THE EFFECTIVENESS OF THE CANADIAN TRIAGE GUIDELINES IN IMPROVING THE TREATMENT OUTCOMES OF CANCER PATIENTS WITH FEBRILE NEUTROPENIA

by

Anas Alsharawneh

A thesis submitted to the School of Graduate Studies

in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

Faculty of Nursing

Memorial University of Newfoundland

July 2019

St. John's Newfoundland

Abstract

Background: Febrile neutropenia (FN) is among the most common side effects related to cancer treatment and a significant cause of morbidity and mortality. Patients with FN are at a higher risk of developing life-threatening sepsis without prompt treatment.

Purpose: To evaluate the quality of emergency care of cancer patients with FN. Specifically, the study aimed to examine the effectiveness of triage on select treatment outcomes for patients with FN as specified by the Canadian triage guidelines.

Methods: A retrospective cohort design was employed to collect data over five years from the emergency department (ED) records of all adult cancer patients with FN in one urban health care organization in Atlantic Canada.

Results: The Canadian triage guidelines identify the acuity and urgency of FN. The guidelines, however, do not translate well in practice as two-thirds of the patient sample were inappropriately triaged (mal-triaged) to less urgent triage categories. Mal-triage was significantly associated with delayed times for physician initial assessment, administration of antibiotics, and decision about admission. Additional factors that contributed to the quality of ED care of cancer patients with FN were also examined.

Conclusion: The results of our quality evaluation provided evidence that improvements in a number of the quality dimensions have the potential to enhance the care provided to individuals with FN. Our results established an initial understanding of the factors that influence the mal-triage of patients with FN. Improving triage decision-making is an essential first step but this will not completely improve the quality of care in the ED for clients presenting with FN until problems in other parts of the system are resolved to address the health care outcomes and needs of this vulnerable population.

Acknowledgments

I would like to thank my family for their emotional support and understanding during this long journey –my parents who always stood by me and prayed for my success, my daughter Lujain, who has grown from a toddler to completing her 1st grade, and my son Zaid, who was born during this busy time and always made me laugh just when I needed some stress relief.

My dissertation committee has been very helpful and supportive. A special thanks to my supervisor Dr. Joy Maddigan for her help and support for my research and thesis. Thank you so much Joy for helping me to conceptualize my research and bring my thoughts to words and a plan to move forward. Also, I would like to thank the other members in the committee – Dr. Alice Gaudine for her unlimited support and kindness even before the start of my studies when I was overseas, Dr. Holly Etchegary for her insightful ideas in making this study more feasible, and Dr. Zhiwei Gao for his invaluable statistical expertise and assistance with understanding the analyzed data. The pronouns ‘we’ and ‘our’ are used frequently in this document and refer to the student and his dissertation committee. The pronouns ‘I’ and ‘my’ refer to the student.

I would like to acknowledge and thank the Health personnel at the oncology and emergency departments for giving me access to their ED and Meditech system.

Thank you all for helping me seeing this through to completion.

Table of Contents

List of Tables

List of Figures

List of Abbreviations and Symbols

ACLS: Advanced Cardiac Life Support

ANC: Absolute Neutrophil Count

CCT: Cognitive Continuum Theory

CDC: Center for Disease Control and Prevention

CEDIS: Canadian Emergency Department Information System

CIHI: Canadian Institute for Health Information

CIs: Confidence Interval

CISNE: Clinical Index of Stable Febrile Neutropenia

COT: Complaint Oriented Triage

CRF: Chart Review Form

CTAS: Canadian Triage and Acuity Scale

e-Triage: Computerized Version of the Canadian Triage and Acuity Scale

E: Effect Size

EBP: Evidence-Based Practice

ECG: Electrocardiogram

ED: Emergency Department

EMS: Emergency Medical Services

ESI: Emergency Severity Index

FACs: Fever Alert Cards

FN: Febrile Neutropenia

FNP: Febrile Neutropenia Pathway

FRR: Fractile Response Rate

G-CSF: Granulocytes- Colony Stimulating Factor

GI: Gastrointestinal

Hosp LOS: Hospital Length of Stay

ICU: Intensive Care Unit

IOM: Institute of Medicine

IV: Intravenous

k: kappa

kw: weighted kappa

LOS: Length of Stay

LWBS: Left Without Being Seen

MAH: Malignancy Associated Hypercalcemia

QI: Quality Improvement

MASCC: Multinational Association for Supportive Care in Cancer

N & V: Nausea and Vomiting

OR: Odds Ratio

p: Level of Significance

PIA: Physician Initial Assessment

SCC: Spinal Cord Compression

SD: Standard Deviation

SOB: Shortness of Breath

SVCS: Superior Vena Cava Syndrome

TLS: Tumor Lysis Syndrome

TTA: Time to Antibiotics

$\bar{x}$: The Average or Mean

B: Beta Coefficients; Standardized Regression Coefficient

$\chi 2$:Chi-squared

List of Appendices

Chapter 1

One of the complexities of emergency care is that the demand for service is unpredictable, and therefore, crowding within the emergency department (ED) is considered an inevitable event (Forero, Mccarthy, & Hillman, 2011). However, timely and effective care in a hospital ED is needed for good patient outcomes (Pines & Hollander, 2008). To achieve this objective, and despite the limited available resources, many EDs have established mechanisms to sort and prioritize patients to make sure that patients with life-threatening or medically urgent conditions are seen immediately while others with more stable conditions are seen later (Beveridge et al., 1998). Historically, EDs did not use standardized triage acuity rating systems, but since 1999, scales have been introduced to Canadian EDs to standardize triage decisions to be more objective and justified (Beveridge et al., 1998; Murray, Bullard, & Grafstein, 2004). Currently, different EDs worldwide use different triage scales, such as the Emergency Severity Index (ESI) developed in the United States, the Manchester Triage System in Britain, the Canadian Triage and Acuity Scale (CTAS) and, more recently, the Italian Triage Emergency Method. However, the recommendations from recent research support the adoption of more reliable and valid five-level triage scales including ESI or CTAS (Ruiperez et al., 2015).

The CTAS categorizes ED arrival acuity into one of five numeric levels based on how urgently, in terms of minutes, patients need to be seen by the ED physician. These categories are: level 1, resuscitation (immediate lifesaving treatment by both nurse and physician); level 2, emergent (up to 15 minutes to be seen by a physician and nurse); level

3, urgent (to be seen by a physician in less than 30 minutes); level 4, less-urgent (to be seen by a physician within 60 minutes); and level 5, non-urgent (up to 120 minutes to be seen by a physician) (Beveridge et al., 1998). The ESI facilitates prioritization of patients in a comparable way to the CTAS. In addition to determining which patient should be seen first, the triage nurse uses the ESI to consider what resources are necessary to move the patient to the final, appropriate disposition (admission, discharge, or transfer) (Martin et al., 2014; Shelton, 2009).

The primary objective for instituting these triage scales was a need for guidelines that would support ED nurses in the correct identification of patients' conditions, and therefore ensure appropriate emergency care is provided promptly (Beveridge et al., 1998). However, previous research in the area of ED triage has raised concerns about the effectiveness and the safety of ED triage, noting that patients' outcomes may be compromised, particularly the outcomes of cancer patients (Leak et al., 2012; Oatley, Fry, & Mullen., 2016; Swenson et al., 1995). The developers of the CTAS recommended health care organization to continuously monitor to verify that the time objectives in the guidelines are met, and to assess the consistency of the triage process and the compliance in following the guidelines (Bullard, Unger, Spence, & Grafstein, 2008).

According to the CTAS guidelines, time objectives are designed to promote the timely delivery of interventions that would result in improved patient outcomes (Beveridge et al., 1998). However, from the limited available research investigating ED care of cancer patients, the results showed that many patients did not reach the benchmarked time for treatment even if they presented with an urgent oncological emergency such as febrile neutropenia (FN) (Nirenberg, Mulhearn, Lin, & Larson, 2004;

Oatley et al., 2016; Swenson et al., 1995; Szwajcer, Czaykowski, & Turner., 2011). There is a considerable gap in the literature for interventions to improve the care of oncology patients in the ED. Studies are lacking that determine the appropriateness of the triage implementation and assess the effectiveness of triage in improving patient outcomes. In particular, research is needed to evaluate the impact of triage on patients with FN and to examine if delayed treatment can be attributed to their triage rating.

The purpose of this thesis was to evaluate the quality of ED care of cancer patients with FN. Specifically, to examine the effectiveness of the triage process in facilitating patient care as specified by the CTAS guidelines. In this first chapter of the thesis, I provide a general overview of available literature for evidence about the effectiveness of the triage system in facilitating patients' care in the emergency setting. I highlight issues regarding consistency and accuracy in the implementation of emergency triage. I review the health burdens associated with FN regarding morbidities and mortalities. I question the effectiveness of triage in improving the treatment outcomes of patients with FN, documenting research studies that report on multiple adverse outcomes among patients with FN. I formulate a hypothesis attributing these adverse outcomes to the delayed emergency care and/or the triage decisions that were made.

My thesis consists of three manuscripts with the first manuscript presented in Chapter 2. In this manuscript, I report on a thorough review of the literature that was conducted to examine the urgency of oncological complaints and emergencies with an evaluation of the CTAS guidelines in identifying these urgencies. The literature on oncological emergencies is discussed as it relates to the nature and urgency of these oncological complaints with a focus on FN as the most common oncological emergency. I

examined the literature as it relates to the electronic triage that is commonly used in Canadian triage EDs. To conduct this analysis, I applied the CTAS guidelines using the 2012 complaint-oriented triage (COT) in a simulated triage of select oncological emergencies, and examined if their urgency could be prioritized appropriately using the CTAS guidelines.

In Chapter 3 and Chapter 4, which constitute the second and third manuscripts respectively, I report and discuss the results obtained from analyzing the data that were collected from patients' medical records in our retrospective cohort study. Chapter 3 is focused on evaluating the quality of ED care in the form of an analysis of CTAS benchmarks relative to cancer patients presenting to ED with FN. The aim was to evaluate the ED quality of care for patients with FN in terms of the four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care. I also assessed if the patients whose medical records were included in the study met the benchmark times for treatment as specified in the Canadian Triage and FN guidelines.

Chapter 4 is dedicated to studying the effect of ED triage on the treatment outcomes of patients with FN. The purpose was to evaluate whether cancer patients received the appropriate triage score when they presented with FN and to explore the effect of mal-triage (inappropriate triage) on their treatment outcomes. Therefore, the effectiveness of the triage system was evaluated to understand the health risks associated with delayed emergency care. This study is a type of clinical quality audit that can inform prospective adoption of rational policies and guide a real change to enhance the efficiency and effectiveness of ED processes in the direction of positive patient outcomes. In

Chapter 5, the findings and implications of the findings included in this thesis are summarized, discussed, and placed in broader perspective.

Research Questions

The thesis was guided by four research questions and are addressed in different manuscripts. The first research question is discussed in the second chapter (first manuscript) and is concerned with the conceptualization of the triage guidelines at the theoretical level. In this chapter, we examine if the acuity of the oncological emergencies including FN was identified in the CTAS guidelines. The second research question guided the study of ED quality of care and is discussed in Chapter 3 (second manuscript). The third and fourth research questions guided the study discussed in Chapter 4 (third manuscript) and are concerned with the effectiveness of triage implementation in practice.

1. Do the Canadian Emergency Department Triage and Acuity Scale (CTAS) guidelines identify the urgency of select oncological emergencies?
2. What is the quality of ED care of patients with FN in terms of the four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care?
3. What effect does the mal-triage of patients with FN have on meeting care standards (time for the physician initial assessment and time to antibiotics), the decision time to admit/discharge, and length of stay (LOS)?
4. Can contextual factors (arrival time, arrival day, mode of arrival, and ED crowding) and select patient characteristics (age, sex, and vital signs) predict the occurrence of mal-triage among patients with FN?

The Significance of the Study

The majority of studies evaluating ED triage using CTAS were done to assess the reproducibility of the decision between triage nurses (inter-rater reliability). However, an interesting question is whether triage decisions were made correctly (i.e., the validity and accuracy of triage decisions). All raters can agree with one another and still be wrong. Many studies illustrated the lack of consistency among nurses in making triage decisions with the majority of patients being incorrectly triaged. However, a better question is one that examine the impact of accurate triage on patient outcomes. No studies have been located to date that explored the effect of ED triage on outcomes for cancer patients.

Evaluating triage implementation for patients with an oncological emergency such as FN could improve the care provided in the ED, expand the knowledge base of emergency care, and identify areas where changes are needed. This study can identify any gap in timing that might exist between what should be achieved as stated by CTAS guidelines and what was actually accomplished. The study findings may inform clinicians, administrators, researchers, and policymakers about the performance of the triage system and its effectiveness in promoting positive patient outcomes.

Conceptual Model

The commitment to base our actions on evidence is one of the most significant advances in health care in the twentieth century (Grol et al., 2013). The effectiveness of care assumes that the right care (not overuse, underuse, or misuse) is delivered to the patient (Berwick, 2014). Health decisions or interventions are supposed to be based on the best available evidence that was found to have efficacy on health outcomes (Polit & Beck, 2010). It is of importance to be pragmatic and follow the principles of scientific

approach in our nursing practice (Polit & Beck, 2010). It allows clinicians to choose the treatment that has known efficacy and adapt them using their critical reasoning and experience as well as patient preferences (Romyn et al., 2003). To be pragmatic, something is real only insofar as it works and has practical consequences. Accordingly, it is crucial to examine the implementation of the triage guidelines in the practice (Issaacs, Ploeg, & Tompkins, 2009). Within this framework, care processes are performed to improve patient outcomes. One of the well-supported models that can explain this relationship between the care that is delivered and patient outcomes is the Donabedian Model. The model categorizes quality of care as measured indicators in the form of structure, process, and outcome variables. Structure variables are mainly concerned with the available relevant resources for the treatment process, which can be easily measured but are often difficult to link directly to the quality of care such as available bed capacity. Process variables reflect what is done for the patient and include actions and interventions aimed at both identifying and resolving the problem and are usually derived from evidence-based guidelines. Outcome indicators measure the effect of treatment and the degree to which patient health is restored (Kelly, Vottero, Christie-McAuliffe, Morita, & Altmiller, 2014).

Therefore, if the right care is provided to patients, there would be a higher probability of achieving positive health outcomes. However, some discrepancies in the provision of health care in the form of overuse (e.g., overdose or aggressive therapy), underuse (e.g., smaller dose), or misuse (e.g., unnecessary or wrong treatment) can be associated with adverse outcomes. Unfortunately, multiple reports suggest that in many incidences, the second scenario is the dominant practice in our health care system

(Berwick, 2014; Graham & Varghese, 2011; Grol et al., 2013; Kelly et al., 2014). Despite the vast evidence of effective treatment, healthcare workers tend to provide alternative care that is not based on evidence and in contrast with the current evidence (Davey, 2015).

In the context of triage, the structural indicators such as the CTAS guidelines or the Complaint Oriented Triage (COT) (an interactive computerized CTAS triage tool) are instituted to help triage decision making. The application of the CTAS guidelines is mandatory in Canada and thought to enhance objective triage decision-making so that, for example, the benchmark for all individuals with FN is that they are seen by the ED physician within 15 minutes. The objective of using the triage guidelines is to promote patient outcomes in ED. If a triage nurse accurately assigns a CTAS score of 2 to the patient with FN, the patient will be enabled to meet the FN guidelines recommended benchmark time for treatment. Therefore, following the recommended care of the guidelines can be considered the best practice as such care was found to be associated with better patient outcomes (Bullard et al., 2017; Freifeld et al., 2011).

According to the Donabedian Model, the assigned triage score can be considered a process indicator that helps determine the treatment outcomes of patients with FN in the ED. These treatment outcomes for my studies are represented by the different ED processes that have been found to be an essential determinant of health outcomes for patients with FN (Bullard et al., 2017; Freifeld et al., 2011; Keng et al., 2015; Rosa & Goldani, 2014; Morneau et al., 2017). These quality indicators included measures regarding safety, effectiveness, patient-centeredness, and timeliness of care to include but were not limited to i) time for the physician initial assessment (PIA), ii) time to antibiotics

(TTA), iii) the decision time to admit/discharge, iv) ED length of stay (ED LOS), v) ED disposition, and vi) hospital length of stay (hospital LOS). Since the associations between these treatment outcomes and patient health outcomes are well supported in the literature, our study is mainly focused on structural and process indicators rather health outcomes. Figure 1 depicts the expected relationships between the measured quality indicators.

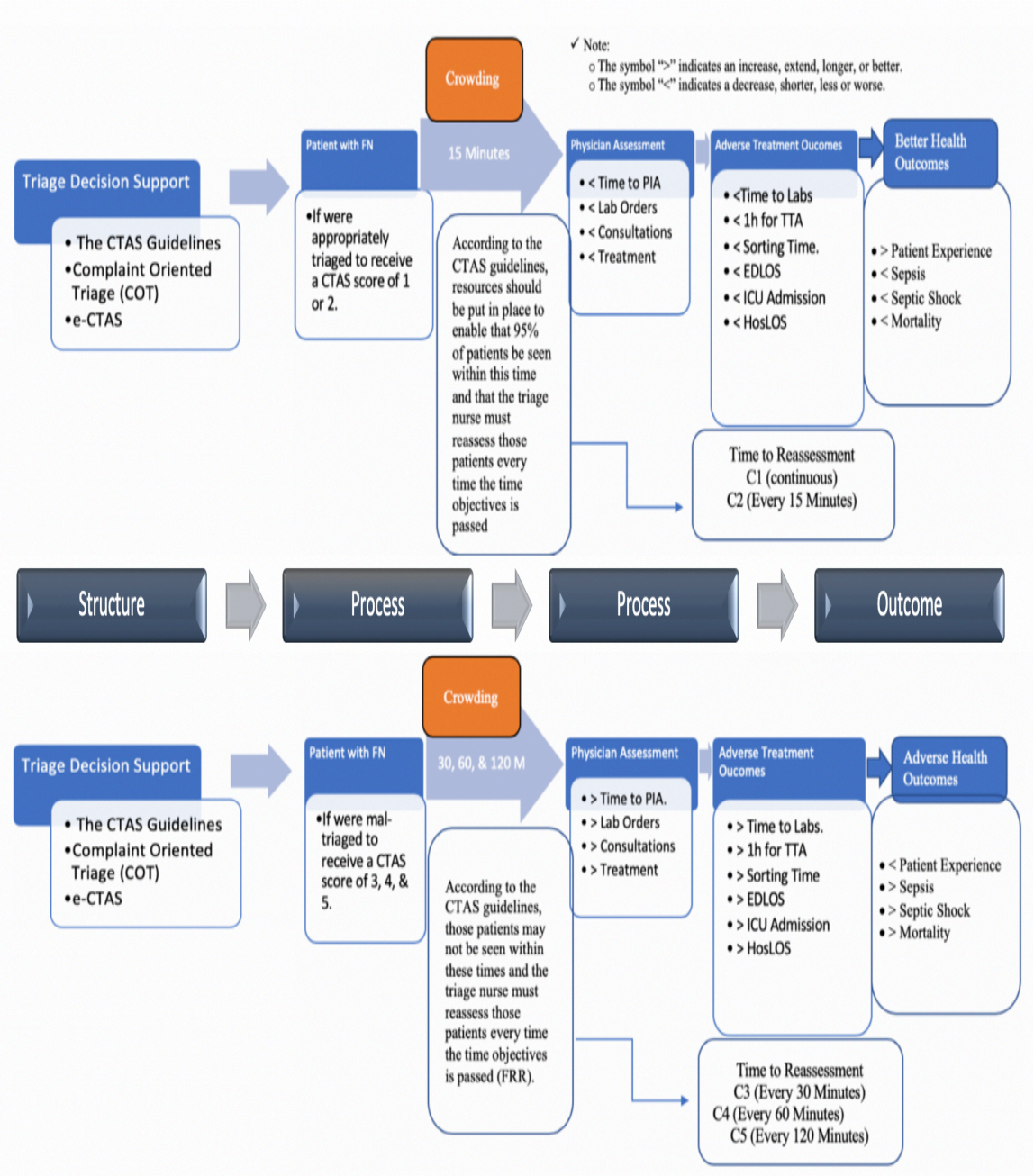

Figure 1

Conceptual Model of the Expected Relationship between Quality Indicators

Note. Each of the manuscript of the thesis was concerned certain part of the model. For example, the first manuscript was focused on the structural indicator of the COT (Complaint Oriented Triage). The second and third manuscript evaluated the process indicators. Also, not all variables depicted in the figure were studied in the thesis. The following variables were not part of my study: e-CTAS, time to labs, consultation, patient experience, sepsis, septic shock, and mortality.

Methods

A retrospective cohort design was used to collect data from all available records of adult patients diagnosed with cancer who presented with fever to one urban ED triage in Atlantic Canada. Data were collected by conducting chart reviews using a standardized, piloted, chart review form (CRF) (Appendix A). A pilot test of the CRF was performed, and changes were made as necessary to enhance the rigor and minimize biases. Each patient was assigned a unique, de-identified study code to protect the confidentiality of their information. The de-identified data will be kept for five years in a locked office & locked cabinet within the graduate office of the school of nursing in the education building (ED-5004).

Identification of relevant health records required data linkages between the provincial cancer registry and ED electronic patient health records. The Cancer Registry identified all adults who received a cancer diagnosis between 2011/12 and 2016/17. This list of individuals was sent by the Cancer Registry to a provincial health information agency to conduct the data linkage. The health information agency identified all target patients from the Cancer Registry using the following inclusion criteria: i) diagnosed with cancer, ii) 18 years and older, iii) presented with fever to the ED during the study period, iv) the date of ED presentation was later than the date of cancer diagnosis, and v) only the first ED visit for fever was included. All data transfer occurred securely through the Managed File Transfer (MFT) system.

Power Analysis

To enable sample size calculation using the t-test sample size equation, the five-ordinal level of CTAS score (predictor variable) will be dichotomized into low acuity

triage (III, IV, & V) and high acuity triage (I or II). In theory, patients with FN are assigned to a CTAS score of 2 and expected to wait for up to 15 minutes. However, in reality, the median wait times for patients presenting to ED with FN was 75 minutes (Szwajcer et al., 2011). Similarly, those patients are expected to start empiric antibiotics administration within an hour of their presentation (60 minutes). Despite the guidelines, the median time to antibiotic administration was between 3- 5 hours (180-300 minutes). If we assume that patients with correct triage score (CTAS2) were enabled to meet the TTA benchmark (60 minutes) and that patients who were mal-triaged (CTAS 3, CTAS 4, & CTAS 5) achieved the observed TTA (180-300 minutes), the estimated effect size range can be calculated as the difference in the value of the observed against the expected TTA between the exposed versus unexposed group (E=300-60=240; E=180-60=120; *E[range]:120-240*). In order to use the t-test sample size equation for the binary predictor variable (exposed vs unexposed) and continuous outcome variables of time (e.g., TTA) we need the variance of time from door to needle which can be estimated from a previous study of patients with FN where time range from ED triage to TTA was 1.23–22.8 hours (SD= [22.8-1.23]/4*60=324 minutes) (Szwajcer et al., 2011). Therefore, the standardized effect size range (E/S) can now be calculated by dividing the effect size by the standard deviation of the outcome variable (TTA) (E/S=120/324=0.37≈ 0.40; E/S=240/324=0.74≈0.70). At a two-sided hypothesis (α=0.05) and β=0.20 assuming a standardized effect size of 0.40, it would require a sample size of 100 or more participants in each group (n=200). At a two-sided hypothesis (α=0.05) and β=0.20 assuming a standardized effect size of 0.70, it would require a sample size of 34 or more participants

in each group (n=68). If we estimate the attrition rate at 30% due to mission information, it would be required an additional 60 participants (Hulley et al., 2013).

Literature Review

The review of literature includes a synthesis of available research articles in the domain of emergency care and ED triage as well as articles reporting on the assessment and management of oncological complaints and emergencies. An electronic search of EBSCOhost CINAHL and the MEDLINE databases was used to identify all relevant scientific articles published up-to-date (February 2019). To complete the search, Google and Google Scholar search engines were used to undertake a broader search of the World Wide Web. We reviewed all articles with the key terms Emergency Severity Index (ESI), Canadian Triage Acuity Scale (CTAS), ED triage, ED wait times, oncological complaints and emergencies, febrile neutropenia, neutropenic fever, and patient outcomes from both qualitative and quantitative methods. A limited number of published studies were identified that evaluated the emergency care of cancer patients; however, none of these studies examined the effect of ED triage or wait times on the outcomes of patients with cancer.

Consistency and Accuracy of ED Triage

The triage process ranks ED patients for whom emergency interventions should be delivered immediately or shortly in the first and second category respectively, while other patients in less urgent categories may wait until a physician is available (Beveridge et al., 1998). Therefore, it is essential that these triage decisions be precise and accurate (Goransson, Ehnfors, Fonteyn, & Enhrenberg, 2008). Precision and accuracy of triage have been an ongoing problem, and researchers have tried to introduce different triage

scales to enhance certainty in the triage process (Bullard, Unger, Spence, & Grafstein, 2008). Using a triage scale, the triage nurse performs a brief focused assessment, then assigns the patient a triage acuity level. This code serves as a tag to identify how long the patient can safely wait before receiving treatment.

In the limited literature about triage, researchers have explored the type and consistency among users of the scales in terms of triage implementation (Chen et al., 2010). Results from these studies revealed discrepancies between triage nurses in making triage decisions using these scales. For instance, the results from surveys using validated triage scenarios demonstrated moderate to poor interrater reliability (k = 0.38 - 0.42) using the Australian Triage Scale (Considine, Botti, & Thomas, 2007; Ekins & Morphet, 2015; Gerdtz & Bucknall, 2007). Similarly, the variability of triage score assignment using the ESI has been recently identified. In the multinational study, the concordance of nurse-assigned ESI scores with a reference standard was universally poor with high variability in the triage decisions made (α = 0.44). The authors concluded that there is a need for more reliable use by nurses (Mistry et al., 2017).

In Canada, similar studies were conducted to assess the reproducibility of CTAS with mixed results in reported interrater agreements. Dallaire, Poitras, Aubin, Lavoie, and Moore (2012) observed that the CTAS had lower reliability than expected (k = 0.44). However, a limitation of the research was the use of hypothetical case scenarios (vignette) to evaluate the consistency of triage, which might be non-replicable in real practice. An robust trial in Atlantic Canada was conducted to assess the performance of CTAS using well-trained nurses who retrospectively triaged actual cases of patients visiting the ED. Results revealed moderate strength of agreement in using CTAS in the triage of patients

(*kw* = 0.48, 95% *CI* = 0.45 – 0.52) (Howlett & Atkinson, 2012). The moderate reliability noted in CTAS has resulted in a new electronic version called e-CTAS. The results of a prospective cohort study of nurses triaging actual patients in real practice revealed that e-CTAS has a similar fair agreement using unweighted kappa ($k = 0.40$) and moderate agreement when weighted kappa was used ($k = 0.52$) between the nurses using it (Dong et al., 2006).

Before we conclude the moderate reliability of CTAS, it is important to mention that all these studies failed to indicate which version of the CTAS guidelines was used in their evaluation among the multiple revisions that were introduced to the guidelines in the years 2004, 2008, 2014, and 2017. Nonetheless, an orphan study by Fernandes and colleagues (2013) had the primary objective of assessing the interrater agreement of the 2008 CTAS guidelines and comparing it to the 2004 CTAS version. The analysis of the vignette survey demonstrated that the 2008 CTAS guidelines was less reliable than the 2004 CTAS guidelines, with a lower level of agreement for the scenarios using the 2008 guidelines than using the 2004 guidelines (Fernandes et al., 2013). However, this is the only study that compared the reliability of the 2008 guidelines to other versions of the guidlines.

The lack of consistency among nurses in making triage decisions can result in patients being incorrectly triaged (also known as mal-triage). Multiple studies have revealed the problem of mal-triage. For instance, Howlett and Atkinson (2012) reported that the assigned triage scores were inconsistent with the CTAS recommendations in about one-third of ED patients. Also, the accuracy of triage decision-making is found to decrease with each less urgent triage category (Ekins & Morphet, 2015). Therefore,

patients who present without life-threatening conditions are more likely to be assigned a less urgent triage categories. Cancer patients can easily fall into this category by presenting with complaints that include but are not limited to fever, fatigue, insomnia, diarrhea, and constipation (Gobel et al., 2009).

A patient who is mal-triaged can either be over-triaged or under-triaged. Under-triage occurs when a patient is assigned a level of urgency that results in the patient waiting longer than is appropriate for a condition that brought the patient to the ED. Over-triage, on the other hand, is described as making decisions that result in an individual being assigned an acuity rating that is higher than is considered necessary (Chen et al., 2010). In one of the studies evaluating the validity of triage, patients were over-triaged and under-triaged at the rate of 24% and 33%, respectively. Multiple problems in the triage process were also identified including the lack of consistency in assessing pain and measuring vital signs during the triage assessment (not used in the triage of 32% and 18% of the patients, respectively) (Howlett & Atkinson, 2012). For instance, patients with oncological complaints were found to be more likely assigned to lower triage categories (less urgent) despite the greater urgency or severity of their manifestations (Oatley et al., 2016). Moreover, around 35% of cancer patients with FN, the most life-threatening oncological emergency, were found to be under-triaged (Szwajcer et al., 2011). Similarly, Livingston, Craike, and Slavin (2012) showed that 30% of ED episodes of FN were inappropriately triaged to lower acuity ratings (less urgent).

Patients who are under-triaged have the potential to experience serious adverse outcomes, or leave ED without being seen, resulting in potential hazards to their health (Ding et al., 2006). On the other hand, over-triage is reported as a standard action that is

practiced by most nurses. Though it seems safer, over-triage has the potential to increase wait times for patients who do need to be seen rapidly, and thus may adversely affect these patients (Olofsson, Gellerstedt, & Carlstrom, 2009).

From another perspective, it was also reported that discrepancies in acuity assignation are not distributed equally among the visitors of ED. For example, patients with cancer are very likely to be assigned a lower triage score (less urgent) (Swenson et al., 1995; Nirenberg et al., 2004; Oatley et al., 2016; Szwajcer et al., 2011). Even the impact of under-triage can vary significantly among patients with different presentations. For instance, under-triaging cancer patients with FN can result in serious complications or even death (Szwajcer et al., 2011). FN is considered an oncological emergency that arises mainly from the treatment of cancer where patients suffer from a profound bone marrow suppression that leaves them susceptible to severe infections (Weycker et al., 2016). In the prospective multiple cohort study ($N = 497$), delayed ED care and increased wait times were found to be associated with adverse outcomes among patients with FN (Keng et al., 2015).

The Objectivity of the Triage Process

While a delay in emergency care and extended wait times can begin with the urgency ratings assigned, the inaccurate score may be due to the beliefs that are held by emergency nurses toward cancer patients. The lack of objectivity and the resultant inconsistencies in triaging patients were documented in several studies (Considine et al., 2007; Dallaire et al., 2012; Dong et al., 2006; Ekins & Morphet, 2015; Gerdtz & Bucknall, 2007). In one of the most extensive studies where hundreds of charts were reviewed from 30 different EDs, it was reported that triage documentations were

inconsistent, incomplete, and inaccurate, often just quoting patients' complaints. Also, the results from a multicentre retrospective cohort study revealed that triage nurses lacked a systematic approach to investigate cancer patients' underlying reasons for seeking emergency care (Berger & Gillespey, 2002). Similarly, a British study reported that the triage nurses assigned acuity ratings based on the physical appearance of the patients and this can be problematic. Such immediate intuitive evaluation of patients' presenting complaints is not only unreliable but also promotes a culture of stereotyping where patients are being judged by their appearances (Edwards, 2007).

It is not known whether Canadian triage nurses use similar approaches, but this intuitive approach to triaging patients is contradictory to the primary objective of any triage guidelines, namely, to make the triage process more objective, and therefore, more consistent (Beveridge et al., 1998). Nevertheless, other studies have also demonstrated a lack of objectivity in implementing triage where personal attitudes, beliefs, and biases were found influential in determining triage decisions (Stanfield, 2015). Moreover, many triage nurses were not able to describe their organizations' triage scale or even demonstrate familiarity with important decision modifiers such as risk factors, pain, and immunocompromised status (McNairy, 2005). Cooper, Schriger, Flaherty, Lin, and Hubbell (2002) highlighted an alarming problem in the triage process where knowing the vital signs of the ED patients did not change the assigned triage score; indeed, 92.1% of triage decisions were not affected by knowing the patient's vital signs. Although this was an American study, a comparable Canadian study reported similar results where pain assessment and vital signs measurement were not considered in the triage of 32% and 18% of the ED patients, respectively (Howlett & Atkinson, 2012). It is true that the

presenting complaints are only valid to determine the complaint-specific minimum CTAS level. However, specific risk modifiers such as vital signs are considered essential first-order modifiers that need to be applied and can be used to change the initial anticipated triage acuity level (Murray et al., 2004). For example, the CTAS recommendations for the triage of cancer patients who receive chemotherapy is to look for the presence of fever (querying them for FN), and therefore, ignoring the vitals of these patients can result in an inappropriate assessment and misclassification with catastrophic complications (Bullard et al., 2017). However, reports are lacking for an up-to-date evaluation of the performance of triage in real-world practice.

Factors Influencing the Process of ED Triage

The process of triage decision making is a complex one, where the triage nurse uses a variety of thinking strategies, which range from searching for information, generating hypotheses, to allocating acuity ratings (Chen et al., 2010; Goransson, Ehrenberg, Marklund, & Ehnfors, 2006). Adding to this complexity are the many factors that influence the triage decision-making process. These factors can be categorized as internal factors, which are nurse-related, and external factors, which correspond to the environment. The internal factors reflect nursing skills and personal capacity. Nursing skills include knowledge, years of emergency triage experience, and clinical judgment of the nurse to have real insight and intuition. The individual ability reflects the unique nurse characteristics of being courageous, confident, and rational in making decisions (Andersson, Omberg, & Svedlund, 2006). However, the results from a Swedish study of 423 registered nurses from 48 Swedish EDs who individually triaged 18 patient scenarios using the CTAS guidelines found no significant association between personal

characteristics of the registered nurses and their ability to triage (Goransson et al., 2006). In the ethnographic study by Wolf (2010), an in-depth exploration of ten emergency nurses with eight to 38 years of nursing experience identified that acuity determination is influenced by external factors such as patient volume, unit leadership, communication with patients and providers, and time constraints. Andersson et al. (2006) identified different but similar abstract external factors that can have an effect on the triage decision such as the working environment in terms of the high workloads and practical arrangements within the ED. However, Dong et al. (2006) challenged this information and argued that ED crowding was not a determining factor in the accuracy of triage decision-making. They conducted a prospective observational study of two groups of nurses to assess the reliability of e-TRIAGE (a web-based triage decision support tool) for assigning triage levels to patients in real practice in one of the largest EDs in Canada. They identified factors such as the chief complaints, the age of the patient, vital signs, pain score, and past medical history as determinants of the triage acuity ratings (Stanfield, 2015).

Clinical experience is generally assumed an essential requisite in the challenging role of ED triage nurses. Nursing managers understand that senior nurses are the most qualified in making triage decisions. Some studies examined the relationship between triage decisions and knowledge and experience of the triage nurses. However, no significant association was documented between the general experience of the triage nurse and the ability to make correct triage decisions (Considine et al., 2007; Martin et al., 2014). Factual knowledge appeared to be a more critical factor than years of emergency nursing experience or experience in triage (Considine et al., 2007; Wolf,

2010). For example, in a randomized control trial of senior-level nursing students, the addition of an Advanced Cardiac Life Support (ACLS) course to the experimental group promoted confidence in triage decision-making. Confidence in triage decision making was assessed by the Triage Decision Making Inventory (TDMI). The instrument measures characteristics such as experience level, critical thinking, and intuition use as an indicator of personal characteristics distinguishing expert triage nurses (Smith et al., 2013). Martin and colleagues (2014) conducted a retrospective cohort study to examine if there was a difference in nurse attitudes and experience for those who assign Emergency Severity Index (ESI) scores accurately and those who did not assign ESI scores accurately. The results of analyzing 64 nurse participants' triage decisions identified that the ESI score assigned by nurse participants did not differ significantly based on years of experience. Understanding the triage tool and possessing the knowledge were found to be reliable indicators of nurses' capacities to make safer triage decisions. The authors of these studies provide some evidence that if nurses possess the proper knowledge, they can make safe and appropriate triage decisions. Yet, the results from these studies provided inconclusive evidence because the employed designs were a retrospective assessment using low fidelity simulation (vignette surveys). There likely is a complex interaction of multiple factors that affect the triage assessment in real-world practice which can be challenging to capture or replicate in such artificial environment (Fitzgerald, Jelinek, Scott, & Gerdtz, 2010).

Febrile Neutropenia

Febrile neutropenia (FN) is considered among the most common side effects related to cancer treatment (Bryant et al., 2015; Nirenberg et al., 2004; Vandyk et al.,

2012). FN is a potentially life-threatening oncologic emergency, which requires prompt emergency care (Lim et al., 2011; Meer et al., 2016; Samphao, Eremin, & Eremin, 2010). FN is defined as "a low neutrophil count of 1.5 × 109 /L and single oral temperature measurement of more than 38.3°C or a temperature of more than 38.0°C sustained over one-hour period" (Freifeld et al., 2011, p. e61). The risk of FN with cancer treatment is about 17% with higher expected risk repeated chemotherapy cycles (Oatley et al., 2016; Weycker, Barron, Kartashov, Legg, & Lyman, 2014). Other studies reported higher rates occurring in half of the patients receiving chemotherapy (Hashiguchi et al., 2015).

Fever is a common symptom that often occurs in association with minor conditions. However, fever occurring in cancer patients may be the only manifestation of a severe underlying infection as signs and symptoms of inflammation are typically attenuated (Freifeld et al., 2011). Bone marrow suppression is an expected side effect of many chemotherapy regimens with the majority of chemotherapeutic drugs having a cytotoxic effect (Adelberg & Bishop, 2009). Infection due to neutropenia is associated with significant morbidity and mortality in patients receiving chemotherapy (Walji et al., 2008). FN patients can present with sepsis at the ED as they may be experiencing subtle, severe underlying infection (Prachanukool, Tangkulpanich, Paosaree, Sawanyawisuth, & Sitthichanbuncha, 2016). However, fever can be the only presentation, or patients may be afebrile (Adelberg & Bishop, 2009; Freifeld et al., 2011). Patients with cancer are four times more likely to present with severe sepsis compared with non-cancer patients (Hsu et al., 2018). Therefore, in the context of triage and the CTAS guidelines, all patients on chemotherapeutic agents or who are immunocompromised come under the category of FN if they present to ED with fever alone (Beveridge et al., 1998).

Morbidity and Mortality of Febrile Neutropenia

FN has considerable clinical consequences such as dose reductions, delays, or even discontinuation of chemotherapy, and is associated with substantial mortality, morbidity, and costs (Lyman, Abella, & Pettengell, 2014). Chevalier et al. (2011) reported that FN resulted in 12% mortality, 24% changing the chemotherapy regimen, and 28% terminating the chemotherapy treatment. FN is potentially life-threatening where failure to implement immediate treatment can be associated with rapid progression to septicemia. Empiric antibiotic therapy should be initiated promptly as delayed initiation of antibiotics can be associated with increased mortality (Adelberg & Bishop, 2009; Gabriel, 2012; Livingston et al., 2012). Early antibiotic administration is associated with fewer complications and higher survival rates among patients with FN (Lynn et al., 2013; Rosa & Goldani, 2014). Despite such benefits, delayed emergency care and prolonged time to antibiotics have been found in many observational studies (Nirenberg et al., 2004; Oatley et al. 2016; Szwajcer et al., 2011).

FN can leave a heavy burden on patients as well as the health care system. This burden can get inflated if patients were exposed to unnecessary delay in treatment where delay is associated with significant complication of sepsis with a prolonged length of stay (Keng et al., 2015; Klastersky, 2004; Koh & Pizzo, 2002). Generally, these ED visits were found unavoidable and resulted in the majority of patients being urgently admitted (Nirenberg et al., 2004; Oatley et al., 2016). Infection accounts for 14% of cancer-related admissions (Numico et al., 2015). Of the studies that evaluated the health care system burden of FN, 13 days of hospital stay were reported with associated costs of $22,800 (Kuderer, Dale, Crawford, Cosler, & Lyman, 2006). The mean LOS in the ED for those

patients ranged from 5.5 to 8.1 hours (Livingston et al., 2012; Nirenberg et al., 2004; Oatley et al., 2016). The median time from the diagnosis of FN to the ICU admission was 10 hours (Strojnik, Mahkovic-Hergouth, Novakovic, & Seruga, 2016). The average hospital LOS for cancer patients with FN was 7.1 days (Oatley et al., 2016). Marked variability was observed concerning hospital LOS associated with FN among different cancer types and treatment with an average range of 7 to 14 days for hospital LOS (Kawatkar et al., 2017; Strojnik et al., 2016; Weycker et al., 2014). The mortality rate associated with FN in cancer patients is between 5% and 20% and can reach up to 75% (Barber, 2001; Courtney et al., 2007; Kawatkar et al., 2017; Kuderer et al., 2006; Lim et al., 2011). Among patients admitted into the ICU with FN, 45% died during their hospital stay. Certain variables were associated with poor outcomes such as intubation and mechanical ventilation support, allogeneic bone marrow transplantation, microbiological documentation of the infection, and the need for hemodialysis (Mokart et al., 2015).

Prevention of Febrile Neutropenia

Naturally, FN is associated with a heavy burden on healthcare in terms of morbidities and mortality. FN is a predisposing factor for sepsis, and therefore, prevention of FN is an important strategy to reduce morbidity and mortality (Paddock, Grock, Deloughery, & Mason, 2017). Consequently, researchers were interested in developing strategies to minimize the occurrence of FN by the use of growth factors and prophylactic antibiotic administration (Cullen & Baijal, 2009; Ganti, Marini, Nagel, Bixby, & Perissinotti, 2017; Taplitz et al., 2018).

Prophylactic administration of growth factors such as Filgrastim (G-CSF) has been associated with a lower incidence of FN (Kawatkar et al., 2017). However, despite

their benefits in decreasing the frequency and severity of FN, growth factors are underused. The results from a retrospective cohort study demonstrated an underuse of G-CSF among patients with FN as Filgrastim was administered to only 62% before their ED presentation (Szwajcer et al., 2011). In the French prospective, multicentre cohort of critically ill cancer patients with FN, the authors reported that G-CSF was initiated in the ED for only 10% of the patients (Andre et al., 2010). Similar results were also reported for the underuse of outpatient prophylactic antibiotics administration. For instance, Courtney et al. (2007) showed that among patients who were admitted with FN, around 67% were on prophylactic antimicrobial medications at home before the presentation. Ganti and colleagues (2017) conducted a retrospective cohort study of adult patients with relapsed/refractory acute myeloid leukemia who were admitted for reinduction chemotherapy over ten years to evaluate the impact of antibacterial prophylaxis with levofloxacin in relapsed/refractory acute leukemia. Their results showed that the benefits of using antibiotic prophylaxis outweighed the risk of antibiotic resistance because their use was associated with a decrease in time to bacteremia, time to neutropenic fever, and reduction in the incidence of infections.

Risk Stratification of Febrile Neutropenia

Multiple scoring systems have been invented to assess the seriousness of FN such as the MASCC (Multinational Association for Supportive Care in Cancer) and CISNE (Clinical Index of Stable Febrile Neutropenia) (Coyne et al., 2017). Since CISNE requires some invasive examination such as monocytes count, I will only focus on MASCC because of its convenience for use at triage.

The calculated MASCC score categorizes patients with FN into low and high risk based on a scoring system. Low-risk FN patients are considered stable and eligible for outpatient management with oral antibiotics (Paddock, Grock, Deloughery, & Mason, 2017). High-risk patients should be admitted to the hospital with an immediate IV broad-spectrum antibiotic administered in the ED. While a number of researchers and clinicians disagree with outpatient management of low-risk FN, the recommendations of different FN guidelines is that these patients receive initial doses of empiric antibacterial therapy within one hour of triage and be monitored for four hours before being discharged (Cancer Care Nova Scotia, 2014; Taplitz et al., 2018). Patients who do not get well after two to three days should be re-evaluated and considered for an inpatient treatment (Taplitz et al., 2018). Table 1 summarizes patient characteristics that are needed to calculate the MASCC score.

Table 1

MASCC Scoring System

Characteristic	Score
The burden of FN with no or mild symptoms	5
No hypotension (i.e., systolic blood pressure > 90 mmHg)	5
No chronic obstructive pulmonary disease	4
Solid tumor or hematologic malignancy with no previous fungal infection	4
No dehydration requiring parenteral fluids	3
Outpatient status	3
Age < 60 years	2

Note. Reprinted from "Outpatient Management of Fever and Neutropenia in Adults Treated for Malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update," by Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient Management of Fever and Neutropenia in Adults Treated for Malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. *Journal of Clinical Oncology, 36*(14), 1443-1453. Copyright 2018 by "American Society of Clinical Oncology."

The total score on the MASCC is calculated by adding the individual score of each of the eight criteria comprising the scale. If the answer is yes to each of the criteria above, a patient gets the score on the right of the table. For example, if the systolic blood

pressure was more than 90 mmHg, then the patient is scored '5' on this criterion. Any patient with a MASCC score of ≥ 21 is considered to have a low-risk FN (Klastersky et al., 2007). However, Coyne et al. (2017) conducted a retrospective cohort study to evaluate all patients with FN (temperature ≥38°C, absolute neutrophil count <1,000 cells/μL) who presented to 2 academic EDs over three years. The MASCC score was calculated for all subjects, and each visit was evaluated for several outcomes to include inpatient length of stay, upgrade in level of care, clinical deterioration, positive blood culture results, and death. Their results were alarming in that 16% of ED patients who were identified as low risk by MASCC score were found to have severe adverse events. According to Paddock et al. (2017), the sensitivity and specificity of the MASCC "might be good in Vegas but not in the ED" (p. 766). Moreover, Strojnik, Mahkovic-Hergouth, Novakovic, and Seruga (2016) retrospectively analyzed all adult cancer patients with FN with severe infection who were admitted to the Intensive Care Unit (ICU) over ten years. Their results were congruent with FN guidelines as they found that 13% of patients with neutropenic infections who were afebrile, were identified as high-risk with a median MASCC score of 13.

Uncertainties in the ED Management of Febrile Neutropenia

With the introduction of outpatient chemotherapy, where more than one-third of cytotoxic drugs are administered orally, patients have experienced an increase in the severity of treatment toxicities believed to be due to a reduction in contact with oncology care providers (Considine, Livingston, Bucknall, & Botti, 2009; Parsad & Ratain, 2007; Walji, Chan, & Peake, 2008). The ED is an accessible entry point for patients requiring immediate healthcare services (Barbera et al., 2012; Vandyk et al., 2012). Notably, when

there is insufficient primary and outpatient care for patients, the ED becomes the only place to manage oncological severe emergencies such as FN (Barbera, Taylor, & Dudgeon, 2010; Bosscher, Leeuwen, & Hoekstra, 2015; Brown et al., 2016; Sadik et al., 2014). This is evident in the results from an up-to-date systematic review of cohort and randomized controlled studies indicated higher rates of ED use among patients with cancer (Lash et al., 2017).

The standard of care for patients with FN is to receive a timely empiric antibiotic administration to prevent the development of sepsis (Weycker et al., 2016). The concern for the prompt treatment of cancer patients in the ED is mainly due to the risk of infection. Infections remain a significant cause of morbidity and mortality among cancer patients with FN. Therefore, the Infectious Diseases Society of America (2010) has updated the clinical guidelines for the use of antimicrobial agents in neutropenic patients with cancer and promoted the immediate administration of a broad-spectrum antibiotic to all ED patients who are suspected to have FN, whether they present with or without fever and before the confirmation of neutropenia (Freifeld et al., 2011). However, patients with FN can be unrecognized due to attenuated inflammatory manifestations. This is evident in delayed emergency care and prolonged time to antibiotics (TTA), which have been illustrated in many epidemiological studies. For instance, in a retrospective cohort study of a random sample of cancer patients (n = 1110 episodes) who presented to one ED, the results showed that patients with FN (n = 286) experienced at least three-hour wait times after triage before the administration of antibiotics (Oatley et al., 2016). Similarly, Nirenberg et al. (2004) retrospectively followed patients with confirmed FN (n = 33) and reported a median TTA of 3.5 hours. Another retrospective cohort by Szwajcer and

colleagues (2011) reported a longer delay where patients with FN (n = 68) received their antibiotic after five hours with only 6% of the patients receiving antibiotics within two hours of triage. Moreover, this delay was associated with a longer time for the release of laboratory values for at least five hours after admission which could have prevented crucial decisions being made regarding the plan of care (Nirenberg et al., 2004).

In the largest retrospective cohort study of 2,731 adult patients with early signs of sepsis from 14 ICUs in Canada and the United States, the time to initiation of effective antimicrobial therapy was reported to be the single most reliable predictor of outcome with 8% drop in survival for every hour of delay (Kumar et al., 2006). In another retrospective chart review of 100 adult cancer patients presenting to an ED with sepsis without hypotension, Morneau et al. (2017) reported that each hour of delay in administration of appropriate antibiotic therapy increased the odds of in-hospital mortality by 16%. The results from an up-to-date meta-analysis provided strong evidence for early management in the ED, suggesting a significant 33% reduction in mortality odds for immediate (within 1 hour) antibiotic administration (Johnston et al., 2017). Furthermore, accumulated evidence supports that delayed ED care and increased wait times were associated with adverse outcomes among patients with FN (Keng et al., 2015; Klastersky, 2004; Koh & Pizzo, 2002), while earlier administration of antibiotics was associated with fewer complications (Lynn et al., 2013).

The concern for the management and treatment of patients with FN in the ED is nothing new (Freifeld et al., 2011; Leak et al., 2012; Nirenberg et al., 2004; Oatley et al., 2016; Swenson et al. 1995; Szwajcer et al., 2011). However, I believe that these concerns should continue because the delays and wait times reported in these studies are coupled

with other research findings, suggesting that cancer patients had higher mortality compared to other ED patients (Considine et al., 2009). Furthermore, the results from a retrospective cohort study suggested an ED visit was an indicator for poor survival among patients with oncological emergencies on the basis that 36% of those patients died within 12 months of their ED presentation (Oatley et al., 2016). Moreover, the cross-sectional analysis of ED visits from the national database in the US identified that 71% of patients with oncological emergencies who died in the ED, did so on their first visit (Leak et al., 2012). Similarly, results from an American outcome study (N = 16,038), which examined risk factors for ICU admission and hospital death among patients with oncological emergencies who were admitted through the ED, reported patients experiencing a higher ICU admission rate and hospital mortality (Elsayem et al., 2014).

Admission to ICU for patients with FN may indicate that patients are having severe neutropenia and/or witnessing complications (Courtney et al., 2007). For instance, in one study in which a quarter of patients with FN were admitted to the ICU, around 75% died due to complications associated with FN. Patients with FN who required ICU care had a significantly higher mortality rate than those who did not require ICU care (Courtney et al., 2007). The results from a prospective cohort study of 1,011 patients who were admitted to the ICU, showed that 45% of the patients with FN died during their hospital stay (Mokart et al., 2015). Sadik et al. (2014) reported a higher rate of mortality in the retrospective review of 408 cancer patients who visited the ED in which death was witnessed in 47% of patients. The most common underlying reasons for ICU admission were septic shock (57%) and severe sepsis (29%) with a median ICU LOS of 5 days (range 1–34 days) (Strojnik et al., 2016). Abou Dagher and colleagues (2017) conducted a

retrospective cohort study (n = 352) of cancer patients with sepsis and found that they were similar to other septic patients regarding ED and ICU LOS. However, cancer patients with sepsis were more likely to die compared to patients who did not have cancer. The 28-day hospital mortality rate was double in the cancer group when compared to other septic patients (49%, 26%, respectively). A high percentage of death (27%) was also documented in a retrospective cohort of patients (n = 452) who presented with a simple complaint or even were hospitalized for symptom management (Numico et al., 2015).

Knowledge and understanding of the unfortunate outcomes among cancer patients with FN are the keys for any change to occur. Some studies highlighted that patients with FN were not accurately identified, nor appropriately triaged. For instance, an Australian retrospective study in an ED setting which uses a similar triage system to CTAS reported that around 80% of patients with oncological emergencies were inappropriately allocated to lower triage categories of 3, 4, and 5 (60%, 18%, 2%, respectively) (Oatley et al., 2016). Similarly, a Canadian retrospective cohort study of multicenter EDs with highly restrictive inclusion criteria of only patients with confirmed fever and neutropenia, reported that at least one-third of patients with definitive FN had received a lower-than-appropriate acuity rating. Although the other two-thirds of patients had received an appropriate acuity score, they were not seen within the CTAS guidelines benchmark time with a minimum one hour of delay to reassessment during their waiting at triage (Szwajcer et al., 2011). It is reasonable to find these results among FN patients because even patients with common, chronic conditions such as myocardial infarction were found to be mal-triaged. For example, a retrospective cohort study was conducted at the

University of Toronto of 11,510 patients who visited 102 EDs to examine the effect of the ED triage score on acute myocardial infarction quality of care. The study results showed that half of the patients with typical ST elevation acute myocardial infarction were assigned to a triage level of 3, 4, and 5 (43%, 5%, and 2%, respectively). Also, this inappropriate under-triage was reported as having a significant and independent effect, causing substantial delays in ECG acquisition and reperfusion therapy. The authors concluded, "the quality of ED triage may be an important factor limiting performance on key measures of quality of acute myocardial infarction care" (Atzema et al., 2009, p.742).

The allocation of patients with FN to less urgent triage categories can be responsible for these patients not reaching the standard benchmark for TTA as recommended by the FN guidelines (Nirenberg et al., 2004; Oatley et al., 2016; Szwajcer et al., 2011). Therefore, the rapid identification of these patients and prompt initiation of treatment have been recommended as an effective strategy for better patient outcomes for decades (Shelton, 1999). ED triage nurses must be keenly aware of the infection risks when prioritizing patients. Fever may be the only indication of severe underlying infection because the signs and symptoms of inflammation among cancer patients are typically attenuated (Freifeld et al., 2011).

Gap in Current Quality Improvement (QI) Initiatives

In the previous discussion, we highlighted the fundamental role of triage in determining the course of patients' care within the ED. However, we documented some critical issues concerning the implementation of triage, suggesting an increased concern for the effectiveness and even the safety of its use among patients with FN. There is a reliability problem where triage decisions are discrepant and vary on different occasions

and between different triage nurses. Consequently, some patients can be mal-triaged where they receive triage scores that are not appropriate for the urgency of patient presentations. However, there is a considerable gap in the current literature; published studies were only concerned with the consistency of the implementation of triage and neglected the primary objective for instating triage, specifically the improvement of patient outcomes. In this study, I am taking a different approach in the investigation of ED triage, I will evaluate the accuracy of triage implementation and the impact on the treatment outcomes. Related to my approach, before I conclude this chapter, I will present some QI initiatives that were examined in the literature to improve the quality of ED care among patients with FN. These clinical solutions will be examined to identify the limitations in such practices despite their aim at improving the efficiency and timeliness in the ED management of patients with FN.

Education. Education is a significant factor in improving the quality of care nurses provide; specialized knowledge such as that contained in nurse certification programs has been shown to lead to higher quality care, even when nurses have little experience. The available evidence to date supports knowledge as the determining factor of the accuracy of triage decisions (Chen et al., 2010; Ekins & Morphet, 2015; Martin et al., 2014; Smith et al., 2013).

Education has been frequently considered the cornerstone of any desired change at the individual level (Grol et al., 2013). Education has a vital role in advancing the skills and capabilities of nurses. Evaluation of the efficiency of a registered nurse is no longer dependent on years of experience, but extends to include specialized knowledge. Reliance on experience alone is no longer considered adequate for making accurate triage decisions

(Considine et al., 2007; Martin et al., 2014). Triage nurses may lack the relevant scientific information regarding the urgency of oncological emergencies (Considine et al., 2007; Wolf, 2010). Therefore, it may be essential to provide them with the necessary education to anticipate the urgency of patients with various presentations. However, enhancing the knowledge of triage nurses is no guarantee for an accurate triage decision when the environment is not supportive. For example, formulating policies, guidelines, and pathways is no guarantee that people will make use of those resources (Grol et al., 2013).

The assumption behind many triage educational programs is that acquiring knowledge will improve triage decisions. Furthermore, at this basic individual level, education strategies should address the need to be objective in the triage process and to promote compliance in using the guidelines. The assignment of a triage acuity rating is expected to be more objective and less open to debate (Bullard et al., 2008). Such a desire for objectivity in triaging patients has led to the development of a computerized aided triage decision-making tool (Dong et al., 2006). However, the use of education or decision supports may not help in improving the triage process. In chapter two, we will elaborate more on this conclusion as we examined the computerized aided triage being used among oncological emergencies.

Moreover, to educate the triage nurses about the urgency of FN with the intention of improving its recognition for prompt management can be ineffective if patients present late at triage. This was evident in pre-hospital delay for a mean time of 21 hours before seeking emergency care by patients with FN (Nirenberg et al., 2004). Therefore, education that is provided to the triage nurses about the risks and complications of FN is equally essential to the knowledge that should be provided to the patients.

Clinical Pathways and Guidelines. Many hospitals established or adapted different algorithms, protocols, or standardized order sets to lower the TTA administration among patients with FN as recommended by FN guidelines. The rationale is that specific hospital pathways may be designed for particular patients to improve their access to ED care and consequently their health outcomes (Kennelly et al., 2014). For example, Richards and colleagues (2011) developed and validated a novel palliative medicine needs assessment tool for patients with cancer in the ED. The instrument was based on the understanding that certain patients who seek emergency care presented with complex problems that they were unable to communicate effectively. This may be due to their acute distress and provider time constraints. Therefore, the instrument was developed as a brief, multidimensional symptom assessment tool designed to be comprehensive, yet rapid, in the assessment of domains of palliative care in an ED.

To further enhance the triage process, resources such as clinical guidelines should be readily available for emergency nurses to complement their professional judgment (Molina, Seow, Heng, Chong, & Ho, 2014). However, clinical guidelines can be ineffective unless they are being operationalized within the system using protocols or clinical pathways. For instance, in one quality initiative, Keng et al. (2015) conducted a prospective multiple cohort study (n = 497) to assess whether the Febrile Neutropenia Pathway (FNP) could reduce antibiotic delays and improve quality of care for patients for a prompt antibiotic administration. Interestingly, their results demonstrated that the implementation of FNP decreased the time to antibiotic administration by almost two thirds. The time for antibiotic administration was reduced from around 4 hours to 81 minutes, and when a pre-order set was used, the time was further reduced to about an

hour (Keng et al., 2015). This study illustrated the magnitude of the effect that ED wait times can have on treatment outcomes. When the change targeted the ED process that was responsible for the delay in the treatment of cancer patients, it resulted in dramatic fast tracking of those patients with a quicker time to the administration of the required antibiotics and shorter hospital length of stay (Keng et al., 2015).

Similarly, Kapil et al. (2016) evaluated the implementation of fever alert cards (FACs) as a communication tool to decrease the time required for administration of antibiotics in patients with FN who present to the ED. The implementation of FACs has helped to improve FN recognition with a higher percentage of patients obtaining a correct urgency rating, which suggests improvement in FN recognition. However, this did not translate to improvement in TTA administration. These results support that the assigned triage acuity rating is not the only determinant of ED care and other factors within the emergency setting are expected to influence the care provision.

A Cancer Unit within the Emergency Department. The change can take a different form by redesigning the way cancer patients are managed within the ED. To meet the needs of patients with cancer and facilitate the management of their oncological complaints, one of the suggestions was to introduce a cancer unit within the emergency setting. Ruegg (2013) argued that an ED unit for patients with cancer could have a valuable role in assessing and managing oncological emergencies. Such an ED unit is essential to control not only the progression of the disease, but also to treat various toxicities and complications related to treatments and link them to hospice and palliative care. These new urgent care models were designed with the intention to benefit cancer patients by providing specialist services that optimize safety, access, and timely care

(Oatley et al., 2016). Ruegg (2013) suggested that NP-led oncology urgent care clinic within the ED can serve as a vital alternative for meeting the immediate complex needs of patients with FN. However, Ahn, Lee, Lim, and Lee (2012) found that the cost of these units is not justified or even beneficial when it cannot reduce the length of stay or rate of admission within the ED.

Other strategies have looked at diverting cancer patients from ED triage by redesigning emergency care and providing different pathways to care. The need for this was established by the findings from many studies which revealed that despite FN being an established oncological emergency, many patients suffered significant delays seeking emergency care (Nirenberg et al., 2004; Oatley et al., 2016; Szwajcer et al., 2011). However, the diversion of such patients may not be useful, but may also be harmful. Indeed, long care delays within the ED are related to waits for ED beds; therefore, diverting away from the ED patients who were assigned to low acuity level of IV and V patients would only minimally reduce the demand for ED beds and only minimally impact wait times. Also, a small proportion of CTAS level IV and V patients do end up requiring admission and triaging them away from the ED could result in adverse outcomes (Vertesi, 2004). Furthermore, there is evidence that FN patients who were identified as low risk by MASCC score and therefore determined eligible for outpatient management, subsequently had severe adverse outcomes (Coyne et al., 2017; Klastersky et al., 2007). Despite the risk of hospital acquired infection and cost, the admission of patients with FN remains the cornerstone of the safer treatment (Paddock et al., 2017).

Summary

In evaluating the literature that investigates the process of emergency triage for individuals with FN, findings indicated many uncertainties in the triage process and the subsequent long wait times for care. To date, consistency and the accuracy of triage decisions are lacking, and it is unclear which factors can be attributed to these ED delays and the subsequent adverse outcomes. In the reviewed literature, studies examining ED triage did not differentiate whether the cause of mal-triage was (1) inappropriate application of the CTAS by the triage nurse, (2) an inherent problem within the CTAS guidelines system itself, or (3) difficulty in identifying FN. Triage performance has been measured through representative case evaluation and scoring by triage nurses using classroom-based testing methods, and this does not lead to evidence for outcome-based decisions (Howlett & Atkinson, 2012).

The effectiveness of ED triage has to be monitored according to the recommendation of CTAS establishers to validate the hypothesis that CTAS is a classification system that enhances ED management and performance outcomes. Authors have studies highlighted the need for research to assess the accuracy of the triage implementation and its impact on patient outcomes. However, to date, the literature is lacking these studies, with the exception of one conducted at the University of Toronto where it was shown that half of the patients with typical ST elevation acute myocardial infarction were assigned to less urgent triage categories. Also, this inappropriate mal-triage reported having a significant and independent effect causing substantial delays in ECG acquisition and reperfusion therapy (Atzema et al., 2009). However, despite these

concerning results, to date, the literature is lacking similar studies that determine whether ED triage and wait times could be associated with adverse outcomes.

The available evidence suggests that TTA is an independent determinant of mortality for cancer patients with FN. Also, there is consistent evidence indicating that admission to the ED may be an essential indicator for lower survival among patients with FN (Leak et al., 2012; Numico et al., 2015; Oatley et al., 2016; Sadik et al., 2014). Therefore, a change is needed for the process of care; however, any change is not meaningful without more research that can explain the exact effect that mal-triage and the subsequent time delays would have on patient outcomes. A study is warranted to examine whether delayed ED care and adverse health outcomes among patients with FN can be attributed to their allocation less urgent triage rating. Patients on chemotherapeutic agents or who are immunocompromised (e.g., cancer patients) are supposed to be receiving a higher acuity level per the CTAS guidelines. However, the fact that such discriminators and risk factors were not familiar terms for most ED triage nurses calls for safety measures (Cooper et al., 2002; Howlett & Atkinson, 2012; McNairy, 2005). The literature is lacking those studies that can determine the effectiveness of triage in improving the treatment and health outcomes of patients with FN. A fundamental question persists about whether mal-triage is associated with adverse outcomes among adult cancer patients with FN. In the upcoming three chapters, I will present the three manuscripts of my thesis in which I answer the research questions raised earlier in this chapter.

References

Abou Dagher, G., El Khuri, C., Chehadeh, A., Chami, A., . . . Bou Chebl, R. (2017). Are patients with cancer with sepsis and bacteremia at a higher risk of mortality? A retrospective chart review of patients presenting to a tertiary care Centre in Lebanon. *BMJ Open, 7*(3), E013502. doi:10.1136/bmjopen-2016-013502

Adelberg, D., & Bishop, M. (2009). Emergencies related to cancer chemotherapy and hematopoietic stem cell transplantation. *Emergency Medicine Clinics of North America, 27*(2), 311-331. doi:10.1016/j.emc.2009.01.005

Ahn, S., Lee, Y., Lim, K., & Lee, J. (2012). Emergency department cancer unit and management of oncologic emergencies: experience in Asan Medical Center. *Support Care Cancer, 20,* 2205–2210. doi: 10.1007/s00520-012-1478-8

Andre, S., Taboulet, P., Elie, C., Milpied, N., Nahon, M., Kierzek, G., . . . Claessens, Y. (2010). Febrile neutropenia in French emergency departments: Results of a prospective multicentre survey. *Critical Care, 14*(2), R68. doi:10.1186/cc8972

Anonymous. (2004). New CMA data confirm access-to-care concerns rising. *Canadian Medical Association Journal, 170*(6), 1061-1.

Andersson, A., Omberg, M., & Svedlund, M. (2006). Triage in the emergency department – a qualitative study of the factors which nurses consider when making decisions. *Nursing in Critical Care, 11*(3), 136-145. doi:10.1111/j.1362-1017.2006.00162.x

Atzema, C. L., Austin, P. C., Tu, J. V., & Schull, M. J. (2009). Emergency department triage of acute myocardial infarction patients and the effect on outcomes. *Annals of Emergency Medicine, 53*(6), 736-745.

Baltic, T., Schlosser, E., Bedell, M. (2002). Neutropenic fever: one institution's quality Improvement project to decrease the time from patient arrival to initiation of antibiotic therapy. *Clinical Journal of Oncology Nursing, 6*, 337340. doi:10.1188/02.CJON.337-340.

Barber, F.D. (2001). Management of fever in neutropenic patients with cancer. *Nursing Clinics of North America, 36*, 631–644.

Barbera, L., Atzema, C., Sutradhar, R., Seow, H., Howell, D., Husain, A., Sussman, J., Earle, C., Liu, Y., & Dudgeon, D. (2012). Do patient-reported symptoms predict emergency department visits in cancer patients? a population-based analysis. *Annals of Emergency Medicine, 61*(4), 427-437. doi.org/10.1016/j.annemergmed.2012.10.010

Barbera, L., Taylor, C., & Dudgeon, D. (2010). Why do patients with cancer visit the emergency department near the end of life? *Canadian Medical Association Journal, 182*(6), 563-568. doi:10.1503/cmaj.091187

Berger, P., & Gillespey, M. (2002). Potential for risk reduction through ISO 9000-based redesign of emergency triage. *Journal of Healthcare Risk Management, 22*(2), 15-21. doi:10.1002/jhrm.5600220205

Beveridge, R., Janes, L., Savage, N., Thompson, J., Murray, M., Nijssen, C. (1998). Implementation Guidelines for The Canadian Emergency Department Triage & Acuity Scale (CTAS). Retrieved from http://caep.ca/sites/caep.ca/files/caep/files/ctased16.pdf

Bosscher, M., Leeuwen, R., & Hoekstra, F. (2015). Mortality in emergency surgical oncology. *Annals of Surgical Oncology, 22*(5), 1577-1584. doi:10.1245/s10434-014-4180-x

Brown, J., Grudzen, C., Kyriacou, D., Obermeyer, Z., Quest, T., Rivera, D., . . . & Shelburne, N. (2016). The emergency care of patients with cancer: setting the research agenda. *Annals of Emergency Medicine, 68*(6), 706-711. doi:10.1016/j.annemergmed.2016.01.021

Bryant, A., Deal, A., Walton, A., Wood, W., Muss, H., & Mayer, D. (2015). Use of ED and hospital services for patients with acute leukemia after induction therapy: One-year follow-up. *Leukemia Research, 39*(4), 406-410. doi:10.1016/j.leukres.2015.01.006

Bullard, M. J., Unger, B., Spence, J., & Grafstein, E. (2008). Revisions to the Canadian emergency department Triage and Acuity Scale (CTAS) adult guidelines. *CJEM, 10*(2), 136. doi:10.1017/S148180350000350X

Canadian Cancer Society, publisher, & Statistics Canada, sponsoring body. (2017). *Canadian cancer statistics 2013: Special topic: Pancreatic cancer* (Canadian cancer statistics; 2017).

Chen, S., Chen, J., Ng, C., Chen, P., Lee, P., & Chang, W. (2010). Factors that influence the accuracy of triage nurses' judgment in emergency departments. *Emergency Medicine Journal, 27*, 451-455. doi:10.1136/emj.2008.059311

Chevalier, P., Lamotte, M., Malfait, M., & Marciniak, A. (2011). The incidence and outcome of febrile neutropenia in different chemotherapy regimens for cancer patients in Belgium. *European Journal of Cancer, 47*, S256. doi:10.1016/S0959-8049(11)71189-3

Chung, J. Y. M. (2005). An exploration of accident and emergency nurse experiences of triage decision making in Hong Kong. *Accident and Emergency Nursing, 13*, 206-213.doi:10.1016/j.a aen.2005.08.003

Cooper, R., Schriger, D., Flaherty, H., Lin, E., & Hubbell, K. (2002). Effect of vital signs on triage decisions. *Annals of Emergency Medicine, 39*(3), 223-232. doi:10.1067/ mem.2002.121524

Considine, J., Botti, M., & Thomas, S. (2007). Do knowledge and experience have specific roles in triage decision-making? *Academic Emergency Medicine, 14*, 722-726. doi:10.1197/ j.aem.2007.04.015

Considine, J., Livingston, P., Bucknall, T., & Botti, M. (2009). A review of the role of emergency nurses in the management of chemotherapy-related complications. *Journal of Clinical Nursing, 18*(18), 2649-2655. doi:10.1111/j.1365-2702.2009.02843.x

Courtney, D., Aldeen, A., Gorman, S., Handler, J., . . . Bennett, C. (2007). Cancer-Associated Neutropenic Fever: clinical outcome and economic costs of emergency department care. *Oncologist, 12*(8), 1019-1026. doi:10.1634/theoncologist.12-8-1019

Coyne, Le, Brennan, Castillo, Shatsky, Ferran, . . . Vilke. (2017). Application of the MASCC and CISNE risk-stratification scores to identify low-risk febrile neutropenic patients in the emergency department. *Annals of Emergency Medicine, 69*(6), 755-764. doi:10.1016/j.annemergmed.2016.11.007

Cullen, M., & Baijal, S. (2009). Prevention of febrile neutropenia: Use of prophylactic antibiotics. *The British Journal of Cancer, 101*(S1), S11-4. doi:10.1038/sj.bjc.6605270

Dallaire, C., Poitras, J., Aubin, K., Lavoie, A., & Moore, L. (2012). Emergency department triage: do experienced nurses agree on triage scores? *The Journal of Emergency Medicine,42*(6), 736–740. doi:10.1016/j.jemermed.2011.05.085

Ding, R., McCarthy, M., Li, G., Kirsch, T. D., Jung, J. J., & Kelen, G. D. (2006). Patients who leave without being seen: Their characteristics and history of emergency department use. *Annals of Emergency Medicine, 48*(6), 686-692. doi:10.116/j.annemergmed.2006.05.022

Dong, S. L., Bullard, M. J., Meurer, D. P., Blitz, S., Ohinmaa, A., Holroyd, B. R., & Rowe, B. H. (2006). Reliability of computerized emergency triage. *Academic Emergency Medicine, 13*, 269-275. doi:10.1197/j.aem.2005.10.014

Easen, P. & Wilcockson, B. (1996). Intuition and rational decision making in professional thinking: a false dichotomy? *Journal of Advanced Nursing 24*, 667-673. doi:10.1046/j.1365-2648.1996.02413.x

Edwards, B. (2007). Walking in – initial visualization and assessment at triage. *Accident and Emergency Nursing, 15*, 73–78. doi:10.1016/j.aaen.2006.12.008

Ekins, K., & Morphet, J. (2015). The accuracy and consistency of rural, remote and outpost triage nurse decision making in one Western Australia Country Health Service Region. *Australasian Emergency Nursing Journal, 18*(4), 227-233. doi.org/10.1016/j.ae nj.2015.05.002

Ekwall, A., Gerdtz, M., & Manias, E. (2008). The influence of patient acuity on satisfaction with emergency care: perspectives of family, friends, and carers. *Journal of Clinical Nursing, 17*, 800–809. doi:10.1111/j.1365-2702.2007.02052.x

Elsayem, A., Silvestre, J., Merriman, K., Chaftari, P., Gonzalez, C., & Yeung, S. (2014). Outcome of cancer patients admitted through the emergency department (ED) of a comprehensive cancer center: A call for ED-based palliative care. *Journal of Clinical Oncology, 32*(31), 194. doi:10.1200/jco.2014.32.31_suppl.194

Fernandes, C., McLeod, S., Krau`se, J., Shah, A., Jewell, J., Smith, B., & Rollins, L. (2013). Reliability of the Canadian Triage and Acuity Scale: Interrater and intrarater agreement from a community and an academic emergency department. *Journal of the Canadian Association of Emergency Physicians, 15*(4), 227-32. doi:10.2310/8000.2013.130943

Fitzgerald, G., Jelinek, G., Scott, D., & Gerdtz, M. (2010). Emergency department triage revisited. *Emergency Medicine Journal, 27*(2), 86-92. doi:10.1136/emj.2009.077081

Forero, R., Mccarthy, S., & Hillman, K. (2011). Access block and emergency department overcrowding. *Critical Care, 15*(2), 216. doi:10.1186/cc9998

Freifeld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., Mullen, C., . . . Wingard, J. (2011). Executive summary: Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 52*(4), 427

Gabriel, J. (2012). Acute oncological emergencies. *Nursing Standard, 27*(4), 35-41.

Ganti, B., Marini, B., Nagel, J., Bixby, D., & Perissinotti, A. (2017). Impact of antibacterial prophylaxis during reinduction chemotherapy for relapse/refractory acute myeloid leukemia. *Supportive Care in Cancer, 25*(2), 541-547. doi:10.1007/s00520-016-3436-3

Gerdtz, M. F., & Bucknall, T. K. (2007). Influence of task properties and subjectivity on the consistency of triage: a simulation study. *Journal of Advanced Nursing, 58*(2), 180-190. doi:10.1111/j.1365-2648.2006.04192.x

Gobel, B., Triest-Robertson, S., Vogel, W., Oncology Nursing Society, & ProQuest. (2009). *Advanced oncology nursing certification review and resource manual*. Pittsburg, Pa.: Oncology Nursing Society.

Goransson, K., Ehnfors, M., Fonteyn, M., & Enhrenberg, A. (2008). Thinking strategies used by registered nurses during emergency department triage. *Journal of Advanced Nursing, 61*(2), 163-172. doi:10.1111/j.1365-2648.2007.04473.x

Goransson, K., Ehrenberg, A., Marklund, B., & Ehnfors, M. (2006). Emergency department triage: Is there a link between nurses' personal characteristics and accuracy in triage decisions? *Accident and Emergency Nursing, 14*, 83–88. doi:10.1016/j.aa en.2005.12.001

Graham, W., & Varghese, B. (2011). Quality, quality, quality: Gaps in the continuum of care. *The Lancet, 379*(9811), E5-6. doi:10.1016/S0140-6736(10)62267-2

Grol, R., Wensing, M., Eccles, M., Davis, D., & ProQuest. (2013). *Improving patient care: the implementation of change in healthcare* (2nd ed.). Chichester, England: Wiley-Blackwell.

Hashiguchi, Y., Kasai, M., Fukuda, T., Ichimura, T., . . . Sumi, T. (2015). Chemotherapy induced neutropenia and febrile neutropenia in patients with gynecologic malignancy. *Anti-Cancer Drugs, 26*(10), 1054-1060. doi:10.1097/CAD.0000000000000279

Howlett, M., & Atkinson, P. (2012). A method for reviewing the accuracy and reliability of a five-level triage process (Canadian Triage and Acuity Scale) in a community emergency department setting: Building the crowding measurement infrastructure. *Emergency Medicine International,* 1-5. doi:10.1155/2012/636045

Hsu, J., Donnelly, J., Moore, J., Meneses, K., Williams, G., & Wang, H. (2018). National characteristics of Emergency Department visits by patients with cancer in the United States. *American Journal of Emergency Medicine*, *36*(11), 2038-2043. doi.org/10.1016/j.ajem.2018.03.025

Johnston, A., Park, J., Doi, S., Sharman, V., Clark, J., Robinson, J., & Crilly, J. (2017). Effect of immediate administration of antibiotics in patients with sepsis in tertiary care: a systematic review and meta-analysis. *Clinical Therapeutics, 39*(1), 190-202.e6. doi:10.1016/j.clinthera.2016.12.003

Kapil, P., Macmillan, M., Carvalho, M., Lymburner, P., Fung, R., Almeida, B., . . . Enright, K. (2016). Assessment of fever advisory cards (FACs) as an initiative to improve febrile neutropenia management in a regional cancer center emergency department. *Journal of Oncology Practice, 12*(9), E858-63. doi:10.1200/JOP.2015.009183

Kawatkar, A., Farias, A., Chao, C., Chen, W., Barron, R., Vogl, F., & Chandler, D. (2017). Hospitalizations, outcomes, and management costs of febrile neutropenia in patients from a managed care population. *Supportive Care in Cancer, 25*(9), 2787-2795. doi:10.1007/s00520-017-3692-x

Kelly, P., Vottero, B., Christie-McAuliffe, C., Morita, J., & Altmiller, G. (2014). *Introduction to quality and safety education for nurses: Core competencies*. New York: Springer Publishing Company.

Keng, M., Thallner, E., Elson, P., Ajon, C., Sekeres, J., . . . Sekeres, M. (2015). Reducing time to antibiotic administration for febrile neutropenia in the emergency department. *Journal of Oncology Practice, 11*(6), 450-455. doi:10.1200/JOP.2014.002733

Kennelly, S., Drumm, B., Coughlan, T., Collins, R., O'Neill, D., & Romero-Ortuno, R. (2014). Characteristics and outcomes of older persons attending the emergency department: A retrospective cohort study. *Monthly Journal of the Association of Physicians, 107*(12), 977-987. doi:10.1093/qjmed/hcu111

Klastersky, J. (2004). Antifungal therapy in patients with fever and neutropenia — more rational and less empirical. *New England Journal of Medicine, 351*(14), 1445-1447. doi:10.1056/NEJMe048203

Klastersky, J., Ameye, L., Maertens, J., Georgala, A., Muanza, F., Aoun, M, . . . Paesmans, M. (2007). Bacteraemia in febrile neutropenic cancer patients. *International Journal of Antimicrobial Agents, 30* (1), S51-9. doi:10.1016/j.ijantimicag.2007.06.012

Koh, A., & Pizzo, P. (2002). Empirical oral antibiotic therapy for low risk febrile cancer patients with neutropenia. *Cancer Investigation, 20*(3), 420-433. doi:10.1081/CNV-120001186

Kuderer, N., Dale, D., Crawford, J., Cosler, L., & Lyman, G. (2006). Mortality, morbidity, and cost associated with febrile neutropenia in adult cancer patients. *Cancer, 106*(10), 2258-2266. doi:10.1002/cncr.21847

Kumar, E., Anand, E., Daniel, E., Kenneth, E., Bruce, . . . Cheang, E., Mary. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine, 34*(6), 1589-1596. doi:10.1097/01.CCM.0000217961.75225.E9

Lash, R. S., Bell, J. F., Reed, S. C., Poghosyan, H. K., Rodgers, J. J., Kim, K. G., . . . Joseph, J. (2017). A systematic review of emergency department uses among cancer patients. *Cancer Nursing, 40*(2), 135-144. doi:10.1097/NCC.0000000000000360

Leak, A., Mayer, D., & Travers, D. (2012). Why do cancer patients die in the emergency department? an analysis of 283 deaths in NC EDs. *American Journal of Hospice & Palliative Medicine, 30*(2), 178-182. doi:10.1177/1049909112445306

Lim, J., Kim, H., Choi, W., Kim, K., Shin, D., & Lee, M. (2011). Outcomes in 102 patients that present to the emergency department with chemotherapy-induced febrile neutropenia. *Turkish Journal of Haematology, 28*(3), 193-197. doi:10.5152/tjh.2011.53

Livingston, P., Craike, M., & Slavin, M. (2012). Clinical and economic burden of emergency department presentations for neutropenia following outpatient chemotherapy for cancer in Victoria, Australia. *Oncologist, 17*(7), 998-1004. doi:10.1634/theoncologist.2011-0456

Lyman, G., Abella, E., & Pettengell, R. (2014). Risk factors for febrile neutropenia among patients with cancer receiving chemotherapy: A systematic review. *Critical Reviews in Oncology/ Hematology, 90*(3), 190-199. doi:10.1016/j.critrevonc.2013.12.006

Lynn, J., Chen, K., Weng, Y., & Chiu, T. (2013). Risk factors associated with complications in patients with chemotherapy-induced febrile neutropenia in emergency department. *Hematological Oncology, 31*(4), 189-196. doi:10.1002/hon.2040

Martin, A., Davidson, C., Panik, A., Buckenmyer, C., Delpais, P., & Ortiz, M. (2014). An examination of ESI triage scoring accuracy in relationship to ED nursing attitude and experience. *Journal of Emergency Nursing, 40*(5), 461-468. doi.org/10.1016/j.jen.2013.09.009

McNairy, R. (2005). It Takes More than String to Fly a Kite: 5-Level Acuity Scales Are Effective, but Education, Clinical Expertise, and Compassion Are Still Essential. *Journal of Emergency Nursing, 31*(6), 600-603. doi:10.1016/j.jen.2005.07.061

Meer, D., Weiland, M., Philip, T., Jelinek, J., Boughey, J., . . . Kelly, H. (2016). Presentation patterns and outcomes of patients with cancer accessing care in emergency departments in Victoria, Australia. *Supportive Care in Cancer, 24*(3), 1251-1260. doi:10.1007/s00520-015-2921-4

Mistry, B., De Ramirez, S., Kelen, G., Schmitz, P., Balhara, K., Levin, S., Martinez, D., Psoter, K., Anton, X., Hinson, J. (2017). Accuracy and reliability of emergency department triage using the Emergency Severity Index: An international multicenter assessment. *Annals of Emergency Medicine, 71*(5), 581-587.*e3*. doi:10.1016/ j.annemergmed.2017.09.036

Mokart, D., Darmon, M., Resche-Rigon, M., Lemiale, V., . . . Azoulay, E. (2015). Prognosis of neutropenic patients admitted to the intensive care unit. *Intensive Care Medicine, 41*(2), 296-303. doi:10.1007/s00134-014-3615-y

Molina, J., Seow, E., Heng, B., Chong, W., & Ho, B. (2014). Outcomes of direct and indirect medical intensive care unit admissions from the emergency department of an acute care hospital: A retrospective cohort study. *British Medical Journal, 4*(11),1-9. doi:10.1136/bmjopen-2014- 005553

Morneau, K., Chisholm, G., Tverdek, F., Bruno, J., & Toale, K. (2017). Timing to antibiotic therapy in septic oncologic patients presenting without hypotension. *Supportive Care in Cancer, 25*(11), 3357-3363. doi:10.1007/s00520-017-3754-0

Murray, M., Bullard, M., & Grafstein, E. (2004). Revisions to the Canadian Emergency Department Triage and Acuity Scale Implementation Guidelines. *CJEM, 6(06), 421-427*.doi:http://dx. doi.org/10.1017/S1481803500009428

Nirenberg, A., Mulhearn, L., Lin, S., & Larson, E. (2004). Emergency department waiting times for patients with cancer with febrile neutropenia: A pilot study. *Oncology Nursing Forum, 31*(4), 711-5. doi:10.1188/04.ONF.711-715

Numico, G., Cristofano, A., Mozzicafreddo, A., Cursio, O., Franco, P., Courthod, G., . . . Silvestris, N. (2015). Hospital admission of cancer patients: avoidable practice or necessary care? *PLoS One, 10*(3), E0120827. doi:10.1371/journal.pone.0120827

Oatley, M., Fry, M., & Mullen, L. (2016). A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. *International Emergency Nursing, 24*, 35-38. doi:10.1016/j.ienj.2015.05.007

Olofsson, P., Gellerstedt, M., & Carlstrom, E. D. (2009). Manchester triage in Sweden-interrater reliability and accuracy. *International Emergency Nursing, 17*, 143-148. doi:10.1016/j.ienj.2008.11.008

Ontario. Ministry of Health Long-Term Care, Ontario Hospital Association, & Canadian Electronic Library. (2006). *Improving access to emergency care addressing system issues*. (DesLibris. Documents collection). Ottawa, Ont.: Ontario Hospital Association.

Paddock, M., Grock, A., Deloughery, T., & Mason, J. (2017). Can neutropenic fever ever be low risk? *Annals of Emergency Medicine, 69*(6), 765-767. doi:10.1016/j.annemergmed.2017.03.068

Parsad, S., & Ratain, M. (2007). Oral Chemotherapy. *British Medical Journal, 334*(7590), 376. doi:10.1136/bmj.39128.449317.BE

Pines, J. M., & Hollander, J. E. (2008). Emergency department crowding is associated with poor care for patients with severe pain. *Annals of Emergency Medicine, 51*(1), 1-5. doi:10.1016/j.annemergmed.2007.07.008

Polit, D., Beck, C. (2010). *Essentials of Nursing Research, methods, appraisal, and utilization* (7th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.

Prachanukool, T., Tangkulpanich, P., Paosaree, P., Sawanyawisuth, K., & Sitthichanbuncha, Y. (2016). Cancer patients are at high risk of mortality if presenting with sepsis at an emergency department. *Asian Pacific Journal of Cancer Prevention, 17*(7), 3423-6. doi:10.14456/apjcp.

Public Health Agency of Canada (2014). Infection prevention and control guidelines: Critical appraisal toolkit. Retrieved from http://publications.gc.ca/collections/collection_2014/aspc-phac/HP40-119-2014-eng.pdf

Richards, C., Gisondi, M., Chang, C., Courtney, D., Engel, K., Emanuel, L., & Quest, T. (2011). Palliative care symptom assessment for patients with cancer in the emergency department: Validation of the screen for palliative and end-of-life care needs in the emergency department instrument. *Journal of Palliative Medicine,14*(6), 757-64. doi:10.1089/jpm.2010.0456

Rosa, R. & Goldani, L. (2014). Cohort study of the impact of time to antibiotic administration on mortality in patients with febrile neutropenia. *Antimicrobial Agents and Chemotherapy, 58*(7), 3799. doi:10.1186/1471-2334-14-286

Ruegg, T. (2013). A nurse practitioner-led urgent care center: meeting the needs of the patient with cancer. *Clinical Journal of Oncology Nursing, 17*(4), 52-57. doi:10.1188/13.CJON.E52-E57

Ruiperez, T., Costa, C., Martinez, M., Perez, B., Lopez, D., Agea, J., . . . Diaz Agea, J. (2015). Evidence of the validity of the Emergency Severity Index for triage in a general hospital emergency department. *Emergencias, 27*(5), 301-306.

Sadik, M., Ozlem, K., Huseyin, M., Aliayberk, B., Ahmet, S., & Ozgur, O. (2014). Attributes of cancer patients admitted to the emergency department in one year. *World Journal of Emergency Medicine, 5*(2), 85-90. doi:10.5847/wjem.j.1920-8642.201

Samphao, S., Eremin, J. M., & Eremin, O. (2010). Oncological emergencies: Clinical importance and principles of management. *European Journal of Cancer Care, 19*(6), 707-713. doi:10.1111/j.1365-2354.2009.01091.x

Shelton, R. (2009). The Emergency Severity Index 5-Level Triage System. *Dimensions of Critical Care Nursing, 28*(1), 9-12. doi:10.1097/01.DCC.0000325106.28851.89

Smith, A., Lollar, J., Mendenhall, J., Brown, H., Johnson, P., & Roberts, S. (2013). Use of multiple pedagogies to promote confidence in triage decision making: a pilot study. *Journal of Emergency Nursing, 39*(6), 660-666. doi:org/10.1016/j.jen.2011.12.007

Stanfield, L. M. (2015). Clinical decision making in triage: An integrative review. *Journal of Emergency Nursing, 41*(5), 396-403. doi:10.1016/j.jen.2015.02.003

Strojnik, S., Mahkovic-Hergouth, K., Novakovic, B., & Seruga, B. (2016). Outcome of severe infections in afebrile neutropenic cancer patients. *Radiology and Oncology, 50*(4), 442-448. doi:10.1515/raon-2016-0011

Swailes, E., Rich, E., Lock, K., & Cicotte, C. (2009). From triage to the treatment of severe abdominal pain in the emergency department: evaluating the implementation of the Emergency Severity Index. *The Journal of Emergency Nursing, 35*, 485-489. doi:10.1016/j.jen.2009.05.010

Swenson, K. K., Rose, M. A., Ritz, L., Murray, C. L., & Adlis, S. A. (1995). Recognition and evaluation of oncology-related symptoms in the emergency department. *Annals of Emergency Medicine 26*, 12–17. doi:10.1016/S0196-0644(95)70231-8

Szwajcer, D., Czaykowski, P., & Turner, D. (2011). Assessment and management of febrile neutropenia in emergency departments within a regional health authority-a benchmark analysis. *Current Oncology, 18*(6), 280-294. doi:10.3747/co.v18i6.841

Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. *Journal of Clinical Oncology, 36*(14), 1443-1453. doi:10.1200/ JCO.2017.77.6211

Vandyk, A., Harrison, D., Macartney, M., Ross-White, B., & Stacey, G. (2012). Emergency department visits for symptoms experienced by oncology patients: A systematic review. *Supportive Care in Cancer, 20*(8), 1589-1599. doi:10.1007/s00520-012-1459-y

Vertesi, L. (2004). Does the Canadian Emergency Department Triage and Acuity Scale identify non-urgent patients who can be triaged away from the emergency department? *CJEM, 6*(5), 337-42.

Walji, N., Chan, A., & Peake, D. (2008). Common acute oncological emergencies: Diagnosis, investigation and management. *Postgraduate Medical Journal, 84*(994), 418-27. doi:10.1136/pgmj.2007.067033

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2014). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3), 190-198. doi:10.1177/1078155213492450

Weycker, D., Li, X., Figueredo, J., Barron, R., Tzivelekis, S., & Hagiwara, M. (2016). Risk of chemotherapy-induced febrile neutropenia in cancer patients receiving pegfilgrastim prophylaxis: Does timing of administration matter? *Supportive Care in Cancer, 24*(5), 2309-2316. doi:10.1007/s00520-015-3036-7

Wolf, L. (2010). Acuity assignation an ethnographic exploration of clinical decision making by emergency nurses at initial patient presentation. *Advanced Emergency Nursing Journal, 32*(3), 234–246. doi:10.1097/tme.0b013e3181e972ec

Co-authorship Statement

The Ph.D. student (Anas Alsharawneh), his supervisor (Dr. Joy Maddigan), and his supervisory committee (Dr. Alice Gaudine, Dr. Holly Etchegary, and Dr. Zhiwei Gao) have made a full contribution in designing the research proposal, data analysis, and manuscripts preparation of this Ph.D. dissertation.

I (Mr. Alsharawneh) contributed to defining the overall problem and proposed the scientific method to approach it. I collected the data myself from the patients' medical record, entered it into the database, verified it, analyzed it, and discussed it within the perspective of previous evidence. I wrote the entire draft version of the manuscripts and revised it according to co-authors comments.

Dr. Maddigan (my supervisor) contributed significantly to every process in conducting this research from conceptualizing the study, implementing it, and in the analysis as well. Dr. Maddigan and the other members of the supervisory committee assisted in carefully reviewing the full dissertation including the three manuscripts and continuously proposed various refinements to the different drafts. Further, Dr. Gao helped in analyzing the data and, together with the other authors, assisted in interpreting the results.

Do the Canadian Triage Guidelines Identify the Urgency of Oncological Emergencies?

Chapter Two

This chapter constitutes the first manuscript of the thesis. In this manuscript, the CTAS guidelines were examined to determine if the urgency of the oncological emergencies was identified appropriately in the guidelines. To conduct this analysis, I applied the CTAS guidelines using the 2012 complaint-oriented triage (COT) in a simulated triage of select oncological emergencies and examined if their urgency can be prioritized appropriately using the CTAS guidelines.

Abstract

Background: Triage in an emergency department (ED) plays a pivotal role as the volume of ED visitors is unpredictable. All ED patients are triaged to make sure that patients with urgent or life-threatening conditions are seen immediately while others with more stable conditions are safe to wait.

Purpose: To examine the Canadian Triage and Acuity Scale (CTAS) guidelines to determine if the urgency of oncological emergencies can be prioritized appropriately using the CTAS guidelines.

Methods: We used the Complaint Oriented Triage (COT 2012), which is an interactive computerized CTAS tool, to triage select oncological emergencies; superior vena cava syndrome, cardiac tamponade, tumor lysis syndrome, and febrile neutropenia .

Results: Patients with cancer have a higher acuity compared to many other ED patients. However, most of the oncological emergencies can be subtle and nonspecific. The CTAS guidelines need to be strengthened to better represent the urgency of these life-threatening conditions.

Conclusion: Although revisions have been implemented and the reliability of the CTAS tool has improved, the guidelines are designed to be generic and cannot address every health situation. Febrile neutropenia is an excellent example of the additional supports needed at triage to accurately determine the patient's health status. Knowledge of the signs and symptoms of these emergencies will enable triage nurses to accurately differentiate the urgency of the different presenting complaints. Formalized education that prepares triage nurses to better understand the complexity of the symptom presentation and the needed care for patients with different oncological emergencies is essential.

Cancer is a serious public health problem that remains a significant cause of mortality worldwide (Benny, 2015). In Canada, cancer is the leading cause of death and is responsible for 30% of all deaths. Prevalence of cancer is also on the rise with improved survival due to advances in treatment and targeted therapy (Canadian Cancer Statistics, 2017). However, treatment continues to be aggressive causing severe complications and contributing to the prevalence of cancer-related emergencies (Khan, Shanholtz, & Mccurdy, 2017; Iacobellis et al., 2018).

The emergency department (ED) is considered an important entry point into health care for individuals with cancer requiring urgent treatment (Oatley, Fry, & Mullen, 2016). In the ED, patients are sorted by priority in a triage process, which plays a pivotal role as the volume of ED visitors is unpredictable. All ED patients are triaged to make sure that patients with urgent or life-threatening conditions are seen immediately while others with more stable conditions are safe to wait (Bullard et al., 2017). However, the assessment and identification of seriously ill oncology patients is problematic as patients can present with non-specific symptoms, which could lead to extensive delay in ED treatment and negative health consequences (Livingston, Craike, & Considine, 2011). Findings from available studies revealed that most cancer patients suffer significant delays seeking emergency care even when they present with oncological emergencies (Oatley et al., 2016; Szwajcer, Czaykowski, & Turner, 2011).

The recognition of oncological emergencies is essential to establish the correct identification and prompt delivery of appropriate care (Iacobellis et al., 2018). It is the responsibility of the triage nurses to identify those patients correctly to ensure prompt assessment and treatment in the ED. In this paper, we have three main objectives. We first

review select oncological emergencies that are regularly treated in the ED and discuss the characteristics and outcomes of each. Febrile neutropenia (FN) is given a particular focus because it is the most common oncological emergency. Second, we conduct a critical evaluation of the effectiveness of the Canadian Emergency Department Triage and Acuity Scale (CTAS) in identifying the urgency of common oncological emergencies. Finally, we provide some recommendations for refining the CTAS guidelines and evidence-based strategies which, if implemented, would improve the ED care of oncological emergencies.

Methods

We used the Complaint Oriented Triage (COT 2012) - (English Canada Version 02.02) to triage select oncological emergencies. The COT is an interactive computerized tool used in Canadian EDs to triage patients. This tool is based on the 2012 version of the Canadian Triage and Acuity Scale (CTAS 2012), Pediatric CTAS (Ped-CTAS 2012), and the Canadian Emergency Department Information System (CEDIS 2012) Chief Complaint list v2.0. It was established by the CTAS National Working Group and the Canadian Association of Emergency Physicians, by integrating the national CEDIS presenting complaint list with the CTAS modifiers. The COT Power point application can be freely downloaded from the Canadian Association of Emergency Physicians website. The first author evaluated the process of ED triage using the common manifestations of each oncological emergency. The purpose was to examine if these emergencies can be prioritized appropriately using the CTAS guidelines.

This COT tool is intuitive and can guide the triage decision through the triage assessment until the appropriate triage score is assigned to the patient. Triage assessment using this tool starts with age selection as the nurse can select between adult CTAS

(CTAS 2012) or pediatric CTAS (Ped-CTAS 2012). In the 2nd step, the nurse selects the chief complaint as described by the patient (Figure 1).

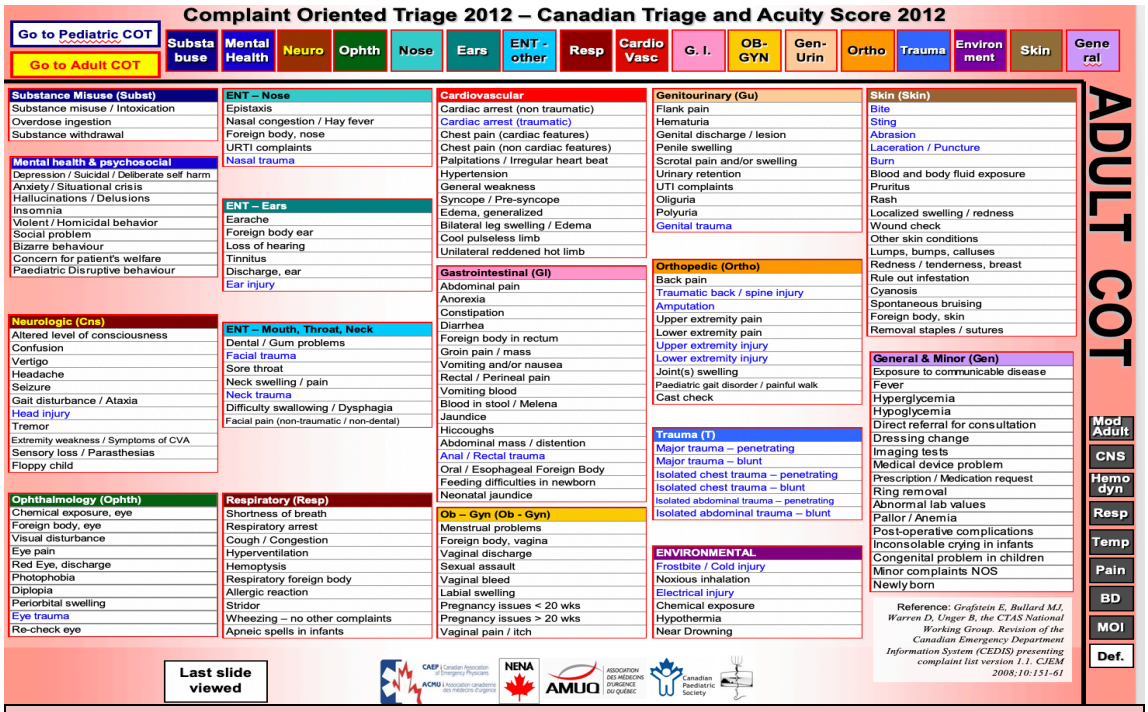

Figure 1. Chief Complaint Selection

Note. Screenshot from the COT application. The application can be freely downloaded from the Canadian Association of Emergency Physicians website at http://www.caep.ca/template.asp?id=B7951640823742 89BBD9C1C2BF4B8D32.

For the demonstration, a triage nurse considered a patient with cancer who presented with fever. If a nurse selects “Fever” from the “General & Minor” icon or the temperature icon from the sidebar, the tool will transfer the nurse to a different screen as seen in Figure 2 and 3; respectively. From these screens, the nurse can see that patients who are immunocompromised with neutropenia (or suspected) are supposed to receive a triage score of 2 without the need for any further assessment. The guidelines define immunocompromised status as those with neutropenia (or suspected neutropenia) or on chemotherapy or immunosuppressive drugs including steroids (Bullard et al., 2017).

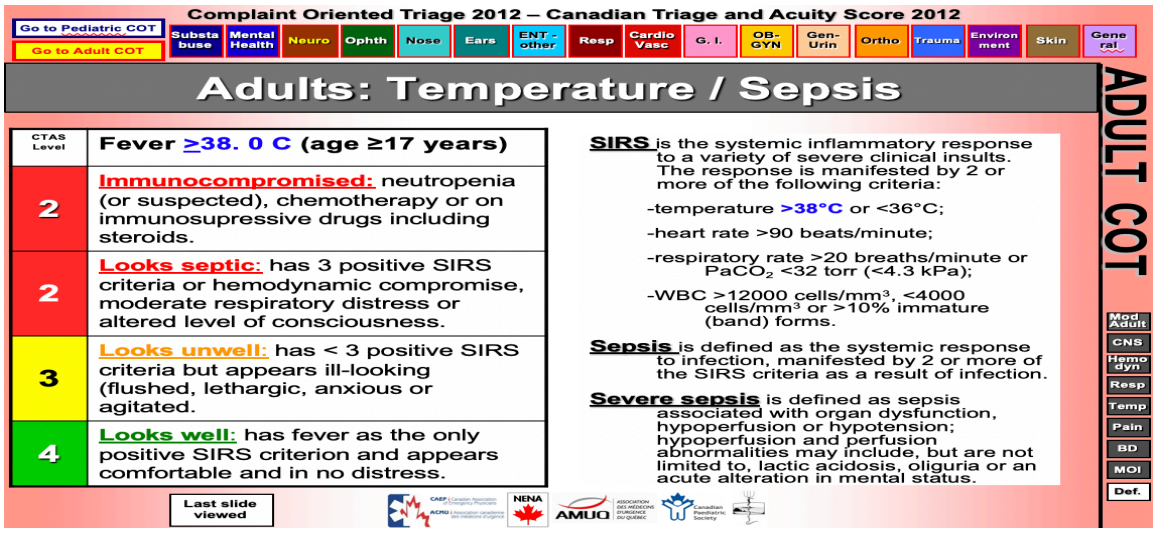

Figure 2. Triage of Fever

Note. Screenshot from the COT application. The application can be freely downloaded from the Canadian Association of Emergency Physicians website at http://www.caep.ca/template.asp?id=B7951640823742 89BBD9C1C2BF4B8D32.

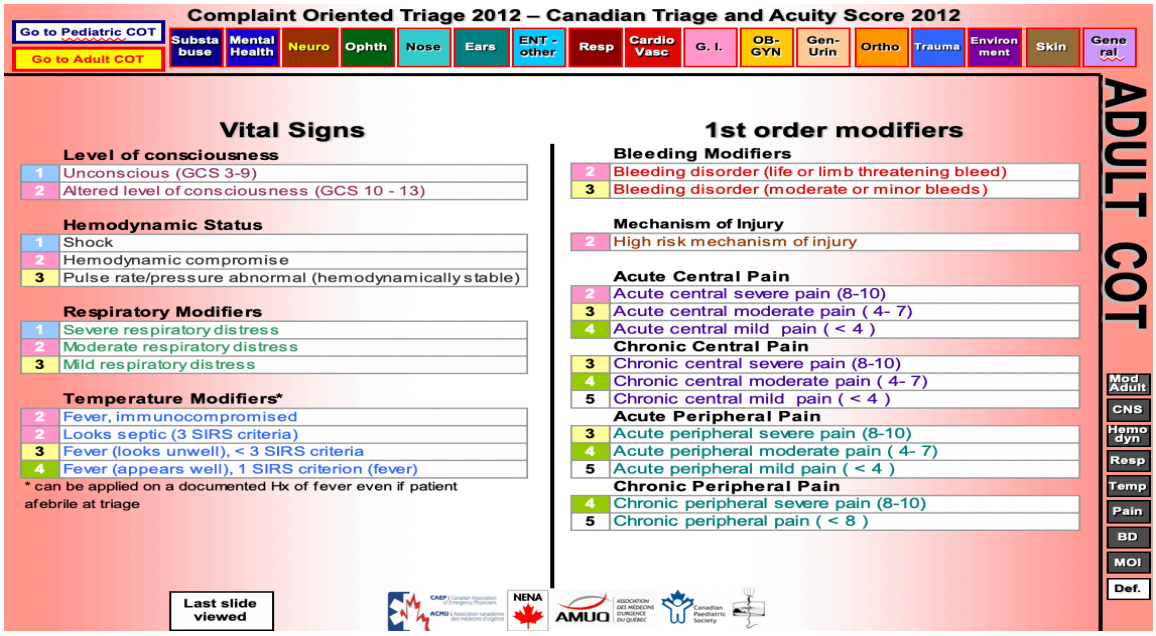

Figure 3. First Order Modifiers

Note. Screenshot from the COT application. The application can be freely downloaded from the Canadian Association of Emergency Physicians website at http://www.caep.ca/template.asp?id=B7951640823742 89BBD9C1C2BF4B8D32.

Furthermore, the COT system guides the triage nurse to assign a triage score of 2 to any immunocompromised patient regardless of their chief complaint, if this patient has a temperature at the time of triage. Complaints such as chest pain, hypertension, general

weakness, leg swelling, facial trauma, sore throat, facial pain, and even a complaint such as anorexia are considered as potentially indicative of sepsis (a complication of FN) if the patient has an increased temperature at triage (Figure 4). Similarly, we have applied the 2012 COT in the triage of remaining oncological complaints and emergencies. In this article, however, we only report on four of the most life-threatening oncological emergencies including superior vena cava syndrome (SVCS), cardiac tamponade, tumor lysis syndrome (TLS), and febrile neutropenia (FN).

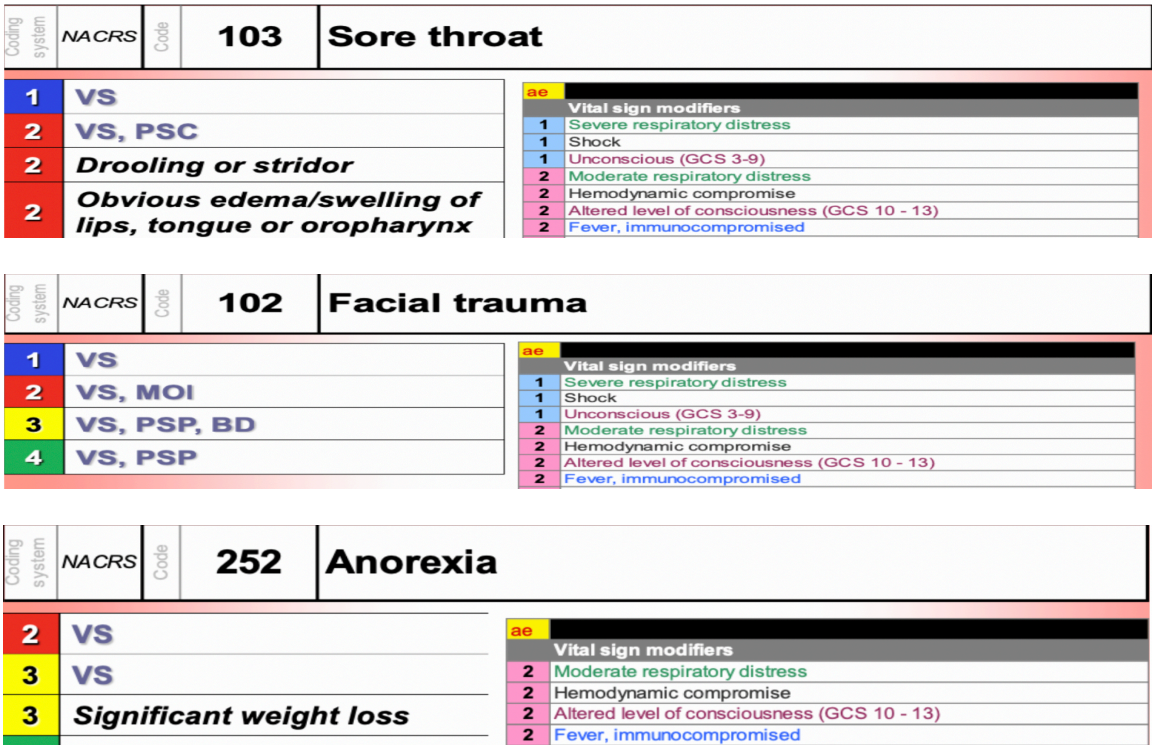

Figure 4. Other Chief Complaints

Note. Screenshot from the COT application. The application can be freely downloaded from the Canadian Association of Emergency Physicians website at http://www.caep.ca/template.asp?id=B7951640823742 89BBD9C1C2BF4B8D32.

The Urgency of the Oncological Complaints

Although cancer is a chronic disease, patients with cancer can still experience acute emergencies, and therefore, be referred to the ED (Bosscher, Leeuwen, & Hoekstra,

2015; Brown et al., 2016; Sadik et al., 2014). The frequency of ED use among patients with cancer is considered high with many patients visiting the ED during chemotherapy treatment (Gorham et al., 2013; Oatley et al., 2016). Despite the frequency of visits, individuals with cancer represent a small minority when compared to the total number of emergency visitors. In a study on the characteristics of ED visits by patients with cancer, the number of visits by individuals with cancer ranged between two and six percent of all ED visits (Hsu et al., 2018). This small percentage of patients likely represents a challenge for triage nurses. In addition to the infrequency of presentation at the ED, individuals with cancer suffer from a wide variety of cancer diseases. This results in a broad range of disease-specific complications that adds to the challenge of accurately identifying severe health concerns.

Other factors may also add to the complexity of effective triage of oncological emergencies. For example, cancer is dominant among the elderly population who are often affected by multiple comorbidities (Barnett et al., 2012). This may cloud the origin of the presenting problem. As well, ED visits were found to be more frequent among terminally ill cancer patients. Researchers of a study in Canada identified that individuals with cancer made the majority of ED visits in the last six months of life, with 83% visiting the ED within the last two weeks before death (Elsayem, Elzubeir, Brock, & Todd, 2016). Gorham and colleagues (2013) reported that patients with advanced and metastatic cancer comprised 95% of all cancer visits. It is possible, therefore, that some patients with cancer are misidentified by associating their ED visit with the need for palliative or hospice care. Acute complications are attributed to the dying process and do not get addressed appropriately (Tang et al., 2009). However, the findings of other studies

support that these presentations were true emergencies and were associated with severe complications (Delgado-Guay et al., 2015).

Patel and colleagues (2015) explored the outcomes of telephone triage services designed to help individuals living with cancer manage their symptoms. Results indicated that 62% of individuals who made a call were referred to the ED. The urgency of oncological complaints is high; in one study, more than two-thirds of patients with these complaints reported to the ED (McKenzie et al., 2011). This is to be expected considering that patients usually require more ED resources such as radiologic imaging, invasive procedures, and medication administration (Hsu et al., 2018).

The burden and consequences of these oncological complaints are also significant, resulting in considerable morbidities and mortality (Considine, Livingston, Bucknall, & Botti, 2009). Patients with cancer have a higher admission rate than that of the general ED population (Brown et al., 2016). Multiple studies reported an admission rate range of 60 - 90% in patients with oncology-related ED visits compared to an admission rate range in the other adult ED patients of 13 - 46% (Bryant et al., 2015; Brown et al., 2016; Elsayem et al., 2016; Oatley et al., 2016). Cancer-related complaints were ten times more likely to result in admission compared to other ED patients (Meer et al., 2016). Cancer-related admission accounts for 14% of total admissions from the ED (Fortun et al., 2004).

As well, individuals with cancer have high readmission rates to the hospital which is indicative of the gap between needed versus provided care. Results from the Canadian Institute for Health Information (CIHI) indicated that oncological complaints were one of the top five conditions for readmission rate (CIHI, 2012). A study of patients with head and neck cancer reported 22% of patients were readmitted two to three times (Tang,

Cheng, Huang, Chang, & Chen, 2015). Patients with cancer can also experience a longer length of stay in the ED and hospital (five hours and nine days, respectively) (Hsu et al., 2018). This is expected as oncological complaints have a higher level of acuity, which requires more intervention resulting in longer management time and length of stay in the ED and hospital (Meer et al., 2016). On average, patients stay in the hospital for nine days with 58% of the admissions staying more than one week.

Furthermore, ED patients with oncological complaints are at higher risk for death than other ED patients. On average, between 10 - 12% of patients with cancer-related presentations die in the ED (Kotlinska-Lemieszek & Wyrwinska, 2014; Tang et al., 2015). Results from a systematic review showed higher mortality rates (13 - 20%) among ED patients with oncological presentations (Vandyk et al., 2012). However, a lower mortality rate (1%) is noted in the general ED population (Dent, Rofe, & Sansom, 1999; Doherty, 2003). Emergency visits were also described as a predictor of poor survival among patients with cancer (Oatley et al., 2016). For instance, the one-year overall survival of all patients with cancer visiting ED was 7.3 months (Sadik et al., 2014). Other studies reported poorer survival rates in which half of the cancer patients passed away within three months of their visit to the ED (Bryant et al., 2015). Minami and colleagues (2013) documented much worse survival time with a median interval from ED visit to death of 49 days.

The Nature of Oncological Complaints

In the previous discussion, the high acuity experienced by individuals with cancer who seek emergency care was established. Most of these patients were admitted, experienced an extended LOS, and had increased mortality. However, by examining the

presenting complaints of those patients, it was found that they appeared simple with typical signs and symptoms such as pain, nausea and vomiting, weakness, dyspnea, and fever (Kao, Liu, Koo, & Chiang, 2018).

The urgency of oncological complaints cannot be understood without examining the nature of the serious underlying problems causing these simple complaints. Although many presented with simple complaints, the underlying pathology was severe and resulted in a difficult-to-detect oncological emergency. Oncologic emergencies are described as complications of cancer or its treatment that become life-threatening or may lead to an irreversible disability (Samphao, Eremin, & Eremin, 2010). Oncological emergencies can be caused by the local effects of the primary tumor, metastasis to other organs, and complications from chemotherapy or other cancer treatment (Iacobellis et al., 2018). Some oncologic emergencies are insidious; whereas, others manifest swiftly, causing devastating outcomes such as paralysis and death (Sadik et al., 2014). Therefore, in the next section, we review select oncological emergencies and examine the challenges of accurate triage decisions and the timely delivery of emergency care.

Emergency Triage of Oncological Emergencies

Oncological emergencies are known to be emergent and need to be identified expeditiously to allow for prompt treatment to minimize morbidity and mortality (Khan et al., 2017; Pi et al., 2016). Unfortunately, patients experiencing oncological emergencies are found to have longer-than-safe ED wait times even though they were suffering from severe conditions (Nirenberg, Mulhearn, Lin, & Larson, 2004; Oatley et al., 2016; Szwajcer et al., 2011). Still, EDs are designed to provide emergency care according to the clinical urgency of the health problem. For example, individuals with severe and life-

threatening conditions are supposed to be assessed and treated first (Considine et al., 2009). To achieve this objective, different triage systems were introduced worldwide to ensure the correct identification of patients' health status, and therefore, provide care and treatment promptly.

In Canada, the Canadian Triage and Acuity Scale (CTAS) guidelines are used to standardize triage decisions, making decisions more objective and justified (Bullard et al., 2017). On arrival to the ED, the triage nurse uses the CTAS guidelines to categorize the patient's health acuity into one of five categories. CTAS categories represent the level of urgency of the patient's presenting health condition. Clinical decisions as to the appropriate CTAS category are based on how urgently the patient needs to be seen by the ED physician. Categories are determined by the time in minutes that an individual can safely wait before medical intervention. The five CTAS categories are: 1) resuscitation (immediate lifesaving treatment by both nurse and physician), 2) emergent (up to 15 minutes to be seen by a physician), 3) urgent (between 15 and 30 minutes), 4) less-urgent (60 minutes), and 5) non-urgent (more than 120 minutes) (Beveridge et al., 1998).

In this section, we will review the CTAS guidelines and evaluate if select oncological emergencies were appropriately identified in the guidelines. It is essential to examine whether such documented delayed emergency care could be attributed to an inherent limitation within the triage guidelines.

Superior vena cava syndrome (SVCS). Many chemotherapeutic agents can cause cardiotoxicity and increase the risk for one of the cardiovascular oncological emergencies including SVCS and cardiac tamponade (Adelberg & Bishop, 2009). SVCS occurs when the venous circulation through the superior vena cava is obstructed. Tumor

expansion can compress the superior vena cava externally with metastasis (Kehoe, 2007). It is estimated that over 90% of cases of SVCS are attributed to malignancy (Wilson, Detterbeck, & Yahalom, 2007). Signs and symptoms of SVCS include dyspnea, non-productive cough, hoarseness, dysphagia, facial swelling, visual disturbances, headache, and altered level of consciousness (Wilson et al., 2007). SVCS is an emergency requiring immediate treatment, but detection is difficult (McCurdy & Shanholtz, 2012). Because it develops gradually, SVCS is unlikely to present as a life-threatening condition (Samphao et al., 2010). Consequently, patients who present with no clear manifestations or present with non-severe manifestation such as cough, hoarseness, dysphagia, facial swelling, and visual disturbances may be triaged to the lower acuity level of '4' or '5'. Under CTAS, patients with SVCS would only be triaged to the higher acuity level of '1' or '2' if they presented with severe symptoms such as altered level of consciousness.

Cardiac tamponade. This life-threatening emergency is the result of pericardial effusion, which affects 20-34% of patients with cancer (Khan et al., 2017; McCurdy & Shanholtz, 2012). Excess fluid accumulates in the pericardial space, resulting in increased intrapericardial pressure. The pressure can compress the heart and decrease cardiac output, resulting in tamponade (Kehoe, 2007; Khan et al., 2017). Dyspnea is the presenting symptom for 80% of patients. Pulsus paradoxus (a decrease in blood pressure during inspiration) is another common sign that occurs in 30% of individuals with oncological pericardial effusion and 77% of those with acute tamponade (McCurdy & Shanholtz, 2012). Other symptoms can include chest pain, tachypnea, orthopnea, tachycardia, distended neck veins, dizziness, fatigue, and diaphoresis (Gabriel, 2012; Kehoe, 2007). Cardiac tamponade requires timely recognition to prevent rapid fatal

deterioration. The cardiac shock associated with tamponade is treated differently than traditional shocks as fluid resuscitation can be potentially detrimental, and patients usually require bedside emergency pericardiocentesis (McCurdy & Shanholtz, 2012). Cardiac tamponade patients present with complaints of cardiac decompensation and according to the CTAS guidelines, these patients should be triaged to an acuity level of '2'. However, the gradual and chronic accumulation of fluids makes it unlikely to present with a life-threatening condition as the body adapts to these incremental changes. This makes cancer-related cardiac tamponade more severe as the patient can collapse quickly due to cardiogenic shock. Therefore, triage nurses must have prior knowledge and be critical in their examination of all cancer patients with cardiac manifestations to ensure the appropriate triage of this life-threatening oncological emergency.

Tumor lysis syndrome (TLS). TLS is another vague oncological emergency. TLS can present insidiously but can be associated with significant morbidities and mortality if not recognized early and treated appropriately (Howard, Jones, & Pui, 2011; Muslimani et al., 2011). TLS is a metabolic emergency resulting from lysis of tumor cells leading to the release of tumor cellular contents into the systemic circulation (Cairo, Coiffier, Reiter, & Younes, 2010). The kidneys cannot compensate for the large volume of toxins that need to be filtered from the body (Kehoe, 2007). The subsequent metabolic abnormalities include hyperkalemia, hyperphosphatemia, hypocalcemia, hyperuricemia, and acute kidney injury. These metabolic abnormalities can lead to life-threatening manifestations such as cardiac dysrhythmias and neurologic complications (Namendys-Silva et al., 2015).

TLS can occur spontaneously but is usually associated with the induction of chemotherapy or radiotherapy (Pi et al., 2016). However, all types of cancer treatment can cause TLS (Davidson et al., 2004). The clinical manifestations can include vague signs and symptoms such as diarrhea, lethargy, muscle cramps, nausea and vomiting, weakness, and oliguria (Kehoe, 2007). Diagnosis is dependent on the laboratory values including a complete blood cell count and a metabolic panel of liver and kidneys (Lyman, Abella, & Pettengell, 2014). Emergency management includes measures to reduce the risk of renal impairment and treatment of metabolic abnormalities with fluid resuscitation to increase excretion of the extra metabolites (Cairo et al., 2010; Coiffier, Altman, Pui, Younes, & Cairo, 2008).

Tumor lysis syndrome can be hard to triage appropriately and a patient can receive less priority according to the CTAS guidelines. Patients can earn a higher triage acuity score if they present with fatal cardiac arrhythmias, but early detection at triage is unlikely because an ECG is required, and this is not usually performed during triage assessment. Delayed identification can have severe, life-threatening complications with significant morbidities and mortality as previous reports support (Howard et al., 2011; Muslimani et al., 2011).

Febrile Neutropenia (FN). Bone marrow suppression is an expected side effect for many of the chemotherapeutic regimens, and specifically, neutropenia is the most profound clinical consequence. All chemotherapeutic drugs have a cytotoxic effect and are capable of inducing neutropenia to various degrees (Adelberg & Bishop, 2009). Fever and infection secondary to neutropenia are the most severe, life-threatening complications of cancer treatment and are a significant cause of hospitalization and death (Bryant et al.,

2015; Kuderer, Dale, Crawford, Cosler, & Lyman, 2006). Patients with cancer are four times more likely to present with severe sepsis from neutropenia compared with non-cancer patients (2.1% vs. 0.5%) (Hsu et al., 2018). Cancer patients have double the risk of mortality if presenting with sepsis at the ED as they may be experiencing a subtle but severe underlying infection (Prachanukool, Tangkulpanich, Paosaree, Sawanyawisuth, & Sitthichanbuncha, 2016).

Fever is one of the most common reasons for ED visits among patients with cancer (Vandyk et al., 2012). Fever may be the only presentation for FN, but many patients are afebrile (Freifeld et al., 2011). Fever as a cancer-related ED presentation is likely to be associated with neutropenia (45%), sepsis (26%), and pneumonia (14%). Reports of ED care of patients with fever demonstrated the urgency of this complaint as more than 83% of patients with fever were admitted to the hospital (Sadik et al., 2014; Vandyk et al., 2012). Emergency admissions of cancer patients were found to be significantly associated with the complaint of fever (Tanaka et al., 2017). Not all neutropenic patients will present with a fever, nor does all fever indicate febrile neutropenia (FN). However, all cancer patients presenting to ED should be queried for FN until ruled out with proper examination (Adelberg & Bishop, 2009).

The risk of FN with chemotherapy is about 17%, and the risk rises with repeated chemotherapy cycles (Oatley et al., 2016; Weycker, Barron, Kartashov, Legg, & Lyman, 2014). Others reported a higher rate of FN occurring in half of the patients receiving chemotherapy (Hashiguchi et al., 2015). FN may result in significant clinical implications such as delaying and discontinuing chemotherapy and is associated with considerable morbidity, mortality, and costs (Lyman et al., 2014). One study documented the burden of

hospitalized FN in relation to hospital mortality (14%), length of stay (13 days), and costs ($22,800) (Kuderer et al., 2006). FN is the cause of death in 4% to 30% of patients with cancer (Talcott, Finberg, Mayer, & Goldman, 1998). Empiric antibiotics should be initiated promptly as delayed initiation of antibiotics can be associated with increased mortality due to rapid progression to septicemia (Adelberg & Bishop, 2009; Lim et al., 2011; Livingston, Craike, & Slavin, 2012; Meer et al., 2016).

The CTAS guidelines do identify the urgency of FN but only if the patient has a high fever at triage. The guidelines recommend the assignment of a triage rating of '2' if the patient has a fever and is immunocompromised or is receiving chemotherapy treatment (Beveridge et al., 1998). Moreover, fever in FN is defined as "a low neutrophil count of 1.5 × 109 /L and single oral temperature measurement of > 38.3°C or a temperature of > 38.0°C sustained over one-hour period" (Freifeld et al., 2011, p. e61). Nirenberg et al. (2004) found that the majority of FN patients experienced fever for a mean time of 21 hours before seeking emergency care. However, patients may not have a fever when presenting at triage which renders them to be assigned to a less urgent triage category.

In reviewing studies examining triage implementation among patients with oncological emergencies, findings confirmed that this patient population was more likely to be assigned a lower acuity triage score. For example, an Australian ED study of newly diagnosed patients with cancer receiving chemotherapy showed that 79% of patients were assigned an acuity rating that was lower than recommended by the Australian Triage Scale guidelines (Livingston et al., 2011). Similarly, a Canadian study of patients with emergency-related oncological complaints demonstrated that two-thirds of patients were

assigned to lower triage acuity ratings (less urgent) (Barbera et al., 2012). Furthermore, cancer patients and their families perceived that their oncological presentations were not given accurate ratings at triage (Ekwall, Gerdtz, & Manias, 2008). These perceptions were accurate as patients have been inappropriately delayed in receiving needed care (Nirenberg et al., 2004; Oatley et al., 2016; Szwajcer et al., 2011).

The standard of care is to treat FN as an oncologic emergency; patients are expected to be seen right away to commence prompt delivery of the necessary treatment (Lim et al., 2011). Although fever is an essential sign of infection, lack of fever does not necessarily exclude it (Adelberg & Bishop, 2009). The FN clinical guidelines recommend that afebrile neutropenic patients who have new signs or symptoms suggestive of infection to be evaluated and treated as high-risk patients (Freifeld et al., 2011). Furthermore, the presence of fever does not guarantee proper triage. For instance, an Australian study of 200 neutropenic episodes illustrated that 1/3 of patients were inappropriately assigned to the less urgent triage category to be seen in a time that is far longer than what is considered clinically appropriate (Livingston et al., 2012). A study of ED oncological complaints reported that the deceased group of patients were more likely to have been triaged to less urgent categories where they witnessed longer wait times and ED length of stay (Livingston et al., 2012). For patients with FN, timely care is very important as the time to initiation of effective antimicrobial therapy is the most reliable predictor of outcome among patients with early signs of sepsis, with around 8% drop in their survival for every hour of delay (Kumar et al., 2006). The CTAS guidelines allow for prompt treatment of patients with fever. The recommendations are to allocate those patients into the second acuity triage rating, enabling them to be seen by a physician

within 15 minutes. However, not all FN patients have a fever at triage, meaning a lower rating is allocated; patients often experience significant delays. Furthermore, the implementation of the CTAS seems inappropriate in most of the occasions where two-thirds of patients with FN who had a fever at triage were allocated to a lower than appropriate triage acuity rating.

Discussion

The ED remains an accessible place to receive timely treatment with the availability of multiple and comprehensive laboratory and radiological examinations and a provision of coordinated and multidisciplinary care that is adequate for the complex conditions of those patients (Numico et al., 2015). However, with large volumes of patients and periodic overcrowding, the accuracy of ED triage becomes more critical as inaccurate triage can result in longer delays (Bryant et al., 2015). Timely treatment of oncology patients in the ED can dramatically enhance their quality of life and improve their survival (Mofid, Novin, Roointan, & Forouzanfar, 2016). ED health professionals, and especially triage nurses as the gatekeepers of emergency care, should have a strong knowledge base regarding oncological emergencies and be thorough in their examination of patients with these conditions (Samphao et al., 2010). Oncologic emergencies may be insidious and may have rapidly deleterious effects (Wagner & Arora, 2017). Knowledge of the signs and symptoms of these emergencies will enable triage nurses to accurately differentiate the urgency of the different presenting complaints (Diaz-Couselo et al., 2004). Education that prepares triage nurses to better understand the complexity of the symptom presentation and the needed care for patients with different oncological emergencies is essential (Grol et al., 2013). There is strong evidence that adequate

knowledge is the most crucial element in making accurate triage decisions (Considine, Botti, & Thomas, 2007; Smith et al., 2013). Knowledgeable health providers, in partnership with patients and families who are well-informed about the risks and complications of oncological emergencies, can ensure the best care possible.

The review of the CTAS guidelines has identified some limitations concerning clear guidance for triage nurses. Although revisions have been implemented and the reliability of the CTAS tool has improved, the guidelines are designed to be generic and cannot address every health situation (Bullard et al., 2008). Febrile neutropenia is an excellent example of the additional supports needed at triage to accurately determine the patient's health status. The FN clinical guidelines, for example, identify afebrile neutropenic patients as high-risk (Freifeld et al., 2011), demonstrated by a significantly higher 30-day in-hospital mortality (Strojnik et al., 2016). Accordingly, the CTAS guidelines must be updated to reflect such up-to-date evidence. Point of care testing at triage can enable the early recognition of neutropenia and prevent any inappropriate delay among afebrile neutropenia patients.

Also, triage nurses need to be well informed about and convinced by the scientific evidence in order to follow the guidelines more closely (Grol et al., 2013). Some studies highlighted discrepancies in triaging cancer patients even when they present with FN (Howlett and Atkinson, 2012; Nirenberg et al., 2004; Oatley et al., 2015; Szwajcer et al., 2011). A similar discrepancy was evident among acute myocardial infarction patients (Atzema et al., 2009). Education strategies should address the need to objectify the triage process and to promote skill and ease in those using the guidelines. This

specific recommendation was made by the establishers of the CTAS guidelines, that is, to properly use and implement the CTAS guidelines in order to make an accurate assignment of triage levels (Bullard et al., 2008). Such a desire for objectivity in triaging patients has led to the development of a computerized version of emergency triage (e-CTAS) (Dong et al., 2006). However, we used a similar version to this e-CTAS using the 2012 complaint-oriented triage (COT), but we failed to prioritize the urgency of these oncological emergencies using this tool.

Other strategies to improve recognition of oncological emergencies were also found helpful such as the implementation of fever alert cards (FACs). Kapil et al. (2016) evaluated FACs as a communication tool to decrease TTA in patients with FN who present to the ED. The implementation of FACs helped in improving FN recognition with a higher percentage of patients obtaining a correct CTAS score. This can be combined with clinical protocols and pathways to fast-track patients with certain conditions. For example, the Febrile Neutropenia Pathway (FNP) was introduced to one ED and was found helpful in reducing time to antibiotics by almost two thirds (Keng et al., 2015). However, we could not allocate similar strategies to improve recognition or timely treatment in the ED for other oncological emergencies described earlier. Finally, EDs should follow the CTAS guidelines recommendations in monitoring the time objectives set by the guidelines and tailor their resources to meet these benchmarks (Bullard et al., 2008). Routine system monitoring and benchmark analysis of wait times for patients in different categories can be considered necessary. However, studies with such main objective are of rarity or can be underreported.

Conclusion

In this paper, we reviewed the underlying reasons for patients with cancer to seek emergency care. We demonstrated that these ED presentations and subsequent hospitalizations are a necessary service for individuals with cancer and are not avoidable. Patients with cancer have a higher acuity compared to many other ED patients and they experience high rates of hospital admission and increased risk of death. However, most cancer patients suffer significant delays when seeking emergency care even when they presented with oncological emergencies. Many of these emergencies have time-sensitive interventions, making it crucial to establish the correct identification at triage to enable the prompt delivery of appropriate care. Because many of these complaints can be subtle and nonspecific accurate identification often takes time. This poses risk to those experiencing oncological emergencies and suggests that the CTAS guidelines need to be strengthened to better represent the urgency of these life-threatening conditions.

Based on our review, we suggested a couple of refinements to the guidelines to increase their sensitivity in detecting oncological emergencies. Also, strategies were identified to improve compliance in using the guidelines. We emphasized the role played by education to prepare the patients, families, and the triage nurses to better understand the complexity of oncological emergencies, their signs and symptoms, and the needed emergency care. Finally, routine system monitoring and benchmarks analysis were highlighted as one approach to meet the time objectives set by the guidelines.

References

Adelberg, D., & Bishop, M. (2009). Emergencies related to cancer chemotherapy and hematopoietic stem cell transplantation. *Emergency Medicine Clinics of North America, 27*(2), 311-331. doi:10.1016/j.emc.2009.01.005

Atzema, C. L., Austin, P. C., Tu, J. V., & Schull, M. J. (2009). Emergency department triage of acute myocardial infarction patients and the effect on outcomes. *Annals of Emergency Medicine, 53*(6), 736-745.

Barbera, L., Atzema, C., Sutradhar, R., Seow, H., . . . Dudgeon, D. (2012). Do patient reported symptoms predict emergency department visits in cancer patients? A population-based analysis. *Annals of Emergency Medicine, 61*(4), 427-437. doi:10.1016/j.annemergmed.2012.10.010

Barnett, K., Mercer, S., Norbury, M., Watt, G., . . . Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: A cross-sectional study. *The Lancet, 380* (9836), 37-43. doi:10.1016/S0140-6736(12)60240-2

Benny, P. (2015). Global trends in cancer: developing countries need more focus. *International Journal of Preventive and Therapeutic Medicine, 3* (2), 32-33.

Beveridge, R., Janes, L., Savage, N., Thompson, J., Murray, M., Nijssen, C. (1998). Implementation guidelines for the Canadian Emergency Department Triage & Acuity Scale (CTAS). Retrieved from http://caep.ca/sites/caep.ca/files/caep/files/ctased16.pdf

Bosscher, M., Leeuwen, R., & Hoekstra, F. (2015). Mortality in Emergency Surgical Oncology. *Annals of Surgical Oncology, 22*(5), 1577-1584. doi:10.1245/s10434-014-4180-x

Brown, J., Grudzen, C., Kyriacou, D., Obermeyer, Z., Quest, T., Rivera, D., . . . & Shelburne, N. (2016). The emergency care of patients with cancer: setting the research agenda. *Annals of Emergency Medicine, 68*(6), 706-711. doi:10.1016/j.annemergmed.2016.01.021

Bryant, A., Deal, A., Walton, A., Wood, W., Muss, H., & Mayer, D. (2015). Use of ED and hospital services for patients with acute leukemia after induction therapy: One-year follow-up. *Leukemia Research, 39*(4), 406-410. doi:10.1016/j.leukres.2015.01.006

Bullard, M., Musgrave, E., Warren, D., Unger, B., Skeldon, T., Grierson, R., . . . Swain, J. (2017). Revisions to the Canadian emergency department Triage and Acuity Scale (CTAS) guidelines 2016. *CJEM, 19*(S2), S18-S27.

Cairo, M., Coiffier, B., Reiter, A., & Younes, A. (2010). Recommendations for the evaluation of risk and prophylaxis of tumour lysis syndrome (TLS) in adults and children with malignant diseases: An expert TLS panel consensus. *British Journal of Haematology, 149*(4), 578-586. doi:10.1111/j.1365-2141.2010.08143.x

Canadian Cancer Society, publisher, & Statistics Canada, sponsoring body. (2017). *Canadian cancer statistics 2013: Special topic: Pancreatic cancer* (Canadian cancer statistics; 2017).

Canadian Electronic Library, & Canadian Institute for Health Information. (2012). *All-cause readmission to acute care and return to the emergency department* (DesLibris. Documents collection). Ottawa Ont.: Canadian Institute for Health Information.

Coiffier, B., Altman, A., Pui, C., Younes, A., & Cairo, M. (2008). Guidelines for the management of pediatric and adult tumor lysis syndrome: An evidence-based review. *Journal of Clinical Oncology, 26*(16), 2767-2778. doi:10.1200/JCO.2007.15.0177

Considine, J., Botti, M., & Thomas, S. (2007). Do knowledge and experience have specific roles in triage decision-making? *Academic Emergency Medicine, 14*, 722-726. doi:10.1197/j.aem.2007.04.015

Considine, J., Livingston, P., Bucknall, T., & Botti, M. (2009). A review of the role of emergency nurses in management of chemotherapy-related complications. *Journal of Clinical Nursing, 18*(18), 2649-2655. doi:10.1111/j.1365-2702.2009.02843.x

Davidson, M., Thakkar, S., Hix, Bhandarkar, N., Wong, A., & Schreiber, M. (2004). Pathophysiology, clinical consequences, and treatment of tumor lysis syndrome. *The American Journal of Medicine, 116*(8), 546-554. doi:10.1016/j.amjmed.2003.09.045

Delgado-Guay, M., Kim, Y., Shin, S., Chisholm, G., . . . Bruera, E. (2015). Avoidable and unavoidable visits to the emergency department among patients with advanced cancer receiving outpatient palliative care. *Journal of Pain and Symptom Management, 49*(3), 497-504. doi:10.1016/j.jpainsymman.2014.07.007

Dent, A., Rofe, G., & Sansom, G. (1999). Which triage category patients die in hospital after being admitted through emergency departments? A study in one teaching hospital. *Emergency Medicine 11*(2), 68–71. doi:10.1046/j.1442-2026.1999.00016.x

Diaz-Couselo, F., O'Connor, J., Nervo, A., Tossen, G., . . . Zylberman, V. (2004). Non-scheduled consultation in oncologic patients. How many of them are true emergencies? *Supportive Care in Cancer, 12*(4), 274-7. doi:10.1007/s00520-003-0584-z

Doherty, S. (2003). Inpatient mortality as related to triage category in three New South Wales regional base hospitals. *Emergency Medicine 15*(4), 334–340. doi:10.1046/j.1442-2026.2003.00471.x

Dong, S., Bullard, M., Meurer, D., Blitz, S., . . . Rowe, B. (2006). Reliability of computerized emergency triage. *Academic Emergency Medicine, 13*, 269-275. doi:10.1197/ j.aem.2005.10.014

Ekwall, A., Gerdtz, M., & Manias, E. (2008). The influence of patient acuity on satisfaction with emergency care: perspectives of family, friends, and carers. *Journal of Clinical Nursing, 17*, 800–809. doi:10.1111/j.1365-2702.2007.02052.x

Elsayem, A., Elzubeir, H., Brock, P., & Todd, K. (2016). Integrating palliative care in oncologic emergency departments: challenges and opportunities. *World Journal of Clinical Oncology, 7*(2), 227-33. doi:10.5306/wjco.v7.i2.227

Flowers, C., Seidenfeld, J., Bow, E., Karten, C., Gleason, C., . . . Ramsey, S. (2013). Antimicrobial prophylaxis and outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology clinical practice guideline. *Journal of Clinical Oncology, 31*(6), 794-810. doi:10.1200/JCO.2012.45.8661

Fortun, M., Encina, Y., Etxebarria, M., Escudero, J., Bardon, A., & Martinez, S. (2004). The oncology patient in emergencies. Epidemiological data. *Anales Del Sistema Sanitario De Navarra, 27* (3), 9-16.

Freifeld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., Mullen, C., . . . Wingard, J. (2011). Executive Summary: Clinical Practice Guideline for the Use of Antimicrobial Agents in Neutropenic Patients with Cancer: 2010 Update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 52*(4), 427

Gabriel, J. (2012). Acute oncological emergencies. *Nursing Standard, 27*(4), 35-41.

Gorham, J., Ameye, L., Berghmans, T., Sculier, J., & Meert, A. (2013). The lung cancer patient at the emergency department: A three-year retrospective study. *Lung Cancer, 80*(2), 203-208. doi:10.1016/j.lungcan.2012.12.006

Grol, Richard, et al., eds. (2013). *Improving patient care: the implementation of change in healthcare*. John Wiley & Sons.

Hashiguchi, Y., Kasai, M., Fukuda, T., Ichimura, T., . . . Sumi, T. (2015). Chemotherapy induced neutropenia and febrile neutropenia in patients with gynecologic malignancy. *Anti-Cancer Drugs, 26*(10), 1054-1060. doi:10.1097/CAD.0000000000000279

Howard, S., Jones, D., & Pui, C. (2011). The Tumor Lysis Syndrome. *The New England Journal of Medicine, 364*(19), 1844-1854. doi:10.1056/NEJMra0904569

Howlett, M., & Atkinson, P. (2012). A method for reviewing the accuracy and reliability of a five-level triage process (Canadian Triage and Acuity Scale) in a community emergency department setting: building the crowding measurement infrastructure. *Emergency Medicine International,5,* 1-5. doi:10.1155/2012/636045

Hsu, J., Donnelly, J., Moore, J., Meneses, K., Williams, G., & Wang, H. (2018). National characteristics of emergency department visits by patients with cancer in the United States. *American Journal of Emergency Medicine*, *36*(11), 2038-2043. doi.org/10.1016/j.ajem.2018.03.025

Iacobellis, F., Perillo, A., Iadevito, I., Tanga, M., Romano, L., . . . Scaglione, M. (2018). Imaging of Oncologic Emergencies. *Seminars in Ultrasound, CT, and MRI, 39*(2), 151-166. doi:10.1053/j.sult.2017.12.001

Kao, Y., Liu, Y., Koo, M., & Chiang, J. (2018). Factors associated with emergency services use in Taiwanese advanced cancer patients receiving palliative home care services during out-of-hours periods: A retrospective medical record study. *BMC Palliative Care, 17*(1), 46-52. doi:10.1186/s12904-018-0302-8

Kapil, P., Macmillan, M., Carvalho, M., Lymburner, P., . . . Enright, K. (2016). Assessment of Fever Advisory Cards (FACs) as an initiative to improve febrile neutropenia management in a regional cancer center emergency department. *Journal of Oncology Practice, 12*(9), 858-863. doi: 10.1200/JOP.2015.009183

Kehoe, C. (2007). Getting to know oncologic emergencies. *Nursing Made Incredibly Easy, 5*(5), 56-58. doi:10.1097/01.NME.0000286207.74779.90

Keng, M., Thallner, E., Elson, P., Ajon, C., Sekeres, J., . . . Sekeres, M. (2015). Reducing time to antibiotic administration for febrile neutropenia in the emergency department. *Journal of Oncology Practice, 11*(6), 450-455. doi:10.1200/JOP.2014.002733

Khan, U., Shanholtz, C., & Mccurdy, M. (2017). Oncologic mechanical emergencies. *Hematology/oncology Clinics of North America, 31*(6), 927940. doi:10.1016/ j.hoc.2017.08.001

Kotlinska-Lemieszek, A., & Wyrwinska, A. (2014). Patients with cancer in the emergency departments. *Medycyna Paliatywna, 6*(3), 134-139.

Kuderer, N., Dale, D., Crawford, J., Cosler, L., & Lyman, G. (2006). Mortality, morbidity, and cost associated with febrile neutropenia in adult cancer patients. *Cancer, 106*(10), 2258-2266. doi:10.1002/cncr.21847

Kumar, E., Anand, E., Daniel, E., Kenneth, E., Bruce, . . . Cheang, E., Mary. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine, 34*(6), 1589-1596. doi:10.1097/01. CCM.0000217961.75225.E9

Lee, S., Wong, F., & Tung, S. (2018). No ordinary back pain: malignant spinal cord compression. *The American Journal of Medicine, 131*(7), 772-774. doi:10.1016/ j.amjmed.2018.02.001

Lim, J., Kim, H., Choi, W., Kim, K., Shin, D., & Lee, M. (2011). Outcomes in 102 patients that present to the emergency department with chemotherapy-induced febrile neutropenia. *Turkish Journal of Haematology, 28*(3), 193-197. doi:10.5152/tjh.2011.53

Livingston, P., Craike, M., & Slavin, M. (2012). Clinical and economic burden of emergency department presentations for neutropenia following outpatient chemotherapy for cancer in Victoria, Australia. *Oncologist, 17*(7), 998-1004. doi:10.1634/theoncologist.2011-0456

Livingston, P., Craike, M., & Considine, J. (2011). Unplanned presentations to emergency departments due to chemotherapy induced complications: Opportunities for improving service delivery. *Australasian Emergency Nursing Journal, 14*(2), 62-68. doi:10.1016/ j.aenj.2011.03.005

Lyman, G., Abella, E., & Pettengell, R. (2014). Risk factors for febrile neutropenia among patients with cancer receiving chemotherapy: A systematic review. *Critical Reviews in Oncology/ Hematology, 90*(3), 190-199. doi:10.1016/j.critrevonc.2013.12.006

McCurdy, M., & Shanholtz, C. (2012). Oncologic emergencies. *Critical Care Medicine, 40*(7), 2212-2222. doi:10.1097/CCM.0b013e31824e1865

McKenzie, H., Hayes, L., White, K., Cox, K., Fethney, J., Boughton, M., & Dunn, J. (2011). Chemotherapy outpatients' unplanned presentations to hospital: A retrospective study. *Supportive Care in Cancer, 19*(7), 963-969. doi:10.1007/s00520-010-0913-y

Meer, D., Weiland, M., Philip, T., Jelinek, J., Boughey, J., Knott, G., . . . Kelly, H. (2016). Presentation patterns and outcomes of patients with cancer accessing care in emergency departments in Victoria, Australia. *Supportive Care in Cancer, 24*(3), 1251-1260. doi:10.1007/s00520-015-2921-4

Minami, S., Yamamoto, S., Ogata, Y., Takeuchi, Y., Hamaguchi, M., Koba, T., . . . Komuta, K. (2013). Emergency department visits after hours by lung cancer patients in Japan. *Supportive Care in Cancer, 21*(9), 2443-2451. doi:10.1007/s00520-013-1814-7

Mofid, B., Novin, K., Roointan, E., & Forouzanfar, M. (2016). Epidemiology and death-related factors of oncology patients in emergency department. *Emergency, 4*(3), 145-50.

Muslimani, A., Zakalik, D., Chisti, M., Daw, H., Wills, S., Huang, J., . . . Jaiyesimi, I. (2011). How we treat tumor lysis syndrome. *Oncology, 25*(4), 369-75.

Namendys-Silva, S., Arredondo-Armenta, J., Plata-Menchaca, E., Guevara-García, H., García-Guillén, F., Rivero-Sigarroa, E., & Herrera-Gómez, A. (2015). Tumor lysis syndrome in the emergency department: Challenges and solutions. *Open Access Emergency Medicine, 7*, 39-44. doi:10.2147/OAEM.S73684

Nirenberg, A., Mulhearn, L., Lin, S., & Larson, E. (2004). Emergency department waiting times for patients with cancer with febrile neutropenia: A pilot study. *Oncology Nursing Forum, 31*(4), 711-5. doi:10.1188/04.ONF.711-715

Numico, G., Cristofano, A., Mozzicafreddo, A., Cursio, O., Franco, P., Courthod, G., . . . Silvestris, N. (2015). Hospital admission of cancer patients: avoidable practice or necessary care? *PLoS One, 10*(3), E0120827. doi:10.1371/journal.pone.0120827

Oatley, M., Fry, M., & Mullen, L. (2016). A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. *International Emergency Nursing, 24*, 35-38. doi:10.1016/j.ienj.2015.05.007

Patel, M., Williams, D., Wohlforth, C., Fisher, G., Wakelee, H., & Blayney, D. (2015). Are patients with thoracic malignancies at risk for uncontrolled symptoms? *Journal of Oncology Practice, 11*(1), E98-e102. doi:10.1200/JOP.2014.001502

Pi, J., Kang, Y., Smith, M., Earl, M., Norigian, Z., & Mcbride, A. (2016). A review in the treatment of oncologic emergencies. *Journal of Oncology Pharmacy Practice, 22*(4), 625-638. doi:10.1177/1078155215605661

Prachanukool, T., Tangkulpanich, P., Paosaree, P., Sawanyawisuth, K., & Sitthichanbuncha, Y. (2016). Cancer patients are at high risk of mortality if presenting with sepsis at an emergency department. *Asian Pacific Journal of Cancer Prevention, 17*(7), 3423-6. doi:10.14456/apjcp.

Sadik, M., Ozlem, K., Huseyin, M., Aliayberk, B., Ahmet, S., & Ozgur, O. (2014). Attributes of cancer patients admitted to the emergency department in one year. *World Journal of Emergency Medicine, 5*(2), 85-90. doi:10.5847/wjem.j.1920-8642.201

Samphao, S., Eremin, J. M., & Eremin, O. (2010). Oncological emergencies: Clinical importance and principles of management. *European Journal of Cancer Care, 19*(6), 707-713. doi:10.1111/j.1365-2354.2009.01091.x

Smith, A., Lollar, J., Mendenhall, J., Brown, H., Johnson, P., & Roberts, S. (2013). Use of multiple pedagogies to promote confidence in triage decision making: a pilot study. *Journal of Emergency Nursing, 39*(6), 660-666. doi:org/10.1016/j.jen.2011.12.007

Strojnik, S., Mahkovic-Hergouth, K., Novakovic, B., & Seruga, B. (2016). Outcome of severe infections in afebrile neutropenic cancer patients. *Radiology and Oncology, 50*(4), 442-448. doi:10.1515/raon-2016-0011

Szwajcer, D., Czaykowski, P., & Turner, D. (2011). Assessment and management of febrile neutropenia in emergency departments within a regional health authority-a benchmark analysis. *Current Oncology, 18*(6), 280-294. doi:10.3747/co.v18i6.841

Talcott, J., Finberg, R., Mayer, R., & Goldman, L. (1988). The medical course of cancer patients with fever and neutropenia. Clinical identification of a low-risk subgroup at presentation. *Archives of Internal Medicine, 148*(12), 2561-2568. doi:10.1001/archinte.1988.00380120031007

Tanaka, T., Taguri, M., Fumita, S., Okamoto, K., Matsuo, Y., & Hayashi, H. (2017). Retrospective study of unplanned hospital admission for metastatic cancer patients visiting the emergency department. *Supportive Care in Cancer, 25*(5), 1409-1415. doi:10.1007/s00520-016-3535-1

Tang, N., Stein, J., Hsia, R., Maselli, J., & Gonzales, R. (2010). Trends and characteristics of US emergency department visits, 1997-2007. *Journal of America Medical Association, 304*(6), 664-670. doi:10.1001/jama.2010.1112

Tang, P., Cheng, J., Huang, W., Chang, H., & Chen, H. (2015). Why Do Head and Neck Cancer Patients Visit the Emergency Department? *American Journal of Emergency Medicine, 33*(8), 1102-1105. doi:10.1016/j.ajem.2015.04.077

Tang, S., Wu, S., Hung, Y., Huang, E., Chen, J., & Liu, T. (2009). Trends in quality of end-of-life care for Taiwanese cancer patients who died in 2000-2006. *Annals of Oncology, 20*(2), 343-348. doi:10.1093/annonc/mdn602

Vandyk, A., Harrison, M., Macartney, G., Ross-White, A., & Stacey, D. (2012) Emergency department visits for symptoms experienced by oncology patients: a systematic review. *Support Care Cancer 20*(8), 1589–1599. doi:10.1007/s00520-012-1459-y

Wagner, J., & Arora, S. (2017). Oncologic Metabolic Emergencies. *Hematology/oncology Clinics of North America, 31*(6), 941-957. doi:10.1016/j.hoc.2017.08.002

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2014). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3), 190-198. doi:10.1177/1078155213492450

Wilson, L., Detterbeck, F., & Yahalom, J. (2007). Superior Vena Cava Syndrome with malignant causes. *The New England Journal of Medicine, 356*(18), 1862-1869. doi:10.1056/ NEJMcp067190

The Quality of Care in the Emergency Management of Cancer Patients with Febrile Neutropenia

Chapter Three

This chapter constitutes the second manuscript of the thesis. In this manuscript, the aim was to evaluate the ED quality of care for patients with FN in terms of the four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care.

Abstract

Background: Febrile neutropenia (FN) is one of the most severe oncological emergencies associated with the treatment of cancer. Patients with FN are at a grave risk of developing life-threatening sepsis unless there is rapid initiation of treatment.

Purpose: To evaluate the quality of ED care of patients with FN using the four quality dimensions of safety, effectiveness, patient-centeredness, and timeliness of care.

Methods: A retrospective review of all available records of adult cancer patients with FN who presented to one urban ED in Atlantic Canada was conducted over five years.

Results: Examining twelve quality indicators of the 431 patients included in the study identified areas for improvement in each of the four dimensions. Over one-third of the participants were unsafely discharged from the ED despite the severity of their condition. The vast majority were not prescribed a growth factor at the initiation of cancer treatment, a prevention strategy for the development of FN, and were not provided a prescription during their ED visit. Pain assessment and management were not prioritized during the ED experience. Patients in the study were not seen promptly by the physician, and did not receive timely treatment during different phases of their visit. Most importantly, the delay in antibiotic administration presented a major risk for this population.

Conclusion: Aspects of care provided to this cohort of FN patients were inconsistent with the recommended evidence. Strengthening ED care is necessary to reduce the gap between evidence-based and actual care. Quality initiatives can be implemented to improve care to become safer, effective, patient-centered, and timely. Nurses who are in direct contact with the patients and who are actively involved in every single process of the health care system are well positioned to lead this change.

Febrile neutropenia (FN) is the most common side effect related to cancer treatment (Bryant et al., 2015). FN is a potentially life-threatening condition as patients can suffer a profound bone marrow suppression leaving them susceptible to severe infections (Weycker et al., 2016). Infection due to neutropenia is associated with significant morbidity and mortality in patients receiving chemotherapy (Meer et al., 2016; Walji et al., 2008 ; Weycker et al., 2016). For example, FN is a predisposing factor for sepsis, and therefore, prevention of FN is a crucial strategy to reduce the disease burden (Paddock, Grock, Deloughery, & Mason, 2017). Evidence-based strategies have been promoted to minimize the occurrence of FN, particularly the use of growth factors and prophylactic antibiotics (Ganti, Marini, Nagel, Bixby, & Perissinotti, 2017; Taplitz et al., 2018). Administration of growth factors such as Filgrastim (G-CSF) has been associated with a lower incidence of FN (Kawatkar et al., 2017). However, despite this benefit, their use is limited, which likely impacts the number of patients experiencing FN (Andre et al., 2010; Szwajcer, Czaykowski, & Turner, 2011).

The emergency department (ED) remains an accessible place for patients with FN to receive timely treatment, and until more focus is given to prevention of this complication, it should be anticipated by the ED (Kawatkar et al., 2017; Numico et al., 2015). The standard of care is for individuals with FN to be seen by the ED physician within 15 minutes of triage (Bullard et al., 2017) and to commence antibiotics within one hour (Freifeld et al., 2011). The time to initiation of effective antimicrobial therapy was reported as the single most reliable predictor of outcome among patients with early signs of sepsis (Kumar et al., 2006).

Delayed ED care and increased wait times are associated with adverse outcomes among patients with FN (Keng et al., 2015; Klastersky, 2004; Koh & Pizzo, 2002), while earlier administration of antibiotics is associated with fewer complications in terms of infection, sepsis, and prolonged LOS (Lynn et al., 2013). Morneau et al. (2017) found that each hour of delay in the administration of antibiotic therapy increased the odds of in-hospital mortality by 16%, while earlier management significantly reduced the mortality odds by 33% (Johnston et al., 2017). However, delayed emergency care and prolonged time to antibiotics have been reported in a number of epidemiological studies where antibiotics were administered from 3.5 – 5.0 hours after ED presentation (Nirenberg, Mulhearn, Lin, & Larson, 2004; Oatley, Fry, & Mullen, 2016; Szwajcer et al., 2011).

The aim of this study was to evaluate the quality of ED care of patients with FN in terms of four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care. The other two quality dimensions (efficiency and equity) were not examined. In particular, we were interested in whether patients were treated according to the benchmarked time for treatment as specified in the triage and FN guidelines. Limited information is available to determine if appropriate and timely emergency care is provided for this vulnerable population. Previous studies were limited to the examination of the benchmarked time for the administration of antibiotics only. This study has taken a broader perspective that includes observations on several dimensions of quality within the ED and, to a lesser degree, observations on some aspects of primary care known to prevent the occurrence of FN. This evaluation can inform the adoption of evidence-based policies to enhance the efficiency and effectiveness of ED processes for more positive patient outcomes.

Methods

The research design was a retrospective review of available records of adult cancer patients undergoing active treatment for cancer. The targeted population included all cancer patients in the provincial cancer registry with a first presentation of fever to one ED occurring on a date after the time of their cancer diagnosis. The provincial cancer registry contains information on all individuals diagnosed with cancer in the province and is maintained by the provincial cancer program. Patients were included in the study if they were: i) at least 18 years old, ii) undergoing active cancer treatment, and ii) came to the ED with a presentation of fever between April 1, 2011, and March 31, 2016. Patient data from the cancer registry were directly and securely transferred to the province's health information agency. There, the registry data were linked with the identified hospital's ED patient information system using the inclusion criteria. After the data linkage, 444 patient health records were provided to the researchers. A review of the files identified 13 that were ineligible as the presenting complaint at the ED was not related to fever. The sample was sufficient according to the prior sample size calculation. To facilitate accurate data collection from the patient health record, the first author engaged in a two-week, informal orientation to the study setting to observe and understand the context and flow of care in the ED. These observations also helped understand the language and the abbreviations that were documented in the patient health records.

Data were collected by conducting chart reviews using a standardized chart review form (CRF). A pilot test of the CRF was performed, and changes were made as necessary to enhance the rigor and minimize biases. For example, items on the CRF were rearranged to match the arrangement of data in the patient health records. As well, a

random selection of 176 cases (40% of the sample) was checked to ensure proper data coding and entry. Patients were assigned a unique study code to protect the confidentiality of their information. The provincial Health Research Ethics Board approved the study.

Measures

The ED quality of care was evaluated in terms of four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care. These domains were operationalized using twelve measures. There is national consensus on the use of these measures, which are included as part of the Canadian ED national benchmarks (Schull et al., 2010).

Safety. The first domain, safety, was measured by three variables: i) the frequency of patients who left without being seen (LWBS), ii) time to triage reassessment while waiting to be seen, and iii) appropriate ED disposition based on stratification of the severity of FN using the Multinational Association for Supportive Care in Cancer (MASCC) score as per the FN guidelines (Coyne et al., 2017). The MASCC score is used to assess the seriousness of FN and inform a decision about patient discharge. The calculated MASCC score categorizes patients with FN into low and high-risk based on a scoring system. Low-risk FN patients (MASCC score of ≥ 21) are considered stable and eligible for outpatient management with oral antibiotics (Paddock et al., 2017). High-risk patients should be admitted to the hospital with an immediate IV broad-spectrum antibiotic administered in the ED. Table 1 summarizes the MASCC criteria used to calculate the severity of FN. We rated each patient based on these criteria to decide on the appropriate disposition of patients from the ED.

Table 1

MASCC Scoring System

Characteristic	Score
The burden of FN with no or mild symptoms	5
No hypotension (i.e., systolic blood pressure > 90 mmHg)	5
No chronic obstructive pulmonary disease	4
Solid tumor or hematologic malignancy with no previous fungal infection	4
No dehydration requiring parenteral fluids	3
Outpatient status	3
Age < 60 years	2

Note. Reprinted from "Outpatient Management of Fever and Neutropenia in Adults Treated for Malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update," by Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient Management of Fever and Neutropenia in Adults Treated for Malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. *Journal of Clinical Oncology, 36*(14), 1443-1453. Copyright 2018 by "American Society of Clinical Oncology."

Effectiveness. The effectiveness of care was the second domain and was evaluated by two measures. First, the risk of FN can be lowered with the appropriate use of preventive strategies such as the prescribing of growth factors for patients when they are receiving active cancer treatment. Second, the Fractile Response Rate (FRR) was used to assess the proportion of patients in each triage level seen within the guidelines' time objective. The guidelines recommend that 95% of patients with FN be seen within 15 minutes (be assigned a triage score of 2).

Patient-centeredness. The third dimension was patient-centeredness, which was evaluated in terms of proper pain assessment and management in the ED.

Timeliness. The final dimension, timeliness, was evaluated by five variables: time to physician initial assessment (PIA), ii) time to antibiotics (TTA), iii) sorting time, iv) boarding time, and v) ED length of stay (LOS). Operational definitions of these measures are provided in Table 2.

Table 2

Operational Definitions of the Study Variables

Quality Dimension	Measures of the Quality Dimension	Measurement
Safety	1. Left without being seen.	ED patients who leave the ED on their own without proper discharge by the ED physician or nurse.
	2. Time to Reassessment at Triage.	The time from initial assessment at triage to the secondary assessment at triage when the observed wait time has passed the expected wait time.
	3. ED disposition.	The final destination in the ED. Patients can be admitted, discharged, or be deceased.
Effectiveness	4. Prescription of Growth Factors.	The administration of growth factors such as Filgrastim (G-CSF) in the ED or before the ED visit.
	5. Fractile Response Rate.	The proportions of patients in each triage level seen by a physician within the CTAS time objective for that level.
Patient-Centeredness	6. Pain assessment.	The assessment of pain during the first assessment at triage.
	7. Pain management.	The administration of analgesia during the ED visit.
Timeliness	8. Physician initial assessment (PIA).	The time from ED triage assessment to the time to be seen by an ED physician.
	9. Time to antibiotics (TTA).	The time from ED triage assessment to the time of the administration of antibiotics.
	10. Sorting Time.	The time from ED triage assessment until the decision on admission or discharge is made.
	11. Boarding time.	The time spent in the ED after the decision to admit until a hospital bed became available.
	12. ED length of stay.	The total time spent in the ED from ED triage assessment until the patient leaves the department.

Note. These quality measures are considered evidence-based quality of care indicators and are included in the Canadian Emergency Department national benchmarks (Bullard et al., 2017; Freifeld et al., 2011; Health Quality Ontario, 2016; Kelly et al., 2014; Schull et al., 2010; Taplitz et al., 2018). The indicators were categorized based on the dimensions defined by the Institute of Medicine (2003).

Data Analysis

We used one sample t-test to examine the observed vs. the expected PIA, TTA, and ED length of stay among admitted and discharged patients (15 minutes, 60 minutes, and four and eight hours for admitted and discharged, respectively). The remaining variables were analyzed and summarized using descriptive statistics. The analysis was done using the SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

Results

Characteristics of Patients

We identified 431 oncology patients from the provincial cancer registry who presented to one ED in Atlantic Canada with an episode of FN over the study period. About half of patients (51.5 %) were male with a mean age of 60 years (*Range* = 20-91). Most of the visits (56.0%) occurred during the evening hours (15:00H to 22:59H) with 13.0% arriving by ambulance. The majority of patients (68%) were diagnosed with solid tumor and two-thirds had advanced malignancy (stage III or VI). Table 3 shows the patient demographics and their cancer characteristics.

Table 3

Patient Demographics and Cancer Characteristics

Characteristic		*n* (%)
Sex		
	Female	209 (48.5)
	Male	222 (51.5)
Age		
	< 60 yrs.	174 (40.0)
	60-70 yrs.	158 (37.0)
	>70 yrs.	99 (23.0)

Arrival Time		
	Day	110 (25.0)
	Evening	240 (56.0)
	Night	81 (19.0)
Day of Arrival		
	Weekdays	293 (68.0)
	Weekend	138 (32.0)
Arrival Mode		
	Walk-In	374 (87.0)
	Ambulance	57 (13.0)
Type of Cancer		
	Solid	293 (68.0)
	Hematological	138 (32.0)
Cancer stage		
	1+2	121 (37.0)
	3	99 (31.0)
	4	104 (32.0)

Results of the Quality Care Measures

This quality evaluation provided evidence of needed improvements in the four quality dimensions: safety, effectiveness, patient-centeredness, and timeliness of care.

Safety. Examining the three indicators within the domain of safety identified a small number of patients who left the ED after triage, but before being seen by the physician. Six patients (1.4%) left the ED without being seen (LWBS). In addition, the vast majority of the patients who waited at triage were not reassessed by the triage nurse at the intervals recommended in the CTAS guidelines. The seven patients (1.6%) who had a documented triage reassessment in their ED record waited an average of 98 minutes before being reassessed. Results for the safety indicators are summarized in Table 4.

The final safety indicator, disposition, revealed that 154 patients (36%) were discharged home. Of note, were the 53 (34%) high-risk patients who went home in violation of the guidelines as the seriousness of their condition is considered too risky for

outpatient management. A small number of discharged patients (*n* = 7, 5%) were found to suffer profound neutropenia with an absolute neutrophil count (ANC) of less than 500.

Table 4

Descriptive Results for Indicators in Three Quality Domains

SAFETY DOMAIN	***n***	**%**	**EFFECTIVENESS DOMAIN**	***n***	**%**
Indicator			**Indicator**		
1] Left without being seen	6	1.4	1] Growth factor	26	6.0
2] Reassessment at triage (Mean = 98 M).	7	1.6	2] Fractile response rate		
3] Disposition:			CTAS level of 2 (15 M)	17	10.8
Admitted	271	64.0	CTAS level of 3 (30 M)	27	10.5
Low-Risk FN (MASCC ≥ 21)	31	11.4	Distribution of CTAS scores		
Discharged	154	36.0	Level 1: Resuscitation	1	0.2
High-Risk FN (MASCC < 21)	53	34	Level 2: Emergent	158	36.7
ANC < 500	7	4.5	Level 3: Urgent	258	59.9
Profound & High-Risk FN with No Antibiotics	5	3.3	Level 4: Less-Urgent	13	3
PATIENT CENTEREDNESS			Level 5: Non-Urgent	1	0.2
Indicator			*Note.* MASCC = Multinational Association for Supportive Care in Cancer; ANC = Absolute Neutrophil Count; CTAS = Canadian Triage and Acuity Scale; M = Minutes		
1] Pain Manifestations	38	9.0			
2] Pain assessment at triage	4	1.0			
3] Administration of analgesic (Mean = 228 M)	39	9.0			

Effectiveness. Results for the effectiveness indicators are summarized in Table 4. Two indicators were measured under this quality domain. One, the taking of growth factors while under active cancer treatment, is a preventive measure against the development of FN. Only 6% of study participants received the growth factor, Filgrastim

(G-CSF), prior to their presentation to the ED and no patients were started on G-CSF in the ED. The second effectiveness indicator was the fractile response rate (FRR) of triage implementation, which is an indication of how well the organization is meeting the time objectives of the CTAS guidelines. Only 11% of patients in both triage categories of two and three were seen by a physician in a time that was consistent with the CTAS recommendations.

Patient-centeredness. Pain assessment at triage was documented in only four patients (1.0%), but 38 patients (9.0%) presented with pain and 39 patients (9.0%) received opioids such as morphine at some point during their ED visit. The mean time to the administration of analgesia was 228 minutes. Patient-centeredness indicators are summarized in Table 4.

Timeliness of Care. Five, time-sensitive indicators were measured to assess if patients with FN received the appropriate ED treatment that was responsive to their potentially life-threatening condition. The time from triage to the physician's initial assessment (PIA) is a critical indicator in the timely initiation of required treatment. In the ED, the mean waiting time from triage to PIA was 81 minutes, which is significantly longer than the benchmark of 15 minutes ($p = .001$). On average, patients had to wait for 228 minutes before the administration of antibiotics, which is significantly longer than the benchmark 60 minutes ($p = .001$). Only 4.0% of the patients in our sample received antibiotics within the time frame of one-hour as recommended in the guidelines. On average, it took more than 5.4 hours ($SD = 3.2$) for the health care team to decide on admission or discharge (sorting time). After the decision was made to admit the patient, there was an average wait time of 10.6 hours in the ED before being moved to an

inpatient bed. Among the admitted patients, the mean ED LOS was 21.9 hours (*SD* = 15.1), which is significantly longer than the benchmark of eight hours ($p = .001$). Among the discharged patients, the mean ED LOS was 4.4 hours (*SD* = 2.6), which is significantly longer than the benchmark of four hours ($p = .026$). Treatment times of the FN patients are summarized in Table 5. Results from the one sample t-test are reported in Table 6.

Table 5

Descriptive Results for Indicators in the Quality Domain of Timeliness

Event	Mean (*SD*)	Median (*IQR*)	Percentiles				
			5%	25%	50%	75%	90%
Minutes Until Physician Initial Assessment (PIA)	81.0 (69.6)	60.0 (67.0)	15.0	37.0	60.0	104.0	158.0
Minutes Until Administration of Antibiotics (TTA)	228.0 (189.0)	175.0 (158.0)	63.0	116.0	175.0	274.0	458.0
Hours Until Decision for Admission or Discharge (Sorting Time)	5.4 (3.2)	4.7 (2.9)	2.0	3.5	4.7	6.5	8.6
Boarding Time (hrs)	10.6 (14.2)	3.7 (17.3)	0.0	0.1	3.7	17.4	27.0
Admitted Patients ED LOS (hrs)	21.9 (15.1)	19.3 (18.0)	5.1	9.8	19.3	27.8	43.8
Discharged Patients ED LOS (hrs)	4.4 (2.6)	3.9 (2.1)	1.8	2.9	3.9	5.1	6.7

Note. The right side of the table illustrates the proportions of patients treated according to the benchmarks. For example, the cross-tabulation between the third column and the first row gives the proportion of patients who have met the CTAS guidelines benchmark for PIA (e.g., only 5% were seen by physician within 15 minutes as recommended by the guidelines). The last column (90^{th} percentile) illustrates the maximum amount of time within which nine out of 10 patients were seen by the ED physician.

Table 6

Comparison Between the Observed vs. Expected Treatment Time Using one sample t-test

	Test Value PIA = 15 minutes Test Value TTA = 60 minutes Test Value Admitted ED LOS = 8 hours Test Value Discharged ED LOS = 4 hours					
	t	**df**	**Sig (2-tailed)**	**Mean Difference**	**95% Confidence Interval of the Difference**	
					lower	**Upper**
PIA (minutes)	19.535	424	.001	66.0	59.36	72.64
TTA (minutes)	16.173	333	.001	167.539	147.16	187.92
Admitted Patients ED LOS (hrs)	15.139	270	.001	13.945	12.132	15.759
Discharged Patients ED LOS (hrs)	2.241	153	.026	.471	.055	.886

Discussion

The Institute of Medicine of America (IOM) published a report in 2000 titled "To Err is Human" highlighting many safety and quality problems with current health care practices (Berwick, 2014; Kohn, Corrigan, Donaldson, & ProQuest, 2000). Similarly, the "Canadian Adverse Events Study" reported that 13.5% of the 2.5 million annual hospital admissions in Canada involved at least one adverse event with one in five patients experiencing permanent disability or death (Baker et al., 2004). These reports demystified the concept of quality of care as taken for granted, re-centering the focus on patient safety and demanded a redesign of the healthcare system to improve quality and safety (Kelly et al., 2014). In this study, we evaluated the quality of care on four of the six dimensions of quality according to the Institute of Medicine to include safety, effectiveness, efficiency, equity, patient-centeredness, and timeliness of care.

The Safety of Care

Safety was operationalized by measuring three indicators. The frequency of patients who left without being seen (LWBS) was 1.4% which represents the proportion of patients with a failed attempt to access the ED. Previous studies suggest that a rate of less than 5.0% for patients who LWBS is deemed to be safe for patients with a low acuity rating (Ding et al., 2006). Nevertheless, this cannot apply to patients with FN as delayed emergency care is associated with severe adverse consequences (Keng et al., 2015). FN patients cannot afford not to receive emergency care; this rate should be zero for the safety of FN patients.

Another indicator of potentially unsafe care is the absence of reassessment while waiting at triage. This evaluation is part of the triage process because the patients are expected to be continuously monitored until their initial assessment. Only seven patients (1.6%) had documentation in their ED record that they were reassessed while waiting at triage. This contradicts the triage guidelines because re-evaluation of patients who are waiting is necessary to ensure that their status is stable and their waiting remains safe. Moreover, the small number who were reassessed did not meet the recommended time for reassessment.

Finally, safety was evaluated by the appropriate ED disposition after stratification of the severity of FN. The standard of care for patients with FN is to be admitted for protective isolation for prophylactic antibiotics until neutropenia is resolved (Weycker et al., 2014). Accumulated evidence suggests that the ED visits by individuals with FN are both unavoidable, and necessary, as seen by the majority of patients being urgently admitted (Nirenberg et al., 2004; Oatley et al., 2016). However, some patients can be

considered for initial management of FN in the ED with the possibility of discharge if certain conditions were met. In our sample of patients with FN, 36.0% were discharged home but over half of those discharged (59.0%) did not receive antibiotics in the ED. Of note, were the 53 (34%) high-risk, discharged patients who were not eligible for outpatient management based on the guidelines (Paddock et al., 2017). Also, seven patients (4.5%) of those high-risk discharged patients were found to suffer from a profound neutropenia with ANC of less than 500. Among the high-risk discharged FN patients with profound neutropenia were those five patients (3.3%) who were not given antibiotics in the ED. Although such stratification of patients' risk is clinically revealing, it does not appear to have been used in making the clinical decision to discharge these patients.

Many researchers and clinicians oppose the outpatient management of low-risk FN, considering it unsafe especially with its reduced sensitivity and specificity (Paddock et al., 2017; Taplitz et al., 2018). The rationale behind this opposition is that a high number of adverse events were documented when low-risk patients were treated as outpatients. Evidence indicates that one-third of ED patients who were identified as low-risk by MASCC scores were found to have severe complications after discharge (Coyne et al., 2017; Paddock et al., 2017). Other organizations continue to allow outpatient management, but clear conditions are applied (Nova Scotia Oncological Emergencies Guidelines, 2014). The Nova Scotia Guidelines recommend that patients receive empirical antibacterial therapy within one hour of triage and be monitored for four hours before being discharged. Patients who do not get well after two to three days should be re-evaluated and considered for inpatient treatment. Patients with acute leukemia are

never regarded as a low-risk. In addition, individuals in Nova Scotia who are managed as outpatients must have prescription coverage, reside within 60 minutes of the ED, have telephone access, and have 24-hour live-in support. They should also be able to return to the facility for follow-up (Cancer Care Nova Scotia, 2014).

The Effectiveness of Care

Two measures were used to evaluate the effectiveness of care. At the primary level, the risk of FN can be minimized with the use of strategies such as growth factors and prophylactic antibiotics (Freifeld et al., 2011; Ganti et al., 2017; Smith et al., 2006; Taplitz et al., 2018). However, only 6.0% of patients in our sample had received Filgrastim (G-CSF) before their ED presentation. However, 29% (n = 123) of patients in our sample presented with profound neutropenia (ANC < 500). Szwajcer et al. (2011) reported similar underuse of G-CSF among patients with FN in which Filgrastim was administered to only 62.0% before their ED presentation. In the French study of critically ill cancer patients with FN, the authors reported that management was inadequate where G-CSF was initiated in the ED for only 10.0% of the patients (Andre et al., 2010). None of the patients in our sample started G-CSF in the ED. The second effectiveness indicator was the fractile response rate (FRR), which provided information about patient flow as it measures the adequacy of triage implementation suggesting ineffective triage implementation in 89% of the patients with FN. The guidelines mandate organizations to tailor different resources to meet this quality indicator because FRR is based on the urgency and acuity of the presenting complaint and is related to patient outcomes (Bullard et al., 2017).

Patient Centeredness

Patient-centeredness was evaluated in terms of proper pain assessment and management. Berwick (2014) defined patient-centeredness as having three aspects: 1) the needs of the patient have priority, 2) the patient participates in all health decisions, 3) the patient receives the full attention of the health care team. The lack of appropriate pain assessment and management may mean that the patient needs were not given priority. The evaluation of pain was documented in only four patients (1.0%), while 38 patients (9.0%) presented with pain manifestations and 39 patients (9.0%) were found to receive opioids such as morphine. This finding is congruent with the data from previous studies reporting that some cancer patients do not receive proper pain management in the ED (Barbera et al., 2012; Jain et al., 2013; Patel et al., 2017). Furthermore, pain in cancer patients is often not an isolated symptom but a manifestation of severe underlying conditions such as compressed spinal cord, obstructed intestine, or compressed heart (Sun & Nemecek, 2010). Cancer related pain can also be associated with other oncological emergencies including FN. It is the most common presenting symptom for patients with newly diagnosed cancer in the ED (Kehoe, 2007), as well as those who are living with the disease (Scholer et al., 2017). Pain can be unbearable symptom and can cause severe suffering and inferior quality of life (Jain et al., 2013). It is also a forerunner of urgency as it is the chief complaint among patients who get admitted from the ED (Barbera et al., 2010). The lack of formal pain assessment may indicate a lack of awareness. Pain should be managed, even at the triage stage, with the suitable analgesia until the patient can go through the proper examination to identify the underlying cause of pain. Education of the

triage nurses with the introduction of an advanced protocol for analgesic treatment can improve their quality of care and minimize patient suffering (Jain et al., 2013).

The Timeliness of Care

Patients in our sample were not seen promptly, nor did they receive timely treatment in different phases of their ED visit. The average time to see a physician was 81 minutes (95% CI [74, 88]) which was significantly longer than recommended for patients with FN (the expected PIA = 15 minutes). The average time to receive antibiotics was 228 (95% CI [207, 248]) minutes which was significantly longer than that recommended for patients with FN (the expected TTA = 60 minutes). Our results were consistent with previous studies where ED wait times of cancer patients with FN were far from ideal benchmarks. Patients were found to experience at least between 180 and 300 minutes before the administration of antibiotics (Nirenberg et al., 2004; Oatley et al., 2015; Szwajcer et al., 2011).

Untimely care was also demonstrated by the long period of time that study participants spent in the ED waiting to receive necessary services. In Canada and the UK, the expected benchmark for ED length of stay (ED LOS) for patients who are discharged is four hours. For individuals who require inpatient admission, the ED LOS benchmark is eight hours (Health Quality Ontario, 2016; Iacobucci, 2019). Patients in our study experienced longer ED stays than recommended. Discharged patients spent an average of four and a half hours in the ED while admitted patients were in the ED for an average of 22 hours.

Implications and Limitations

Quality is about changing the behavior of health care providers by using evidence to drive their decisions (Berwick, 2014). This review of quality indicators in the ED revealed that aspects of the care provided for this sample of patients with FN was not based on evidence nor was consistent with the guidelines. There was a considerable gap in the care proposed by the guidelines and the actual care that was received by patients in the ED. Quality initiatives are needed to improve care to be safer, more effective, patient-centered, and timely (IOM, 2003). However, this study was academic-led and focused on a specific patient population with a particular clinical condition (FN). This approach to quality improvement cannot be sustainable and could contribute to fragmented ED quality measurement and improvement. It is also time-consuming and can be challenging for most conditions because the conventional treatment, timeliness of the intervention, and prognosis can vary significantly among different conditions and across different illnesses. Hospitals need to establish ways to inspect quality in a way that is faster, easier, and cost effective. Investment could be made in health care information technology and health databases which turn data into information and then into knowledge that the caregivers can use to both deliver and improve care (Kelly et al., 2014). This will make the health workers aware of their performance and continuously improve the quality of the delivered care. Nurses who are in direct contact with the patients and who are actively involved in every single process of the health care system are well positioned to lead this change.

Conclusion

In evaluating the quality of emergency care of patients with FN, the results of this study provide evidence that additional improvements in a number of the quality

dimensions have potential to greatly enhance the care provided to individuals with FN. Strengthening the effectiveness of the care delivered to patients with FN will reduce the gap between the recommended evidence-based care and actual care.

References

Andre, S., Taboulet, P., Elie, C., Milpied, N., Nahon, M., Kierzek, G., . . . Claessens, Y. (2010). Febrile neutropenia in French emergency departments: Results of a prospective multicentre survey. *Critical Care, 14*(2), R68. doi: 10.1186/cc8972

Baker, G., Norton, P., Flintoft, V., Blais, R., Brown, A., Cox, J., . . . Tamblyn, R. (2004). The Canadian Adverse Events Study: The incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal,170*(11), 1678-86.

Barbera, L., Atzema, C., Sutradhar, R., Seow, H., . . . Dudgeon, D. (2012). Do patient reported symptoms predict emergency department visits in cancer patients? A population-based analysis. *Annals of Emergency Medicine, 61*(4), 427-437. doi:10.1016/ j.annemergmed.2012.10.010

Barbera, L., Taylor, C., & Dudgeon, D. (2010). Why do patients with cancer visit the emergency department near the end of life? *Canadian Medical Association Journal, 182*(6), 563-568. doi:10.1503/cmaj.091187

Berwick, D., & Institute for Healthcare Improvement. (2014). *Promising care: How we can rescue health care by improving it.* San Francisco, California: Jossey-Bass

Bryant, A., Deal, A., Walton, A., Wood, W., Muss, H., & Mayer, D. (2015). Use of ED and hospital services for patients with acute leukemia after induction therapy: One-year follow-up. *Leukemia Research, 39*(4), 406-410. doi: 10.1016/j.leukres.2015.01.006

Bullard, M., Musgrave, E., Warren, D., Unger, B., Skeldon, T., Grierson, R., . . . Swain, J. (2017). Revisions to the Canadian Emergency Department Triage and Acuity Scale (CTAS) Guidelines 2016. *CJEM, 19*(S2), S18-S27.

Bullard, M. J., Unger, B., Spence, J., & Grafstein, E. (2008). Revisions to the Canadian Emergency Department Triage and Acuity Scale (CTAS) adult guidelines. *CJEM, 10*(2), 136.doi:http://dx. doi.org/10.1017/S148180350000350X

Cancer Care Nova Scotia (2014). *Guidelines for the Management of Oncologic Emergencies in Adult Patients* – Full Version. © Crown copyright, Province of Nova Scotia.

Courtney, D., Aldeen, A., Gorman, S., Handler, J., . . . Bennett, C. (2007). Cancer-Associated Neutropenic Fever: clinical outcome and economic costs of emergency department care. *Oncologist, 12*(8), 1019-1026. doi:10.1634/theoncologist.12-8-1019

Coyne, C., Le, V., Brennan, J., Castillo, E., Shatsky, R., Ferran, K., . . . Vilke, G. (2017). Application of the MASCC and CISNE risk-stratification scores to identify low-risk febrile neutropenic patients in the emergency department. *Annals of Emergency Medicine, 69*(6), 755-764. doi:10.1016/j.annemergmed.2016.11.007

Ding, R., McCarthy, M., Li, G., Kirsch, T. D., Jung, J. J., & Kelen, G. D. (2006). Patients who leave without being seen: Their characteristics and history of emergency department use. *Annals of Emergency Medicine, 48*(6), 686-692. doi:10.1016/j.annemerg med.2006.05.022

Elsayem, A., Silvestre, J., Merriman, K., Chaftari, P., Gonzalez, C., & Yeung, S. (2014). Outcome of cancer patients admitted through the emergency department (ED) of a comprehensive cancer center: A call for ED-based palliative care. *Journal of Clinical Oncology, 32*(31), 194. doi:10.1200/jco.2014.32.31_suppl.194

Freifeld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., Mullen, C., . . . Wingard, J. (2011). Executive summary: Clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 52*(4), 427

Ganti, B., Marini, B., Nagel, J., Bixby, D., & Perissinotti, A. (2017). Impact of antibacterial prophylaxis during reinduction chemotherapy for relapse/refractory acute myeloid leukemia. *Supportive Care in Cancer, 25*(2), 541-547. doi:10.1007/s00520-016-3436-3

Health Quality Ontario. (2016). *Under Pressure: Emergency Department Performance in Ontario.* (Documents collection). Canadian Electronic Library distributor.

Iacobucci, G. (2019). A & E performing better than last year but missed targets an ongoing concern, say medical leaders. *British Medical Journal, 364*, L184. doi:10.1136/bmj.l184

Institute of Medicine, & ProQuest. (2003). *Crossing the quality chasm* (Richard and Hinda Rosenthal lectures; 2001). Washington, D.C. National Academy Press.

Jain, P., Parab, S., & Thota, R. (2013). A prospective, non-interventional study of assessment and treatment adequacy of pain in the emergency department of a tertiary care cancer hospital. *Indian Journal of Palliative Care, 19*(3), 152-157. doi:10.4103/0973-1075.121529

Johnston, A., Park, J., Doi, S., Sharman, V., Clark, J., Robinson, J., & Crilly, J. (2017). Effect of immediate administration of antibiotics in patients with sepsis in tertiary care: a systematic review and meta-analysis. *Clinical Therapeutics, 39*(1), 190-202.e6. doi:10.1016/ j.clinthera.2016.12.003

Kawatkar, A., Farias, A., Chao, C., Chen, W., Barron, R., Vogl, F., & Chandler, D. (2017). Hospitalizations, outcomes, and management costs of febrile neutropenia in patients from a managed care population. *Supportive Care in Cancer, 25*(9), 2787-2795. doi:10.1007/s00520-017-3692-x

Kehoe, C. (2007). Getting to know oncologic emergencies. *Nursing Made Incredibly Easy, 5*(5), 56-58. doi:10.1097/01.NME.0000286207.74779.90

Kelly, P., Vottero, B., Christie-McAuliffe, C., Morita, J., & Altmiller, G. (2014). *Introduction to quality and safety education for nurses: Core competencies.* New York: Springer Publishing Company.

Keng, M., Thallner, E., Elson, P., Ajon, C., Sekeres, J., Wenzell, C., . . . Sekeres, Mikkael A. (2015). Reducing Time to Antibiotic Administration for Febrile Neutropenia in the Emergency Department. *Journal of Oncology Practice, 11*(6), 450-455. doi:10.1200/JOP.2014.002733

Klastersky, J. (2004). Antifungal therapy in patients with fever and neutropenia — more rational and less empirical. *New England Journal of Medicine, 351*(14), 1445-1447. doi:10.1056/NEJMe048203

Koh, A., & Pizzo, P. (2002). Empirical oral antibiotic therapy for low risk febrile cancer patients with neutropenia. *Cancer Investigation, 20*(3), 420-433. doi:10.1081/CNV-120001186

Kumar, E., Anand, E., Daniel, E., Kenneth, E., Bruce, . . . Cheang, E., Mary. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine, 34*(6), 1589-1596. doi:10.1097/01.CCM.0000217961.75225.E9

Kohn, L., Corrigan, J., Donaldson, M., & ProQuest. (2000). *To err is human: Building a safer health system.* Washington, DC: National Academy Press.

Lynn, J., Chen, K., Weng, Y., & Chiu, T. (2013). Risk factors associated with complications in patients with chemotherapy-induced febrile neutropenia in emergency department. *Hematological Oncology, 31*(4), 189-196. doi:10.1002/hon.2040

Meer, D., Weiland, M., Philip, T., Jelinek, J., Boughey, J., Knott, G., . . . Kelly, H. (2016). Presentation patterns and outcomes of patients with cancer accessing care in emergency departments in Victoria, Australia. *Supportive Care in Cancer, 24*(3), 1251-1260. doi:10.1007/s00520-015-2921-4

Mokart, D., Darmon, M., Resche-Rigon, M., Lemiale, V., . . . Azoulay, E. (2015). Prognosis of neutropenic patients admitted to the intensive care unit. *Intensive Care Medicine, 41*(2), 296-303. doi:10.1007/s00134-014-3615-y

Morneau, K., Chisholm, G., Tverdek, F., Bruno, J., & Toale, K. (2017). Timing to antibiotic therapy in septic oncologic patients presenting without hypotension. *Supportive Care in Cancer, 25*(11), 3357-3363. doi:10.1007/s00520-017-3754-0

Nirenberg, A., Mulhearn, L., Lin, S., & Larson, E. (2004). Emergency department waiting times for patients with cancer with febrile neutropenia: A pilot study. *Oncology Nursing Forum, 31*(4), 711-5. doi:10.1188/04.ONF.711-715

Numico, G., Cristofano, A., Mozzicafreddo, A., Cursio, O., Franco, P., Courthod, G., . . . Silvestris, N. (2015). Hospital admission of cancer patients: avoidable practice or necessary care? *PLoS One, 10*(3), E0120827. doi:10.1371/journal.pone.0120827

Oatley, M., Fry, M., & Mullen, L. (2016). A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. *International Emergency Nursing, 24*, 35-38. doi:10.1016/j.ienj.2015.05.007

Paddock, M., Grock, A., Deloughery, T., & Mason, J. (2017). Can neutropenic fever ever be low risk? *Annals of Emergency Medicine, 69*(6), 765-767. doi:10.1016/j.annemergmed.2017.03.068

Patel, P., Goodman, L., Knepel, S., Miller, C., Azimi, A., Phillips, G., . . . Hartman, A. (2017). Evaluation of emergency department management of opioid-tolerant cancer patients with acute pain. *Journal of Pain and Symptom Management, 54*(4), 501-507. doi:10.1016/j. jpainsymman.2017.07.013

Sadik, M., Ozlem, K., Huseyin, M., Aliayberk, B., Ahmet, S., & Ozgur, O. (2014). Attributes of cancer patients admitted to the emergency department in one year. *World Journal of Emergency Medicine, 5*(2), 85-90. doi:10.5847/wjem.j.1920-8642.201

Scholer, A., Mahmoud, O., Ghosh, D., Schwartzman, J., Farooq, M., Cabrera, J., . . . Chokshi, R. (2017). Improving cancer patient emergency room utilization: A New Jersey state assessment. *Cancer Epidemiology, 51*, 15-22. doi:10.1016/j.canep.2017.09.006

Schull, M. J., Hatcher, C. M., Guttmann, A., Leaver, C. A., Vermeulen, M., Rowe, B. H., Anderson, G. M., Zwarenstein, M. (2010). *Development of a consensus on evidence-based quality of care indicators for Canadian emergency departments* (ICES investigative report). Toronto, Ont.: Institute for Clinical Evaluative Sciences.

Smith, T., Khatcheressian, J., Lyman, G., Ozer, H., Armitage, J., Balducci, L., . . . Wolff, A. (2006). 2006 update of recommendations for the use of white blood cell growth factors: An evidence-based clinical practice guideline. Journal of Clinical Oncology : Official Journal of the American Society of Clinical Oncology, 24(19), 3187-205.

Strojnik, S., Mahkovic-Hergouth, K., Novakovic, B., & Seruga, B. (2016). Outcome of severe infections in afebrile neutropenic cancer patients. *Radiology and Oncology, 50*(4), 442-448. doi:10.1515/raon-2016-0011

Sun, H., & Nemecek, A. (2010). Optimal management of malignant epidural spinal cord compression. *Hematology/Oncology Clinics of North America, 24*(3), 537-551. doi:10.1016/j.emc.2009.02.001

Szwajcer, D., Czaykowski, P., & Turner, D. (2011). Assessment and management of febrile neutropenia in emergency departments within a regional health authority-a benchmark analysis. *Current Oncology, 18*(6), 280-4. doi:10.3747/co.v18i6.841

Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. *Journal of Clinical Oncology, 36*(14), 1443-1453. doi:10.1200/JCO.2017.77.6211

Walji, N., Chan, A., & Peake, D. (2008). Common acute oncological emergencies: Diagnosis, investigation and management. *Postgraduate Medical Journal, 84*(994), 418-27. doi:10.1136/pgmj.2007.067033

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2014). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3), 190-198. doi:10.1177/1078155213492450

Weycker, D., Li, X., Figueredo, J., Barron, R., Tzivelekis, S., & Hagiwara, M. (2016). Risk of chemotherapy-induced febrile neutropenia in cancer patients receiving pegfilgrastim prophylaxis: Does timing of administration matter? *Supportive Care in Cancer, 24*(5), 2309-2316. doi:10.1007/s00520-015-3036-7

The Impact of Emergency Department Triage on the Treatment Outcomes of Cancer Patients with Febrile Neutropenia

Chapter Four

This chapter constitutes the third manuscript of the thesis. The purpose was to evaluate whether patients with cancer received the appropriate triage score when they presented with FN, and to explore how inappropriate scores (mal-triage) affected the treatment process and treatment outcomes throughout the ED stay. Data were collected from the health records of all adults with cancer who presented with FN to one Canadian ED over a five-year period.

Abstract

Background: The emergency department (ED) is an important entry point for patients with cancer requiring acute care due to oncological emergencies. Febrile neutropenia (FN) is one of the most common oncological emergencies and carries a significant risk of morbidity and mortality. There is evidence from previous studies that FN patients wait far longer in the ED than recommended by the triage and FN guidelines.

Purpose: The aim was to examine whether individuals with cancer presenting at the ED with FN were triaged appropriately, and to explore if, and how, triage affected their treatment outcomes.

Methods: A retrospective cohort design was employed to collect data over five years from all available ED records of adult cancer patients who presented with fever.

Results: Of the 431 eligible patients, 63% (n = 272) were assigned triage scores that were detrimental to their immediate health. Findings from the multiple linear regression analyses showed that inaccurate or mal-triage was significantly associated with delayed times for the initial physician assessment, administration of antibiotics, and decision on admission. The absence of fever at the time of triage assessment contributed significantly to the prediction of mal-triage.

Conclusion: The allocation of patients with FN to a lower, inaccurate priority was partly responsible for the inability of those patients to meet the standard benchmarks for the initial physician assessment and the administration of antibiotics identified by the triage and febrile neutropenia guidelines. Ongoing strategies are needed to both enhance the application of the triage guidelines and institute organizational and system changes that promote timeliness and effectiveness throughout the entire ED episode of care.

Febrile neutropenia (FN) is the most common oncological emergency (Bryant et al., 2015; Vandyk, Harrison, Macartney, Ross-White, & Stacey, 2012). FN results in considerable morbidity, mortality and costs, and can cause the termination of effective chemotherapy treatment (Lyman, Abella, & Pettengell, 2014). One study documented the clinical burden of FN as 13 days of hospital stay, 14.0% mortality, and a single hospitalization cost of over $22,000 (Kuderer et al., 2006). FN is considered potentially life-threatening as failure to implement immediate treatment can be associated with rapid progression to septicemia. Empiric antibiotic therapy should be initiated promptly as delayed initiation of antibiotics can relate to increased mortality (Adelberg & Bishop, 2009; Gabriel, 2012; Livingston, Craike, & Slavin, 2012). Morneau and colleagues (2017) reported a 16.0% probability increase for in-hospital mortality for every hour of delay in the administration of the needed antibiotics, whereas other researchers have reported that early antibiotic administration is associated with fewer complications and higher survival rates among patients with FN (Lynn, Chen, Weng, & Chiu, 2013; Rosa & Goldani, 2014). The results from a recent systematic review provided strong evidence for early management in the ED suggesting a significant 33% reduction in mortality odds for immediate (within 1 hour) antibiotic administration (Johnston et al., 2017). Despite such benefits of early administration of antibiotics, delayed emergency care and prolonged time to antibiotics have been identified in many epidemiological studies (Nirenberg, Mulhearn, Lin, & Larson, 2004; Oatley, Fry, & Mullen, 2016; Szwajcer, Czaykowski, and Turner, 2011).

In the ED, the demand for emergency service is unpredictable, and crowding within an ED is considered an inevitable event (Forero, Mccarthy, & Hillman, 2011).

However, timely and effective ED care is needed for good patient outcomes (Pines & Hollander, 2008). To better achieve this objective, many EDs established mechanisms to sort and prioritize patients to make sure that those with a life-threatening condition such as FN are seen immediately, while others with more stable conditions are safe to wait (Bullard et al., 2017). Historically, EDs did not use standardized triage systems, but since 1999, scales have been introduced to Canadian EDs to standardize triage decisions making them more objective and justified (Beveridge et al., 1998; Murray, Bullard, & Grafstein, 2004). The Canadian Triage and Acuity Scale (CTAS) guidelines categorize ED arrival acuity into one of five numeric levels based on how urgently, in terms of minutes, patients need to be seen by the ED physician (Beveridge et al., 1998).

Currently, cancer patients presenting with FN are benchmarked to be assessed within 15 minutes, which equates to a CTAS level of '2' (Bullard et al., 2017). Antibiotics are to be given within one hour of the patient's ED presentation (Freifeld et al., 2011). However, patients can be inappropriately triaged resulting in a longer wait time than is considered safe for their condition. Registered nurses are the professionals who carry out the triage function in most EDs. They are essential to initiating an effective treatment process for each patient. Assigning accurate triage scores is particularly crucial for patients with life-threatening conditions to ensure appropriate emergency care is provided promptly.

This study represents a first step in meeting a longer-term goal of helping triage nurses bridge the gap between theory (the expected care), and practice (the observed or actual care). It was part of a more extensive study that examined the quality of ED care throughout the ED visit for cancer patients with FN. This study focused on triage

decisions and aimed to evaluate whether cancer patients presenting with FN were triaged appropriately and how triage affected their treatment outcomes. The findings from this study will be used to improve the care provided in the ED, expand the knowledge base of emergency care, and inform clinicians, administrators, researchers, and policymakers about the performance of the triage system and its effectiveness in promoting patient outcomes.

Research Questions

1. What effect does the mal-triage of patients with FN have on meeting care standards (time for the physician initial assessment and time to antibiotics), the decision time to admit/discharge, length of stay (LOS), and ED disposition?
2. Can contextual factors (arrival time, arrival day, mode of arrival, and ED crowding) and select patient characteristics (age, sex, and vital signs) predict the occurrence of mal-triage among patients with FN?

Methods

The study design was a retrospective cohort. Data were collected from all available records of adult patients diagnosed with cancer who presented with fever to one urban ED triage in Atlantic Canada. Individuals were eligible if they were at least 18 years of age and had presented to the ED with a fever in the five-year study period from 2011 to 2016. Data were collected by conducting chart reviews using a standardized, piloted, chart review form (CRF). A pilot test of the CRF was performed, and changes were made as necessary to enhance the rigor and minimize biases. For example, the order of items on the CRF was changed to match the order of data in the patient health records. Each patient was assigned a unique de-identified study code to protect the confidentiality

of their information. Health ethics approval was obtained by the provincial health research ethics board (Ref #: 20190499).

Cohort Assembly

Identification of relevant health records required data linkages between the provincial cancer registry and ED electronic patient health records. The Cancer Registry for the province where this study was performed identified all adults who received a cancer diagnosis between 2011/12 and 2015/16. This list of individuals was sent by the Cancer Registry to a provincial health information agency where the data linkage was conducted. The health information agency identified all target patients from the Cancer Registry using the following inclusion criteria: i) diagnosed with cancer, ii) 18 years and older, iii) presented with fever to the ED during the study period, iv) the date of ED presentation was later than the date of cancer diagnosis, and v) only the first ED visit was included. All data transfer occurred securely through the Managed File Transfer (MFT) system.

Eligible patients were categorized into two groups based on their exposure status. For this study, exposure was defined as receiving an inaccurate triage classification. The exposed group consisted of FN patients who were mal-triaged: that is, they received a CTAS score of ‘3’, ‘4’, or ‘5’. The unexposed group contained the individuals who were appropriately triaged: that is, were classified as ‘1’ or ‘2’ under the triage guidelines. Each participant in the sample was expected to receive a CTAS score of ‘2’ (or ‘1’ if he/she was unstable).

Measures

The outcome variables of mal-triage represented different ED processes that were found to be essential determinants of the health outcomes for patients with FN (Bullard et al., 2017; Freifeld et al., 2011; Keng et al., 2015; Rosa & Goldani, 2014; Morneau et al., 2017). These six variables were : i) time for the physician initial assessment (PIA), ii) time to antibiotics (TTA), iii) the decision time to admit or discharge, iv) ED disposition, v) ED length of stay (ED LOS), and vi) hospital length of stay (hospital LOS).

Data were also collected about possible confounders that might have an impact on the study outcomes. In the regression models, we accounted for the following potential confounders: (1) patient demographics (age and sex), (2) vital signs (temperature (Temp), blood pressure (BP), heart rate (HR), respiratory rate (RR), and peripheral capillary oxygen saturation (spo2)), and (3) contextual factors (arrival mode, time of arrival, day of arrival, and ED crowding) (Atzema, Austin, Tu, & Schull, 2009). ED crowding was measured by boarding time which is the time spent in the ED after the decision was made to admit the patient (Hwang et al., 2011; Mccarthy et al., 2009).

Furthermore, we applied additional scoring systems to assess the severity and the seriousness of FN in terms of i) growth factor use, ii) absolute neutrophil count (ANC), and iii) the Multinational Association for Supportive Care in Cancer scoring system (MASCC). Prophylactic administration of growth factors can be associated with a lower incidence or less severe FN and an improved recovery (Kawatkar et al., 2017). The ANC measures the percentage of neutrophils in the white blood count calculated by multiplying the white blood count (WBC) by the total neutrophils (segmented neutrophils% + segmented bands%) by ten. The ANC is indicative of immunosuppression and the risk for

infection. The MASCC is used to assess the seriousness of FN based on eight criteria that categorize the severity of FN into low and high-risk FN. These criteria were age of the patient, the burden of FN, presence of hypotension, having chronic obstructive pulmonary disease, solid tumor or hematologic malignancy, history of previous fungal infection, no dehydration requiring parenteral fluids, and the outpatient status (Taplitz et al., 2018).

Quality Control

We implemented a number of quality control audits to ensure the reliability and validity of data collection and entry. First, data were collected using a standardized form. Data collection was done by the first author of this article who had expertise in chart audits. The data were coded on a data entry form using a standardized codebook. Then, data entry was verified by the same researcher selecting a random sample of 176 cases (40% of our sample) for review to ensure correct data entry. Any variable with a single error in data entry was to be subjected to the full analysis of every case, to provide proper data entry for that variable. However, no errors were found in the predictor variable (triage score) or the main outcomes variables (PIA, TTA, and sorting time).

Statistical Analysis

The continuous variables (e.g., PIA, TTA, LOS, etc.) were summarized using means and standard deviations (SD) and were collapsed into categories according to the clinically substantial cut-offs. The categorical variables (e.g., sex, type of cancer, risk of FN, and ED disposition) were summarized using frequencies and percentages. The differences in the distribution between the exposed and unexposed groups were examined at baseline using the Chi-square test. The differences in the distributions between the two

groups were not statistically significant if the p-values were equal to or higher than the predetermined α level of 0.05.

Multiple linear regression analyses were used to test if mal-triage was significantly associated with each of outcome variables while accounting for age, sex, time of arrival, mode of arrival, day of arrival, MASCC score, and ED crowding. Multiple logistic regression analyses were used to identify the factors which were significantly associated with risk of not meeting the guidelines' time objective for physician initial assessment and antibiotic administration. Multiple logistic regression analysis was also used to identify the variables that were significantly associated with the occurrence of mal-triage. Also, bidirectional (backward & forward) elimination criteria for stepwise regression were implemented to build each of the multiple, different, final regression models with α entry of 0.20 and α stay of 0.05 after assessing any significant confounders and interaction effect. The analysis was done using the SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

Results

Baseline Study Cohort Characteristics

The study sample consisted of 431 patients who were categorized into one of two groups based on their exposure status. Two hundred and seventy-two patients (63%) from the total sample comprised the exposed or mal-triaged group. The exposed group received a triage score of '3', '4', or '5'. This group was 48% female and had an average age of 61 years. The majority (n = 152, 56%) visited the ED during evening hours (15:00h to 22:59h), and 14% (n = 37) arrived by ambulance. Nearly 69% (n = 188) were diagnosed with a solid cancer tumor, and the remaining 84 individuals (31%) had a form of

hematological cancer. Two-thirds (66%) of the mal-triage group were in an advanced stage of illness.

The unexposed group, that is, those who received the appropriate triage score of '1' or '2', constituted 37% (n = 159) of the total sample. This group was 50% female and slightly younger with an average age of 59 years. Over half of the unexposed group (55%) presented to the ED during evening hours (15:00h to 22:59h), and 13% arrived by ambulance. Two-thirds (n = 105) had a solid tumor, and one-third (n = 54) suffered from one of the hematological malignancies with more than half (57%) having advanced stage cancer. Table 1 provides the comparisons of the characteristics between the exposed and unexposed groups. The two groups were equivalent at the outset as there were no statistically significant differences regarding age, sex, type of malignancy, and stage of cancer, arrival time, day of arrival, mode of arrival, and prior growth factors administration ($p > .05$). The severity and the seriousness of FN are reported in Table 2. Around two-thirds of patients who were exposed (68%) and those who were unexposed (70%) were identified to have a high-risk FN (MASCC < 21). 36% of unexposed patients had profound neutropenia (ANC < 500) compared to 24% of patients who were exposed.

Table 1

Description of the Study Cohort

Characteristic		Mal-triaged	
		Yes ***n* (%)**	No ***n* (%)**
Sex	Female	130 (48)	79 (50)
	Male	142 (52)	80 (50)
Age	<60 yrs.	100 (37)	74 (46)
	60-70 yrs.	106 (39)	52 (33)
	>70 yrs.	66 (24)	33 (21)
Arrival Time	0700H-14:59H	69 (25)	41 (26)
	1500H-22:59H	152 (56)	88 (55)
	2300H-06:59H	51 (19)	30 (19)
Day of Arrival	Weekdays	189 (69)	104 (65)
	Weekends	83 (31)	55 (35)
Arrival Mode	Walk-In	235 (86)	139 (87)
	Ambulance	37 (14)	20 (13)
Type of Malignancy	Solid	188 (69)	105 (66)
	Hematological	84 (31)	54 (34)
Stage of Cancer	1+2	69 (34)	52 (43)
	3	63 (31)	36 (29)
	4	70 (35)	34 (28)
Growth Factor	G–CSF	12 (4.4)	14 (8.8)
	None	260 (95.6)	145 (91.2)

Note. The results from chi-square test revealed that the two groups were equivalent at the outset ($p > .05$).

Table 2

Assessment and Risk Stratification of the Study Cohort

Characteristic	Mal-triaged	
	Yes ***n* (%)**	No ***n* (%)**
Triage Score		
Resuscitation (1)	-	1 (0.6)
Emergent (2)	-	158 (99.4)
Urgent (3)	258 (95)	-
Less-Urgent (4)	13 (4.7)	-
None-Urgent (5)	1 (0.3)	-
Absolute Neutrophil Count		
ANC < 100	36 (13.2)	39 (24.5)
100 < ANC < 500	29 (10.6)	19 (11.9)
ANC >500	207 (76.2)	101 (63.6)
Multinational Association for Supportive Care in Cancer		
High-Risk FN (MASCC < 21)	184 (67.6)	112 (70.4)
Low-Risk FN (MASCC ≥ 21)	88 (32.4)	47 (29.6)

Effect of Mal-triage on Treatment Outcomes

Table 3 shows the effect of mal-triage on the treatment outcomes. The results from multiple linear regression analysis revealed that the mal-triage of patients with FN significantly prolonged the time for physician initial assessment (PIA). On average, mal-triage was associated with 49 minutes increase (95% *CI* [36, 62], $p = .001$) before being seen by the ED physician. The multiple logistic regression analysis identified that patients who were mal-triaged were seven times more likely not to meet the benchmark time to be seen by a physician (within 15 minutes) compared to those who were appropriately triaged ($OR = 7$, 95% *CI* [2.6, 20.1], $p = .001$).

Table 3

Comparison of Key Treatment Outcomes by Exposure Status (Multivariate Analyses)

Outcome	Mal-triaged		Group Differences (*β*) [95% CI] *p* value
	Yes	**No**	
	Mean *(SD)*	Mean *(SD)*	
Physician Initial Assessment (PIA) (Minutes)	99.0 (78.0)	50.0 (35.0)	*β* = 49 [36, 62] *p* = .001
Time to Antibiotics (TTA) (Minutes)	270.0 (216.6)	165.0 (114.2)	*β* = 68 [27, 109] *p* = .001
Time to Decision for Admitted Patients (Hours)	6.3 (3.2)	5.5 (3.5)	*β* = 0.84 [0 .04, 1.70] *p* = .045
ED LOS (Hours)	21.0 (14.6)	22.0 (15.9)	*β = 0.49* [-0.33, 1.32] *p = .245*
Hospital LOS (Days)	7.6 (7.1)	8.2 (10.4)	*β* = -0.49 [-2.59, 1.62] *p* = .654

Note. Variables included in the multivariate analysis were mal-triage, age, sex, time of arrival, mode of arrival, day of arrival, ANC, MASCC score, and ED crowding (boarding time).

Final Model: PIA = mal-triage, sex, MASCC, & boarding time.
Final Model: TTA = mal-triage, PIA, & boarding time.
Final Model: Time to Decision on Admission = mal-triage, PIA, MASCC, & boarding time.
Final Model: ED LOS = Time to Decision on Admission & boarding time.
Final Model: Hospital LOS = boarding time.

Note. ANC = absolute neutrophil count; MASCC = Multinational Association for Supportive Care in Cancer scoring system.

The results from multiple linear regression analysis have also shown that mal-triage was significantly associated with delayed time to antibiotics (TTA). On average, mal-triage was associated with a delay of 68 minutes (95% CI [27, 109], $p = .001$) before the administration of antibiotic therapy. The multiple logistic regression analysis revealed that patients who were mal-triaged were over nine times more likely to fail to meet the

60-minute benchmark time for treatment compared to those who were appropriately triaged (*OR* = 9, 95% CI [2.1, 43.1], *p* = .003).

In the multiple linear regression analysis, mal-triage was significantly associated with a prolonged time for an admission decision among the patients who were admitted from the ED (β = 0.84, *t* (272) = 2.1, *p* = .045). Mal-triage had no statistically significant impact on the ED length of stay (LOS) (*p* = .276). The average ED LOS was 21 and 22 hours among mal-triaged patients and those who were appropriately triaged, respectively. For both groups, more than two-thirds of the ED LOS was spent waiting for an inpatient bed (Mean = 16 hours). Mal-triage had no statistically significant impact on hospital LOS with a mean hospital LOS of eight days (*p* = .654).

Furthermore, despite the fact that a larger proportion of appropriately triaged patients were admitted compared to patients who were mal-triaged (70% vs. 60%), there were no significant differences in the disposition outcomes of the two groups (Table 4). The majority of patients from both the mal-triaged (*n* = 162) and appropriately triaged (*n* = 111) groups were admitted to an inpatient bed with a small number (14%) requiring admission to the ICU.

Table 4

Disposition of the FN patients by Exposure Status in the ED

Outcome		Mal-triaged		
		Yes *n (%)*	**No** *n (%)*	*p* value
ED Disposition	Admitted	162 (60)	111 (70)	$p = 0.055$
	Discharged	107 (40)	48 (30)	
Admission Site	ICU	7 (4.3)	11 (10)	$p = .178$
	Ward	154 (95.7)	100 (90)	

Predictors of Mal-triage

Multiple variables were examined to assess the occurrence of mal-triage. Only two variables were found to make a significant contribution to mal-triage. First, the absence of fever at the time of triage assessment contributed significantly to the prediction of mal-triage. Patients with a temperature of less than 38.0°C had double the risk of being mal-triaged compared to those whose measured temperature was more than 38.0°C during the triage assessment (*OR* = 1.99, CI [1.26, 3.14], $p = .003$). Finally, heart rate (HR) contributed significantly to the prediction of mal-triage (*OR* = 0.97, CI [0.96, 0.98], $p = .001$). Predictors of Mal-triage are shown in Table 5.

Table 5

Predictors of Mal-triage

Variable	*OR* [95% CI], *p* value	Variable	*OR* [95% CI], *p* value
Temp Afebrile vs. Febrile	1.99 [1.26, 3.14], $p = .003$*	**HR**	0.97 [0.96, 0.98], $p = .001$*
Sex Males vs. Females	0.92 [0.55, 1.54], $p = .702$	**spo2**	0.96 [0.86, 1.07], $p = .223$
Age	0.99 [0.97, 1.01], $p = .836$	**BP**	0.99 [0.97, 1.02], $p = .672$
Arrival Time Evening vs. Day Night vs. Day	1.00 [0.54, 1.83], $p = .999$ 1.01 [0.59, 1.73], $p = .946$	**RR**	0.95 [0.86, 1.06], $p = .134$
Day of Arrival Weekdays vs. Weekend	0.58 [0.22, 1.34], $p = .191$	**MASCC Score**	0.97 [0.90, 1.06], $p = .813$
Mode of Arrival Walk-in vs. Ambulance	1.15 [0.29, 4.56], $p = .877$	**ED Crowding** Boarding time	1.00 [1.00, 1.01], $p = .283$
Type of Malignancy Solid vs. Hematological	1.07 [0.53, 2.13], $p = .632$	**Growth Factors** Yes vs. No	0.77 [0.26, 2.29], $p = .837$

Note. Variables included in the multivariate logistic regression analysis were age, sex, time of arrival, mode of arrival, day of arrival, MASCC score, vital signs, type of cancer, growth factor use, and ED crowding (boarding time). Only Temp and HR were remained in the final model; Temp = temperature; HR = heart rate; spo2 = peripheral capillary oxygen saturation; BP = blood pressure; RR = respiratory rate; MASCC = Multinational Association for Supportive Care in Cancer scoring system.

Discussion

The early recognition and the prompt delivery of emergency care of patients with FN have been recommended as effective strategies for several decades (Shelton, 1999). However, triage implementation can go wrong, exposing patients to mal-triage. We found that 63% of the patients in our sample were inappropriately triaged and assigned to less urgent triage categories. Our results are similar to previous studies that found assigned triages scores were not consistent with triage recommendations for patients with FN and conditions such as myocardial infarction (Atzema et al., 2009; Howlett & Atkinson, 2012;

Oatley et al., 2016; Szwajcer et al., 2011). The impact of mal-triage can be detrimental as inappropriate triage can translate into longer wait times and delayed treatment (Bryant et al., 2015; Mofid, Novin, Roointan, & Forouzanfar, 2016).

The mal-triage of patients with FN was significantly associated with a number of clinically relevant treatment outcomes. On average, mal-triaged patients had to wait 99 minutes (*Median* = 78 minutes) before being examined by the ED physician. The CTAS guidelines recommend a wait time no longer than 15 minutes for patients with FN. However, 98% of the patients who were mal-triaged were not seen by the physician within the expected timeframe. Patients who were mal-triaged were seven times more likely not to meet the benchmarked time to be seen by a physician compared to those who were appropriately triaged. Livingston and colleagues (2012) reported shorter wait time with the median ED wait time of 10 minutes. Strojnik et al. (2016) reported similar time to our study where patients had to wait for a median time of 75 minutes before being evaluated by the ED physician.

Mal-triage was also significantly associated with prolonged TTA. On average, mal-triaged patients had to wait 270 minutes (*Median* = 197 minutes) before receiving the required antibiotics. The FN guidelines recommend the administration of antibiotics within one hour. Patients who were mal-triaged were over nine times more likely to fail to meet the 60-minute benchmark compared to those who were appropriately triaged. Courtney et al. (2007) reported that antibiotics were administered in the ED at a median time of 102 minutes. Lim et al. (2011) documented a median time from ED presentation to the start of antibiotic therapy of 120 minutes. Other studies reported longer median times of around 210 minutes (Burry et al., 2012; Nirenberg et al., 2004; Szwajcer et al.,

2011). These results indicate that the ED assessment and care of FN patients does not reflect current guidelines regarding PIA and TTA, especially among those who were mal-triaged.

Our findings also revealed that mal-triage was significantly associated with a prolonged admission decision time. Moreover, while the evidence from multiple studies suggested that triage can be predictive of ED and hospital LOS, mal-triage had no statistically significant impact on ED LOS in this study. Boarding time was a better predictor of ED LOS than exposure to mal-triage. Boarding time measured the time from the decision to admit a patient to an inpatient service until the time the patient was transported to that service. The mean ED LOS in our sample was 16 hours with more than half of that time spent waiting for an inpatient bed (the mean boarding time = 10 hours). Only one study (Strojnik et al. 2016) reported a similar wait time (10 hours) from the admission decision until the final disposition to the inpatient unit. However, the ED LOS in our sample is much longer than what is reported in the literature. Nirenberg et al. (2004) reported a mean time for an ED LOS of 5.5 hours. Similarly, Oatley et al. (2016) documented a mean ED LOS for cancer patients of 8 hours compared to 5 hours for the entire ED presentations. Other studies reported shorter times with an ED LOS of 3.3 hours (Courtney et al., 2007). This long ED LOS has the potential to affect the quality of care. Patients with FN are at a higher risk of infection and sepsis complications. Therefore, the standard of care is to keep those patients in protective isolation rather than leaving them in a highly infectious setting such as the ED setting (Freifeld et al., 2011; Vandyk et al., 2012). Finally, mal-triage had no statistically significant impact on hospital LOS. Boarding time was found a better predictor of hospital LOS than mal-triage. The

mean hospital LOS was eight days in both groups which is similar to the figures from previous studies (Culakova et al., 2004; Kawatkar et al., 2017; Oatley et al., 2016; Weycker et al., 2014).

The absence of fever at the time of triage assessment contributed significantly to the prediction of mal-triage. Although fever is an essential sign of infection, lack of fever does not necessarily exclude it (Adelberg & Bishop, 2009). The FN clinical guidelines recommend that afebrile, neutropenic patients who have new signs or symptoms suggestive of infection be evaluated and treated as high-risk patients (Freifeld et al., 2011). Patients with afebrile neutropenia were found to have significantly higher 30-day in-hospital mortality rates when compared to patients with FN (Strojnik et al., 2016).

Vital signs are considered essential first-order modifiers that need to be applied, and if done so appropriately, can be used to change the initial anticipated triage acuity level (Murray et al., 2004). Ignoring the vital signs of these patients contradicts the definition of fever in FN where fever is defined as "a single oral temperature measurement of 38.3°C or a temperature of 38.0°C sustained over a 1-h period" (Freifeld et al., 2011, p.3). Accordingly, many patients in our study had a fever of 38.3°C in the ambulance or at home, but again were mal-triaged because the measured temperature at triage was 38°C or less. Still, half of patients who had a high fever (> 38.3°C) at triage were also mal-triaged to lower triage categories. Nirenberg et al. (2004) found that the majority of FN patients experienced fever for a mean time of 21 hours before seeking emergency care. Moreover, more than one-third (37%) of patients in our sample had profound neutropenia (ANC < 500) in the initial ANC results suggesting the earlier onset of FN from home. Triage nurses should follow the triage guidelines and allocate those

afebrile patients to the urgent triage category (level 2) if they report the occurrence of fever before presentation to the ED (Bullard et al., 2017). Furthermore, while heart rate (HR) contributed significantly to the prediction of mal-triage, we do not see any clinical significance for this result ($OR \approx 1$) because the indication for the sinus tachycardia probably resulted from the presenting complaint of fever (increased temperature).

A first step to improve the ED care of patients with FN is to enhance triage nurse's knowledge of FN to better inform triage decision-making. This process should be continuous and interactive using an audit and feedback system. Knowledge of FN, including its signs and symptoms, is fundamental to enable triage nurses to differentiate the risk and urgency of FN. Triage decisions should be evaluated periodically, and regular triage competency assessments should be conducted annually. Also, as part of the competency assessment, chart audits should be carried out to provide individual triage nurses with the findings specific to their performance. Customized strategies could then be put in place to address the explicit challenges of each individual triage nurse.

Accumulated evidence supports the need to conduct routine system monitoring and benchmark analysis to meet the time objectives set by the guidelines to tailor different ED resources to meet these benchmarks (Bullard et al., 2017; Howlett & Atkinson, 2012). The CTAS developers, for example, recommended a continuous monitoring of the time objective set out by the guidelines (Bullard, Unger, Spence, & Grafstein, 2008). In this study, we were driven by this mandate to make sure that patients with FN are identified early to receive a timely treatment with antibiotics as per the recommendations of the FN guidelines. This study focused solely on treatment outcomes

such as PIA and TTA; however, future research should examine the occurrence of severe adverse health outcomes such as sepsis, septic shock, and death.

Strengths of this study include anticipating possible threats to validity and addressing them effectively. Selection bias was reduced because the subjects were recruited by the provincial information center who independently identified eligible relevant health records. Moreover, the use of standardized and piloted chart review form maintained the consistency of data collection process and minimized information bias. Last, we assessed and controlled the effect of possible confounding variables. Still, this study has some inherent limitations demonstrated in the employed retrospective design where the validity of the results will be dependent upon the accuracy of the reviewed medical records. Also, this observational design shares the common limitations in that unknown confounders often muddy the observed effect. Finally, we were not able to enroll patients who had recent visits to ED because there was a two-year delay in entering new individuals with a cancer diagnosis in the cancer registry.

Conclusion

To allocate patients with FN to a lower, inaccurate priority resulted in a longer time for the initial physician assessment, for the administration of antibiotics, and to decide on admission in the crowded and potentially high risk for acquiring infection. Mal-triage contributed significantly to those patients not reaching the standard benchmark for initial physician assessment and the administration of antibiotics as recommended by the triage and febrile neutropenia guidelines. The rapid identification of these patients and prompt initiation of treatment is essential for better patient outcomes. Triage nurses should use the triage guidelines effectively to enable these patients to meet the

benchmarks. An audit and feedback system for the implementation of triage should be established to enhance conformance with guidelines.

References

Adelberg, D., & Bishop, M. (2009). Emergencies related to cancer chemotherapy and hematopoietic stem cell transplantation. *Emergency Medicine Clinics of North America, 27*(2), 311-331. doi:10.1016/j.emc.2009.01.005

Andre, S., Taboulet, P., Elie, C., Milpied, N., Nahon, M., Kierzek, G., . . . Claessens, Y. (2010). Febrile neutropenia in French emergency departments: Results of a prospective multicentre survey. *Critical Care, 14*(2), R68. doi:10.1186/cc8972

Atzema, C., Austin, P., Tu, J., & Schull, M. (2009). Emergency department triage of acute myocardial infarction patients and the effect on outcomes. *Annals of Emergency Medicine, 53*(6), 736-745. doi:10.1016/j.annemergmed.2008.11.011

Berwick, D. M. (2011). Preparing nurses for participation in and leadership of continual improvement. *Journal of Nursing Education, 50*(6), 322–327. doi:10.3928/0148483420110519

Beveridge, R., Janes, L., Savage, N., Thompson, J., Murray, M., Nijssen, C. (1998). Implementation Guidelines for The Canadian Emergency Department Triage & Acuity Scale (CTAS). Retrieved from http://caep.ca/sites/caep.ca/files/caep/files/ctased16.pdf

Bryant, A., Deal, A., Walton, A., Wood, W., Muss, H., & Mayer, D. (2015). Use of ED and hospital services for patients with acute leukemia after induction therapy: One-year follow-up. *Leukemia Research, 39*(4), 406-410. doi: 10.1016/j.leukres.2015.01.006

Bullard, M., Musgrave, E., Warren, D., Unger, B., Skeldon, T., Grierson, R., . . . Swain, J. (2017). Revisions to the Canadian emergency department Triage and Acuity Scale (CTAS) Guidelines 2016. *CJEM, 19*(S2), S18-S27.

Burry, E., Punnett, A., Mehta, A., Thull-Freedman, J., Robinson, L., & Gupta, S. (2012). Identification of educational and infrastructural barriers to prompt antibiotic delivery in febrile neutropenia: A quality improvement initiative. *Pediatric Blood & Cancer, 59*(3), 431-435. doi:10.1002/pbc.23418

Culakova, E., Khorana, A., Kuderer, N., Crawford, J., Dale, D., & Lyman, G. (2004). Hospitalization with febrile neutropenia in colorectal cancer patients. *Journal of Clinical Oncology, 22*(14), 3706-3706. doi:http://dx.doi.org/10.1200/jco.2004.22.90140.3706

Courtney, D., Aldeen, A., Gorman, S., Handler, J., . . . Bennett, C. (2007). Cancer-associated neutropenic fever: clinical outcome and economic costs of emergency department care. *Oncologist, 12*(8), 1019-1026. doi:10.1634/theoncologist.12-8-1019

Forero, R., Mccarthy, S., & Hillman, K. (2011). Access block and emergency department overcrowding. *Critical Care, 15*(2), 216. doi:10.1186/cc9998

Freifeld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., Mullen, C., . . . Wingard, J. (2011). Executive summary: clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 52*(4), 427

Gabriel, J. (2012). Acute oncological emergencies. *Nursing Standard, 27*(4), 35-41.

Hwang, U., McCarthy, M., Aronsky, D., Asplin, B., Crane, P., Craven, C., . . . Bernstein, S. (2011). Measures of crowding in the emergency department: A systematic review. *Academic Emergency Medicine, 18*(5), 527-38. doi:10.1111/j.1553-2712.2011.01054.x

Howlett, M., & Atkinson, P. (2012). A method for reviewing the accuracy and reliability of a five-level triage process (Canadian Triage and Acuity Scale) in a community emergency department setting: Building the crowding measurement infrastructure. *Emergency Medicine International,* 1-5. doi:10.1155/2012/636045

Johnston, A., Park, J., Doi, S., Sharman, V., Clark, J., Robinson, J., & Crilly, J. (2017). Effect of immediate administration of antibiotics in patients with sepsis in tertiary care: A systematic review and meta-analysis. *Clinical Therapeutics, 39*(1), 190-202.e6. doi:10.1016/ j.clinthera.2016.12.003

Kawatkar, A., Farias, A., Chao, C., Chen, W., Barron, R., Vogl, F., & Chandler, D. (2017). Hospitalizations, outcomes, and management costs of febrile neutropenia in patients from a managed care population. *Supportive Care in Cancer, 25*(9), 2787-2795. doi:10.1007/s00520-017-3692-x

Keng, M., Thallner, E., Elson, P., Ajon, C., Sekeres, J., . . . Sekeres, M. (2015). Reducing time to antibiotic administration for febrile neutropenia in the emergency department. *Journal of Oncology Practice, 11*(6), 450-455. doi:10.1200/JOP.2014.002733

Klastersky, J. (2004). Antifungal therapy in patients with fever and neutropenia — more rational and less empirical. *New England Journal of Medicine, 351*(14), 1445-1447. doi:10.1056/NEJMe048203

Kuderer, N., Dale, D., Crawford, J., Cosler, L., & Lyman, G. (2006). Mortality, morbidity, and cost associated with febrile neutropenia in adult cancer patients. *Cancer, 106*(10), 2258-2266. doi:10.1002/cncr.21847

Lim, J., Kim, H., Choi, W., Kim, K., Shin, D., & Lee, M. (2011). Outcomes in 102 patients that present to the emergency department with chemotherapy-induced febrile neutropenia. *Turkish Journal of Haematology, 28*(3), 193-197. doi:10.5152/tjh.2011.53

Lyman, G., Abella, E., & Pettengell, R. (2014). Risk factors for febrile neutropenia among patients with cancer receiving chemotherapy: A systematic review. *Critical Reviews in Oncology/ Hematology, 90*(3), 190-199. doi:10.1016/j.critrevonc.2013.12.006

Lynn, J., Chen, K., Weng, Y., & Chiu, T. (2013). Risk factors associated with complications in patients with chemotherapy-induced febrile neutropenia in emergency department. *Hematological Oncology, 31*(4), 189-196. doi:10.1002/hon.2040

Mccarthy, M., Zeger, S., Ding, R., Levin, S., Desmond, J., Lee, J., & Aronsky, M. (2009). Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Annals of Emergency Medicine, 54*(4), 492-503.e4. doi:10.1016/j.annemergmed.2009.03.006

Mofid, B., Novin, K., Roointan, E., & Forouzanfar, M. (2016). Epidemiology and death-related factors of oncology patients in emergency department. *Emergency, 4*(3), 145-50.

Morneau, K., Chisholm, G., Tverdek, F., Bruno, J., & Toale, K. (2017). Timing to antibiotic therapy in septic oncologic patients presenting without hypotension. *Supportive Care in Cancer, 25*(11), 3357-3363. doi:10.1007/s00520-017-3754-0

Murray, Bullard, & Grafstein. (2004). Revisions to the Canadian emergency department Triage and Acuity Scale implementation guidelines. *CJEM, 6(06), 421-427*. doi:10.1017/S1481803500009428

Nirenberg, A., Mulhearn, L., Lin, S., & Larson, E. (2004). Emergency department waiting times for patients with cancer with febrile neutropenia: A pilot study. *Oncology Nursing Forum, 31*(4), 711-5. doi:10.1188/04.ONF.711-715

Oatley, M., Fry, M., & Mullen, L. (2016). A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. *International Emergency Nursing, 24*, 35-38. doi:10.1016/j.ienj.2015.05.007

Painter, D. R. (2010). Nurse's responsibility to improve practice (editorial). *Nephrology Nursing Journal, 37*(3), 227.

Pines, J. M., & Hollander, J. E. (2008). Emergency department crowding is associated with poor care for patients with severe pain. *Annals of Emergency Medicine, 51*(1), 1-5. doi:10.1016/j.annemergmed.2007.07.008

Prachanukool, T., Tangkulpanich, P., Paosaree, P., Sawanyawisuth, K., & Sitthichanbuncha, Y. (2016). Cancer patients are at high risk of mortality if presenting with sepsis at an emergency department. *Asian Pacific Journal of Cancer Prevention, 17*(7), 3423-6. doi:10.14456/apjcp.

Rosa, R. & Goldani, L. (2014). Cohort study of the impact of time to antibiotic administration on mortality in patients with febrile neutropenia. *Antimicrobial Agents and Chemotherapy, 58*(7), 3799. doi:10.1186/1471-2334-14-286

Shelton, R. (2009). The Emergency Severity Index 5-level triage system. *Dimensions of Critical Care Nursing, 28*(1), 9-12. doi:10.1097/01.DCC.0000325106.28851.89

Strojnik, S., Mahkovic-Hergouth, K., Novakovic, B., & Seruga, B. (2016). Outcome of severe infections in afebrile neutropenic cancer patients. *Radiology and Oncology, 50*(4), 442-448. doi:10.1515/raon-2016-0011

Szwajcer, D., Czaykowski, P., & Turner, D. (2011). Assessment and management of febrile neutropenia in emergency departments within a regional health authority-a benchmark analysis. *Current Oncology, 18*(6), 280-294. doi:10.3747/co.v18i6.841

Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America clinical practice guideline update. *Journal of Clinical Oncology, 36*(14), 1443-1453. doi:10.1200/ JCO.2017.77.6211

Vandyk, A., Harrison, D., Macartney, M., Ross-White, B., & Stacey, G. (2012). Emergency department visits for symptoms experienced by oncology patients: A systematic review. *Supportive Care in Cancer, 20*(8), 1589-1599. doi:10.1007/s00520-012-1459-y

Wagner, J., & Arora, S. (2017). Oncologic metabolic emergencies. *Hematology/oncology Clinics of North America, 31*(6), 941-957. doi:10.1016/j.hoc.2017.08.002

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2014). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3), 190-198. doi:10.1177/1078155213492450

Weycker, D., Li, X., Figueredo, J., Barron, R., Tzivelekis, S., & Hagiwara, M. (2016). Risk of chemotherapy-induced febrile neutropenia in cancer patients receiving pegfilgrastim prophylaxis: Does timing of administration matter? *Supportive Care in Cancer, 24*(5), 2309-2316. doi:10.1007/s00520-015-3036-7

Chapter Five

Summary

Despite transformative changes and improvements in health care (e.g., electronic medical records and self-management in chronic diseases), problems related to poor quality care continue to exist (Graham & Varghese, 2011). In health care, the supply is always driven by the demand, disregarding the impact of such supply on the quality and outcome of care (Berwick, 2013). An example of this failure can be seen in the emergency departments (EDs) with a high demand for services, ED overcrowding, and long wait times (Ontario Hospital Association, 2006). However, patients who seek emergency care are likely to require time-sensitive interventions in which such long wait times could have a detrimental effect (Bullard et al., 2017).

The institution of ED triage is considered one of the innovations to the delivery of the current emergency services to regulate the flow and trajectory of patients' care within the department (Forero, Mccarthy, & Hillman, 2011). Historically, EDs did not use standardized triage acuity rating systems, but many emergency agencies support the adoption of a five-level triage scale such as the Canadian Triage and Acuity Scale (CTAS). The CTAS guidelines categorize ED arrival acuity into one of five numeric levels based on how urgently patients need to be seen by the ED physician. For instance, the guidelines prioritize cancer patients who present with fever and recommend allocating them to the second (emergent) triage category. This assigned triage score translates into the patient being assessed by a nurse and a physician within 15 minutes of their arrival to the ED (Bullard et al., 2014).

The CTAS guidelines prioritize fever occurring in cancer patients because this manifestation alone can indicate a severe underlying infection (Freifeld et al., 2011; Weycker et al., 2016). Bone marrow suppression is an expected side effect for many

chemotherapy regimens (Adelberg & Bishop, 2009). Infection due to neutropenia is associated with significant morbidity and mortality in patients receiving chemotherapy (Walji et al., 2008). Evidence indicates that patients with febrile neutropenia (FN) who were exposed to longer ED wait times had substantial antibiotic delays and developed complications of infections and sepsis (Keng et al., 2015; Klastersky, 2004). Results from recent research have raised concerns regarding the accuracy of the triage process, as evidenced by a disparity in health care provision and subsequent adverse outcomes, especially among cancer patients with FN (Oatley, Fry, & Mullen., 2016; Szwajcer, Czaykowski, & Turner., 2011). Therefore, the purpose of this study was to evaluate the effectiveness of the CTAS guidelines in improving the treatment outcomes of cancer patients with FN.

The developers of the CTAS recommended continuous monitoring to verify that the time objective in the guidelines is met and to assess the consistency of the triage process and the compliance in following the guidelines (Bullard, Unger, Spence, & Grafstein, 2008). The literature is lacking studies that determine the appropriateness of the triage implementation and assess the effectiveness of triage in improving patient outcomes. In this summary of my thesis, I have five main objectives. I first review the CTAS guidelines to evaluate if they were identifying the urgency of patients with FN. Second, I discuss the impact of implementing triage in clinical practice. Third, I provide a comprehensive assessment of select ED quality of care indicators for patients with FN. Fourth, I discuss the benefits of early recognition of patients with FN in the ED, highlighting the other factors that contribute to the delayed emergency care even among

patients who were appropriately triaged. Finally, I provide several implications for the results of this study for future research, nursing education and practice.

The Acuity of Febrile Neutropenia Using the CTAS Guidelines

In this study, the CTAS guidelines were evaluated to determine their effectiveness in improving the outcomes of patients with FN. At the theoretical level, I reviewed the CTAS guidelines, their different revisions and updates, the manuals used in the training of triage nurses, and the desktop-supported Complaint Oriented Triage (COT). I conducted an analysis applying the COT in the triage of select oncological emergencies and examined if the acuity of these emergencies was appropriately identified by the guidelines. I found that the CTAS guidelines do anticipate the acuity and urgency of FN. In particular, in the ED setting where the study was conducted, the policy is to use the COT to support the triage decision-making process. The COT prioritizes patients who are immunocompromised with neutropenia (or suspected) and assigns them a triage score of '2' without the need for any further assessment. The guidelines define immunocompromised status as those with neutropenia (or suspected neutropenia), or on chemotherapy or immunosuppressive drugs including steroids (Bullard et al., 2017).

The COT is an interactive computerized tool used in Canadian EDs to triage patients. The COT system instructs the triage nurse to assign a triage score of '2' to all immunocompromised patients, whatever their presenting chief complaint if they were found to have a fever during the triage assessment. Complaints such as chest pain, hypertension, general weakness, leg swelling, facial trauma, sore throat, facial pain, and even anorexia were considered emergent and must be assigned an acuity score of '2' if the patient has an increased temperature at triage.

The Impact of Triage Implementation in Patients with Febrile Neutropenia

The results of triage decision-making in clinical practice were evaluated by reviewing the medical records of all cancer patients who presented with FN to one Canadian ED. Such a focus was justified given the current evidence that identified variations in the triage process, with subsequent long wait times. Precision and accuracy of triage have been an ongoing problem, even with the use of the CTAS guidelines. The findings of multiple studies provide evidence that patients can be assigned to a level of urgency incongruent with the CTAS recommendations resulting in longer wait times (Howlett and Atkinson, 2012; Nirenberg et al., 2004; Oatley et al., 2016; Szwajcer et al., 2011).

I retrospectively followed patients with cancer who presented with fever to one ED triage in the five years from 2011 to 2016. My purpose was to evaluate whether cancer patients received the appropriate triage score when they presented with FN and to explore how mal-triaged decisions affected their treatment outcomes. Limited information is available to determine if proper and timely emergency care is provided for this vulnerable population. Previous studies were limited to examining the benchmarked time for the administration of antibiotics. This study took a broader perspective to be inclusive of various dimensions of quality within the ED. This research study can inform the adoption of evidence-based policies to enhance the efficiency and effectiveness of ED processes for more positive patient outcomes.

Our results were in line with previous studies, in that cancer patients presenting to the ED with FN did not meet the benchmarked times for treatment as specified in the Canadian Triage and FN guidelines. In the ED, the mean waiting time from triage to

physician initial assessment (PIA) was 81 minutes. On average, patients had to wait for 228 minutes before the administration of antibiotics (TTA). Two-thirds of the patients in our sample (63%) were mal-triaged to less urgent triage categories of three, four and five. The mal-triage of patients with FN was significantly associated with several clinically relevant treatment outcomes. On average, mal-triage was associated with 49 minutes delay before the ED physician saw the patients. Patients who were mal-triaged were seven times more likely to not meet the CTAS guidelines' benchmarked time to be seen by a physician compared to those who were appropriately triaged. Mal-triage was also significantly associated with prolonged TTA. On average, mal-triage was associated with 68 minutes delay before the administration of required antibiotics. Patients who were mal-triaged were 9.5 times more likely to not meet the FN guidelines' benchmarked time for the administration of antibiotics compared to those who were appropriately triaged.

Multiple variables were examined that were thought to predict the occurrence of mal-triage. The absence of fever at the time of triage assessment contributed significantly to the prediction of mal-triage. Patients with FN who presented with a temperature of less than 38.0°C had double the risk of being mal-triaged compared to those with high fever (Temperature ≥ 38.0°C). Although fever is a sign of infection, lack of fever does not necessarily exclude it (Adelberg & Bishop, 2009). The FN clinical guidelines recommend that afebrile neutropenic patients who have new signs or symptoms suggestive of infection be evaluated and treated as high-risk patients (Freifeld et al. 2011). Patients with afebrile neutropenia were found to have significantly higher 30-day in-hospital mortality rates when compared to patients with FN (Strojnik et al., 2016).

Many patients in the study's sample had an increased, recorded temperature at home or in the ambulance but were mal-triaged when their triage temperature was 37.9°C and not 38.0°C. However, this understanding contradicts the definition of fever in FN as fever is defined as "a single oral temperature measurement of more than 38.3°C or a temperature of more than 38.0°C sustained over a 1-h period" (Freifeld et al., 2011, p.3). Accordingly, many patients had a fever of more than 38.3°C in the ambulance but again were mal-triaged because the measured temperature at triage was less than 38°C. Still, half of the patients who had a high fever (> 38.3°C) at triage were also mal-triaged to lower triage categories. This result can be very detrimental as inappropriate triage can translate into longer wait times and delayed treatment for time-sensitive interventions such as TTA (Bryant et al., 2015; Mofid, Novin, Roointan, & Forouzanfar, 2016).

The Quality of Care of Patients with Febrile Neutropenia

While the interest to conduct this research was driven primarily by our interest in triage, we also performed a comprehensive assessment of select ED quality of care indicators for patients with FN. Such a focus was justified given that the current evidence identified variations in care and long wait times in the ED (Oatley et al., 2016; Szwajcer et al., 2011).

The results of our quality evaluation provided evidence that additional improvements in a number of the quality dimensions have the potential to enhance the care provided to individuals with FN. We demonstrated quality issues in four of the six aspects of quality defined by the Institute of Medicine to include safety, effectiveness, equity, efficiency, patient-centeredness, and timeliness of care. We found three indicators of potentially unsafe care including i) the absence of reassessment while waiting at triage,

ii) patients who had left the ED without being seen (LWBS), and iii) inappropriate discharge from the ED. Patients in our sample experiencing long delays were not reassessed while waiting at the triage which contradicts the CTAS recommendation to reassess delayed patients every 15 minutes. Moreover, although the frequency of patients who LWBS was minimal (1.4%), these patients cannot afford not to receive emergency care, and this rate should be zero for the care of FN patients to be considered safe. Disposition of patients was also unsafe in which two-thirds of the one-third of patients who were discharged home were discharged without receiving antibiotics in the ED. Of note, were the 53 high-risk discharged patients (34%) who cannot be eligible for an outpatient management (Paddock et al., 2017). Also, around 5% of those high-risk discharged patients were found to suffer from a profound neutropenia with ANC of less than 500. Among the high-risk discharged FN patients with profound neutropenia were those five patients (3.3%) who were not given antibiotics in the ED. Although such stratification of patients' risk is clinically revealing, it does not appear to have been used in making the clinical decision to discharge these patients.

In terms of the quality domain effectiveness, there was a notable gap in the care recommended by the guidelines and the actual care that was received by the patient. First, at the primary health care level, there was underuse of growth factors which are known to be effective in decreasing the risk of FN (Freifeld et al., 2011; Ganti et al., 2017; Smith et al., 2006; Taplitz et al., 2018). Also, none of the patients in our sample started growth factors in the ED despite their benefits in improving recovery (Freifeld et al., 2011; Ganti et al., 2017). The second effectiveness indicator was the fractile response rate (FRR) of triage implementation suggesting ineffective triage implementation in 89% of the patients

with FN. The guidelines mandate organizations to tailor different resources to meet this quality indicator because FRR is based on the urgency and acuity of the presenting complaint and is related to patient outcomes (Bullard et al., 2017).

Patient-centeredness was another aspect of poor-quality care as demonstrated in the deficient responsiveness to pain management in the ED for patients with FN. The lack of appropriate pain assessment and management can indicate that the patient quality of life and preferences were ignored. The evaluation of pain was documented in only four patients (1.0%), while 39 patients (9.0%) were found to receive opioids such as morphine. This finding is congruent with the data from previous studies reporting that some patients do not receive proper pain management in the ED (Barbera et al., 2012; Jain et al., 2013; Patel et al., 2017). Education of the triage nurses with the introduction of an advanced protocol for analgesic treatment can improve their quality of care and minimize patient suffering (Jain et al., 2013).

Patients in our sample were not seen promptly, nor did they receive timely treatment in different phases of their ED visit. The average time to see a physician was 81 minutes which was longer than that recommended for patients with FN (within 15 minutes). The average time to receive antibiotics was 228 minutes which was longer than that recommended for patients with FN (within 60 minutes). Untimely care can be also demonstrated in the 90th percentile time to treatment, which is the maximum amount of time within which nine out of 10 patients were treated. In Canada and the UK, the expected benchmark ED LOS for the discharged patients is four hours and eight hours for patients who get admitted from the ED (Health Quality Ontario, 2016; Lipley, 2004). However, on average, patients in our sample had to spend around 5 and 22 hours in the

ED among the discharged and admitted patients, respectively. Also, 90% of those immunocompromised patients had to spend more than 32 hours in the ED, which is a highly infectious environment, with 70% of this time spent waiting (possibly in a corridor) until the inpatient bed became available. This certainly can contribute to the longer hospital LOS in which patients were hospitalized, on average, for eight days with some patients having an extended stay of more than two months.

Identification of the limitations of the actual care provided could be used to initiate a quality improvement cycle for patients with FN. Strengthening the quality of the care delivered to patients with FN will close the gap between the recommended evidence-based care and the actual care that is received by patients in the ED.

Patients Who were Triaged Appropriately

The rapid identification of patients with FN and prompt initiation of treatment is an effective strategy for better patient outcomes (Freifeld et al. 2011). This was the rationale behind the need to establish the CTAS guidelines to guide ED nurses in the correct identification of patients' needs, and therefore, ensure appropriate emergency care is provided promptly (Beveridge et al., 1998). According to the CTAS guidelines, time objectives are designed to ensure interventions are delivered on time with subsequent improved patient outcomes (Bullard et al., 2017). For example, patients in our sample who were triaged appropriately were enabled to be seen by a physician and to receive the required antibiotics, on average, in about 49 minutes and 68 minutes quicker than those who were mal-triaged. Moreover, patients who were triaged appropriately had better odds to meet the benchmark compared to those who were mal-triaged.

While 37% of our patients were assigned with the appropriate triage category (CTAS score of '2'), the majority (90%) of patients were not seen within the guidelines' benchmarked time for the treatment of patients with FN. It seems that mal-triage is not the core problem. It is a problem, but if it was resolved, the benchmarks would still be unmet, at least in our sample. Although, the validity of this conclusion is limited to our ED because we rely on a single center study and the use of descriptive (proportion of patients) rather than inferential statistics. Further research is needed to identify the other contributing factors that includes multiple ED settings with larger sample size for better generalizable data.

On the other hand, some evidence in the literature can still support this conclusion. It is not logical to conceive that triage alone would be the only contextual factor within the ED setting. This was evident in our sample where the majority of patients were not seen within the guidelines' benchmarked time for the treatment of patients with FN. Other factors within the ED system likely contributed to this delay even among patients who were triaged appropriately. For instance, the ED is a complex environment that can get congested because it has an open-door policy. Also, the ED staff do not have control of their exit doors because they are unable to transfer patients to a hospital unit if there are no available beds (Affleck, Parks, Drummond, Rowe, & Ovens, 2013). In the ED, wait time is the manifestation of the patient flow and is related to the unregulated inflow of patients and the outflow to inpatient beds. Therefore, an increase of illness or injury in the surrounding population or the inability to discharge patients from inpatient beds can increase wait time in the ED (Health Quality Ontario).

From a broader perspective, the wait time problem is complex and requires time and resources in many levels of the health care system. This problem may have primary causes concentrated outside the ED itself; it is part of a system-wide problem with access to care and would require system-wide solutions (Grol et al., 2013). This system problem is manifested as inadequate access to care as evident in the 2004 CMA report, in which the long wait times for ED services is identified as one of Canadians' top four areas of concern about their health care system (CMA, 2004). Such concern is understandable because the impact of long wait times extends beyond the simple inconvenience of spending hours waiting in an ED. Indeed, it prevents patients from efficiently flowing through the system, and as a result, can cause many negative consequences by blocking access to care (Schull, Vermeulen, Guttmann, & Stukel, 2015).

An excellent example of genuine commitment to ED accessibility can be drawn from the United Kingdom where decreased ED wait time was observed following changes in all levels of the healthcare system (Cass, 2005). This success highlighted the need to develop integrated, system-wide solutions in response to the underlying problems driving ED wait times. The target was to decide the final disposition of ED patients within a four-hour time frame. This was coupled with an aggressive and comprehensive emergency care reform strategy and a government commitment to funding. A diagnostic tool was used to pinpoint the leading causes of delays in each ED and results were used to help health communities better understand where they needed to focus. Since the implementation of the strategy, 96% of patients were found spending four hours or less in UK EDs (Lipley, 2004). However, in recent years, the health board recorded the worst

performance with 79.3% of patients receiving ED care within the four-hour target (Iacobucci, 2019).

Implications

The study results have many implications for future research, nursing education, and practice. While the study was focused on examining the effect of mal-triage on important treatment outcomes such as PIA and TTA, future research should examine the occurrence of severe adverse consequences such as sepsis, septic shock, and death because research relates these health outcomes to the treatment outcomes that were identified to be determined by the accuracy of the triage decision. Mortality was rare in this study (7%); a case-control study is recommended to study mortality and examine if patients who have died had higher exposure to mal-triage. Research is also needed to compare individuals with FN to individuals who have afebrile neutropenia to assess if the absence of fever at ED presentation can be associated with their allocation to inaccurate CTAS categories. It would also be useful to replicate this Canadian study using other patient populations seeking different types of emergency care.

Furthermore, qualitative research is needed to explore the factors contributing to wrong triage decisions. This research could investigate the experiential knowledge of triage nurses but could also include the experiences of patients and families. For example, in this study, two participants were mal-triaged, had long wait times, and were discharged home. Both returned to the ED on the same day; one was admitted for an extended time (63 days), and the other participant did not survive to be discharged. The families of those patients could be interviewed to help understand the context of triage decisions.

The results of this study have many implications for nursing education and practice as well. Triage decision-making was problematic as triage decisions were incorrect for two-thirds of the patients in our sample. There is good evidence that nurses with proper knowledge are more accurate, and therefore, safer when making triage decisions (Considine, Botti, & Thomas, 2007; Martin et al., 2014). The reasons why there was mal-triaged remains unclear, but it does warrant further consideration and investigation. Our findings point to the need for a review of triage training and policies to increase their effectiveness. The implementation of annual triage competency assessments should also be considered. As a starting point, providing nurses with ongoing education and simulated practice to better understand the complexity of the needed care and expected outcomes with proper triage decisions are foundational to improving the quality of care in the ED (Grol et al., 2013). Education can make incremental changes to the triage process and can improve access to health care by increasing the triage nurse's knowledge of the advantages and consequences of correct triage decisions. Triage nurses need to be well informed about the scientific evidence to strengthen their compliance with the guidelines (Grol et al., 2013). The manuscripts produced from this dissertation are one of the tools that can be used to guide nurses in achieving more accurate triage decisions. Continuing education efforts need to be directed toward both CTAS guidelines and the high-risk oncological emergencies that are initially managed in the ED (Howlett & Atkinson, 2012).

Improvements in the treatment of cancer patients within the ED can be attained by implementing change to improve management of patients, not only to a limited place at triage. Instead, the change can consider the complexity of care and assure the continuity

of care at all parts of the system. At the individual level, education remains the cornerstone to prepare the triage nurses to deliver high-quality nursing care. At this basic level, education strategies should address the need to objectify the triage process and to promote compliance in using the guidelines. Assignment of triage level is expected to become more objective and less open to debate. This specific recommendation was made by the establishers of the CTAS guidelines, to properly use and implement the CTAS guidelines to make an accurate assignment of triage levels (Bullard, Unger, Spence, & Grafstein, 2008). With the different approaches that were used to improve the consistency and accuracy of triage, audit, and feedback can be the most effective strategy because this strategy will provide a continuous feedback system (Howlett & Atkinson. 2012). This monitoring and surveillance by the ED nursing leaders will make the triage nurses responsible and accountable to take ownership in improving their triage decisions and the emergency care they provide.

At the organizational level, a change is needed in the process of ED care, or the redesign of the organizational structures that impact the inflow, treatment within, and outflow of patients in the ED. For instance, hospitals may need to adopt or to establish algorithms, protocols, or standardized order sets to lower the time to antibiotic administration among patients with FN (Baltic, Schlosser, & Bedell, 2002). The notion behind this is that specific hospital pathways may be designed for particular patients to improve their access and consequently their outcomes (Kennelly et al., 2014). However, this should be based on real and up-to-date information in which the health organizations conduct routine system monitoring and benchmarks analysis and then tailor different ED resources to meet these benchmarks. This approach is feasible in Canada across the

provinces as data is now readily available for hospital performance about ED triage, wait times, and length of stays (Health Council of Canada, 2012). This information system should be used by clinicians and researchers to continuously monitor the performance of ED triage and wait times against the benchmarks. With this system, successful EDs across Canada can share examples of optimal working methods from the other settings sharing the same problems. Also, the uniformity of using CTAS across Canada provides an opportunity to study triage and wait time among patients with different presentations and set a target for minimum benchmarking across the country (Atzema, Austin, Tu, & Schull, 2009). Still, a significant level of coordination and integration of care between hospital and alternative care settings is mandatory to deliver high-quality care in the safest, most effective, and efficient way, while reliving some of the pressure on the EDs (Health Quality Ontario, 2016).

Conclusion

The study of my dissertation provides essential information about many of the factors that contribute to the quality of ED care of cancer patients with FN, and potentially to other ED patients. The available evidence was focused primarily on the consistency of triage decisions and neglected the primary objective of why triage was implemented; that is, the improvement of the patient outcomes. In this study, the application of triage to practice was evaluated, and the results showed a lack of consistency, lack of accuracy, and a significant impact on treatment outcomes that can result in adverse patient health outcomes. These results contribute to understanding the three factors that influence the mal-triage of patients with FN: inappropriate application

of the CTAS by triage nurses, inherent problems within the triage system itself, and the difficulty in recognizing FN patients.

While the location of the main problems has been identified, the local health system decision-makers need to conduct a broader examination to understand better where they need to focus. These problems are expected to inflate with time as the pressure on emergency departments is likely to increase with the growth of an aging population. Therefore, any changes and improvements that do not anticipate the future are expected to become less effective soon. In particular, if these changes were an easy fix with a limited implementation to the emergency environment. Triage decisions have to improve and become highly objective. However, this is not going to improve the care in the ED as long as problems in other parts of the system remained unresolved and continue to impact the ED quality of care.

References

Abou Dagher, G., El Khuri, C., Chehadeh, A., Chami, A., . . . Bou Chebl, R. (2017). Are patients with cancer with sepsis and bacteremia at a higher risk of mortality? A retrospective chart review of patients presenting to a tertiary care Centre in Lebanon. *BMJ Open, 7*(3), E013502. doi:10.1136/bmjopen-2016-013502

Adelberg, D., & Bishop, M. (2009). Emergencies related to cancer chemotherapy and hematopoietic stem cell transplantation. *Emergency Medicine Clinics of North America, 27*(2), 311-331. doi:10.1016/j.emc.2009.01.005

Affleck, A., Parks, P., Drummond, A., Rowe, B., & Ovens, H. (2013). Emergency department overcrowding and access block. Canadian Journal of Emergency Medicine, 15(6), 359-384. doi:10.1017/S1481803500002451

Ahn, S., Lee, Y., Lim, K., & Lee, J. (2012). Emergency department cancer unit and management of oncologic emergencies: experience in Asan Medical Center. *Support Care Cancer, 20,* 2205–2210. doi:10.1007/s00520-012-1478-8

Alavi, C., Cooke, M., & Crowe, M. (1997). Becoming a registered nurse. *Nurse Education Today, 17*(6), 473-480. doi:10.1016/S0260-6917(97)80008-1

Andersson, A., Omberg, M., & Svedlund, M. (2006). Triage in the emergency department – a qualitative study of the factors which nurses consider when making decisions. *Nursing in Critical Care, 11*(3), 136-145. doi:10.1111/j.1362-1017.2006.00162.x

Andre, S., Taboulet, P., Elie, C., Milpied, N., Nahon, M., Kierzek, G., . . . Claessens, Y. (2010). Febrile neutropenia in French emergency departments: Results of a prospective multicentre survey. *Critical Care, 14*(2), R68. doi:10.1186/cc8972

Anonymous. (2004). New CMA data confirm access-to-care concerns rising. *Canadian Medical Association Journal, 170*(6), 1061-1.

Atzema, C. L., Austin, P. C., Tu, J. V., & Schull, M. J. (2009). Emergency department triage of acute myocardial infarction patients and the effect on outcomes. *Annals of Emergency Medicine, 53*(6), 736-745.

Baker, G., Norton, P., Flintoft, V., Blais, R., Brown, A., Cox, J., . . . Tamblyn, R. (2004). The Canadian adverse events study: The incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal,170*(11), 1678-86.

Baltic, T., Schlosser, E., Bedell, M. (2002). Neutropenic fever: one institution's quality improvement project to decrease the time from patient arrival to initiation of antibiotic therapy. *Clinical Journal of Oncology Nursing, 6*, 337340. doi:http://dx.doi.org/ 10.1188/02.CJON.337-340.

Barber, F.D. (2001). Management of fever in neutropenic patients with cancer. *Nursing Clinics of North America, 36*, 631–644.

Barbera, L., Atzema, C., Sutradhar, R., Seow, H., Howell, D., Husain, A., Sussman, J., Earle, C., Liu, Y., & Dudgeon, D. (2012). Do patient-reported symptoms predict emergency department visits in cancer patients? a population-based analysis. *Annals of Emergency Medicine, 61*(4), 427-437. doi.org/10.1016/j.annemergmed.2012.10.010

Barbera, L., Taylor, C., & Dudgeon, D. (2010). Why do patients with cancer visit the emergency department near the end of life? *Canadian Medical Association Journal, 182*(6), 563-568. doi:10.1503/cmaj.091187

Barnett, K., Mercer, S., Norbury, M., Watt, G., . . . Guthrie, B. (2012). Epidemiology of multimorbidity and implications for health care, research, and medical education: A cross-sectional study. *The Lancet, 380* (9836), 37-43. doi:10.1016/S0140-6736(12)60240-2

Benny, P. (2015). Global trends in cancer: developing countries need more focus. *International Journal of Preventive and Therapeutic Medicine, 3* (2), 32-33.

Berger, P., & Gillespey, M. (2002). Potential for risk reduction through ISO 9000-based redesign of emergency triage. *Journal of Healthcare Risk Management, 22*(2), 15-21. doi:10.1002/jhrm.5600220205

Berwick, D. M. (2011). Preparing nurses for participation in and leadership of continual improvement. *Journal of Nursing Education, 50*(6), 322–327. doi:10.3928/0148483420110519

Berwick, D., & Institute for Healthcare Improvement. (2014). *Promising care: How we can rescue health care by improving it.* San Francisco, California: Jossey-Bass

Beveridge, R., Janes, L., Savage, N., Thompson, J., Murray, M., Nijssen, C. (1998). Implementation guidelines for the Canadian emergency department Triage & Acuity Scale (CTAS). Retrieved from http://caep.ca/sites/caep.ca/files/caep/files/ctased16.pdf

Bosscher, M., Leeuwen, R., & Hoekstra, F. (2015). Mortality in emergency surgical oncology. *Annals of Surgical Oncology, 22*(5), 1577-1584. doi:10.1245/s10434-014-4180-x

Brown, J., Grudzen, C., Kyriacou, D., Obermeyer, Z., Quest, T., Rivera, D., . . . & Shelburne, N. (2016). The emergency care of patients with cancer: setting the research agenda. *Annals of Emergency Medicine, 68*(6), 706-711. doi:10.1016/j.annemergmed.2016.01.021

Bryant, A., Deal, A., Walton, A., Wood, W., Muss, H., & Mayer, D. (2015). Use of ED and hospital services for patients with acute leukemia after induction therapy: One-year follow-up. *Leukemia Research, 39*(4), 406-410. doi:10.1016/j.leukres.2015.01.006

Buckingham, C., & Adams, A. (2000). Classifying clinical decision making: A unifying approach. *Journal of Advanced Nursing, 32*(4), 981-989. doi:10.1046/j.1365-2648.2000.t01-1-01565.x

Bullard, M. J., Unger, B., Spence, J., & Grafstein, E. (2008). Revisions to the Canadian emergency department Triage and Acuity Scale (CTAS) adult guidelines. *CJEM, 10*(2), 136. doi:10.1017/S148180350000350X

Bullard, M., Musgrave, E., Warren, D., Unger, B., Skeldon, T., Grierson, R., . . . Swain, J. (2017). Revisions to the Canadian emergency department Triage and Acuity Scale (CTAS) Guidelines 2016. *CJEM, 19*(S2), S18-S27.

Burry, E., Punnett, A., Mehta, A., Thull-Freedman, J., Robinson, L., & Gupta, S. (2012). Identification of educational and infrastructural barriers to prompt antibiotic delivery in febrile neutropenia: A quality improvement initiative. *Pediatric Blood & Cancer, 59*(3), 431-435. doi:10.1002/pbc.23418

Cairo, M., Coiffier, B., Reiter, A., & Younes, A. (2010). Recommendations for the evaluation of risk and prophylaxis of tumour lysis syndrome (TLS) in adults and children with malignant diseases: An expert TLS panel consensus. *British Journal of Haematology, 149*(4), 578-586. doi:10.1111/j.1365-2141.2010.08143.x

Canadian Cancer Society, publisher, & Statistics Canada, sponsoring body. (2017). *Canadian cancer statistics 2013: Special topic: Pancreatic cancer* (Canadian cancer statistics; 2017).

Canadian Electronic Library, & Canadian Institute for Health Information. (2012). *All-cause readmission to acute care and return to the emergency department* (DesLibris. Documents collection). Ottawa Ont.: Canadian Institute for Health Information.

Cancer Care Nova Scotia (2014). *Guidelines for the Management of Oncologic Emergencies in Adult Patients* – Full Version. © Crown copyright, Province of Nova Scotia.

Cass, D. (2005). Once upon a time in the emergency department: A cautionary tale. *Annals of Emergency Medicine, 46*(6), 541-543. doi:10.1016/ j.annemergmed.2005.07.015

Chen, S., Chen, J., Ng, C., Chen, P., Lee, P., & Chang, W. (2010). Factors that influence the accuracy of triage nurses' judgment in emergency departments. *Emergency Medicine Journal, 27*, 451-455. doi:10.1136/emj.2008.059311

Cheng-Lin, M., Jun-Wen, F., & Ju, B. (2007). Intuitive decision theory analysis and evaluation model. *Management Science and Engineering,1*(2), 63-67.

Chevalier, P., Lamotte, M., Malfait, M., & Marciniak, A. (2011). The incidence and outcome of febrile neutropenia in different chemotherapy regimens for cancer patients in Belgium. *European Journal of Cancer, 47*, S256. doi:10.1016/S0959-8049(11)71189-3

Chung, J. Y. M. (2005). An exploration of accident and emergency nurse experiences of triage decision making in Hong Kong. *Accident and Emergency Nursing, 13*, 206-213. doi:10.1016/j.a aen.2005.08.003

Coiffier, B., Altman, A., Pui, C., Younes, A., & Cairo, M. (2008). Guidelines for the management of pediatric and adult tumor lysis syndrome: An evidence-based review. *Journal of Clinical Oncology, 26*(16), 2767-2778. doi:10.1200/JCO.2007.15.0177

Considine, J., Botti, M., & Thomas, S. (2007). Do knowledge and experience have specific roles in triage decision-making? *Academic Emergency Medicine, 14*, 722-726. doi:10.1197/j.aem.2007.04.015

Considine, J., Livingston, P., Bucknall, T., & Botti, M. (2009). A review of the role of emergency nurses in management of chemotherapy-related complications. *Journal of Clinical Nursing, 18*(18), 2649-2655. doi:10.1111/j.1365-2702.2009.02843.x

Cooper, R., Schriger, D., Flaherty, H., Lin, E., & Hubbell, K. (2002). Effect of vital signs on triage decisions. *Annals of Emergency Medicine, 39*(3), 223-232. doi:10.1067/mem.2002.121524

Courtney, D., Aldeen, A., Gorman, S., Handler, J., . . . Bennett, C. (2007). Cancer-Associated Neutropenic Fever: clinical outcome and economic costs of emergency department care. *Oncologist, 12*(8), 1019-1026. doi:10.1634/theoncologist.12-8-1019

Coyne, C., Le, V., Brennan, J., Castillo, E., Shatsky, R., Ferran, K., . . . Vilke, G. (2017). Application of the MASCC and CISNE risk-stratification scores to identify low-risk febrile neutropenic patients in the emergency department. *Annals of Emergency Medicine, 69*(6), 755-764. doi:10.1016/j.annemergmed.2016.11.007

Culakova, E., Khorana, A., Kuderer, N., Crawford, J., Dale, D., & Lyman, G. (2004). Hospitalization with febrile neutropenia in colorectal cancer patients. *Journal of Clinical Oncology, 22*(14), 3706-3706. doi:10.1200/jco.2004.22.90140.3706

Cullen, M., & Baijal, S. (2009). Prevention of febrile neutropenia: Use of prophylactic antibiotics. *The British Journal of Cancer, 101*(S1), S11-4. doi:10.1038/sj.bjc.6605270

Dallaire, C., Poitras, J., Aubin, K., Lavoie, A., & Moore, L. (2012). Emergency department triage: do experienced nurses agree on triage scores? *The Journal of Emergency Medicine,42*(6), 736–740. doi:10.1016/j.jemermed.2011.05.085

Davidson, M., Thakkar, S., Hix, Bhandarkar, N., Wong, A., & Schreiber, M. (2004). Pathophysiology, clinical consequences, and treatment of tumor lysis syndrome. *The American Journal of Medicine, 116*(8), 546-554. doi:10.1016/j.amjmed.2003.09.045

Delgado-Guay, M., Kim, Y., Shin, S., Chisholm, G., . . . Bruera, E. (2015). Avoidable and unavoidable visits to the emergency department among patients with advanced cancer receiving outpatient palliative care. *Journal of Pain and Symptom Management, 49*(3), 497-504. doi:10.1016/j.jpainsymman.2014.07.007

Dent, A., Rofe, G., & Sansom, G. (1999). Which triage category patients die in hospital after being admitted through emergency departments? A study in one teaching hospital. *Emergency Medicine 11*(2), 68–71. doi:10.1046/j.1442-2026.1999.00016.x

Diaz-Couselo, F., O'Connor, J., Nervo, A., Tossen, G., . . . Zylberman, V. (2004). Non-scheduled consultation in oncologic patients. How many of them are true emergencies? *Supportive Care in Cancer, 12*(4), 274-7. doi:10.1007/s00520-003-0584-z

Ding, R., McCarthy, M., Li, G., Kirsch, T. D., Jung, J. J., & Kelen, G. D. (2006). Patients who leave without being seen: Their characteristics and history of emergency department use. *Annals of Emergency Medicine, 48*(6), 686-692. doi:10.116/j.annemergmed.2006.05.022

Doherty, S. (2003). Inpatient mortality as related to triage category in three New South Wales regional base hospitals. *Emergency Medicine 15*(4), 334–340. doi:10.1046/j.1442-2026.2003.00471.x

Dong, S. L., Bullard, M. J., Meurer, D. P., Blitz, S., Ohinmaa, A., Holroyd, B. R., & Rowe, B. H. (2006). Reliability of computerized emergency triage. *Academic Emergency Medicine, 13*, 269-275. doi: 10.1197/j.aem.2005.10.014

Easen, P. & Wilcockson, B. (1996). Intuition and rational decision making in professional thinking: a false dichotomy? *Journal of Advanced Nursing 24*, 667-673. doi:10.1046/j.1365-2648.1996.02413.x

Edwards, B. (2007). Walking in – initial visualization and assessment at triage. *Accident and Emergency Nursing, 15*, 73–78. doi:10.1016/j.aaen.2006.12.008

Edwards, T. (2011). How rapid assessment at triage can improve care outcomes. *Emergency Nurse, 19*(6), 27-30.

Ekins, K., & Morphet, J. (2015). The accuracy and consistency of rural, remote and outpost triage nurse decision making in one Western Australia Country Health Service Region. *Australasian Emergency Nursing Journal, 18*(4), 227-233. doi.org/10.1016/j.ae nj.2015.05.002

Ekwall, A., Gerdtz, M., & Manias, E. (2008). The influence of patient acuity on satisfaction with emergency care: perspectives of family, friends, and carers. *Journal of Clinical Nursing, 17*, 800–809. doi:10.1111/j.1365-2702.2007.02052.x

Elsayem, A., Elzubeir, H., Brock, P., & Todd, K. (2016). Integrating palliative care in oncologic emergency departments: challenges and opportunities. *World Journal of Clinical Oncology, 7*(2), 227-33. doi:10.5306/wjco.v7.i2.227

Elsayem, A., Silvestre, J., Merriman, K., Chaftari, P., Gonzalez, C., & Yeung, S. (2014). Outcome of cancer patients admitted through the emergency department (ED) of a comprehensive cancer center: A call for ED-based palliative care. *Journal of Clinical Oncology, 32*(31), 194. doi:10.1200/jco.2014.32.31_suppl.194

Fernandes, C., McLeod, S., Krau`se, J., Shah, A., Jewell, J., Smith, B., & Rollins, L. (2013). Reliability of the Canadian Triage and Acuity Scale: Interrater and intrarater agreement from a community and an academic emergency department. *Journal of the Canadian Association of Emergency Physicians, 15*(4), 227-32. doi:10.2310/8000.2013.130943

Fernandes, C., Tanabe, P., Gilboy, N., Johnson, L., Mcnair, R., . . . Suter, R. (2005). Five-level triage: a report from the ACEP/ENA five-level triage task force. *Journal of Emergency Nursing, 31*(1), 39-50. doi:10.1016/j.jen.2004.11.002

Fitzgerald, G., Jelinek, G., Scott, D., & Gerdtz, M. (2010). Emergency department triage revisited. *Emergency Medicine Journal, 27*(2), 86-92. doi:10.1136/emj.2009.077081

Flowers, C., Seidenfeld, J., Bow, E., Karten, C., Gleason, C., . . . Ramsey, S. (2013). Antimicrobial prophylaxis and outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology clinical practice guideline. *Journal of Clinical Oncology, 31*(6), 794-810. doi:10.1200/JCO.2012.45.8661

Forero, R., Mccarthy, S., & Hillman, K. (2011). Access block and emergency department overcrowding. *Critical Care, 15*(2), 216. doi:10.1186/cc9998

Fortun, M., Encina, Y., Etxebarria, M., Escudero, J., Bardon, A., & Martinez, S. (2004). The oncology patient in emergencies. Epidemiological data. *Anales Del Sistema Sanitario De Navarra, 27* (3), 9-16.

Freifeld, A., Bow, E., Sepkowitz, K., Boeckh, M., Ito, J., Mullen, C., . . . Wingard, J. (2011). Executive summary: clinical practice guideline for the use of antimicrobial agents in neutropenic patients with cancer: 2010 update by the Infectious Diseases Society of America. *Clinical Infectious Diseases, 52*(4), 427

Gabriel, J. (2012). Acute oncological emergencies. *Nursing Standard, 27*(4), 35-41.

Ganti, B., Marini, B., Nagel, J., Bixby, D., & Perissinotti, A. (2017). Impact of antibacterial prophylaxis during reinduction chemotherapy for relapse/refractory acute myeloid leukemia. *Supportive Care in Cancer, 25*(2), 541-547. doi:10.1007/s00520-016-3436-3

Gerdtz, M. F., & Bucknall, T. K. (2007). Influence of task properties and subjectivity on the consistency of triage: a simulation study. *Journal of Advanced Nursing, 58*(2), 180-190. doi:10.1111/j.1365-2648.2006.04192.x

Gobel, B., Triest-Robertson, S., Vogel, W., Oncology Nursing Society, & ProQuest. (2009). *Advanced oncology nursing certification review and resource manual*. Pittsburg, Pa.: Oncology Nursing Society.

Goransson, K., Ehnfors, M., Fonteyn, M., & Enhrenberg, A. (2008). Thinking strategies used by registered nurses during emergency department triage. *Journal of Advanced Nursing, 61*(2), 163-172. doi:10.1111/j.1365-2648.2007.04473.x

Goransson, K., Ehrenberg, A., Marklund, B., & Ehnfors, M. (2006). Emergency department triage: Is there a link between nurses' personal characteristics and accuracy in triage decisions? *Accident and Emergency Nursing, 14*, 83–88. doi:10.1016/j.aa en.2005.12.001

Gorham, J., Ameye, L., Berghmans, T., Sculier, J., & Meert, A. (2013). The lung cancer patient at the emergency department: A three-year retrospective study. *Lung Cancer, 80*(2), 203-208. doi:10.1016/j.lungcan.2012.12.006

Graham, W., & Varghese, B. (2011). Quality, quality, quality: Gaps in the continuum of care. *The Lancet, 379*(9811), E5-6. doi:10.1016/S0140-6736(10)62267-2

Grol, R., Wensing, M., Eccles, M., Davis, D., & ProQuest. (2013). *Improving patient care: the implementation of change in healthcare* (2nd ed.). Chichester, England: Wiley-Blackwell.

Hashiguchi, Y., Kasai, M., Fukuda, T., Ichimura, T., . . . Sumi, T. (2015). Chemotherapy induced neutropenia and febrile neutropenia in patients with gynecologic malignancy. *Anti-Cancer Drugs, 26*(10), 1054-1060. doi:10.1097/CAD.0000000000000279

Health Council of Canada, & Canadian Electronic Library. (2012). *Measuring and reporting on health system performance in Canada opportunities for improvement* (DesLibris. Documents collection). Toronto, Ont.: Health Council of Canada.

Health Quality Ontario. (2016). *Under Pressure: Emergency Department Performance in Ontario*. (Documents collection). Canadian Electronic Library distributor.

Howard, S., Jones, D., & Pui, C. (2011). The tumor lysis syndrome. *The New England Journal of Medicine, 364*(19), 1844-1854. doi:10.1056/NEJMra0904569

Howlett, M., & Atkinson, P. (2012). A Method for reviewing the accuracy and reliability of a five-level triage process (Canadian Triage and Acuity Scale) in a community emergency department setting: building the crowding measurement infrastructure. *Emergency Medicine International,* 1-5. doi:10.1155/2012/636045

Hsu, J., Donnelly, J., Moore, J., Meneses, K., Williams, G., & Wang, H. (2018). National characteristics of emergency department visits by patients with cancer in the United States. *American Journal of Emergency Medicine*, *36*(11), 2038-2043. doi.org/10.1016/j.ajem.2018.03.025

Hulley, S., Cummings, S. R., Browner, W. S., Grady, D. G., & Newman, T. B. (2013). *Designing clinical research* (4th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.

Hwang, U., McCarthy, M., Aronsky, D., Asplin, B., Crane, P., Craven, C., . . . Bernstein, S. (2011). Measures of crowding in the emergency department: A systematic review. *Academic Emergency Medicine, 18*(5), 527-38. doi:10.1111/j.1553-2712.2011.01054.x

Iacobellis, F., Perillo, A., Iadevito, I., Tanga, M., Romano, L., . . . Scaglione, M. (2018). Imaging of oncologic emergencies. *Seminars in Ultrasound, CT, and MRI, 39*(2), 151-166. doi:10.1053/j.sult.2017.12.001

Iacobucci, G. (2019). A&E performing better than last year but missed targets an ongoing concern, say medical leaders. *British Medical Journal, 364*, L184. doi:10.1136/bmj.l184

Institute of Medicine, & ProQuest. (2003). *Crossing the quality chasm* (Richard and Hinda Rosenthal lectures; 2001). Washington, D.C. National Academy Press.

Issaacs, S., Ploeg, J., & Tompkins, C. (2009). How can Rorty help nursing science in the development of a philosophical 'foundation'? *Nursing Philosophy, 10*, 81–90.

Jain, P., Parab, S., & Thota, R. (2013). A prospective, non-interventional study of assessment and treatment adequacy of pain in the emergency department of a tertiary care cancer hospital. *Indian Journal of Palliative Care, 19*(3), 152-157. doi:10.4103/0973-1075.121529

Johnston, A., Park, J., Doi, S., Sharman, V., Clark, J., Robinson, J., & Crilly, J. (2017). Effect of immediate administration of antibiotics in patients with sepsis in tertiary care: A systematic review and meta-analysis. *Clinical Therapeutics, 39*(1), 190-202.e6. doi:10.1016/ j.clinthera.2016.12.003

Kao, Y., Liu, Y., Koo, M., & Chiang, J. (2018). Factors associated with emergency services use in Taiwanese advanced cancer patients receiving palliative home care services during out-of-hours periods: A retrospective medical record study. *BMC Palliative Care, 17*(1), 46-52. doi:10.1186/s12904-018-0302-8

Kapil, P., Macmillan, M., Carvalho, M., Lymburner, P., Fung, R., Almeida, B., . . . Enright, K. (2016). Assessment of fever advisory cards (FACs) as an initiative to improve febrile neutropenia management in a regional cancer center emergency department. *Journal of Oncology Practice, 12*(9), E858-63. doi:10.1200/JOP.2015.009183

Kawatkar, A., Farias, A., Chao, C., Chen, W., Barron, R., Vogl, F., & Chandler, D. (2017). Hospitalizations, outcomes, and management costs of febrile neutropenia in patients from a managed care population. *Supportive Care in Cancer, 25*(9), 2787-2795. doi:10.1007/s00520-017-3692-x

Kehoe, C. (2007). Getting to know oncologic emergencies. *Nursing Made Incredibly Easy, 5*(5), 56-58. doi:10.1097/01.NME.0000286207.74779.90

Kelly, P., Vottero, B., Christie-McAuliffe, C., Morita, J., & Altmiller, G. (2014). *Introduction to quality and safety education for nurses: Core competencies.* New York: Springer Publishing Company.

Keng, M., Thallner, E., Elson, P., Ajon, C., Sekeres, J., . . . Sekeres, M. (2015). Reducing time to antibiotic administration for febrile neutropenia in the emergency department. *Journal of Oncology Practice, 11*(6), 450-455. doi:10.1200/JOP.2014.002733

Kennelly, S., Drumm, B., Coughlan, T., Collins, R., O'Neill, D., & Romero-Ortuno, R. (2014). Characteristics and outcomes of older persons attending the emergency department: A retrospective cohort study. *Monthly Journal of the Association of Physicians, 107*(12), 977-987. doi:10.1093/qjmed/hcu111

Khan, U., Shanholtz, C., & Mccurdy, M. (2017). Oncologic mechanical emergencies. *Hematology/oncology Clinics of North America, 31*(6), 927940. doi:10.1016/j.hoc.2017.08.001

Klastersky, J. (2004). Antifungal therapy in patients with fever and neutropenia — more rational and less empirical. *New England Journal of Medicine, 351*(14), 1445-1447. doi:10.1056/NEJMe048203

Klastersky, J., Ameye, L., Maertens, J., Georgala, A., Muanza, F., Aoun, M, . . . Paesmans, M. (2007). Bacteraemia in febrile neutropenic cancer patients. *International Journal of Antimicrobial Agents, 30* (1), S51-9. doi:10.1016/j.ijantimicag.2007.06.012

Koh, A., & Pizzo, P. (2002). Empirical oral antibiotic therapy for low risk febrile cancer patients with neutropenia. *Cancer Investigation, 20*(3), 420-433. doi:10.1081/CNV-120001186

Kohn, L., Corrigan, J., Donaldson, M., & ProQuest. (2000). *To err is human: Building a safer health system.* Washington, DC: National Academy Press.

Kotlinska-Lemieszek, A., & Wyrwinska, A. (2014). Patients with cancer in the emergency departments. *Medycyna Paliatywna, 6*(3), 134-139.

Kuderer, N., Dale, D., Crawford, J., Cosler, L., & Lyman, G. (2006). Mortality, morbidity, and cost associated with febrile neutropenia in adult cancer patients. *Cancer, 106*(10), 2258-2266. doi:10.1002/cncr.21847

Kumar, E., Anand, E., Daniel, E., Kenneth, E., Bruce, . . . Cheang, E., Mary. (2006). Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. *Critical Care Medicine, 34*(6), 1589-1596. doi:10.1097/01.CCM.0000217961.75225.E9

Lash, R. S., Bell, J. F., Reed, S. C., Poghosyan, H. K., Rodgers, J. J., Kim, K. G., . . . Joseph, J. (2017). A systematic review of emergency department uses among cancer patients. *Cancer Nursing, 40*(2), 135-144. doi:10.1097/NCC.0000000000000360

Leak, A., Mayer, D., & Travers, D. (2012). Why do cancer patients die in the emergency department? an analysis of 283 deaths in NC EDs. *American Journal of Hospice & Palliative Medicine, 30*(2), 178-182. doi:10.1177/1049909112445306

Lee, S., Wong, F., & Tung, S. (2018). No ordinary back pain: malignant spinal cord compression. *The American Journal of Medicine, 131*(7), 772-774. doi:10.1016/ j.amjmed.2018.02.001

Lim, J., Kim, H., Choi, W., Kim, K., Shin, D., & Lee, M. (2011). Outcomes in 102 patients that present to the emergency department with chemotherapy-induced febrile neutropenia. *Turkish Journal of Haematology, 28*(3), 193-197. doi:10.5152/tjh.2011.53

Lipley, N. (2004). Welcome for integrated emergency services plan. *Nursing Standard, 19*(8), 6.

Livingston, P., Craike, M., & Considine, J. (2011). Unplanned presentations to emergency departments due to chemotherapy induced complications: Opportunities for improving service delivery. *Australasian Emergency Nursing Journal, 14*(2), 62-68. doi:10.1016/ j.aenj.2011.03.005

Livingston, P., Craike, M., & Slavin, M. (2012). Clinical and economic burden of emergency department presentations for neutropenia following outpatient chemotherapy for cancer in Victoria, Australia. *Oncologist, 17*(7), 998-1004. doi:10.1634/theoncologist.2011-0456

Lyman, G., Abella, E., & Pettengell, R. (2014). Risk factors for febrile neutropenia among patients with cancer receiving chemotherapy: A systematic review. *Critical Reviews in Oncology/ Hematology, 90*(3), 190-199. doi:10.1016/j.critrevonc.2013.12.006

Lynn, J., Chen, K., Weng, Y., & Chiu, T. (2013). Risk factors associated with complications in patients with chemotherapy-induced febrile neutropenia in emergency department. *Hematological Oncology, 31*(4), 189-196. doi:10.1002/hon.2040

Martin, A., Davidson, C., Panik, A., Buckenmyer, C., Delpais, P., & Ortiz, M. (2014). An examination of ESI triage scoring accuracy in relationship to ED nursing attitude and experience. *Journal of Emergency Nursing, 40*(5), 461-468. doi.org/10.1016/j.jen.2013.09.009

Mccarthy, M., Zeger, S., Ding, R., Levin, S., Desmond, J., Lee, J., & Aronsky, M. (2009). Crowding delays treatment and lengthens emergency department length of stay, even among high-acuity patients. *Annals of Emergency Medicine, 54*(4), 492-503.e4. doi:10.1016/j.annemergmed.2009.03.006

McCurdy, M., & Shanholtz, C. (2012). Oncologic emergencies. *Critical Care Medicine, 40*(7), 2212-2222. doi:10.1097/CCM.0b013e31824e1865

McKenzie, H., Hayes, L., White, K., Cox, K., Fethney, J., Boughton, M., & Dunn, J. (2011). Chemotherapy outpatients' unplanned presentations to hospital: A retrospective study. *Supportive Care in Cancer, 19*(7), 963-969. doi:10.1007/s00520-010-0913-y

McNairy, R. (2005). It takes more than string to fly a kite: 5-level acuity scales are effective, but education, clinical expertise, and compassion are still essential. *Journal of Emergency Nursing, 31*(6), 600-603. doi:10.1016/j.jen.2005.07.061

Meer, D., Weiland, M., Philip, T., Jelinek, J., Boughey, J., . . . Kelly, H. (2016). Presentation patterns and outcomes of patients with cancer accessing care in emergency departments in Victoria, Australia. *Supportive Care in Cancer, 24*(3), 1251-1260. doi:10.1007/s00520-015-2921-4

Minami, S., Yamamoto, S., Ogata, Y., Takeuchi, Y., Hamaguchi, M., Koba, T., . . . Komuta, K. (2013). Emergency department visits after hours by lung cancer patients in Japan. *Supportive Care in Cancer, 21*(9), 2443-2451. doi:10.1007/s00520-013-1814-7

Mistry, B., De Ramirez, S., Kelen, G., Schmitz, P., Balhara, K., Levin, S., Martinez, D., Psoter, K., Anton, X., Hinson, J. (2017). Accuracy and reliability of emergency department triage using the Emergency Severity Index: An international multicenter assessment. *Annals of Emergency Medicine, 71*(5), 581-587.*e3*. doi:10.1016/ j.annemergmed.2017.09.036

Mofid, B., Novin, K., Roointan, E., & Forouzanfar, M. (2016). Epidemiology and death-related factors of oncology patients in emergency department. *Emergency, 4*(3), 145-50.

Mokart, D., Darmon, M., Resche-Rigon, M., Lemiale, V., . . . Azoulay, E. (2015). Prognosis of neutropenic patients admitted to the intensive care unit. *Intensive Care Medicine, 41*(2), 296-303. doi:10.1007/s00134-014-3615-y

Molina, J., Seow, E., Heng, B., Chong, W., & Ho, B. (2014). Outcomes of direct and indirect medical intensive care unit admissions from the emergency department of an acute care hospital: A retrospective cohort study. *British Medical Journal, 4*(11),1-9. doi:10.1136/bmjopen-2014- 005553

Morneau, K., Chisholm, G., Tverdek, F., Bruno, J., & Toale, K. (2017). Timing to antibiotic therapy in septic oncologic patients presenting without hypotension. *Supportive Care in Cancer, 25*(11), 3357-3363. doi:10.1007/s00520-017-3754-0

Murray, M., Bullard, M., & Grafstein, E. (2004). Revisions to the Canadian emergency department Triage and Acuity Scale implementation guidelines. *CJEM, 6(06), 421-427*. doi:10.1017/S1481803500009428

Muslimani, A., Zakalik, D., Chisti, M., Daw, H., Wills, S., Huang, J., . . . Jaiyesimi, I. (2011). How we treat tumor lysis syndrome. *Oncology, 25*(4), 369-75.

Namendys-Silva, S., Arredondo-Armenta, J., Plata-Menchaca, E., Guevara-García, H., García-Guillén, F., Rivero-Sigarroa, E., & Herrera-Gómez, A. (2015). Tumor lysis syndrome in the emergency department: Challenges and solutions. *Open Access Emergency Medicine, 7*, 39-44. doi:10.2147/OAEM.S73684

Newfoundland Labrador. Department of Health Community Services. (2012). *A strategy to reduce emergency department wait times in Newfoundland and Labrador*. St. John's, NL: Dept. of Health and Community Services.

Nirenberg, A., Mulhearn, L., Lin, S., & Larson, E. (2004). Emergency department waiting times for patients with cancer with febrile neutropenia: A pilot study. *Oncology Nursing Forum, 31*(4), 711-5. doi:10.1188/04.ONF.711-715

Numico, G., Cristofano, A., Mozzicafreddo, A., Cursio, O., Franco, P., Courthod, G., . . . Silvestris, N. (2015). Hospital admission of cancer patients: avoidable practice or necessary care? *PLoS One, 10*(3), E0120827. doi:10.1371/journal.pone.0120827

Oatley, M., Fry, M., & Mullen, L. (2016). A cross-sectional study of the clinical characteristics of cancer patients presenting to one tertiary referral emergency department. *International Emergency Nursing, 24*, 35-38. doi:10.1016/j.ienj.2015.05.007

Olofsson, P., Gellerstedt, M., & Carlstrom, E. D. (2009). Manchester triage in Sweden-interrater reliability and accuracy. *International Emergency Nursing, 17*, 143-148. doi:10.1016/j.ienj.2008.11.008

Ontario. Ministry of Health Long-Term Care, Ontario Hospital Association, & Canadian Electronic Library. (2006). *Improving access to emergency care addressing system issues*. (DesLibris. Documents collection). Ottawa, Ont.: Ontario Hospital Association.

Paddock, M., Grock, A., Deloughery, T., & Mason, J. (2017). Can neutropenic fever ever be low risk? *Annals of Emergency Medicine, 69*(6), 765-767. doi:10.1016/j.annemergmed.2017.03.068

Parsad, S., & Ratain, M. (2007). Oral chemotherapy. *British Medical Journal, 334*(7590), 376. doi: 10.1136/bmj.39128.449317.BE

Patel, M., Williams, D., Wohlforth, C., Fisher, G., Wakelee, H., & Blayney, D. (2015). Are patients with thoracic malignancies at risk for uncontrolled symptoms? *Journal of Oncology Practice, 11*(1), E98-e102. doi:10.1200/JOP.2014.001502

Patel, P., Goodman, L., Knepel, S., Miller, C., Azimi, A., Phillips, G., . . . Hartman, A. (2017). Evaluation of emergency department management of opioid-tolerant cancer patients with acute pain. *Journal of Pain and Symptom Management, 54*(4), 501-507. doi: 10.1016/j. jpainsymman.2017.07.013

Pi, J., Kang, Y., Smith, M., Earl, M., Norigian, Z., & Mcbride, A. (2016). A review in the treatment of oncologic emergencies. *Journal of Oncology Pharmacy Practice, 22*(4), 625-638. doi:10.1177/1078155215605661

Pines, J. M., & Hollander, J. E. (2008). emergency department crowding is associated with poor care for patients with severe pain. *Annals of Emergency Medicine, 51*(1), 1-5. doi:10.1016/j.annemergmed.2007.07.008

Polit, D., Beck, C. (2010). *Essentials of Nursing Research, methods, appraisal, and utilization* (7th ed.). Philadelphia, PA: Lippincott, Williams & Wilkins.

Prachanukool, T., Tangkulpanich, P., Paosaree, P., Sawanyawisuth, K., & Sitthichanbuncha, Y. (2016). Cancer patients are at high risk of mortality if presenting with sepsis at an emergency department. *Asian Pacific Journal of Cancer Prevention, 17*(7), 3423-6. doi:10.14456/apjcp.

Public Health Agency of Canada (2014). Infection prevention and control guidelines: Critical appraisal toolkit. Retrieved from http://publications.gc.ca/collections/collection_2014/aspc-phac/HP40-119-2014-eng.pdf

Richards, C., Gisondi, M., Chang, C., Courtney, D., Engel, K., Emanuel, L., & Quest, T. (2011). Palliative care symptom assessment for patients with cancer in the emergency department: Validation of the screen for palliative and end-of-life care needs in the emergency department instrument. *Journal of Palliative Medicine,14*(6), 757-64. doi:10.1089/jpm.2010.0456

Rosa, R. & Goldani, L. (2014). Cohort study of the impact of time to antibiotic administration on mortality in patients with febrile neutropenia. *Antimicrobial Agents and Chemotherapy, 58*(7), 3799. doi:10.1186/1471-2334-14-286

Ruegg, T. (2013). A nurse practitioner-led urgent care center: meeting the needs of the patient with cancer. *Clinical Journal of Oncology Nursing, 17*(4), 52-57. doi:10.1188/13.CJON.E52-E57

Ruiperez, T., Costa, C., Martinez, M., Perez, B., Lopez, D., Agea, J., . . . Diaz Agea, J. (2015). Evidence of the validity of the Emergency Severity Index for triage in a general hospital emergency department. *Emergencias, 27*(5), 301-306.

Sadik, M., Ozlem, K., Huseyin, M., Aliayberk, B., Ahmet, S., & Ozgur, O. (2014). Attributes of cancer patients admitted to the emergency department in one year. *World Journal of Emergency Medicine, 5*(2), 85-90. doi:10.5847/wjem.j.1920-8642.201

Samphao, S., Eremin, J. M., & Eremin, O. (2010). Oncological emergencies: Clinical importance and principles of management. *European Journal of Cancer Care, 19*(6), 707-713. doi:10.1111/j.1365-2354.2009.01091.x

Scholer, A., Mahmoud, O., Ghosh, D., Schwartzman, J., Farooq, M., Cabrera, J., . . . Chokshi, R. (2017). Improving cancer patient emergency room utilization: A New Jersey state assessment. *Cancer Epidemiology, 51*, 15-22. doi:10.1016/j.canep.2017.09.006

Schull, M. J., Hatcher, C. M., Guttmann, A., Leaver, C. A., Vermeulen, M., Rowe, B. H., Anderson, G. M., Zwarenstein, M. (2010). *Development of a consensus on evidence-based quality of care indicators for Canadian emergency departments* (ICES investigative report). Toronto, Ont.: Institute for Clinical Evaluative Sciences.

Schull, M., Vermeulen, M., Guttmann, A., & Stukel, T. (2015). Better performance on length-of-stay benchmarks associated with reduced risk following emergency department discharge: An observational cohort study. *Journal of the Canadian Association of Emergency Physicians, 17*(3), 253-262. doi: 10.1017/cem.2014.39

Shelton, R. (2009). The Emergency Severity Index 5-level triage system. *Dimensions of Critical Care Nursing, 28*(1), 9-12. doi:10.1097/01.DCC.0000325106.28851.89

Smith, A., Lollar, J., Mendenhall, J., Brown, H., Johnson, P., & Roberts, S. (2013). Use of multiple pedagogies to promote confidence in triage decision making: a pilot study. *Journal of Emergency Nursing, 39*(6), 660-666. doi:org/10.1016/j.jen.2011.12.007

Stair, Beveridge, & Wuerz. (2003). Agreement of Canadian Triage and Acuity Scale with Emergency Severity Index. *Annals of Emergency Medicine, 42*(4), S6.

Standing, M. (2008). Clinical judgment and decision-making in nursing – nine modes of practice in a revised cognitive continuum. *Journal of Advanced Nursing, 62*(1), 124-134. doi:10.1111/j.1365-2648.2007.04583.x

Stanfield, L. M. (2015). Clinical decision making in triage: An integrative review. *Journal of Emergency Nursing, 41*(5), 396-403. doi:10.1016/j.jen.2015.02.003

Stowe, M. (2011). Staff responses to an emergency department admission alert system. *Cancer Nursing Practice, 10*(5), 31-35.

Strojnik, S., Mahkovic-Hergouth, K., Novakovic, B., & Seruga, B. (2016). Outcome of severe infections in afebrile neutropenic cancer patients. *Radiology and Oncology, 50*(4), 442-448. doi:10.1515/raon-2016-0011

Sun, H., & Nemecek, A. (2010). Optimal management of malignant epidural spinal cord compression. *Hematology/Oncology Clinics of North America, 24*(3), 537-551. doi:10.1016/j.emc.2009.02.001

Swailes, E., Rich, E., Lock, K., & Cicotte, C. (2009). From triage to the treatment of severe abdominal pain in the emergency department: evaluating the implementation of the Emergency Severity Index. *The Journal of Emergency Nursing, 35*, 485-489. doi:10.1016/j.jen.2009.05.010

Swenson, K. K., Rose, M. A., Ritz, L., Murray, C. L., & Adlis, S. A. (1995). Recognition and evaluation of oncology-related symptoms in the emergency department. *Annals of Emergency Medicine 26*, 12–17. doi:10.1016/S0196-0644(95)70231-8

Szwajcer, D., Czaykowski, P., & Turner, D. (2011). Assessment and management of febrile neutropenia in emergency departments within a regional health authority-a benchmark analysis. *Current Oncology, 18*(6), 280-294. doi:10.3747/co.v18i6.841

Talcott, J., Finberg, R., Mayer, R., & Goldman, L. (1988). The medical course of cancer patients with fever and neutropenia. Clinical identification of a low-risk subgroup at presentation. *Archives of Internal Medicine, 148*(12), 2561-2568. doi:10.1001/archinte.1988.00380120031007

Tanaka, T., Taguri, M., Fumita, S., Okamoto, K., Matsuo, Y., & Hayashi, H. (2017). Retrospective study of unplanned hospital admission for metastatic cancer patients visiting the emergency department. *Supportive Care in Cancer, 25*(5), 1409-1415. doi:10.1007/s00520-016-3535-1

Tang, N., Stein, J., Hsia, R., Maselli, J., & Gonzales, R. (2010). Trends and characteristics of US emergency department visits, 1997-2007. *Journal of America Medical Association, 304*(6), 664-670. doi:10.1001/jama.2010.1112

Tang, P., Cheng, J., Huang, W., Chang, H., & Chen, H. (2015). Why do head and neck cancer patients visit the emergency department? *American Journal of Emergency Medicine, 33*(8), 1102-1105. doi:10.1016/j.ajem.2015.04.077

Tang, S., Wu, S., Hung, Y., Huang, E., Chen, J., & Liu, T. (2009). Trends in quality of end-of-life care for Taiwanese cancer patients who died in 2000-2006. *Annals of Oncology, 20*(2), 343-348. doi:10.1093/annonc/mdn602

Taplitz, R., Kennedy, E., Bow, E., Crews, J., Gleason, C., Hawley, D., . . . Flowers, C. (2018). Outpatient management of fever and neutropenia in adults treated for malignancy: American Society of Clinical Oncology and Infectious Diseases Society of America Clinical Practice Guideline Update. *Journal of Clinical Oncology, 36*(14), 1443-1453. doi:10.1200/ JCO.2017.77.6211

Vandyk, A., Harrison, D., Macartney, M., Ross-White, B., & Stacey, G. (2012). Emergency department visits for symptoms experienced by oncology patients: A systematic review. *Supportive Care in Cancer, 20*(8), 1589-1599. doi:10.1007/s00520-012-1459-y

Vertesi, L. (2004). Does the Canadian emergency department Triage and Acuity Scale identify non-urgent patients who can be triaged away from the emergency department? *CJEM, 6*(5), 337-42.

Wagner, J., & Arora, S. (2017). Oncologic metabolic emergencies. *Hematology/oncology Clinics of North America, 31*(6), 941-957. doi:10.1016/j.hoc.2017.08.002

Walji, N., Chan, A., & Peake, D. (2008). Common acute oncological emergencies: Diagnosis, investigation and management. *Postgraduate Medical Journal, 84*(994), 418-27. doi:10.1136/pgmj.2007.067033

Weycker, D., Barron, R., Kartashov, A., Legg, J., & Lyman, G. (2014). Incidence, treatment, and consequences of chemotherapy-induced febrile neutropenia in the inpatient and outpatient settings. *Journal of Oncology Pharmacy Practice, 20*(3), 190-198. doi:10.1177/1078155213492450

Weycker, D., Li, X., Figueredo, J., Barron, R., Tzivelekis, S., & Hagiwara, M. (2016). Risk of chemotherapy-induced febrile neutropenia in cancer patients receiving pegfilgrastim prophylaxis: Does timing of administration matter? *Supportive Care in Cancer, 24*(5), 2309-2316. doi:10.1007/s00520-015-3036-7

Wilson, L., Detterbeck, F., & Yahalom, J. (2007). Superior vena cava syndrome with malignant causes. *The New England Journal of Medicine, 356*(18), 1862-1869. doi:10.1056/ NEJMcp067190

Wolf, L. (2010). Acuity assignation an ethnographic exploration of clinical decision making by emergency nurses at initial patient presentation. *Advanced Emergency Nursing Journal, 32*(3), 234–246. doi:10.1097/tme.0b013e3181e972ec

Appendix A

Patient Chart Review Form (CRF)

A. Patient Information

1. Patient's Deidentified Code.....☐☐☐☐☐☐☐☐☐☐
2. Patient's Age at Triage.....Day☐☐ Month☐☐ Year☐☐☐☐
3. Patient's Sex.....Male☐ Female☐ Other☐

B. Triage

1. Date of Triage.....Day☐☐ Month☐☐ Year☐☐☐☐
2. Time of Triage.....Hour☐☐ Minutes☐☐
3. Arrival Mode.....Walking☐ Wheelchair☐ Ambulance☐
4. Assigned Triage Score.....One☐ Two☐ Three☐ Four☐ Five☐
5. Time to Reassessment.....Hour☐☐ Minutes☐☐
6. Re-Triaged.....No☐ Yes☐; The new Score☐

C. Clinical Presentation

1. Presenting Complaint.....☐
2. Vital signs:
    i. BP.....☐
    ii. HR. .....☐
    iii. RR.....☐
    iv. Spo2.....☐
    v. Temperature.....☐

vi. Pain Score.....☐

D. ED Treatment

1. Left without Being Seen.....No☐ Yes☐
2. Time to Physician.....Hour☐☐ Minutes☐☐
3. Time to Analgesia.....Hour☐☐ Minutes☐☐
4. Type of Antibiotic.....Antibacterial☐;Antiviral☐; Antifungal agent☐ None☐
5. Time to Antibiotics.....Hour☐☐ Minutes☐☐
6. Time to Decision in ED.....Hour☐☐ Minutes☐☐
7. Decision Taken.....Admission☐ Discharged☐ Referred☐
8. Departure Time.....Hour☐☐ Minutes☐☐
9. Final Disposition from ED.....Admission☐ Expired☐ Discharged☐
10. Location of Admission if admitted.....Tumor Centre☐ OR☐ ICU☐ Ward☐
11. Admission Diagnosis.....☐
12. EDLOS.....Hour☐☐ Minutes☐☐
13. Boarding Time.....Hour☐☐ Minutes☐☐
14. HospLOS.....Hour☐☐ Minutes☐☐

E. Oncological Information:

1. Type of Cancer.....☐

2. Stage of Disease.....1☐; 2☐; 3☐; 4☐; NA☐
3. Growth Factor.....None☐; Granulocyte–Colony-Stimulating Factor☐

F. Laboratory Value:

1. White Blood Cell Count.....X 10^9/L☐
2. Polys.....%☐
3. Bands.....%☐
4. ANC.....%☐

Appendix B

Operational Definitions

- Leave without Being Seen (LWBS): is a patient with failed attempt to enter the health care system. They are ED patients who leave the ED on their own without proper discharge by the ED physician or nurse.
- Fractile Response Rate (FRR): is the proportions of patients in each triage level seen within the CTAS time objective for that level. The guidelines recommend FRR of 98, 95, 90, 85, and 80 for the CTAS categories of I, II, III, IV, and V, respectively.
- Time to Reassessment for Each CTAS Category: is the time from initial assessment at triage to the secondary assessment at triage when the observed wait time has passed the expected wait time as benchmarked in the CTAS guidelines. This evaluation is part of the triage process and the triage nurses are expected per the CTAS guidelines to continuously assess patients in category 1, every 15 minutes for patients with level 2, every 30 minutes for patients with level 3, every 60 minutes for patients with level 4, and every 120 minutes for patients with CTAS score of 5.
- Mal-triaged: are those FN patients who were assigned to a lower acuity triage category (3,4, & 5). Also, the rate of Mal-triage will be calculated as the percentage of FN patients who are assigned to a lower triage category of III, IV, and V.
- Time to Physician: is the time spent in the ED from the door (ED triage assessment) to be seen by an ED physician (initial physician assessment).
- Time to Antibiotics: is the time spent in the ED from the door (ED triage assessment) to the administration of indicated antibiotics.

- Boarding Time: is the time spent in the ED after the decision to admit until a hospital bed becomes available.
- Emergency Department Length of Stay (EDLOS): is the time (in hours and minutes) from the door (ED triage assessment) until the disposition to be admitted or discharged.
- Hospital Length of Stay (HospLOS): is the time of days from admission until discharge.
- Reassignment of CTAS Score (Re-Triage): is a patient who is initial triage score is changed for any given reason.
- Absolute Neutrophil Count: measures the percentage of neutrophils in the white blood count. The ANC is calculated by multiplying the white blood count (WBC) by the total neutrophils (segmented neutrophils% + segmented bands%) by 10.

Appendix C

Approval from Health Research Ethics Board (HREB)

HREB
HEALTH RESEARCH ETHICS BOARD

Ethics Office
Suite 200, Eastern Trust Building
95 Bonaventure Avenue
St. John's, NL
A1B 2X5

July 19, 2018

School of Nursing

Dear Dr. Alsharawneh:

Researcher Portal File # 20190499
Reference # 2018.155

RE: "Effect of Emergency Department Triage on the Outcomes of Patients with Febrile Neutropenia"

Your application was reviewed by a sub-committee of the Health Research Ethics Board (HREB) via a delegated review process. **Ethics approval** of this research study has been granted for one year effective July 18, 2018. This ethics approval will be reported to the HREB at the next scheduled meeting.

This is your ethics approval only. Organizational approval may also be required. It is your responsibility to seek the necessary organizational approval from the Regional Health Authority (RHA) or other organization as appropriate. You can refer to the HREA website for further guidance on organizational approvals.

This is to confirm that the HREB reviewed and approved or acknowledged the following documents (as indicated):

- Application, approved
- Research proposal, approved
- Letter to the Data Custodian- HISI, approved
- Letter to the Data Custodian- Cancer Program, approved
- Patient Chart Review Form, approved
- Data Flow & Management, approved
- Data Extraction Form- Cancer Program, approved
- NLCHI Application_ Revised for appropriate data custodian, acknowledged

MARK THE DATE

This ethics approval will lapse on July 18, 2019. It is your responsibility to ensure that the Ethics Renewal form is submitted prior to the renewal date; you may not receive a reminder. The Ethics Renewal form can be found on the Researcher Portal as an Event Form.

If you do not submit the completed Ethics Renewal form prior to date of renewal:

- **You will no longer have ethics approval**
- You will be required to stop research activity immediately
- You may not be permitted to restart the study until you reapply for and receive approval to undertake the study again
- Lapse in ethics approval **may result in interruption or termination of funding**.

You are solely responsible for providing a copy of this letter, along with your approved HREB application form; to **Research Grant and Contract Services** should your research depend on funding administered through that office.

Modifications of the protocol/consent are not permitted without prior approval from the HREB. **Implementing changes in the protocol/consent without HREB approval may result in your ethics approval being revoked, meaning your research must stop.** Request for modification to the protocol/consent must be outlined on an amendment form available on the Researcher Portal website as an Event Form and submitted to the HREB for review. Please refer to the attached guidance document regarding on-going reporting requirements to the HREB.

The HREB operates according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2), the Health Research Ethics Authority Act (HREA Act) and applicable laws and regulations.

You are responsible for the ethical conduct of this research, notwithstanding the approval of the HREB.

We wish you every success with your study.

Sincerely,

Elizabeth Dicks

Dr. Elizabeth Dicks (Chair, Non-Clinical Trials Health Research Ethics Board Delegated review)

CC: Dr. Joy Maddigan

Appendix D

Approval from Newfoundland & Labrador Centre for Health Information (NLCHI)

Newfoundland & Labrador Centre for Health Information

September 20, 2018

Anas Alsharawneh
School of Nursing
Memorial University

Dear Mr. Alsharawneh:

RE: Effect of Emergency Department Triage on Outcomes of Patients with Febrile Neutropenia
Our Reference *IM135776*

This is to advise you that the Centre's Secondary Uses Committee (SUC) has reviewed your application to request identifiable Record-Level Information for Secondary Use. Having consulted with the SUC chair, I authorize the disclosure of the requested data.

The approval of your application and use of the requested data is conditional upon the following:

- The data received must be used only for the purposes of this request. Any future uses and/or disclosures of the data provided must have HREB approval as well as approval from the Centre;
- Cell counts or statistics based on cell counts less than 5 are not published;
- The data must be stored on a Memorial University asset and must not be placed on a personal device;
- All members of the research team must comply with Memorial University's policies and procedures for privacy, security and data storage, and have signed an Oath of Confidentiality;
- At the end of the data retention period data must be disposed of by ensuring the drives on the device are appropriately sanitized (securely deleted or destroyed) prior to the disposal or repurposing of the system or any storage components;

Newfoundland and Labrador Centre for Health Information
www.nlchi.nl.ca
70 O'Leary Avenue, St. John's, NL A1B 2C7
t. 709 752 6000 f. 709 752 6011 e. contact@nlchi.nl.ca

- If there are changes with the research study and/or research team then the Centre must be notified. Any amendments or updated HREB approval(s) will be supplied to the Centre accordingly;
- An employee of the Centre who is not a member of the research team will perform the data extraction/linkage;
- Transfer of all record-level data to and from the Centre will be completed using the Centre's Managed File Transfer System (MFT);
- The Centre reserves the right to conduct an audit review of requestors who have been disclosed record-level data.

Please sign below and return to acknowledge you accept the above conditions of approval.

Signed: _____ Date: 22/09/2018

On behalf of the Centre, I wish you every success with this research study.

Sincerely,

Gillian Sweeney
Vice President, Clinical Information Programs and Quality
NL Centre for Health Information
Cc: Donna Roche, Chair, Secondary Uses Committee

Newfoundland and Labrador Centre for Health Information
www.nlchi.nl.ca
70 O'Leary Avenue, St. John's, NL A1B 2C7
t. 709.752.6000 f. 709.752.6011 e. contact@nlchi.nl.ca