an innovation (Rogers, 2003). There were two open-ended questions to allow for the triaging RNs to elaborate on their perceptions of eCTAS.

To ensure the questionnaires were reliable, valid, and served their purpose, several steps were taken. The content validity was assessed by five professionals who are experts with the CTAS guidelines as they are certified instructors of the CTAS course, who served as content validity experts (Polit & Yang, 2016). They reviewed the relevance and comprehensiveness of the questionnaire (Polit & Yang, 2016). In addition, the five experts completed the content validity index (CVI). They provided both qualitative and quantitative feedback to the questionnaire (Polit & Yang, 2016). Each expert rated each item on the questionnaire using a four-point scale regarding the relevance of that specific item (Polit & Yang, 2016). The qualitative feedback served to address conceptual definitions (Polit & Yang, 2016). The results of the CVI supported agreement between the experts in CTAS guidelines and the content in the questionnaire.

The analysis of the CVI feedback promoted the removal of several questions due to lower relevance ratings and led to changes to phrasing and terminology used within the questionnaire.

To obtain demographic data, additional questions were asked. Demographics collected were age, years triaging on the previous paper-based system, years of emergency nursing experience, and length of time triaging using eCTAS.

### **Data Collection Procedures**

The questionnaire was created using Qualtrics, which is Western University's preferred platform for surveys, and it was distributed via email to study subjects at the target hospital. The researcher has a hospital email address that was used to send the recruitment emails to the email group titled, "Emergency Department Nurses". The email contained a link to the questionnaire to maintain anonymity, as well as a letter of information and consent outlining the purpose of the study and the protection of subject confidentiality. An email-based questionnaire was chosen for several reasons. Kapoor et al. (2014) state that questionnaires are the most frequently used method when using the DOI theory to assess adoption of an innovation. An email-based questionnaire provides the researcher with an efficient and cost-effective strategy for collecting data (Polit & Beck, 2016; Schaefer & Dillman, 2018). In addition, email-based questionnaires have demonstrated quicker response times and more complete answers for open-ended questions (Schaefer & Dillman, 2018). Also, this method aids in preventing interviewer bias and allowed for increased convenience for the respondents (Van Selm & Jankowski, 2006). An introductory email explaining the purpose of the study was sent out one month prior to the questionnaire being released to increase the study response rate (see Appendix B) (Van Selm & Jankowski, 2006). The recruitment email was sent out with

the questionnaire link and the letter of information and consent as an attachment (see Appendix C for recruitment email and Appendix D for the letter of information and consent). Reminder emails containing a link to the questionnaire and thank you notes were sent out three weeks and six weeks after the initial email to further increase the number of respondents (see Appendix E) (Van Selm & Jankowski, 2006). The data collection period was open for three months.

### **Data Analysis**

The IBM Statistical Package for Social Sciences (SPSS) version 25.0 was used to analyze the data collected (IBM, 2017). The Likert Scale categorical data were assessed using descriptive statistics, including percentages and numbers (Knapp, 2017). Missing data were assessed and specified within SPSS with the code of 999, so the missing values were not processed in the statistical calculations (Knapp, 2017). Relationships between selected study variables were explored using the Spearman Rho, Mann Whitney U test, and Kruskal-Wallis test. The demographics of the participants were analyzed and contrasted with the data from the questionnaire results. For all the analyses the level of statistical significance was set at  $p < 0.05$ .

Additional analysis was conducted on the three DOI attributes being assessed: relative advantage, complexity, and compatibility. The means of the responses within each attribute were calculated to represent which attribute had the most positive response, with the higher the mean demonstrating a more positive response. Cronbach's alpha was calculated for each set of questions within each attribute to test for internal reliability. For this analysis, all negatively phrased questions were recoded so that higher numbers correspond to agreement for all items.



The open-ended questions were analyzed using a content analysis method. This method is well suited for open-ended survey questions (Kondracki, Wellman & Amundson, 2002). Additionally, the conventional content analysis method is an appropriate approach when there is limited research available on the phenomenon being studied (Hsieh & Shannon, 2005).

### **Ethical Considerations**

The study was approved by the University of Western Ontario Ethics Review Board for Health Sciences Research (Appendix F) and through the Research Ethics Board at the study hospital (Appendix G). Anonymity and confidentiality were of utmost importance to protect subject identities as this is essential when working with human participants (Carli et al., 2012). Data were kept on a password protected file on the researcher's personal computer using FileVault. The password chosen was strong and a password protected screen saver was set to activate after 10 minutes of inactivity (Western University, 2018). Volume storage was utilized as only the files related to the research were encrypted and stored in FileVault (Western University, 2018). A recovery key to FileVault was created as a backup safety measure to access the encrypted data. The recovery key was kept in an alternate location from the researcher's computer to maintain safety and confidentiality of the data. The researcher was the only one with the proper credentials to access FileVault. Participants were informed that if results are published, the responses will be presented in the form of group data, ensuring that the individual responses will not be identified. Data will be kept for seven years as per Western University's Policy.

## Results

### Demographics

A response rate of 75.7% was achieved as 28 responses were received out of a total eligible triaging RN population of 37. Respondents varied in age. There were four missing answers, totaling 24 responses to the age demographic question. Age had a 30 year range from 29-59, with a mean of 43.04 years (SD=10.17) and a median age of 41. To better represent the age distribution of respondents, the continuous variable of age was broken down into four categories (see Table 1).

Years spent emergency nursing was varied, with one missing answer, totaling 27 responses. There was a range of 31 years from 3-34 years, with a mean years of experience of 15.78 (SD=10.28), and a median of 13. Years spent in emergency nursing was broken down into four categories: 0-9 years, 10-19 years, 20-29 years, and 30 years or more (see Table 1).

Years spent with the previous paper-based system was varied, with two missing responses, totaling 26 responses. There was a range of 29 years from 2-31 years, with a mean years of experience of 13.42 (SD=8.9), and a median of 11.5. Years spent with the previous paper-based system was broken down into four categories: 0-9 years, 10-19 years, 20-29 years, and 30 years or more (see Table 1).

### Level of Satisfaction with Previous Paper-Based System and eCTAS

There were two rating scale questions asking participants to rate their satisfaction of the previous paper-based system and with eCTAS. Both scales were from 0-10, with 0 being extremely dissatisfied and 10 being extremely satisfied. 25 respondents answered both of these questions. The mean response rating for the satisfaction with the previous paper-based system was greater at 7.6 (SD=1.6) than the mean rating of satisfaction with

eCTAS at 6.4 (SD=2.1), although the statistical test of the difference between these ratings was not significant (Wilcoxon rank test  $p=0.053$ ). There was a range of seven with the previous paper-based system with minimum of three and maximum of 10. The range of eCTAS was nine, with a minimum of zero and a maximum of nine. A bar graph was created to illustrate the distribution of responses (Figure 1). Based on these results, there is a fairly uneven level of satisfaction with the new eCTAS system, with most rating it at seven or higher and several respondents providing low ratings. The satisfaction with the previous paper system demonstrated a much more uniform distribution of responses.

Table 1

*Demographic Characteristic of Sample (N=28)*

Age (in years) n=24	Mean=43.04 SD=10.17	20-29=4.2% (n=1)
		30-39=45.8% (n=11)
		40-49=16.7% (n=4)
		50 and greater=33.3% (n=8)
		Missing=4
Years Spent Emergency Nursing (in years) n=27	Mean=15.78 SD=10.28	0-9=29.6% (n=8)
		10-19=40.7% (n=11)
		20-29=11.1% (n=3)
		30 and greater=18.5% (n=5)
		Missing=1
Years Using the Previous Paper Based System (in years) n=26	Mean=13.42 SD=8.9	0-9=38.5% (n=10)
		10-19=30.8% (n=8)
		20-29=26.9% (n=7)
		30 and greater= 3.8% (n=1)
		Missing=2

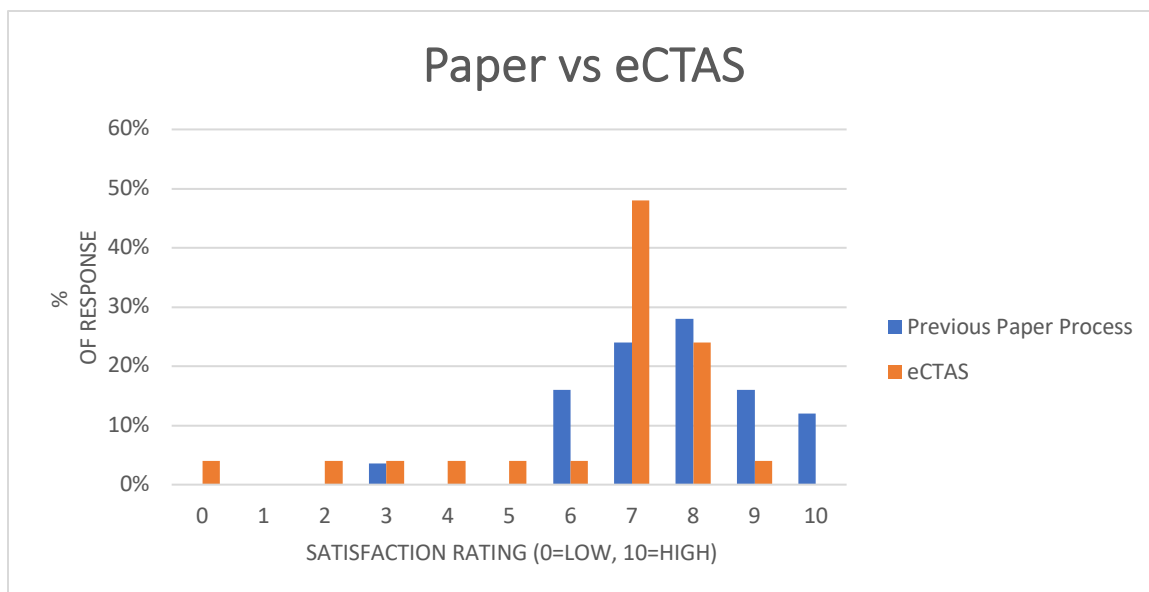


Figure 1: Comparison of Satisfaction Ratings between Previous Paper System and eCTAS

### Perceptions of eCTAS

There were 16 Likert Scale questions. Eleven questions were positively phrased and five were negatively phrased (Table 2). Other than one missing response, all participants answered all Likert Scale questions. The majority of the Likert Scale questions were written using the perceived attributes of the DOI Theory and will be presented under the attribute specific subheadings: relative advantage, compatibility, and complexity. Complexity had the most positive response with a mean of 3.8 (SD=0.89,  $\alpha=0.707$ ), followed by compatibility at 3.5 (SD= 0.89,  $\alpha=0.803$ ), and lastly, relative advantage with a mean of 3.0(SD=0.85,  $\alpha=0.826$ ). There are two questions that do not relate directly to the perceived attributes of the DOI theory which will be analyzed separately.

**Relative advantage.** As previously described, relative advantage assesses whether the users believe that the new innovation is better than the previous system or

idea (Rogers, 2003). Relative advantage is operationalized as RNs' perceptions of eCTAS as an improvement over the paper-based CTAS system. There were six questions that reflected relative advantage.

In response to whether eCTAS helps with the RNs decision making at triage, over half of the respondents somewhat agreed with this statement (53.6%, n=15), with 21.4% (n=6) of respondents disagreeing or somewhat disagreeing. In response to eCTAS being a more accurate approach to triage than the previous paper based process, the responses favoured a negative perception with just over half of the respondents (53.5%, n=15) responding either somewhat disagree or disagree, and only 28.5% (n=8) responded with either somewhat agree or agree. In response to the question regarding whether RNs think the change to eCTAS is a positive move, just over half of the respondents, 55.4 % (n=15), either somewhat agreed or agreed, with 17.8% (n=5) either disagreeing or somewhat disagreeing. When RNs answered whether eCTAS improved their ability to choose an appropriate CTAS score, almost half the respondents (46.4% (n=13) either disagreed or somewhat disagreed to this question, 25% (n=7) responded that they neither agree nor disagree, and 28.6% (n=8) either somewhat agreed or agreed. The last question reflecting relative advantage asked whether the presentation of the modifiers on the eCTAS screen helped the RNs understand the guidelines better. Half of the respondents (50%, n=14) responded that they either somewhat agreed or agreed and 25% (n=7) of respondents disagreed or somewhat disagreed.

**Complexity.** Complexity refers to how difficult the new technology is to use and understand (Rogers, 2003). This construct is operationalized to understand whether RNs feel that eCTAS is user-friendly and easy to understand. There were three questions that reflected complexity.

The first statement regarding complexity was whether eCTAS was complicated to learn, with most participants (75%, n=21) responding with either somewhat disagree or disagree. While it was clear that eCTAS was easy to learn, there was less consensus about whether eCTAS is convenient to use, with just over half of the respondents (53.6%, n= 15) either somewhat agreeing or agreeing with this and almost one third of respondents (32.2%, n=9) responding with somewhat disagree or disagree. Supporting the notion that eCTAS is simple to use was that 82.1% (n=23) of the participants either somewhat disagreed or disagreed that eCTAS is difficult to use.

**Compatibility.** Compatibility considers how the innovation aligns with the experiences, needs, and values of the adopters (Rogers, 2003). Past experiences with the previous innovation will be used when judging the latest innovation (Rogers, 2003). Compatibility is operationalized as whether RNs believe that eCTAS fits the needs of the triage process, and is perceived as guiding a decision for an appropriate CTAS score, capturing necessary patient information, and improving quality of care at triage. There were five questions that reflected compatibly.

The first statement was that eCTAS supports patient safety. The responses were somewhat evenly distributed, with the neither agree nor disagree receiving the largest amount of responses with 39.3% (n=11). RNs supported the statement that eCTAS is organized logically with 75% (n=21) either somewhat agreeing or agreeing. When asked whether when they apply the appropriate modifiers that eCTAS helps them to generate an accurate CTAS score, more than half of the respondents (67.9%, n=19) either somewhat agreed or agreed to this, with only 17.8 % (n=5) disagreeing or somewhat disagreeing. In response to the statement that eCTAS interferes with patient centred care, the responses were fairly evenly distributed, however there were more responses (46.5%, n=13) that

either somewhat disagreed or disagreed with this. The last statement reflecting compatibility stated that eCTAS cues the RN to collect the relevant patient information required at triage. Over half of the respondents (53.6%, n=15) either somewhat agreed or agreed, however, almost one third (32.1%, n=9) of participants neither agreed nor disagreed.

**Other DOI questions.** There were two questions that did not directly reflect the three perceived attributes presented above, but are still related to the DOI theory. They are listed below under continued adoption and knowledge stage.

**Continued Adoption.** Adoption refers to, “the relative speed with which an innovation is adopted by members of a social system. It is generally measured as the number of individuals who adopt a new idea in a specified period, such as each year” (Rogers, 2003, p.221). This construct can be measured by assessing whether RNs would prefer to keep using eCTAS, thus supporting continued adoption, or if they had the choice, they would revert to the previous paper-based system.

The question used in the study stated that RNs would rather complete the triage using the previous paper based process. The responses were fairly evenly distributed. 10.7% (n=3) disagreed, 28.6% (n=8) somewhat disagreed, 21.4% (n=6) neither agreed nor disagreed, 25% (n=7) somewhat agreed, and 14.3% (n=4) agreed.

**Training.** Prior to the implementation of eCTAS, all RNs received a two-hour training session provided by the hospital. The eCTAS education aligns with the knowledge stage of the innovation-decision process, where the user gains an understanding of the necessary functions of the innovation (Rogers, 2003). The question used in this study to address this concept was that the training on eCTAS was sufficient to meet the learning needs of the RN, which was strongly supported by 92.8% (n=26) of the participants.

Table 2

*Likert Scale Frequencies (N=28)*

Question	Disagree % (n)	Somewhat Disagree % (n)	Neither Agree nor Disagree % (n)	Somewhat Agree % (n)	Agree % (n)
eCTAS helps with my decision making at triage	10.7% (n=3)	10.7% (n=3)	25% (n=7)	53.6% (n=15)	0 (n=0)
eCTAS is complicated to learn	32.1% (n=9)	42.9% (n=12)	14.3% (n=4)	10.7% (n=3)	0% (n=0)
eCTAS has a more accurate approach to triage than the previous paper based process	21.4% (n=6)	32.1% (n=9)	17.9% (n=5)	21.4% (n=6)	7.1% (n=2)
eCTAS supports patient safety	10.7% (n=3)	17.9% (n=5)	39.3% (n=11)	25% (n=7)	7.1% (n=2)
eCTAS is convenient to use	17.9% (n=5)	14.3% (n=4)	14.3% (n=4)	39.3% (n=11)	14.3% (n=4)
The training on eCTAS was sufficient to meet my learning needs	0% (n=0)	0% (n=0)	7.1% (n=2)	35.7% (n=10)	57.1% (n=16)
eCTAS is organized logically for me (missing=1)	11.1% (n=3)	7.4% (n=2)	3.7% (n=1)	44.4% (n=12)	33.3% (n=9)
I think the change to eCTAS is a positive move	7.1% (n=2)	10.7% (n=3)	28.6% (n=8)	17.9% (n=5)	35.7% (n=10)
I am more likely to make triaging mistakes using eCTAS than with the previous paper based system	3.6% (n=1)	17.9% (n=5)	35.7% (n=10)	32.1% (n=9)	10.7% (n=3)
When I apply the appropriate modifiers, eCTAS helps me to generate an accurate CTAS score	7.1% (n=2)	10.7% (n=3)	14.3% (n=4)	50% (n=14)	17.9% (n=5)



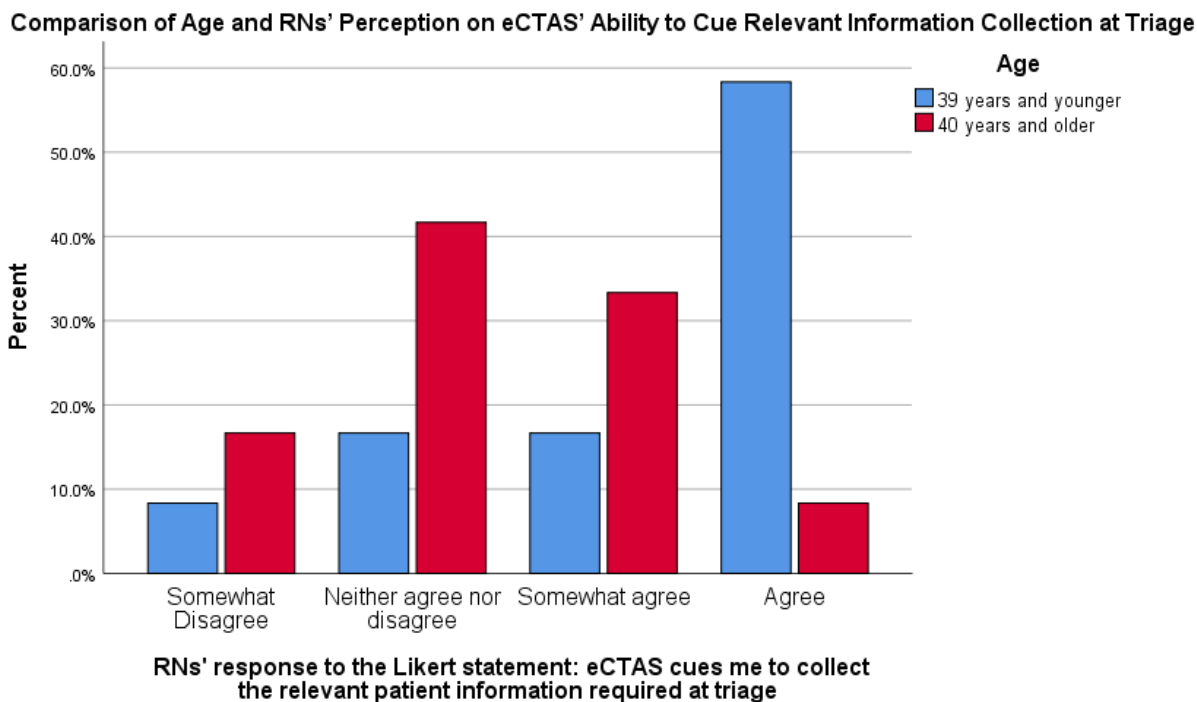
Question	Disagree % (n)	Somewhat Disagree % (n)	Neither Agree nor Disagree % (n)	Somewhat Agree % (n)	Agree % (n)
eCTAS interferes with patient centered care	17.9% (n=5)	28.6% (n=8)	25% (n=7)	17.9% (n=5)	10.7% (n=3)
eCTAS improves my ability to choose an appropriate CTAS score	14.3% (n=4)	32.1% (n=9)	25% (n=7)	25% (n=7)	3.6% (n=1)
I would rather complete the triage using the paper based process	10.7% (n=3)	28.6% (n=8)	21.4 % (n=6)	25% (n=7)	14.3% (n=4)
eCTAS cues me to collect the relevant patient information required at triage	3.6% (n=1)	10.7% (n=3)	32.1% (n=9)	25% (n=7)	28.6% (n=8)
eCTAS is difficult to use	50% (n=14)	32.1% (n=9)	7.1% (n=2)	10.7% (n=3)	0% (n=0)
The presentation of the modifiers on the eCTAS screen has helped me understand the guidelines better	14.3% (n=4)	10.7% (n=3)	25% (n=7)	35.7% (n=10)	14.3% (n=4)

### **Analysis of Relationships between Age, Years Working the ED, and Years Triaging with Previous Paper Based Process with RN's Perception of eCTAS**

**Age and RN's perception of eCTAS.** Statistical analysis was conducted to determine if there was any relationship between age and RNs' perceptions of eCTAS. The participants' answers to the rating scale questions and Likert scale questions were used for this analysis. Age is a continuous variable, however the distribution was flat and only 24 respondents answered the age question, therefore, the nonparametric Spearman Rho correlation test was used. There was a statistically significant relationship found that demonstrated that younger RNs were more likely to think that eCTAS cues them to collect the relevant patient information required at triage (p value=0.008). Age was

further divided into a dichotomous variable using 39 or younger and 40 or older. The Mann-Whitney U test was completed for the rating scale questions and Likert questions as well. This analysis also found a statistically significant relationship between age and whether RNs felt that eCTAS cues them to collect the relevant patient information required at triage ( $p=0.028$ ). A bar graph was created (Figure 2) to illustrate the distribution of answers to the Likert Scale statement “eCTAS cues me to collect the relevant patient information required at triage”. Considering the statistically significant results of the Spearman Rho and Mann-Whitney U Test, the results indicate that the younger the nurse, the more likely they are to feel that eCTAS cues them to collect the relevant patient information required at triage. There were no other statistically significant results from the analysis between age and the other questions related to RNs’ perceptions of eCTAS.

**Years in ED and RN’s perception of eCTAS.** Statistical analysis was completed to determine if there was any relationship between years working in the ED and RNs’ perceptions of eCTAS. The participants’ answers to the rating scale questions and Likert scale questions were used for this analysis. Twenty seven respondents answered the demographic for years spent working in the ED. Years working in the ED is a continuous variable, however the distribution was not normal, therefore, the nonparametric Spearman Rho test was used to look for associations. No statistical significance was found using the Spearman Rho test. Years working in the ED was transformed into a categorical variable using 9 or less years, 10-19 years, and 20 or greater years experience. The Kruskal-Wallis test compared was categorical years working in the ED with RNs’ perceptions of eCTAS. There were no statistically significant relationships found using the Kruskal-Wallis test.



*Figure 2.* Comparison of Age and RN's Perception on eCTAS' Ability to Cue Relevant Information Collection at Triage

**Years triaging with previous paper based system and RN's perception of eCTAS.** Statistical analysis was completed to determine if there was any relationship between years triaging with the previous paper based system and RNs' perceptions of eCTAS. The participants' answers to the rating scale questions and Likert scale questions were used for this analysis. Twenty seven respondents answered the demographic for years triaging with the previous paper-based system. Years triaging with the previous paper based system is a continuous variable, however the distribution was not normal, therefore, the nonparametric Spearman Rho test was used. No statistical significance was found using the Spearman Rho test. Years triaging with the previous paper based system was transformed into a categorical variable using 5 or less years, 6-15

years, and 16 or greater years' experience. The Kruskal-Wallis test compared categorical years triaging with the previous paper based system and its relationship with RNs' perceptions of eCTAS. There were no statistically significant relationships found using the Kruskal-Wallis test.

### **Post-Hoc Power Analysis**

Although the current study was designed to be descriptive, to give context to the analysis a post-hoc power analysis was completed. Using a two-tailed correlational design, with an alpha of 0.05, the study had a power of 80% to detect moderately strong correlations at  $r=0.50$ .

### **Open-Ended Questions**

Two open-ended questions were included in the questionnaire, which asked respondents to list two things they liked about eCTAS and two things they did not like about eCTAS. Content analysis was used to explore the responses for patterns. Five themes emerged from the question, "what are two things you like about eCTAS". The themes were: prefer typing/less writing, legibility, modifiers on the screen, electronic and easy, and the design and functionality. Five themes emerged from the question, "what are two things you dislike about eCTAS". The themes were: login process/other nurses using other accounts, format and flow, slow system/computers, impact on critical thinking and judgement, and modifiers/decision support functions.

**Things liked about eCTAS. *Prefer typing/less writing.*** Prefer typing/less writing was the most commonly occurring response. RNs identified that they like to be able to type at triage, rather than handwrite. This theme had ten responses, including answers such as "my hand doesn't cramp up" (p7), "I can type faster than I write" (p24), "easier to type down multiple meds" (p11), and "less writing" (p17).

**Legibility.** The open-ended questions demonstrated that RNs like that eCTAS provides a clear and legible triage printout. This theme had nine responses, such as “easy to read” (p4), “I like having a typed-readable triage” (p14), and “able to read each person’s triage notes versus handwriting” (p8).

**Modifiers on the screen.** RNs identified that they like that eCTAS provides a list of the modifiers and that they are visible on the screen. Examples of the modifiers on the screen theme include, “having the modifiers on the screen” (p10), “modifiers” (p21), and “modifiers displayed” (p5).

**Electronic and easy.** The theme of electronic and easy demonstrated that RNs like the understandable layout and user friendly aspects of eCTAS. This theme contained six responses, including “easy to navigate” (p17) and “electronic and easy to use” (p14).

**Design and function.** The last theme, design and function, contained 17 responses that pertain to different aspects of the eCTAS program that RNs stated they liked. The comments within this theme contained broadly differentiated responses, thus, there were no clear themes identified. Examples of these responses are, “pre-selected CEDIS list” (p13), “more consistency in CTAS scores” (p25), “assigned locations for vitals, meds, etc. – organized” (p8), and “prompts to collect information” (p15).

**Things disliked about eCTAS. Login process/other nurses using other accounts.** With 12 responses, login process/other nurses using other accounts was the most commonly occurring response and made it apparent that RNs have trouble with the login process of eCTAS and that there are concerns about other RNs using their login credentials. Examples in this theme were, “lengthy process of logging on” (p3), “log on process” (p10), “frequently nurses triage under another nurse’s name”(p3), “having to sign in to each and every computer, this seems very time consuming” (p11), “slow

program and difficult log in” (p5), and “log on is slow – making situations of people using other people’s log ons more likely”(p19).

***Format and flow.*** In the theme format and flow, there were 12 responses. This theme encompasses the things about how the program functions that RNs do not like and contained broadly differentiated responses, thus, there were no clear themes identified. Examples of the comments include “we have to complete FRI screening before proceeding with complaint” (p22), “swiping health card and entering demographics” (p10), “lot of blank space on paper, writing could be bigger, easier to see” (p8), and “why does it ask me for things like if the pt is on O<sub>2</sub> but then not print it out” (p16).

***Slow system/computers.*** The slow system/computers theme contained six responses, which expresses the RNs’ frustrations with potentially slow technology. This theme included responses such as “ very slow computers, not ergonomic for work and the computer programs are slow and will often glitch and kick out, mid assessment making us have to triage all over again” (p6), and “how slow the system is” (p16).

***Impact on critical thinking and judgement.*** There were five responses in the theme of impact on critical thinking and judgement, which demonstrates that RNs have concerns over eCTAS impacting their ability to critically think and the importance of their own judgement. This theme includes responses such as “it takes away critical thinking for new triage nurses” (p7), “potential for error” (p26), and “inability to use clinical judgement to determine most appropriate CTAS” (p13).

***Modifiers/decision support functions.*** The theme modifiers/decision support functions had 13 responses. This theme illustrates how some RNs do not like some of the decision support features of eCTAS, including the modifiers. Some examples of these include, “it automatically inputs modifiers” (p7), “having to adjust the triage level that

gets assigned” (p24), “pain modifiers make levels higher even in pt playing video games and drinking pop” (p1), and “modifiers automatically applied when not necessary” (p15).

### **Discussion**

The purpose of this study was to examine the perceptions that RNs have of the new Electronic Canadian Triage and Acuity Scale (eCTAS) implemented by a community hospital in Ontario using a descriptive analysis. The study also sought to determine if there were any relationships between age, years working the emergency department, and years triaging and perception of eCTAS. A finding that is important to note considering that the adoption of eCTAS happened in a critical high stress environment and required a significant process change, is that 68% of the RNs rated their satisfaction with eCTAS as 7/10 and greater, where 0 was extremely dissatisfied and 10 was extremely satisfied, demonstrating moderate satisfaction. Unfortunately, since there is limited research on nurses views of information technology in the clinical practice setting, (Likourezos et al., 2004; Top, Yilmaz, & Gider, 2013), the results of this study cannot be comprehensively compared to previous research outcomes.

In regards to the DOI theory, some of the perceived attributes studied represented more positive perceptions than others. The attribute that demonstrated the strongest positive perception was complexity, which assesses how difficult the new technology is to use and understand (Rogers, 2003). Most RNs responded that eCTAS was not complicated to learn or difficult to use and just over half of the RNs thought that eCTAS was convenient to use. While Rogers (2003) notes that complexity may not be as important as relative advantage or compatibility, he states that complexity can be a very important barrier to adoption for some new ideas. The high positive perception suggests that despite the critical, fast paced nature of the ED, RNs did not perceive complexity as a

barrier. This finding is similar to Top et al., (2013) who found nurses reported EMRs to be easy to use.

Relative advantage, which reflects whether a user believes that the new innovation is better than the previous one (Roger, 2003), had a mix of positive and negative perceptions from RNs. Just over half of the RNs felt that eCTAS helped with their decision making at triage. In addition, half of the RNs felt that having the modifiers visible on the screen helped them understand the guidelines better. This is an important result as one of the main functions of eCTAS is to be a decision support tool. However, a more negative perception was that more than half of the RNs did not think eCTAS was a more accurate approach to triage than the previous paper-based system. In addition, only one fifth of the respondents disagreed or somewhat disagreed when asked if they are more likely to make triaging mistake with eCTAS than the previous paper-based process. When Rahimi (2009) et al. used the DOI theory to assess physicians and nurses adoption of Computerized Provider Order Entry (CPOE), they too found that there were concerns about errors leading to increase adverse drug events. Since a mistake at triage can impact patient morbidity and mortality (Gerdtz & Bucknall, 2001), these perceptions are important. These negative perceptions may indicate the RNs do not feel that eCTAS enhances their triage skill set. Adopters of a new innovation will decide what specific type of relative advantage is important to them (Rogers, 2003). The necessary skill set of triage RNs requires them to make rapid critical assessments using decision making skills in a complex environment (CAEP, 2018; CNO, 2018). To have significant relative advantage, eCTAS would need to positively impact the triage RNs' perceptions in the areas that are vital to their role. The findings indicate that essential elements, such as



triage accuracy and risk of error, are not perceived to have any advantage in eCTAS over the previous paper based system.

The last attribute studied was compatibility, which reflects whether the new innovation aligns with the experiences and needs of the adopters (Rogers, 2003). The results did not demonstrate a substantial positive or negative perception in regards to RNs perceptions of eCTAS in relation to patient safety and patient centred care. This coincides with Likourezos et al. (2004) who found that both nurses and physicians felt that EMRs have limited impact on patient care. The compatibility results further supported that some RNs like the decision support functions of eCTAS, including that it cues them to collect the required information at triage and when they apply the appropriate modifiers, eCTAS helped them generate an accurate CTAS score. Within the analysis of the open-ended questions, the results also indicated that RNs liked the presentation of the modifiers on the screen, signifying that this is a useful component of eCTAS. Snyder-Halpern, Corcoran-Perry, and Narayan (2001) state that nurses should be supported by computerized information systems that provide decision support due to the complex, challenging, and rapidly changing environments that they work in. The findings of the current study suggest that eCTAS is supporting the RNs through decision support functions, including the modifiers presented on the screen and the cueing of information, aligning Snyder-Halpern et al's (2001) claim that support from computerized information system support is necessary.

Further supporting the positive perception of the decision support functions of eCTAS was that younger RNs felt that eCTAS helps them to collect the relevant patient information required at triage ( $p=0.008$ ). As triage is a high stress environment, it is helpful to know which design functions are perceived as useful by the RNs to inform

future decisions with eCTAS and other IT systems in health care. With the average age of a nurse in Ontario being 44.6 years, it is important that future triaging RNs find eCTAS beneficial and supports their practice at triage (Canadian Institute for Health Information, 2017). However, older RNs were less likely to find the cueing of relevant patient information useful. The statistical significance found may demonstrate that the older RNs do not require the cues that eCTAS has to ensure all the proper information is collected.

A negative perception of compatibility was identified through the content analysis where a strong theme emerged emphasizing that RNs disliked the prolonged logon process for eCTAS. Considering the limited time that a triage RN has to capture the required patient information at triage, it was apparent that the logon process negatively impacted the work routine. The relationship between work routine and adoption of an innovation was also highlighted by Rahimi et al. (2009) as they found that physicians and nurses were reluctant to use a newly implemented CPOE system because it was not adapted to their previous work routines. Since a new innovation is more likely to be adopted if it aligns with the needs and experiences of the user (Rogers, 2003), it is essential that a program designed for triage is compatible with the needs of the triage RN where they need to rapidly identify the most urgent patients arriving to the ED. The prolonged logon process was identified as incompatible with the needs of the triage RN.

Other trends that are important to note are that RNs value the triage documentation is now printed, clear, legible, easy to read, and requires less hand writing. The clear printout helps support RNs to meet CNO (2008) standards, which dictate that documentation must be legible. The positive perception of legibility was also found in a DOI based study by Rahimi et al. (2009) in regards to a transition to CPOE.

Furthermore, RNs like that they can visualize the modifiers on the screen and that eCTAS is easy to use. However, it was clear that the login process causes substantial dislikes among the RNs. RNs also made it clear that there can be difficulties when the computer and program are slow.

RNs expressed some concerns regarding the potential loss of critical thinking skills. This potential loss is concerning considering the CNO (2018) states that RNs have foundational knowledge in critical thinking, which influences their ability to provide safe and ethical care. When describing an unstable work environment, the CNO (2018) states a key factor is the stability and predictability of the workplace, with a high rate of patient turnover and many unpredictable events considered unstable. When a workplace is unstable, there is a greater need for RNs as they possess the necessary critical thinking skills (CNO, 2018). Using those parameters, the ED would be considered an unstable work environment, emphasizing the importance of strong critical thinking skills among the triaging RNs in the ED. The RNs' concerns regarding eCTAS potentially reducing the critical thinking aligns with the findings of Kossman and Scheidenhelm (2008) who also found that nurses thought that electronic health records negatively impacted critical thinking.

Further research is needed to determine how using eCTAS will impact RNs who are new to triage. This study required that the RNs have experience with the previous paper-based process, however, there are RNs who are now triaging for the first time and are starting with eCTAS. In addition, more research is needed to focus on how the decision support functions impact critical thinking at triage at all levels of RN experience.

### **Limitations of Study**

The limitations of this study are related to the sample size, single location, and the cross-sectional design. The current study was a descriptive study providing exploratory analyses. Only one hospital is the focus of this study. The results would be more generalizable to all hospitals in Ontario if more than one hospital was involved. The single location lead to a smaller sample size, which reduced study power and precluded further analyses, such as factor analysis, correlational analysis, and other psychometric testing. Lastly, a longitudinal study that focused on RNs' perceptions of triaging before eCTAS went live and then a comparison to their perceptions after may have allowed for more direct statistical comparisons before and after implementation.

### **Conclusion**

The results of this study indicate there is a mix of positive and negative perceptions of eCTAS and that age may impact these perceptions. The findings suggest that eCTAS is easy to use and understand, but there are concerns regarding its impact on accuracy and likelihood of making a mistake. eCTAS needs to be further studied using a larger sample size and focus on RNs who are learning how to triage for the first time using eCTAS and eCTAS' impact on critical thinking.

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### CHAPTER 3: DISCUSSION OF IMPLICATIONS

The purpose of this study was to gain an understanding of Registered Nurses' (RNs') perceptions of the Electronic Canadian Triage and Acuity Scale (eCTAS) in the Emergency Department (ED) of a community hospital in Ontario. There was a mix of both positive and negative perceptions. The results indicated multiple positive perceptions of eCTAS, including that it was easy to learn and use, that it can help with decision making at triage, and it helps to collect relevant patient information at triage. Furthermore, RNs stated they liked the clear and legible printout and that the CTAS modifiers presented on the screen were helpful. The notable negative perceptions are that RNs are concerned that eCTAS may potentially lead to more error in triaging, that the triage is not more accurate with eCTAS, the computers and program are slow, and the logon procedure is too lengthy. There were inconclusive results relating to whether RNs think that eCTAS has either a positive or negative impact on patient safety and quality of care. Statistical analyses suggested that younger RNs are more likely to agree that eCTAS helps them to collect the relevant patient information required at triage. The policy, education, practice, and research implications of these findings are discussed below.

#### Implications for Policy

There is rapid technology development in healthcare, including electronic health records and electronic medical records (Canadian Institute for Health Information (CIHI), 2013). Billions of dollars are being utilized on a wide variety of information technologies to help support the coordination and provision of health care to patients in Canada (CIHI, 2013). That being said, with the insurgence of new technology, developers, hospital administrators, and policy makers need to keep the functionality of the product a key priority. There must always be an in-depth assessment on how

technologies will impact the users of the innovations and the impact they have on patient care, including patient safety and quality of care.

It is essential that a program designed for triage fit the needs of the triage RNs as it is a high stress and critical care environment. The results indicated that there was not a consensus among the RNs on whether eCTAS has a positive or negative impact on patient safety and patient centered care. However, a larger sample size to analyze this perception could produce more robust results in future research. The College of Nurses of Ontario (CNO) (2006) describes patient centred care as when the “care involves advocacy, empowerment and respect for the client’s autonomy, voice, self-determination and participation in decision-making. It is not merely about delivering services where the client is located” (p. 4). As this is a standard for all practicing nurses in Canada, the technology being implemented needs to promote and ensure patient centred care is still achievable. New technology should not impede a nurse’s ability to provide patient centred care.

New technology should not only be focused on cost efficiency and data collection, but should align with the needs and values of the RNs. The misalignment between the needs of the RNs and eCTAS was found in the current study as the results suggested that RNs did not like the logon process for eCTAS, indicating that it was too long and slow. There is a substantial amount of information gathered at triage during a brief period of time. A time consuming logon process may not seem like an impactful detriment to those who have not worked in the triage environment. However, a prolonged logon process can take time away from direct patient care in an already time constrained environment. This is significant to acknowledge, especially when considering the responsibilities of the triage RN as they need to rapidly identify the most acute

patients first (CAEP, 2018). This can be extrapolated to any patient care area and signifies the importance of how functions of a new innovation can positively or negatively impact patient care. The Diffusion of Innovation (DOI) theory states that a new innovation is more likely to be adopted by the users if it aligns with the needs and experiences of the adopters (Rogers, 2003). Rahimi, Timpka, Vimarlund, Uppugunduri, and Svensson (2009) found that physicians and nurses were reluctant to use a newly implemented Computerized Provider Order Entry (CPOE) system because it was not adapted to their previous work routines. The innovation's new routines and practices should be aligned with what the adopter perceives as important, and more specifically, should not reduce the time that the nurse spends with the patient. The innovations being used in health care environments present unique and complex challenges that must be considered.

The results of this study indicate several positive aspects of eCTAS in regards to how the innovation fits the needs of the RNs, which may have a positive influence on retention of RNs in the stressful environment of the ED. Over half of the respondents indicated that eCTAS helps cue them to collect the relevant patient information required at triage, with a statistically significant difference between younger RNs (age 39 years and younger) and older RNs (age 40 years or older), with the younger RNs being more likely to agree this was helpful. This is highly beneficial as CTAS guidelines have a specific set of required information that the RN must collect at triage, including vital signs, infection control history, medical history, medications, allergies, and a subjective and objective assessment (CAEP, 2018). In the future, RNs will be learning triage for the first time using eCTAS and will not have had experience completing triage without a

decision support tool. The fact that RNs find eCTAS helpful to gather the required information, could have a positive effect on new triaging RNs.

Another positive finding from this research is that the RNs liked the clear and legible triage print out. The triage documentation is read by multiple members of the healthcare team and therefore needs to be clear and legible to ensure effective communication. Prior to using eCTAS, the triage document was hand written at the hospital that the study was conducted in. The CNO (2008) has strict documentation guidelines for nurses, including that documentation must be legible. With the large amount of RNs in this study who stated that they liked how legible eCTAS was, this could potentially indicate that previous triage documentation was not always legible. Thus, eCTAS could help RNs to abide by the CNO (2008) documentation standards. The legibility finding suggests that RNs perceive eCTAS to be a relative advantage over the paper based system as it aids in their documentation, thereby increasing their rate of adoption (Rogers, 2003).

Policy makers, developers, and hospital administrators must consider all nuances of new technology and how they may impact nursing workflow, standards of care, patient safety, and patient centred care. These considerations must be a priority for all new technology that will be used by nurses and other health care providers. eCTAS does positively impact some considerations, such as cueing RNs to collect the required information, but also has negative impacts, such as workflow. As hospitals continue to move to more electronic processes, engagement of the users during the development and implementation stages is essential. Attention must be given to assessing the perceptions after the innovation is in use to help guide and improve current and future innovations.

## Nursing Education

Nurse educators must ensure the education of nurses reflects the reality of current nursing practice where information technology is being integrated (Gonen, Sharon, & Lev-Ari, 2016). According to the CIHI (2017), the average age of nurses in Ontario is 44.6 years, with 28.1% of nurses being younger than 35 and 25.8% being 55 or older. Not only does nursing education need to stay current with technology, but education for current practicing nurses is essential as there are a significant number of nurses who would have started their nursing profession with minimal information technology. This implication is supported by Gonen et al. (2016) as they state that, “the nursing profession has to respond and integrate appropriate information technology” (p.2). Fortunately, more than half of the participants (55.4%) in the current study, agreed or somewhat agreed that the move to eCTAS was a positive move. This positive perspective helps to demonstrate that nurses are willing and open to integrating information technology into their practice. This is important to nursing educators to understand so they can build curricula to reflect the use of information technology in clinical practice.

The open response portion of the current study indicated that some RNs were concerned with how eCTAS is impacting their critical thinking abilities at triage and how it will impact RNs new to triage. Examples of answers given about this are, “it takes away critical thinking for new triage nurses” (Participant (p)7) and “inability to use clinical judgment to determine most appropriate CTAS” (p13). These are statements that need to be taken seriously and further supports the need to properly integrate the use of information technology into nursing education. The CNO (2018) emphasizes the importance of critical thinking in nursing practice. The CNO (2018) states that critical thinking is an essential component of effective decision-making, which focuses on

understanding and anticipating risks and considering benefits and outcomes while constructing a proactive plan to implement an action. These are skills unique to the RN, which separates their scope from the registered practical nurse (RPN) (CNO, 2018). Nurse educators need to ensure that RNs are still able to develop, use, and refine their critical thinking skills while using information technology of any form. Thus, nursing education objectives focused on the generation of critical thinking skills need to incorporate information technology into this learning.

Another key implication is on how nurses are being educated on new information technology infrastructure. When an individual is deciding if they will adopt a new innovation, the knowledge acquisition is pivotal to the innovation-decision process (Rogers, 2003). It is during the learning process where an individual will work to reduce their uncertainty about the advantages and disadvantages of a new innovation (Rogers, 2003). Rogers states that “consideration of a new idea does not go beyond the knowledge function if an individual does not define the information as relevant to his or her situation, or if sufficient knowledge is not obtained to become adequately informed” (p.174). It is important that adopters are properly educated on a new innovation so they can make an informed decision to adopt or reject. The results of the current study indicated that almost all the RNs (92.8%) either somewhat agreed or agreed that the training on eCTAS was sufficient to meet their learning needs, thus potentially influencing their decision to support continued adoption of eCTAS. The training for eCTAS was approximately two hours long and it explained the purpose of why eCTAS was being implemented and went through multiple case scenarios. The training style and structure could be an example of how to train nurses on new technological innovations.

Overall, the introduction of information technology needs to be properly implemented in each clinical setting. Nurses need to receive sufficient training on the new innovations prior to using it for patient care or in the practice environment and nursing education needs to ensure that nurses are ready to practice in an environment that utilizes information technology. Hebda and Calderone (2010) describe how schools of nursing need to make sure nurses are able to practice in clinical environments that require a unification of skills in human interaction, information technology, and clinical practice. For optimal nursing care and high quality patient care, education and training must be properly conducted.

### **Recommendations for Future Research**

As there is a minimal body of research on nurses perceptions and views on various information technology in the clinical practice setting (Likourezos et al., 2004; Top, Yilmaz, & Gider, 2013), there is substantial need for research in this area. As clinical environments become more electronically dependant, it is essential to understand how the users of the technologies perceive them. For example, more than half of the participants in this study disagreed or somewhat disagreed that eCTAS was a more accurate approach to triage, which is an important perception to consider because RNs carry immense responsibility at triage and eCTAS must fit their needs within that critical environment. With that in mind, researchers and developers need to take significant consideration into the many the facets of information technology used by nurses.

Firstly, research needs to focus on the impact of technological innovation on critical thinking. Over half of the participants (53.6%) either somewhat agreed or agreed that eCTAS helps with decision making at triage. Some innovations not only provide an electronic means to document for the nurse, but they also provide decision support



functions. As previously described, concerns were raised by the participants in this study about eCTAS' impact on critical thinking. Nurses need to be able to provide optimal quality of care and perform superior critical thinking, regardless if there is technological decision support or not. If nurses become reliant on the technology, they need to be prepared to work just as effectively when it is not available. There could be potential safety risks if the nurse has trouble performing to the same calibre without the technological support. With the influx of new nurses entering the profession being more accustomed to technology, these risks may only grow over the upcoming years. This is why it is essential to understand the impact the technology will have on nurse's critical thinking. The impact could be both positive or negative, but this needs to be determined as health care increases its technological dependence.

Understanding the impact of technology on critical thinking and decision making, leads to the next area that research needs to focus on, specifically in regards to eCTAS. RNs new to triage will now be triaging for the first time using eCTAS, thus, they will never have triaged without a decision support tool. Research needs to explore how this affects their decision making at triage, their application of the correct CTAS scores, the accuracy of the patient assessment, and their overall triage performance. These are essential elements to understand as triage is a challenging and complex process that requires decision making skills (Farrohknia et al., 2011). The accuracy of the patient assessment at triage is impacted by the competence of the triage RN, which then can affect patient safety and quality of care (Hitchcock, Gillespie, Crilly, & Chaboyer, 2013). The results of the current study indicated that 42.8% of RNs either somewhat agreed or agreed that they were more likely to make mistakes using eCTAS than the previous paper based system. An inclusion criteria for this study was that the participants had used

previous paper-based system for at least two months in order to capture a comparison between an electronic program, which offers elements such as decision support, and a basic paper document, which does not offer any decision support. The expression of concern regarding the increased mistakes that experienced triage RNs reported is a key reason that future research needs to focus on RNs triaging for the first time using eCTAS. A more positive perception was that exactly half of the respondents (50%) stated that eCTAS' format of presenting the modifiers on the screen has helped them to understand the CTAS guidelines better. As there are both positive and negative perceptions, future research needs to look at how all these connections are related for RNs new to triage.

Another focus of future research needs to look into how technology is impacting the nurse-patient relationship. As the CNO (2006) states, the nurse-patient relationship is at the core of nursing. It requires the nurse to use both knowledge and skill, while using caring behaviours and attitudes (CNO, 2006). Misto, Padula, Bryand, and Nadeau (2018) conducted a study that assessed nurses' perceptions of how completing electronic documentation while in contact with the patient affects the nurse-patient relationship. They found both positive and negative consequences, for example some nurses stated that the electronic documentation improved the relationship because they viewed it as an additional resource and had access to data while with patients (Misto et al., 2018). Meanwhile, other nurses had a more negative view as they felt it distracted them from communicating with the patient (Misto et al., 2018). Research has demonstrated that when nurses complete electronic documentation at the bedside a complex relationship is formed between the nurse, patient, computer, location in the room, and the specific documentation that is required (Gaudet, 2016). Further research exploring how eCTAS impacts the nurse-patient relationship would be advantageous.

As previously stated, there is minimal research available on nurses' perceptions of information technology. This leaves a substantial opportunity for future research. Several key areas require more in-depth inquiry, including understanding how information technology relates to: patient safety, patient quality of care, nurses critical thinking and decisions making, the therapeutic nurse-patient relationship, and its impact on new nurses.

### **Conclusion**

In closing, the results of this study indicate that eCTAS has generated both positive and negative perceptions from the RNs working at one community hospital where the use of eCTAS was mandated. While the sample size was small, the results did help to build an understanding of how RNs feel about this new innovation. The findings from the study help to signify the need for further research focusing on nurses and the introduction of new technology in practice. It is important to consider and understand the impact of information technology on professional standards as new technology is introduced. Information technology needs to promote, support, and inform the achievability of these standards. Nursing education needs to stay informed to reflect the current practice in health care. Overall, the introduction of new innovations in information technology in the clinical environment should aim to improve nursing practice and standards.

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## APPENDICES

### Appendix A

#### Survey Instrument

Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale

Start of Block: Block 5

Dear Participant,

**Project Title** Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital

#### Principal Investigator

Dr. Michael Kerr

[REDACTED]

#### Co-Investigator

Andrea de Jong MScN Candidate, RN

[REDACTED]

Dear Potential Participant,

Thank you for taking the time to read this letter of information on the study titled, "Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital (eCTAS)". You have been invited to participate because you have experience triaging on the previous paper based system and triaging with eCTAS. Your experiences and perceptions of the eCTAS tool is the focus of this research. The researcher hopes to gain an understanding of how Registered Nurses perceive the eCTAS tool as there is no previous research on this.

Andrea de Jong is completing this research study for her thesis as part of her Master of Science in Nursing Program at Western University. While she is also a Registered Nurse at [REDACTED], she is not being sponsored by [REDACTED] to complete this research study. She has received permission from [REDACTED] to use her work email address to distribute the study questionnaires.

You are being asked to complete an online questionnaire that contains both multiple choice and short answer questions, and should take approximately 10 minutes to complete. Your responses will remain anonymous and all information will be kept confidential and encrypted with password protection. If the results of this research are

published, your responses will be presented in the form of group data, meaning that individual responses will remain anonymous. Data will be kept for seven years.

Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on your employment standing in any way. Participation in this study will also have no effect on your employment standing in any way.

There are no identified risks or discomforts associated with participation in this research. You will not be compensated for your participation in this research. Completion of the questionnaire is indication of your consent to participate.

If you have any questions, please contact Andrea de Jong at [adejong5@uwo.ca](mailto:adejong5@uwo.ca). Your time in completing this questionnaire is appreciated. Please note that emails are not a secure method of communication.

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics at Western University [REDACTED], email: [REDACTED].

Thank you for your time and feedback.

Start of Block: Satisfaction with previous paper based system

1 On the following scale of 0-10, please indicate how satisfied you were with the previous paper based triage system that was used before eCTAS.

0 is extremely dissatisfied and 10 is extremely satisfied.

Extremely dissatisfied      Extremely satisfied

0    1    2    3    4    5    6    7    8    9    10

1	
---	--

End of Block: Satisfaction with previous paper based system

Start of Block: eCTAS Questions - Please select the most applicable response

2 Please select the response that is most applicable.

	Disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat agree	Agree
--	----------	----------------------	----------------------------------	-------------------	-------

eCTAS helps with my decision making at triage	0	0	0	0	0
eCTAS is complicated to learn	0	0	0	0	0
eCTAS has a more accurate approach to triage than the previous paper based triage process	0	0	0	0	0
eCTAS supports patient safety	0	0	0	0	0
eCTAS is convenient to use	0	0	0	0	0
The training on eCTAS was sufficient to meet my learning needs	0	0	0	0	0
eCTAS is organized logically for me	0	0	0	0	0
I think the change to eCTAS is a positive move	0	0	0	0	0



I am more likely to make triaging mistakes using eCTAS than with the previous paper based system	0	0	0	0	0
When I apply the appropriate modifiers, eCTAS helps me to generate an accurate CTAS score	0	0	0	0	0
eCTAS interferes with patient centered care	0	0	0	0	0
eCTAS improves my ability to choose an appropriate CTAS score	0	0	0	0	0
I would rather complete the triage using the paper based process	0	0	0	0	0
eCTAS cues me to collect the relevant patient information required at triage	0	0	0	0	0
eCTAS is difficult to use	0	0	0	0	0

<p>The presentation of the modifiers on the eCTAS screen has helped me understand the guidelines better</p>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
---	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

End of Block: eCTAS Questions - Please select the most applicable response

Start of Block: Satisfaction with eCTAS

3 On the following scale of 0-10, please indicate how satisfied you are with eCTAS.

0 is extremely dissatisfied and 10 is extremely satisfied.

Extremely dissatisfied      Extremely satisfied

0    1    2    3    4    5    6    7    8    9    10

1	
---	--

End of Block: Satisfaction with eCTAS

Start of Block: Short Answers

4 What are the two things you like most about eCTAS?

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

5 What are the two things you dislike the most about eCTAS?

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_

End of Block: Short Answers

Start of Block: Demographics: Please indicate or write in the most correct response

6 What is your age in years?

\_\_\_\_\_

7 Please indicate how many years you have worked in emergency nursing.

If less than one year, please indicate how many months you have worked in emergency nursing.

- Years \_\_\_\_\_
- Months \_\_\_\_\_

8 Please indicate how long you have used the previous paper-based triage system prior to the introduction of eCTAS.

- Less than two months
- Two or more months

Display This Question:

If Please indicate how long you have used the previous paper-based triage system prior to the introd... = Two or more months

9 You indicated you have used the previous paper-based triage system prior to the introduction of eCTAS for two or more months.

Can you state how many years you have used the previous paper-based system? If less than one year, please specify how many months.

- Years \_\_\_\_\_
- Months \_\_\_\_\_

10 How many months have you used eCTAS?

- Less than two months
- Two or more months

Display This Question:

If How many months have you used eCTAS? = Two or more months

11 You have indicated you have used eCTAS for two or more months. Please indicate how many months you have used eCTAS.

\_\_\_\_\_

End of Block: Demographics: Please indicate or write in the most correct response

## Appendix B

### Email to Participants One Month before Survey Link Distributed

#### Subject Line: Upcoming notice of a research study

Hello,

The purpose of this email is to inform you of an upcoming research study that you may be invited to participate in. You are receiving this email because you are a member of the group, "Emergency Department Nurses". If you have not triaged using the previous paper based process at [REDACTED] and have not triaged using eCTAS, please disregard this email.

It is a study that I, Andrea de Jong, am conducting. As you may already know, I am also a Registered Nurse at [REDACTED]. I am currently a student of the Master of Science in Nursing program at Western University. This study is being conducted for my thesis at Western University. The study involves using a questionnaire to understand triaging nurses' perceptions of the Electronic Canadian Triage and Acuity Scale. The internet based questionnaire includes both multiple choice and short answers questions and should take approximately 10 minutes to complete. Your participation in this questionnaire is voluntary and all responses will remain anonymous. An email containing the link to complete the questionnaire will be sent to your [REDACTED] email address in approximately one month's time.

If you have any questions or concerns about this, please contact me using the information below.

Thank you,

Andrea de Jong BScN, RN  
MScN student  
[REDACTED]

Version Date: 15/07/2018

**Appendix C**  
**Recruitment Email Script**

**Subject Line: Invitation to participate in research**

Hello,

You are being invited to participate in a study that I, Andrea de Jong, am conducting. As you may already know, I am also a Registered Nurse at [REDACTED]. I am currently a student of the Master of Science in Nursing program at Western University. You are receiving this email because you are a member of the group, "Emergency Department Nurses". If you have not triaged using the previous paper based process at [REDACTED] and have not triaged using eCTAS, please disregard this email.

The study involves using a questionnaire to understand triaging nurses' perceptions of the Electronic Canadian Triage and Acuity Scale. The questionnaire includes both multiple choice and short answers questions and should take approximately 10 minutes to complete. Your participation in this questionnaire is voluntary and all responses will remain anonymous.

Attached to this email is a Letter of Information and Consent which should be reviewed. Completion of the questionnaire is indication of your consent to participate. If you would like to participate in this study please click on the link below.

{URL TO BE INSERTED HERE}

Please contact Andrea de Jong using the contact information below if you have any questions.

Thank you,

Andrea de Jong BScN, RN  
MScN Student

[REDACTED]

Version Date: 15/07/2018

## Appendix D

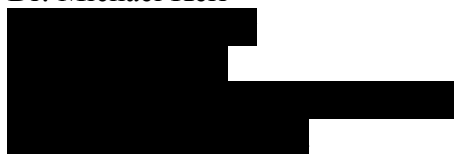
### Letter of Information and Consent

**Project Title**

Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital

**Principal Investigator**

Dr. Michael Kerr

**Co-Investigator**

Andrea de Jong MScN, RN

Western University



Dear Potential Participant,

Thank you for taking the time to read this letter of information on the study titled, "Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital (eCTAS)". You have been invited to participate because you have experience triaging on the previous paper based system and triaging with eCTAS. Your experiences and perceptions of the eCTAS tool is the focus of this research. The researcher hopes to gain an understanding of how Registered Nurses perceive the eCTAS tool as there is no previous research on this.

Andrea de Jong is completing this research study for her thesis as part of her Master of Science in Nursing Program at Western University. While she is also a Registered Nurse at [REDACTED], she is not being sponsored by [REDACTED] to complete this research study. She has received permission from [REDACTED] to use her work email address to distribute the study questionnaires.

You are being asked to complete a questionnaire that contains both multiple choice and short answer questions, and should take approximately 10 minutes to complete. Your responses will remain anonymous and all information will be kept confidential and encrypted with password protection. If the results of this research are published, your responses will be presented in the form of group data, meaning that individual responses will remain anonymous. Data will be kept for five years.

Your participation in this study is voluntary. You may decide not to be in this study. Even if you consent to participate you have the right to not answer individual

questions or to withdraw from the study at any time. If you choose not to participate or to leave the study at any time it will have no effect on your employment standing in any way.

There are no identified risks or discomforts associated with participation in this research. You will not be compensated for your participation in this research. Completion of the questionnaire is indication of your consent to participate.

If you have any questions, please contact Andrea de Jong at [REDACTED]. Your time in completing this questionnaire is appreciated. Please note that emails are not a secure method of communication.

If you have any questions about your rights as a research participant or the conduct of this study, you may contact The Office of Human Research Ethics at Western University [REDACTED]

Thank you,

Andrea de Jong

**This letter is yours to keep for future reference.**

Version Date: 15/07/2018

## Appendix E

### Reminder Email Script for Recruitment

#### **Subject Line: Invitation to participate in research**

Hello,

An email was sent to you three weeks/six weeks ago and I wanted to send you a quick reminder about my study. If you have already completed the questionnaire, thank you for your time and effort, it is greatly appreciated. If you have not triaged using the previous paper based process at [REDACTED] and have not triaged using eCTAS, please disregard this email.

You are being invited to participate in a study that I, Andrea de Jong, am conducting. As you may already know, I am also a Registered Nurse at [REDACTED]. I am currently a student of the Master of Science in Nursing program at Western University. The study involves using a questionnaire to understand triaging nurses' perceptions of the Electronic Canadian Triage and Acuity Scale. The internet based questionnaire includes both multiple choice and short answers questions and should take approximately 10 minutes to complete. Your participation in this questionnaire is voluntary and all responses will remain anonymous. Please use the link below to access to the questionnaire.

{URL TO BE INSERTED HERE}

If you have any questions or concerns about this, please contact me using the information below.

Thank you,

Andrea de Jong BScN, RN  
[REDACTED]

Version Date: 15/07/2018



## Appendix F

### Ethics Approval – Western University



**Date:** 4 September 2018

**To:** Dr. Mickey Kerr

**Project ID:** 112387

**Study Title:** Registered Nurses' Perceptions of the Electronic Canadian Triage and Acuity Scale in a Community Hospital

**Application Type:** HSREB Initial Application

**Review Type:** Delegated

**Full Board Reporting Date:** 18Sept2018

**Date Approval Issued:** 04/Sep/2018 09:42

**REB Approval Expiry Date:** 04/Sep/2019

Dear Dr. Mickey Kerr

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

**Documents Approved:**

Document Name	Document Type	Document Date	Document Version
Email Recruitment V3	Email Script	29/Aug/2018	3
Email Reminder to Participants V2	Email Script	19/Aug/2018	2
Letter of Information and Consent V2	Written Consent/Assent	19/Aug/2018	2
Pre One Month to Survey Release Email to Participants V2	Email Script	19/Aug/2018	2
Registered Nurses' Perceptions of eCTAS Research Proposal	Protocol	15/Jul/2018	1
Survey for Registered Nurses Perceptions of eCTAS V2	Online Survey	19/Aug/2018	V2

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB, except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

*Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).*

## Appendix G

### Ethics Approval –Hospital of Study Location



October 5, 2018

Andrea de Jong



**Re: Registered Nurses' Perceptions of the Electronic Canadian and Acuity Scale in a Community Hospital**

Andrea:

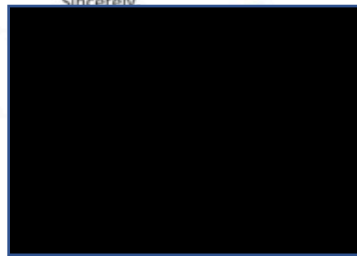
The Research Ethics Board at [REDACTED] (REB) completed a delegated review of the above entitled project on October 3, 2018. The REB has reviewed the above entitled protocol and related recruitment and data collection tools and has approved their use with human subjects within the conduct of the above entitled project for the period of one year (October 3, 2018 to October 2, 2019 inclusive).

Please advise the REB of any unexpected or adverse events that occur during the course of the study, and/or any deviations from the approved protocol. Modifications to the protocol must be approved by the REB prior to implementation, except in situations where it is necessary to remove immediate hazards for the participants.

The Research Ethics Board also requests annual updates on the progress of your research. Should your study continue for more than one year, you must request a renewal of ethics approval on or before October 2, 2019. The REB must be notified in writing at the time of study completion so that we may close our files.

The [REDACTED] Ethics Board is in compliance with the ICH Guidelines and the Tri-Council Policy Statement for Ethical Conduct for Research Involving Humans. No members of the Research Ethics Board have any direct involvement with this project.

Sincerely,



## CURRICULUM VITAE

Name: Andrea de Jong

Post-Secondary Education and Degrees: Western University  
London ON, Canada  
2017-2019 MScN

Trent University  
Peterborough ON, Canada  
2008-2011 BScN

Related Work Experience: Heart and Stroke Foundation  
Project Lead, Stroke Best Practices  
2019-present

Guelph General Hospital  
Crisis Prevention and Management and  
Emergency Clinical Support  
2018-2019

Guelph General Hospital  
Interim Clinical Educator and Professional  
Practice Lead – Emergency Department  
2017-2018

Guelph General Hospital  
Registered Nurse, Emergency Department  
2014-2017

Invermere and District Hospital  
Registered Nurse, Emergency Department  
and General Duty Nurse  
2013-2014

Groves Memorial and Community Hospital  
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2012-2013

Professional Memberships: College of Nurses of Ontario