Patient Wait Time at the Emergency Department of a Rural Hospital in Saskatchewan

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ABSTRACT

Context & Rationale

Emergency department wait times have been a great challenge to healthcare service delivery in most emergency departments across Canada and a challenge to healthcare managers and provincial governments. This study sought to determine how long patients have to wait to see a physician and the total time spent to complete an ER visit at the Meadow Lake Hospital (MLH) emergency department. It examines various factors that could be responsible for the variation in both wait time and total length of stay at the ER, and the characteristics of patients that left the ER without being seen by a physician.

Methods

This is a retrospective study reviewing medical records of patients attending the Meadow Lake hospital ER for medical services. A total of 778 visits were considered for analysis after records were consecutively reviewed without randomization, for a total of four weeks, one week each during winter, spring, summer, and fall in the year 2015.

Results

Results showed that more than half (54%) of the ER users were females; about 80% of patients using the MLH ER arrived by walking, 10% by ambulance. Most of them presented with either less urgent (48%), or non-urgent (28%) medical conditions. A majority (about 80%) of patients were seen and discharged home; only about 8.3% were admitted to the hospital and 7.4% left without being seen by the ER physician. Patients wait an average of about 86.41 minutes (1.44 hours) before being attended to by the ER physicians, and the average total length of stay at the ER was about 163.3 minutes (2.72 hours). Time until physician assessment (wait time) was found

be influenced by a patient's mode of arrival, day of arrival, time of arrival, season of arrival and CTAS level. Total time spent to complete an ER visit was dependent on the patient's day of arrival, time of arrival, season of arrival, severity of medical condition (triage level), need for investigation, monitoring, and consultations with specialists in other health facilities.

Conclusion

Most patients presenting to the Meadow Lake hospital ER were not meant to be seen at the ER, since larger proportions of patients seen and those that left without being seen presented with either less or non-urgent medical conditions. Both wait time and total ER length of stay at the Meadow Lake hospital ER is shorter than the Canadian average for most urban hospital emergency departments.

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ABBREVIATIONS/ACRONYMS

ACAL	Acute Care Access Line
ACERP	The American College of ER Physicians
CAEP	Canadian Association of Emergency Physicians
CIHI	Canadian Institute of Health Information
COPD	Chronic Obstructive airway Disease
CTAS	Canadian Triage and Acuity Scale
ED	Emergency Department
EDLOS	Emergency Department Length of Stay
ER	Emergency Room
EMS	Emergency Medical Services
ESI	Emergency Severity Index
GI	Gastrointestinal
LAMA	Left Against Medical Advice
LWBS	Left Without Being Seen
MLH	Meadow Lake Hospital
NACRS	National Ambulatory Care Reporting System
NTS	National Triage System
PIA	Physician Initial Assessment time
STS	Sundre Triage System
TTPA	Time to Physician Assessment Time
TLOS	Total Length of Stay

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CHAPTER 1

1.0 Introduction

Emergency departments are a key access point to the health care system where urgent and emergent medical services are provided to patients. These services are, however, not always delivered in a timely fashion (Asplin, et al, 2003; Altmayer et al, 2005). Most patients present to the emergency department with non-emergent medical conditions that could be attended to at a doctor's office and this results in the overcrowding of emergency departments (CAEP-NENA, 2001; Asplin et al, 2003; CIHI, 2005).

According to the Canadian Institute of Health Information (CIHI), Canadians make over 14 million visits to emergency departments annually. About 57 % of these visits were found to be for less urgent conditions (e.g. chronic back pain) and non-urgent conditions like sore throats and ear infections (CIHI, 2005). Nearly one in five Canadian adults (18%) responding to an international survey on emergency department use in 2004 said they could have received their emergency department care from a regular physician in a non-ER setting (CIHI, 2005).

In some countries, like the United States, hospital emergency departments serve as a safety net for those without alternative sources of health care (Johnston & Bao, 2011). Prolonged ER wait times have been a challenge to healthcare service delivery in Canada and many countries worldwide (CIHI, 2005; Wait Time Alliance, 2014). The Canadian Institute of Health Information, in its 2007 report, stressed that the long wait times in emergency departments remain a challenge to the Canadian health care system (CIHI, 2007). Canadians wait longer in the hospital ER than citizens of other advanced countries, such as the United Kingdom (WTA, 2014).

About 27% of Canadians using the ER services waited more than four hours in the ER before being seen by the ER physician compared with only 1% in the Netherlands and 5% in the United Kingdom (CIHI, 2012; Wait Time Alliance, 2014).

CIHI has pointed out that the median length of stay in an emergency department measured from the time of registration or triage to the time of discharge was approximately two hours (128 minutes). However, 10% of these patients spent 36 minutes or less (10th percentile) and 10% spent over six hours in the ER (90th percentile) (CIHI, 2005).

Various factors have been attributed to increasing ER wait times, such as a shortage of acute care bed capacity or limited community care resources. A patient's acuity level (CTAS), time of arrival to the ER, day of the week (weekend or weekdays), and season of the year also influence wait time to get required services (CIHI, 2005; Wait Time Alliance, 2014).

Emergency department physicians are committed to providing high-quality emergency care as quickly as possible to all patients but overcrowding and boarding jeopardize this goal as well as patient safety (Rowe et al, 2006). Prolonged wait time at the ER has led to some patients leaving the ER without being seen by a physician. This is potentially dangerous to a patient's health and has been attributed to negative health outcomes (Rowe et al, 2006).

1.1 Background and Justification.

The emergency department is often called the "gateway" to a hospital since it is the first encounter many patients have with it (Asplin et al, 2003; Han et al, 2007). This first encounter

could be marred by a prolonged wait time to receive required medical services. Prolonged waiting at the emergency department has been a challenge to many hospital managers, regional health authorities, and provincial governments. The Canadian Institute of Health Information maintains that the long waiting time in emergency department remains a challenge to the health care system (CIHI, 2010). The use of emergency departments for minor medical conditions is significantly contributing to prolonged wait times. In a national survey, about 13% of people in Saskatchewan reported to have received treatment for their most recent injuries in the emergency department; this figure is similar to the national average (CIHI, 2005).

In an observational study carried out in major ERs in Saskatchewan, it was found that the average time spent to complete an ER visit was approximately five hours, with about one-half of the visit devoted to waiting for the next required service to take place (Willoughby, Chan, & Strenger, 2010).

A media report stated that Saskatchewan's wait times had doubled in three years, hitting an average of 3.5 hours in 2013, up from 1.7 hours in 2010 (NDP communications, 2015; CBC, 2015). Sick patients who need hospital beds languish on emergency room stretchers while suffering patients who need emergency care wait in hallways and waiting rooms (CAEP-NENA, 2001). An incident occurred in August 2015 in a regional hospital emergency department in Saskatchewan when a middle-aged man died from symptoms related to a heart attack after waiting for 3.5 hours in the ER waiting room without been seen (NDP communications, 2015).

In addition to these fatalities, many patients also leave the emergency department without being attended to by the physician. A study in Alberta estimated that about 4.5% of patients left the

hospital before being seen by a doctor (Rowe et al, 2006). The current trend of ER wait times are still not well known across Canada (CIHI, 2005), and most of ER wait time estimates were based on findings from urban hospitals; hence it is worthwhile to estimate the wait time in rural Saskatchewan hospitals and compare with the Canadian expected wait time obtained from urban centers, since no adequate data is available from rural hospitals ER.

Meadow Lake has an estimated population of 5,000 residents and is considered a city (Statistics Canada). However, the location and services provided at the Meadow Lake hospital are still basically that of a rural hospital. Patient wait time at the Meadow Lake hospital emergency unit is still based on health record office estimates, which are not specific (estimated ER length is 3 to 8 hours, with no speculated estimate of when the ER physician will see them). In order to gain the confidence and satisfaction of patients visiting the ER for medical care, an accurate estimate or near accurate estimate of expected wait time to see the doctor and expected total length of stay is important. Hence, well-conducted research is required to estimate the ER wait times and expected total time needed to receive care at the Meadow Lake hospital ER.

Most available data were actually based on, at most, analysis of ER attendance in just one week. This study goes beyond this limited view by looking at the seasonal variation in wait time and also compare wait time on weekdays to that of weekends. Time and season of arrival to the ER, no doubt could influence how long patients need to wait to be seen by the doctor or the total time spent at the ER. A patient's emergency department visit pattern also varies based on time and day of the week (Chan et al, 2001).

Increased wait times contribute to overcrowded ERs, which can result in dissatisfaction, patients

leaving the ER without being assessed by the ER physician, and delays in treatment that could jeopardize their health outcomes (Johnson et al, 2009). Decreased wait times to receive emergency services brings about timely treatment, a decrease in hospitalization time interval, lower treatment costs, and savings in hospital resources (Johnson et al, 2009).

1.2 Research Questions and Objectives

1.2.1 Research Questions

- How long do patients wait to get medical attention at the emergency department of a rural hospital in Saskatchewan?
- What are the factors responsible for the variations in wait times at an emergency department in a rural hospital in Saskatchewan?
- What are the characteristics of patients that leave the emergency department of a rural hospital in Saskatchewan without being seen by the ER physician?

1.2.2 Research Objectives

- To determine wait time and total time spent by patients to complete their visits when presenting to the emergency department of a rural hospital in Saskatchewan.
- To understand the various predictive factors determining the wait time and total length of stay in the emergency department of a rural hospital in Saskatchewan.
- To examine the characteristics of patients that leaves the emergency department of a rural hospital in Saskatchewan without being seen by the ER physician.

1.3 Definition of Key Concepts

- **Emergency Department or Emergency Room (ED and/or ER):** is a unit of the hospital that provides acute care to patients arriving by ambulance or other means 24 hours a day, seven days a week. ED and ER are used interchangeably throughout this study.

- **Physician Initial Assessment time (PIA):** is the time of physician's initial contact with the patient (CIHI, 2005).

- **ER Length of Stay:** is the time from a patient's registration or triage to the time the main service provider (usually the ER physician) makes the decision to discharge the patient, or when the patient is admitted or transferred to another facility for further care. This measure includes time spent waiting for assessment or treatment and time spent receiving care (CIHI, 2005; CIHI, 2012).

- **Time to Physician Assessment (TTPA):** is the time from patient's registration or triage to the time patient is seen by the emergency room physician. The physician usually records this time upon his/her first contact with the patient. The physician initial assessment time is included in the total time spent at the emergency department when receiving medical care. However, it remains an important measure on its own because it may significantly influence the total ER length of stay (CIHI, 2005). It's also referred to as the ER wait time.

- **ER Wait Time:** an ER patient's "wait time" should be defined as "door to provider contact time." In this case, Provider is defined as physician (MD), advanced practice

nurse, or physician assistant (Welch et al. 2011). This is invariably the time to physician assessment time mentioned above.

- **Time Waiting for Inpatient Bed:** is the time from the decision to admit the patient to an acute care bed to the time the patient leaves the ED to go to the inpatient unit (CIHI, 2005; CIHI, 2012).

- **The Canadian Triage and Acuity Scale (CTAS):** is the scale used in emergency departments to determine a patient's need for timely care (Beveridge et al, 1999; CIHI, 2005).

- **Ethnicity:** is the state of belonging to a social group that has a common national or cultural tradition (James, Bourgeois & Shannon, 2005).

- **Race:** a group of people with a common physical feature or features (e. g Caucasian) (James, Bourgeois & Shannon, 2005).

CHAPTER 2

2.0 Literature Review

2.1 Emergency Department.

"Emergency departments are medical treatment facilities, designed to provide episodic care to patients suffering from acute injuries and illnesses as well as patients who are experiencing sporadic flare-ups of underlying chronic medical conditions which require urgent medical attention" (Chan et al, 2001). In most cases, an ED provides comprehensive medical services to acutely ill patients arriving either by ambulance or by other means 24 hours a day, seven days a week (CAEP, 2014; CIHI, 2005).

2.1.1 Workflow at the ER

Most ERs have a similar workflow, from the arrival of a patient (by different means, ambulance, walking, wheel chair), registration, triage during the nurse's assessment, physician's initial assessment, investigation or diagnostic procedures (if required), treatment administration, and disposition (this could include being discharged home, admission for in-patient management, transfer to other facilities, or patients leaving the ER without being seen by the physician) (CIHI, 2005). The usual ER workflow is shown below in Figure 1.

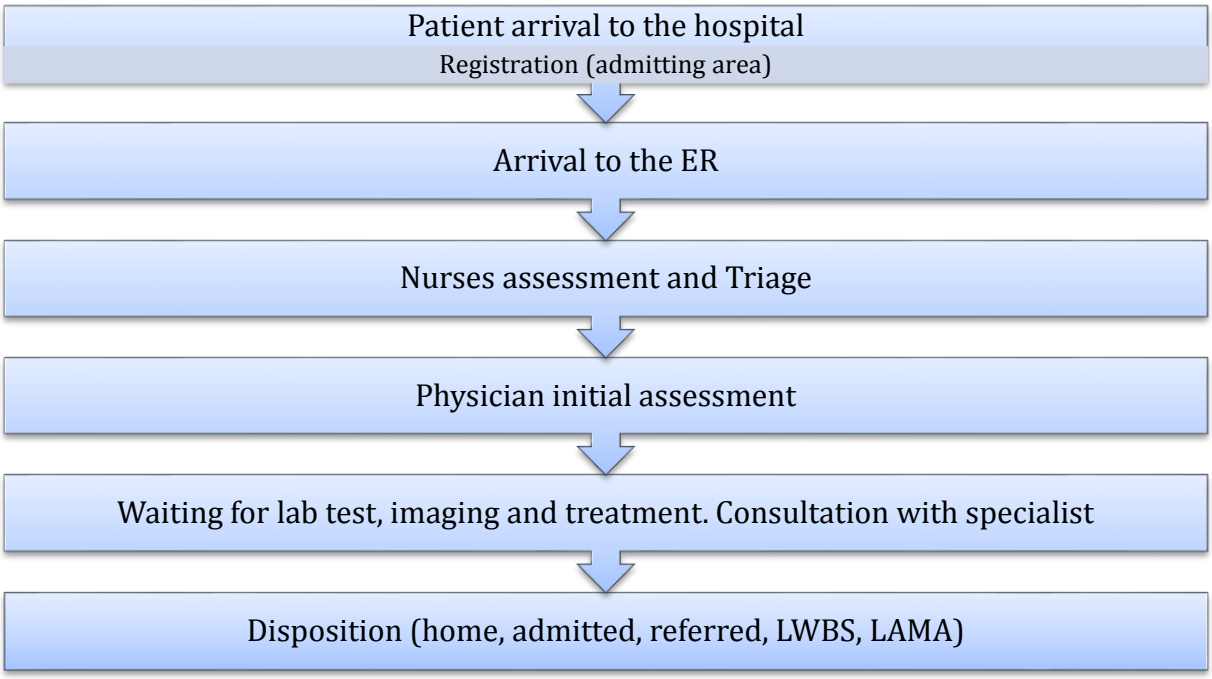

Figure 1: Emergency Department usual workflow

**LWBS*–Left Without Being Seen; *LAMA*–Left Against Medical Advice

2.1.2 The Canadian Triage and Acuity Scale (CTAS)

The Canadian Triage and Acuity Scale was developed by the Canadian Association of Emergency Physicians (CAEP) in 1998 to determine the severity of a patient's medical condition to ensure that patients who need immediate care get seen first and in a timely fashion (CIHI, 2005; CIHI, 2012; CAEP, 2014). CTAS is used by approximately 80 per cent of Canadian emergency departments for quality assurance and standardization purposes (Newfoundland and Labrador, 2012). CTAS actually evolved from work done primarily in urban Australia, where it was called the National Triage System (NTS), and in urban Canada by specialist emergency medicine nurses and physicians (Thompson & Dodd, 2000; Beveridge et al, 1999; CIHI, 2005)**.** It's now being implemented as a national triage standard for Canada's emergency health care system (Thompson & Dodd, 2000; Beveridge et al, 1999; CIHI, 2005).

In the late 1980s, physicians and nurses in Sundre, Alberta developed a truly rural ER triage system; the "Sundre Triage System" (STS), which has been used and still in use in some rural ER in Canada and USA (Thompson & Dodd, 2000; Beveridge, 1998). The equivalent of CTAS in the USA is Emergency Severity Index (ESI) (AHRQ, 2018).

CTAS has five levels categorized by the urgency or severity of the conditions and the time frame in which they need to be treated; these levels are described as follows (Beveridge et al, 1999; CIHI, 2005; CIHI, 2012; CAEP, 2014).

CTAS Level I (Resuscitation). These are patients that present with conditions that are life or limb threatening (or imminent risk of deterioration), requiring immediate and aggressive interventions. Examples of these conditions are cardiac or respiratory arrest, major trauma, unconscious patients, and severe respiratory distress. Patients in this category need to be seen immediately upon arrival to the ER.

CTAS Level II (Emergent). These are patients that present with conditions that are potentially threatening to life, limb, or function and require rapid medical intervention or delegated acts. Examples of these conditions are altered mental states, head injury, severe trauma, acute myocardial infarction, drug overdose, and cardiovascular accident (stroke). Patients in this category need to be seen within 15 minutes of arrival to the ER.

CTAS Level III (Urgent). These are patients that present with conditions that could potentially progress to a serious problem requiring emergency intervention. Such conditions may be associated with significant discomfort that affects the ability to function at work or other daily

activities. Examples of these conditions are exacerbation of asthma or COPD, GI bleeding, vaginal bleeding, acute psychosis and/or suicidal thoughts, and acute pain. Patients in this category need to be seen within 30 minutes of arrival to the ER.

CTAS Level IV (Less Urgent). These are patients that present with conditions that are related to patient age, distress, or potential for deterioration or complications would benefit from intervention or reassurance within 1-2 hours. Examples of these conditions include headache, corneal foreign body, and chronic back pain. Patients in this category need to be seen within 60 minutes of arrival to the ER.

CTAS Level V (Non-Urgent). These are patients that present with conditions that may be acute, but non-urgent, as well as conditions that may be part of a chronic problem with or without evidence of deterioration. The investigation or interventions for some of these illnesses or injuries could be delayed or even referred to other areas of the hospital or health care system. Examples of these conditions are sore throat, urinary tract infection, mild abdominal pain that is chronic or recurring with normal vital signs, vomiting alone, and diarrhea alone. Patients in this category need to be seen within 120 minutes of arrival to the ER (Beveridge et al, 1999; CIHI, 2005; CIHI, 2012; CAEP, 2014).

CTAS levels I, II and III are also classified as high acuity cases, and CTAS levels IV and V as low acuity cases (CIHI, 2012).

2.1.3 The "Sundre Triage System" (STS)

This triage system is used in rural settings as mentioned previously; it also has five levels of acuity or severity arranged in an ascending order. The definition of a patient's condition at each level is the same as that of the Canadian Triage and Acuity Scale. However, estimated time to consultation is a bit longer than those in the CTAS categories. The levels and the estimated time to medical care are as follows:

STS Level 1 (Non-urgent). Patients in this category are expected to be seen 12 hours or more after arrival to the ER.

STS Level 2 (Semi-urgent). Patients in this category are expected to be seen within 3–12 hours of arrival to the ER.

STS Level 3 (Urgent). Patients in this category are expected to be seen between 1–3 hours of arrival to the ER.

STS Level 4 (Emergent). Patients in this category are expected to be seen within an hour of arrival to the ER.

STS Level 5 (Critical). Patients in this category are expected to be seen immediately on arrival.

The differences in time could be explained by the fact that urban emergency room physicians are physically present at the ED during their shifts, but in most rural Eds, the on-call physician is either at home, at the clinic, or on nursing home rounds for a significant part of the day (Beveridge, 1998; Beveridge et al, 1999; Thompson & Dodd, 2000).

2.2 Demographic Characteristic of those Using the ER Services

Studies have found that patients at the two extremes of age, the young and the elderly, use ER services most (Chan et al, 2001; CIHI 2005). Thirty-four per cent of children under five years of age have visited an ER at least once, as did 29 per cent of the population 75 years and older, compared to 18 per cent for persons 5–74 years of age. The number of visits per person also varied by age, again with young children and the elderly having the highest number of visits (Chan et al, 2001; CIHI 2005).

Chan et al (2001) further stated that even though the elderly had high rates of use, they accounted for a relatively small proportion of total ER visits, because they represent a relatively small part of the population. Adults aged 20 to 64 years made up 52.4 per cent of all ER visits, compared to 31.0 per cent for individuals under age 20 years and 16.5 per cent for those aged 65 years and over (Chan et al, 2001). CIHI Reports also confirmed that adults accounted for the largest absolute number of ER visits, 61% of patients visiting the ER were between16 and 64 years old (CIHI, 2005).

Gender variations have also been observed in ER attendants. The Canadian Institute of Health Information reported that males made more ER visits than females, with 52% and 48%, respectively (CIHI, 2005). CIHI also found that those in the lowest income group tend to use the ER more than those in the highest income group, 18% vs. 13% (CIHI, 2005).

Regarding the area of residence, those in rural areas were also more likely to have used ER services more than those in urban areas (15% vs. 13%) (CIHI, 2005). The use of the ER for less urgent medical conditions is higher in rural communities compared to urban centers. A study in

Ontario found that 3,174 ER visits per 100,000 population aged 1–74 years are for conditions that could be treated in alternate primary care settings, with rates varying across counties (Altmayer et al, 2005). These rates were higher in rural counties (up to seven times higher than the provincial average) (Altmayer et al, 2005). Urban counties had lower rates; some were less than one-third of the provincial average (Altmayer et al, 2005).

Patients with limited access to primary healthcare services, and those without family or a primary provider, were found to use the ER more often than others (CIHI, 2012; Han et al, 2007). Results obtained by Han et al, in their study of patients presenting to the ER, confirmed that many patients using ERs do not have access to a primary care physician and failure to receive adequate help at another source (Han et al, 2007).

2.2.1 Mode of Arrival to the ER

Patients arrive to the ER by different means including ambulance, walking, wheelchair, children carried by their parents, and some patients accompanied by the police. National data from CIHI's 2003–2004 survey indicated that only 12% of people arrived the ER by ambulance, most of which were patients with severe health concerns and elderly women age 85 years and older (CIHI, 2005). The report also pointed out that arrival by ambulance was more likely (52% of visits) among those older than 85 years. Although this age group accounted for only 2.9% of ER visits, they represented 14% of ER ambulance arrivals (CIHI, 2005). 78% of those arriving by ambulance were found to have a severe health condition while about 2.8 % have least non-severe medical condition (CIHI, 2005).

2.2.2 ED Attendance According to Patient's Level of Acuity (CTAS Level)

Over half (57%) of ER visits in the 2003–2004 Canadian Institute of Health Information National Survey were for less urgent conditions (like chronic back pain or minor allergic reactions) or non-urgent conditions (such as sore throat, menstrual concerns, or isolated diarrhea) based on the Canadian Triage and Acuity Scale (CTAS) (CIHI, 2005). A more detailed breakdown of the visits' acuity level revealed that patients with CTAS level I accounted for 0.5%, patients with CTAS level II 8%, CTAS level III 35%, CTAS level IV was 43% while CTAS level V accounted for 14% (CIHI, 2005).

2.2.3 ER Patient Volume and Patient Flow Rate

Researchers and clinicians suggest that a key to understanding delays in the patient flow process requires looking beyond the walls of the ER to other system-level factors (CIHI 2007). CIHI reports from 2007 gathered that emergency room patient volume was related to a number of factors, which included staff availability, scheduling of minor procedures at the ER, and unavailability of acute care beds on the ward. A reduction in the ER's capacity to care for new patients occurs, as the number of admitted patients waiting in the ER increases, the ability to treat new patients coming into the ER may be limited. This high volume impedes the flow of patients due to overcrowding, and limited space or time to attend to new incoming patients (CIHI, 2007).

2.2.4 ER Overcrowding

Emergency room crowding is a reflection of larger supply and demand mismatches in the health care system (Asplin et al, 2003). An ER is considered crowded when it has inadequate resources to meet patient demands leading to a reduction in the quality of care (American College of ER Physicians, ACEP-2002). The Canadian Association of Emergency Physicians has defined ER

overcrowding as “a situation in which demand for service exceeds the ability to provide care within a reasonable time, causing physicians and nurses to be unable to provide quality care to patients needing the services at the ER” (CAEP-NENA, 2001; CAEP, 2016). Researchers have attributed ER overcrowding to a myriad of causes, which include increased volume, an aging population with increased health care needs, increased complexity or acuity of the conditions of patients presenting to the ER (many of whom require hospital and or intensive care unit admission), and the relative lack of inpatient and intensive care unit beds (CAEP-NENA, 2001; James, Bourgeois & Shannon, 2005). Other factors include shortages of nurses and other clinical personnel, increased demand for ancillary services, decreased numbers of EDs in Canada and the United States, and lack of access to primary care services (CAEP-NENA, 2001; James, Bourgeois & Shannon, 2005). Overcrowding usually leads to prolonged wait times, which results to increased complaints and decreased satisfaction from patients in addition to decreased quality of care and increased medical errors (Becker, 2009). It also leads to decreased staff satisfaction and increased staff turnover, decreased physician productivity, and decreased hospital revenue (Becker, 2009).

2.3 Wait Time at the ER

The wait time at the ER is usually considered to be the time patients spent waiting for the physician initial assessment. That is, from registration through triage and the nurse’s assessment until the physician sees them. The total length of stay (TLOS) at the ER is the time from registration until the patient leaves the ER by being either by being discharged home, admitted or transferred to another facility (CIHI, 2005; CIHI, 2012; Willoughby, Chan & Strenger, 2010; Newfoundland and Labrador, 2012).

2.3.1. Time to Physician Assessment

As mentioned above, the time to physician assessment is also referred to as ER wait time and it's the time the patient spent at the ER before being assessed by the physician. According to CIHI reports from 2005, using data from NACRS, patients waited a median time of 51 minutes before being assessed by a physician in a 2003–2004 survey. The median time implies the time spent by half the patients seen at the ER before seeing a physician while the remaining half spent more than the median time. The report also estimated that 10% of ER patients waited for 10 minutes or less (10th percentile), while 10% waited for 165 minutes or more (90th percentile). The report concluded that the median wait time to see a physician varied slightly due to the volume of patients in ER at the time of the visit, but more significantly by the severity of a patient's medical condition (CIHI, 2005). The report also went further to highlight the physician assessment time variation with a patient's level of acuity. On average, physicians assessed patients with more urgent conditions more quickly than patients with less urgent conditions. It found that most severely ill patients (CTAS I) were seen by a physician within a median time of approximately five minutes, whereas those with conditions assessed as urgent (CTAS III) waited a median time of just under 60 minutes to be seen by a physician (CIHI, 2005).

The majority of the time that patients assessed as CTAS I spent in ERs occurred after being seen by a physician (97% of their ER total length of stay). For those assessed as CTAS III, the picture is somewhat different, these patients spent 35% of their total time in ERs waiting to be seen by the emergency room physician (CIHI, 2005).

Data from facilities with low and medium ER flows vary slightly compared to those above based on their peculiarities. It was observed that patients with less severe health conditions visiting low

and medium volume ERs, however, had shorter waiting times to see a physician (CIHI, 2005). On average, it tended to take longer for patients to be seen by a physician in ERs that treated more patients (higher patient volume) (CIHI, 2005). Overall, teaching hospitals and high-volume ERs had median wait times from 6 –70 minutes to see a physician, depending on the patient's severity of illness. For low-volume ERs, the range in overall median wait times to see a physician was 1–25 minutes (CIHI 2005). Recent CIHI data looking at physician assessment time in 2012–2013 by hospital type estimated that physician initial assessment time in a teaching hospital setting was 3.5 hours, whereas in a small community ER the wait was 2.4 hours, in a medium community ER it was 3.1 hours, and in a large community ER it was 3.3 hours (CIHI, 2012).

In Saskatchewan, the provincial wait time to see a physician has doubled in the past three years (NDP communications, 2015). CIHI data also estimated the physician assessment time for the Saskatoon Health Region (SHR) is 2.5 hours, and 4.3 hours in the Regina Qu'Appelle Health Region. For Saskatoon hospitals, City Hospital had a physician assessment time of 1.6 hours while St. Paul's Hospital had a time of 2.4 hours (CIHI, 2012). Data for smaller Saskatchewan regional hospitals emergency units were not available.

2.3.2. Total Length of Stay at the ER

Total length of stay at the emergency room (TLOS) is the total time spent by patients to complete their ER visits (from registration to disposition). Disposition could either be any of the following, seen and sent home (discharged), admitted for inpatient management, transferred to other facilities, leaving against medical advice (LAMA), leaving without being seen by the physician (LWBS), and death (Willoughby, Chan & Strenger, 2010; Newfoundland and Labrador, 2012; CIHI, 2005; CIHI, 2012). According to the CIHI 2005 report, the median total length of stay in a

Canadian hospital's ER was approximately 128 minutes, with 10% of patients spending as long as six hours in the ER (CIHI, 2005). The average length of stay across urban hospital ERs in Canada was estimated to be approximately 4.4 hours, with 90% of visits completed within eight hours (CIHI, 2012). An observational study conducted in the ER rooms of five major cities in Saskatchewan (Royal University Hospital, Saskatoon City Hospital, St. Paul's Hospital, Regina General Hospital and Pasqua Hospital) found that the average transit time in these ERs was nearly five hours, with about one-half of this time spent waiting for the next service (Willoughby, Chan & Strenger, 2010). Further analysis also showed that patients with low acuity (i.e. CTAS IV and V) spent an average of two hours to complete their ER visits while those with higher acuity (i.e. CTAS I and II) spent average of 6.5 hours. Meaning that higher acuity patients spent less time to be attended to by the ER physician but had longer transit times overall (Willoughby, Chan & Strenger, 2010).

Various other factors have been identified as prolonging ER wait times, some of which are directly related to a patient's clinical characteristics and others related to factors or circumstances at the ER. Factors contributing to how long patients wait at the ER will be discussed in section 2.4.

2.4 Factors Influencing Wait Time at the ER

A number of factors have been identified as a determinant of or influence on wait times or total time patient spent in the ER. These factors are complex and often unique to each emergency department (Newfoundland and Labrador, 2012). Some researchers have classified these factors into internal and external factors (Yoon, Steiner & Reinhardt, 2003). Among the internal factors

are a patient's characteristics, including age, severity or acuity of their medical conditions, need for laboratory testing, imaging and other investigations, therapeutic procedures like chest tube insert and consultation with other doctors. The number of patients present at the ER and time of the day could also contribute to how much time patients spent at the ER during their visits (CIHI, 2005; Yoon, Steiner & Reinhardt, 2003; Castro, 1993).

External factors that affect wait times include, management practices, ED staffing, accessibility to other healthcare services like walk in clinics, time of operations of these clinics. Late evening and weekend services have been found to reduce ER influx. Geographical location of the ER (rural or urban, densely or less dense area), type of insurance coverage (especially in the US) also determines ER wait time (Park, Lee & Epstein, 2009; Newfoundland and Labrador, 2012; CIHI, 2005). Some researchers have also included race, ethnicity, cultural competence, and language barriers as significant predictors of ER wait time (Sonnenfeld, 2012; Vigil et al, 2015; James, Bourgeois & Shannon, 2005).

Understanding the factors that contribute to ER process times and patient care delays is a critical step in improving ER care efficiency (Yoon, Steiner & Reinhardt, 2003). Other researchers have also classified these factors into four categories as highlighted below (Schull et al, 2002).

Patient demographic and clinical factors*:* these include a patient's age, triage level or urgency (Triage code), diagnosis, time of day and day of week of visit, and disposition.

Community factors: these include, local home care service availability, alternate level of care bed availability, nearby EDs diverting ambulances.

Emergency department factors: these include, number of admitted patients held in the ED, intermittent surges in number of newly arriving ambulance and ambulatory patients, ED physician staffing (physician-hours per day), ED physician characteristics, ED nurse staffing (nurse–hours per day), availability of social work and geriatric teams in the ED, ED consult response times, ED consult policies, ED design (number of stretchers and monitors, size of department) and access to radiological tests after hours.

Hospital factors: these include number of critical care and acute hospital beds (especially medical), overall bed occupancy rate, in-hospital lengths of stay, occupancy rate of acute beds by alternate level of care patients.

2.4.1 Race/Ethnicity and ED Wait Time

Researchers have done a number of studies (mostly in the US) on the influence of race/ethnicity on wait time at the ER. Most of them found that ethnic minorities stay longer at the ER than other ethnic groups (James, Bourgeois & Shannon, 2005; Park, Lee & Epstein, 2009; Wu, Banks & Conwell, 2009; Vigil et al, 2015).

A retrospective study found that unadjusted and adjusted emergency department wait times were significantly longer for non-Hispanic black and Hispanic children than for non-Hispanic white children. Hispanic children had a 10.4 % (95 % CI: 2.2% - 19.1%) longer wait time than non-Hispanic white children when treated at the same hospital (Park, Lee & Epstein, 2009; Wu, Banks & Conwell, 2009).

Another study titled “Association of Race/Ethnicity with Emergency Department Wait Times”

concluded that children who come to ERs have wait times that vary according to race/ethnicity (James, Bourgeois & Shannon, 2005). Several potential explanations have been put forward to explain the disparity found in ER wait time due to racial or ethnic differences. James et al (2005), have linked these variations to patients, providers, or system-related variables. Patient-related variables potentially include language barrier, socioeconomic status, insurance coverage, geographic location, level of literacy, and cultural incompetence (James, Bourgeois & Shannon, 2005). Provider-related variables include bias, prejudice, and stereotyping, which might play a role in triage decisions. System-related variables include availability of primary care services, lack of available interpreter services, and ER volume (James, Bourgeois & Shannon, 2005). Even with adjustment for hospital locations, studies still found that race/ethnicity remained an important predictor of wait time in the ER (James, Bourgeois & Shannon, 2005; Vigil et al, 2015).

2.4.2. Severity of Medical Condition (CTAS Level) and Wait Time

CTAS was designed to prioritize services provided at the ER, based on the severity of patient's condition (CAEP, 2014). However, it plays a significant role in determining the wait time at the ER (Beveridge et al, 1999; CIHI, 2005; CIHI, 2012; CAEP, 2014).

According to National Ambulatory Care Reporting System (NACRS) data, the majority (78%) of patients seen at the ER in 2003–2004 were triaged as either urgent (CTAS III) or less urgent (CTAS IV). Those requiring immediate (CTAS I) or emergent care (CTAS II) represented less than 10% of all ER visits (0.5% and 8.2%, respectively) (CIHI, 2005; CIHI, 2012). On average, physicians assessed patients with more urgent conditions faster than patients with less urgent conditions. The most severely ill patients (CTAS I) were seen by a physician within a median

time of approximately five minutes, whereas those with conditions assessed as urgent (CTAS III) waited a median time of just under 60 minutes to be seen by a physician (CIHI, 2005). However, Patients with more severe conditions tended to spend more time in ER than patients with less severe conditions. CIHI estimated the median emergency department total length of stay for those triaged as most severe (CTAS I) as around 161 minutes compared to 67 minutes for those triaged as least severe (CTAS V). These differences likely reflect, in part, the fact that more complex health problems require more diagnostic tests and more monitoring than conditions that are more straightforward (CIHI, 2005). Patients in intermediate triage levels III and IV generally had the longest waiting times to nurse and physician assessment, and the longest ER lengths of stay. Ninety seven percent of the total ER time spent by patients with CTAS I was attributed to treatment time due to the acuity of their conditions. A larger percentage (35%) of the total time spent at the ER by patient with CTAS III and IV was attributed to time spent waiting for physician initial assessment (CIHI, 2005). Generally, the median wait times to see a physician varied slightly by the volume of patients in ERs at the time of the visit, but more so by patient's severity (CIHI, 2005).

2.4.3. Time of Arrival and Wait Time

The time of arrival to the ER could also determine how long patients need to wait before being seen. Patient flow patterns in the ER vary at different time of the day. NACRS 2003–2004 data, suggest that ER visits tended to increase from 7:00 a.m. until about noon and remained steady during the daytime, until around 8:00 p.m. when it begins to drop (CIHI, 2005). A second peak period was observed in pediatric hospitals between 7:00 p.m. and 10:00 p.m., which was attributed to fever pattern in children and parents that bring their children to the ER after returning from work (CIHI, 2005). Patients waited longer to be assessed by a physician when ER

volumes were highest; CIHI (2005) reports estimated the median waiting time for patients at the ER at a peak time (for example, 11:00 a.m.) at 58 minutes, and the shortest wait time was 38 minutes at around 4:00 am when the ER is usually less busy (CIHI, 2005). Peak patient flow time also varied depending on the location of the hospital (rural or urban). A study conducted by the Institute of Clinical Evaluative Sciences, found that urban Ontario ERs have a substantially higher proportion of their visits occurring after midnight when compared to rural Ontario ERs (CIHI, 2005; Chan et al, 2001).

2.4.4. Day of Arrival and Wait Time

Day of the week also has some influence on the wait time at the Weekday ER visits have are more frequent, however, on weekends patient flow could be higher than expected. A study conducted by Chan et al (2001) found that the peak periods in ER volume are predictable and occur during public holidays, weekends, and summer. The study also found that the ER has the heaviest volume of visits occurring on Sunday, then Saturday, and Monday (Chan et al, 2001). More patients with routine medical or ongoing medical conditions tend to visit the ER on weekends rather than weekdays, probably because they do not have time off work to see their family doctors during the week or because most clinics are closed during weekends (Chan et al, 2001; CIHI, 2005). According to a 2001 Statistics Canada survey, 32% of Canadians aged 15 years and older would seek routine medical care at the ER during weekends and evening hours compared to 4% that would like to visit ER for similar conditions during regular hours (CIHI, 2005).

2.4.5. Season of Arrival and Wait Time

Patient flow and type of conditions presented to the ER varied by time and season of the year. An Ontario survey on ER utilization found that patient visits were higher in the winter and summer months, and characteristic peaks coincided with public holidays. The week straddling the Christmas holiday was the busiest in the year in terms of ER visit volume (Chan et al, 2001). Types of medical conditions seen sometimes varied with seasons, hence the ER flow rate also varied by season (Chan et al, 2001). For instance, flu-like symptoms are more common during fall and winter periods, likewise injuries from falls are also common during winter. This variability tends to affect CTAS of patients with these conditions, hence their wait time before being attended to at the ER. Patients with flu-like symptoms could be assigned a lower CTAS of IV or V, which invariably means that they might stay longer before being attended to by the ER physician. Those with injuries from a fall could be seen earlier but might spend longer time before being discharged because they might require x-rays and casting. This variability could also be more pronounced depending on the number of patients at the ER at that period of time.

2.4.6. Facility Type and Wait Time

Type and location of an ER also determines how long patients will wait to get medical services. ERs have been classified into five different patient groupings: teaching hospitals; pediatric hospitals, and community hospitals treating low, medium, and high numbers of patients (CIHI, 2005). According to CIHI (2005), high-volume community hospital ERs (those with over 30,000 visits annually) accounted for 47% of emergency department visits in 2003–2004 while medium-volume (between 15,000 and 30,000 visits annually) and low-volume (under 15,000 visits annually) facilities accounted for 24% and 11%, respectively. Teaching hospital ERs saw 16% of all ER visits (CIHI, 2005).

Previous analyses have shown that patients in larger hospitals appeared to wait longer in the ER for initial physician assessment and visit completion compared to patients visiting ERs in smaller hospitals (CIHI, 2007). Patients presenting to the teaching hospitals ER usually have more severe or complex medical conditions than those seen at the rural hospitals (CIHI, 2005). The Canadian Institute of Health Information (CIHI) reports that 1% of patients seen in ERs located in teaching hospitals or high-volume ERs were triaged as CTAS I in 2003–2004 compared to 0.2% for medium- and low-volume hospitals (CIHI, 2005).

Patients visiting ERs located in teaching hospitals tended to have longer lengths of stay, regardless of their severity, than patients visiting low-, medium-, or high-volume emergency departments. The overall median ER length of stay was 203 minutes for those visiting teaching hospital ERs in 2003 – 2004, while those visiting low-volume ERs was 61 minutes (CIHI, 2005). There is also an urban-rural variation in wait time that is a result of ER patient volume and peculiarities in different settings. In urban hospitals ER, physicians are physically present in the ER during their shift, but in rural hospitals, the on-call physician may be at home, seeing patients at the clinic or on nursing home rounds (CIHI, 2012).

2.4.7. Place of Residence

A patient's place of residence has been related to ER attendance. Moineddin et al (2011), in their studies in Ontario, pointed out that place of residence is an interesting predictor of emergency department utilization. Results obtained suggested that patients with rural residences use emergency department services at greater rates than non-rural residences (Chan et al, 2001; Moineddin et al, 2011). CIHI reported that, those in rural areas were also more likely to have used ER services than those in urban areas 15% vs. 13%, respectively (CIHI, 2005).

2.4.8 Investigations During ER Visits

A number of patients that visit the ER require some form of clinical investigation. Investigations commonly done at the ER depend on the capacity and level of care provided by the hospital. Urban ERs tend to have capacities to do lots of investigation while patients are still under the care of the emergency department physician. On the other hand, patients in rural ERs might have to be transferred to city hospitals for further investigation. Investigations that are commonly done in ERs include basic laboratory tests, ECG, x-rays, and ultrasounds. Patients that require any test, imaging or ECG would have to wait for the lab and x-ray technician to carry out the investigation and usually have to wait for the results in order for the physician to make final disposition decision. Obviously, this will take time, and hence patients requiring lab tests or other investigations tend to spend more time at the ER to complete their visits compared to patients who do not require any investigation (Moineddin et al, 2011). Also, patients that require monitoring (for pain control, rehydration, nebulization etc.) and those requiring specialist consultation and transfer to other facilities, spent longer time at the ER before disposition plans are made.

2.4.9 Access to Primary Care Facilities and Physicians

Access to a primary care physician has been found to be an important predictor of both the odds and rate of emergency department utilization. An Ontario study found that restructuring primary care services, with the aim of increasing access to underserved populations might result in decreased emergency department utilization rates by approximately 43% for low severity triage level cases (Moineddin et al, 2011). Another study reported that a number of patients who have a primary provider still choose to use the ER, and a majority of repeat emergency department users also had periodic contact with primary care physicians (Chan et al, 2001). Researchers have also

pointed out that, the choice to use the emergency care services by patients who can access primary care in the community may be attributable to the convenience and ease of access to emergency services, relative to primary care services, in their geographic locations (Moineddin et al, 2011; Sempere-Selva et al, 2001).

2.5. Disposition from the ER

After patients have been attended to at the ER, the attending physician usually comes up with disposition plan which could include being discharged home with treatment, admitted into the hospital in-patient ward, or transfer out to another hospital for further specialty care. Some patients leave against medical advice after having been partially attended to, while some others decide to leave without being seen by the physician (Rowe et al, 2006; CIHI, 2005). A majority of the patients seen at the ER are usually sent home; CIHI found that more than 80% of patients assessed in the ER in 2003–2004 were discharged to their places of residence, which included about 84% and 88% in Ontario and Alberta, respectively (CIHI, 2005).

Admission rates through ERs vary across Canada's provinces and territories; CIHI reports that about 11 % and 8% of patients seen in Ontario and Alberta respectively were admitted to the hospital (CIHI, 2005). Overall, more than half of all hospital admissions (excluding pregnancy-related conditions) came through the ER (53%) in that year (CIHI 2005). For example, the Northwest Territories had the highest admission rate through ERs (97/1,000 population). Ontario had the lowest (38/1,000 population). Decisions and rate of admission to the hospital depend on CTAS score and facility type. CIHI reports that most patients admitted to teaching hospitals have CTAS 1-2, while those in these categories seen at the rural hospitals are actually transferred to

the referral hospital. Hence the admission rate is higher at these hospitals (CIHI, 2005).

Patients admitted to in-patient beds might have to wait for bed availability, depending on how long this wait time is, it may influence the flow and wait time of other patients in the emergency department at that time (Schull et al, 2002; CIHI, 2007). The median bed wait time also varied by hospital type, from 18 minutes in a small community hospital to 2.3 hours in teaching hospitals (CIHI, 2007). Based on the analysis of bed wait time in 277 hospitals in Canada during 2005, 86% of patients in small hospitals (small community hospital with about 49 acute care bed) spent two hours or less in the ER waiting for an acute care bed. In contrast, 55% of patients in teaching hospitals had bed wait times of two hours or more (CIHI, 2007). Boarding, which is when a patient in the ER is kept there after ER treatment is completed because there are no inpatient beds available in the hospital, affects the flow of the ER operation (Auburn Memorial Hospital project, 2013).

2.6. Patients Leaving the ER Without Being Seen

Some patients decide to leave the ER without being seen by the physician and this is ultimately a result of prolonged waiting time for the physician initial assessment and also the volume of patients present at the ER. Long wait times result in patient dissatisfaction and increased probability of patients leaving the ER without receiving treatment (Green, Soares, Giglio & Green, 2006; Baker, Stevens & Brook, 1991; CIHI, 2012). CIHI report indicated that average of about 3% of patients left the ER without being seen in 2003–2004 (CIHI, 2005). Woodward et al (2014) reported a higher rate in their study; they found that a total of 4.6% of patients left before being seen by the ER physician (Woodward, Zimmerman, Isom & Summers, 2014). Patients leaving the ER without being seen by the physician are an indirect measure of wait times and

indicate patient dissatisfaction. It may also indicate that the visits to the emergency department were not required (Newfoundland and Labrador, 2012). Rowe et al (2006), in their review of the characteristics of patients that left the ER without being seen, found that the single most important reason why patients left without being seen was being ‘‘fed up with waiting’’. It is interesting that patients felt this way irrespective of the actual time spent waiting and the triage level (Rowe et al, 2006). Leaving the ER without being seen has been attributed to delays in care and consequent adverse outcomes, especially for higher acuity patients (Rowe et al, 2006).

2.6.1. Characteristics of Patients Leaving the ER Without Being Seen

A comprehensive prospective study in a downtown Toronto teaching hospital conducted in 2005 described the socio-demographic characteristics and clinical outcomes of patients who leave the emergency department (ER) without being seen by a physician. It found that about 3.57% of patients that visited the ER during the study period left the ER without being seen by the physician, most (36.7%) of whom left because they had waited for too long (Monzon et al, 2005; Fraser, 2017). Some other researchers found that a higher number of patients left the ER without been seen by the physician; Baker and Stephen (1991), estimated that about 15% of patients left without receiving medical attention from the doctor (Baker, Stevens & Brook, 1991). They noted that patients who left the ER without being seen have different socio-demographic features, methods of accessing the health care system, affiliations and expectations than the general ER population. They are often socially disenfranchised, with limited access to traditional primary care. These patients are generally low acuity, but they are at risk of avoidable adverse outcomes (Monzon et al, 2005). They found that patients that left the ER without being seen (LWBS) were aged between 36 and 40 years, with no gender variations, and they often lacked a regular physician and were, therefore, more likely to attend an ER or urgent care clinic (Monzon et al,

2005). Most of these patients had no emergent problems, and a breakdown of their level of acuity showed that, majority of them have CTAS level III and IV (Monzon et al, 2005).

2.6.2. Length of Stay at the ER before a Patient Leaves Without Being Seen

Monzon and his colleagues also considered how long patients waited for before deciding to leave the ER. They estimated that patients waited for an average of 2.48 hours, with a standard deviation of 1.73 (Monzon et al, 2005). A previous Canadian study conducted in Toronto found that most LWBS patients who leave dissatisfied do so within two hours of ER registration (Fernandes, Daya, Barry & Palmer, 1994; Fraser, 2017). When patients were asked what the main reason was for leaving, 36% of them left because they had waited for too long, 15% left because they started feeling better while 13% were too ill to wait longer (Monzon et al, 2005). An American study found that the number of patients that left the ER without being seen has increased by approximately 67% between 1995 and 2002 (Becker, 2009). The recommended rate of LWBS should be between 2–3% (Newfoundland and Labrador, 2012).

2.6.3. Consequences of Prolonged ER Wait Time

Prolonged ER wait time and length of visit reduces the quality of care and increases suffering and adverse events for patients with serious illnesses (Horwitz, Green & Bradley, 2010; CIHI, 2012). Patients may get tired of waiting and leave without receiving medical treatment and this can affect patient outcomes in dangerous ways (Newfoundland and Labrador 2012). Many LWBS patients do not have an alternative source of healthcare and may not receive treatment (Becker, 2009). Lengthy waiting times can also affect patient care outcomes by creating low compliance with their chronic disease management recommendations (Johnson, Myers, Wineholt, Pollack & Kusmiesz, 2009).

2.6.4. Improving Prolonged ER Wait Times

Improving wait times will improve patient satisfaction, reduce the rate of patients leaving the ER without being seen, and improve the image of the hospital (Purnell, 1991). Evidence suggests that reducing wait times will reduce the number of patients that leave the ER without being seen by the physician (Johnson, Myers, Wineholt, Pollack & Kusmiesz, 2009). Providing patients in ER waiting rooms with an estimated wait time has been shown to significantly decrease the rate of elopements and is thought to be an important customer service initiative (Woodward, Zimmerman, Isom, & Summers, 2014).

Improving some of the external factors causing prolonged wait times will also contribute to wait time reduction. Community-based alternatives to emergency department care, such as improving access to primary health care services, the addition of urgent care clinics and after-hours primary care services can significantly reduce the number of patients visits to the emergency department and wait times (Newfoundland and Labrador, 2012).

Staff training on reducing ER wait time, as executed by the Newfoundland and Labrador Provincial Health Authority, was found to be helpful in reducing ER wait time (Newfoundland and Labrador 2012).

CHAPTER 3

3.0 Methodology

3.1 Introduction

This chapter describes the research methodology used for this study; it elaborates on the study design, study site, study population, ethical considerations, and data collection methods as well as how data was analyzed. This study is relevant and important because of increasing ER wait times, which still a challenge staff, healthcare managers, and policy makers at various levels of government. Most research done in the area of ER wait times were retrospective studies, with few prospective evaluations of ER wait time.

3.2 Study Design

This was a retrospective study, reviewing medical records of patients attending the emergency department of Meadow Lake Hospital in Meadow Lake, Saskatchewan. Patient records were consecutively reviewed for a total of four weeks, one week each during winter, spring, summer, and fall of the year 2015. The study considered January as winter month, April as spring, July as summer and October as fall. For consistency, the second week of the month was considered i.e. January (5–11), April (6 –12), July (6– 12) and October (5–11), from Monday to Sunday.

3.3 Study Site

The study was conducted with records obtained from the emergency department of Meadow Lake hospital, a rural hospital under the Prairie North Health Region in the Northwestern region of Saskatchewan. It attends to about 900 to 1000 patients monthly and about 12, 000 patients annually. According to the Canadian Institute of Health Information (CIHI), it falls under the

category of low volume ER, with an annual patient volume of less than 15,000 (CIHI, 2005). Meadow Lake hospital ER sees patients from Meadow Lake and its neighboring communities that include Waterhen Lake, Flying Dust, Goodsoil, Loon Lake, Green Lake, Big Island Lake, and Canoe Narrows, a majority of which are First Nations communities. Patients from other Saskatchewan cities also use the ER whenever they are visiting friends and relatives or camping in one of the numerous lakes around Meadow Lake Hospital.

The emergency department has 24-hour physician coverage of two shifts (12 hours each), from 08:00 hours till 20:00 hours and from 20:00 hours till 08:00 hours the next day. The ER also host family medicine residents and medical students from the University of Saskatchewan during their rural rotations. The hospital has facilities for laboratory investigations, x-rays, ECG, ultrasound on some days of the week. It also has about 29 in-patient beds, four maternity beds, two delivery rooms, and two operating theatres with attached EMS services. No specialist is available on ground in Meadow Lake; but some are providing outreach consultation every 2-3 months. Based on this, a Meadow Lake Hospital ER physician may have to consult specialists in Saskatoon through ACAL (Acute Care Access Line) or sometimes North Battleford Union Hospital, when needed.

3.4 Study Population

This study examined males and females of all age groups who attended the emergency department of the Meadow Lake Hospital for medical care during the study period.

3.5 Ethical and Operational Approval

Ethical approval was obtained from the University of Saskatchewan Research Ethics Board (Approval number: U of S Bio: 16-143). Operational approval was also obtained from the Prairie North Regional Health Authority as well as the Meadow Lake Hospital management.

Patient confidentiality was highly protected; participants' identification was not linked with data collected. An arbitrary study identifier was generated for each participant and was used throughout data collection and analysis. A Confidentiality Agreement Form is attached as Appendix A.

3.6 Sample Size

The study included all patients who were seen at the emergency department of Meadow Lake hospital during the second week of the month of each season (January, April, July and October). A total of 965 visits were recorded over these periods. No randomization was required since all patients' records were reviewed.

3.7 Inclusion and Exclusion Criteria

3.7.1 Inclusion Criteria

- All patients who were seen during the study periods as stated above.
- All patients who were attended to by a doctor at the emergency department during the designated period.
- Patients who left the ER without being seen by a doctor were considered for the second study objective**.**

3.7.2 Exclusion Criteria

- All patients who were seen at the emergency department before and after the study period.
- Patients attending the emergency department for wound dressing change, removal of stitches and revisits for injections that were not seen by the ER physician.
- Patients attending specialist appointments, Telehealth appointments, day surgery, and other minor procedures.

3.8 Data Collection Method

Data was extracted from paper copies of patients' outpatient visit sheet, as limited data is available electronically. All patients requesting medical care at the Meadow Lake hospital ER are usually registered electronically on arrival. This uploads patients' personal information onto the outpatient sheet and generates patients' arrival time.

The emergency department attendance day sheet was obtained and used to pull out the patients' records from the shelves; this helps to ensure that no patient seen during the study period was mistakenly excluded. The hospital record clerks assisted in pulling out all required patients outpatient records from the shelves. Data extracted from patients' outpatient sheets (Appendix III) were recorded directly onto an Excel spreadsheet. Data cleaning was done afterwards.

3.9 Data Variables

3.9.1 Dependent Variables

- **Time to physician assessment time (TTPA).** Obtained by calculating the time difference between physician assessment time and a patient's arrival time

- **Total length of stay (TLOS).** Obtained by deducting a patient's arrival time from the disposition time.

3.9.2 Independent Variables

- Patient's age
- Patient's gender (male or female)
- Period of arrival, derived from time of arrival, and categorized into four groups (morning, 6:00 am to 12:00 noon; afternoon, 12:00 noon to 6:00 pm; evening, 6:00 pm to 12:00 midnight; night, 12:00 midnight to 6:00 am)
- Day of arrival (Monday to Sunday, also considered as weekdays and weekend)
- Season of the year (winter, spring, summer, and fall, derived from date of arrival)
- Triage level as defined by the Canadian Emergency Department Triage and Acuity Scale (CTAS I- V)
- Mode of arrival (walking, ambulance, wheelchair, carried, brought in by police).
- Place of residence (Meadow Lake, neighboring communities, other Saskatchewan cities, out of province)
- Having a primary provider (considered as yes or no, NA - for those from out of town, out of province and out of country).
- Investigation ordered; blood work, ECG, imaging e.g. X-rays (considered as yes or no)
- Procedures performed e.g. fracture reduction, casting, suturing of lacerations (considered as yes or no)
- Consultation with specialist, which may be required if the patent's condition is severe or if the ER physician needs an expert opinion and recommendations during patient's care (also considered as yes or no)

- Monitoring (considered as yes or no), for patients who required observation or administration of treatment in the ER (intravenous fluid administration for rehydration, nebulization for asthmatic or COPD patients)
- Physician's other duties on the same day e.g. ward round, obstetric calls, or surgical calls (this is obtained from the Meadow Lake Clinic and hospital doctors' monthly duty schedule. It's also considered as yes or no)
- Availability of walk-in clinic/provider (considered as yes or no) also obtained from the Meadow Lake Clinic and hospital doctors' monthly duty schedule.
- Patient disposition (admitted, transferred to other hospital, discharged home, left without being seen, left against medical advice)
- Left without being seen (LWBS). This category of patients was considered for a separate analysis.

3.10 Description of Data

A total of 956 charts were reviewed. Of these, 30 charts were excluded from the analysis because of missing or inaccurate documentation of various times needed for calculating the total length of stay at the ER. Four charts were excluded because patients arrived the ER the day before study began; even though they were discharged on first day of the study (i.e. 956 – 30 – 4 = 922).

Of the 922 remaining charts, another 144 were excluded because patients did not meet the inclusion criteria, as the ER physician did not see them.

The breakdown of these 144 patients is as follows:

- 54 patients presented for dressing change, follow up injections, removal of stitches, all of which are exclusion criteria.

- 28 were referred to the walk-in clinic for consultations.
- 62 left the ER without being seen by the ER physician (LWBS). These patients usually inform nurses whenever they decide to leave, but some just leave without notification. This category of patients was considered in a separate analysis as presented in Chapter 4.

For the remaining 778 charts, the required data was available to calculate the total length of stay (TLOS) at the ER (Fig. 2).

Of the 778 charts, only 648 were considered for TTPA analysis, after 130 charts were excluded due to missing or inaccurately documented physician assessment time.

It's worthy to mention that few variables were randomly missing from the 778 charts considered for full analysis e.g. frequency for mode of arrival was 777 and that for CTAS was 774 as 1 and 4 records were missing for each category respectively. No patient brought by the police was eventually included, as they do not have complete data documentations.

Overview of Data considered for Analysis

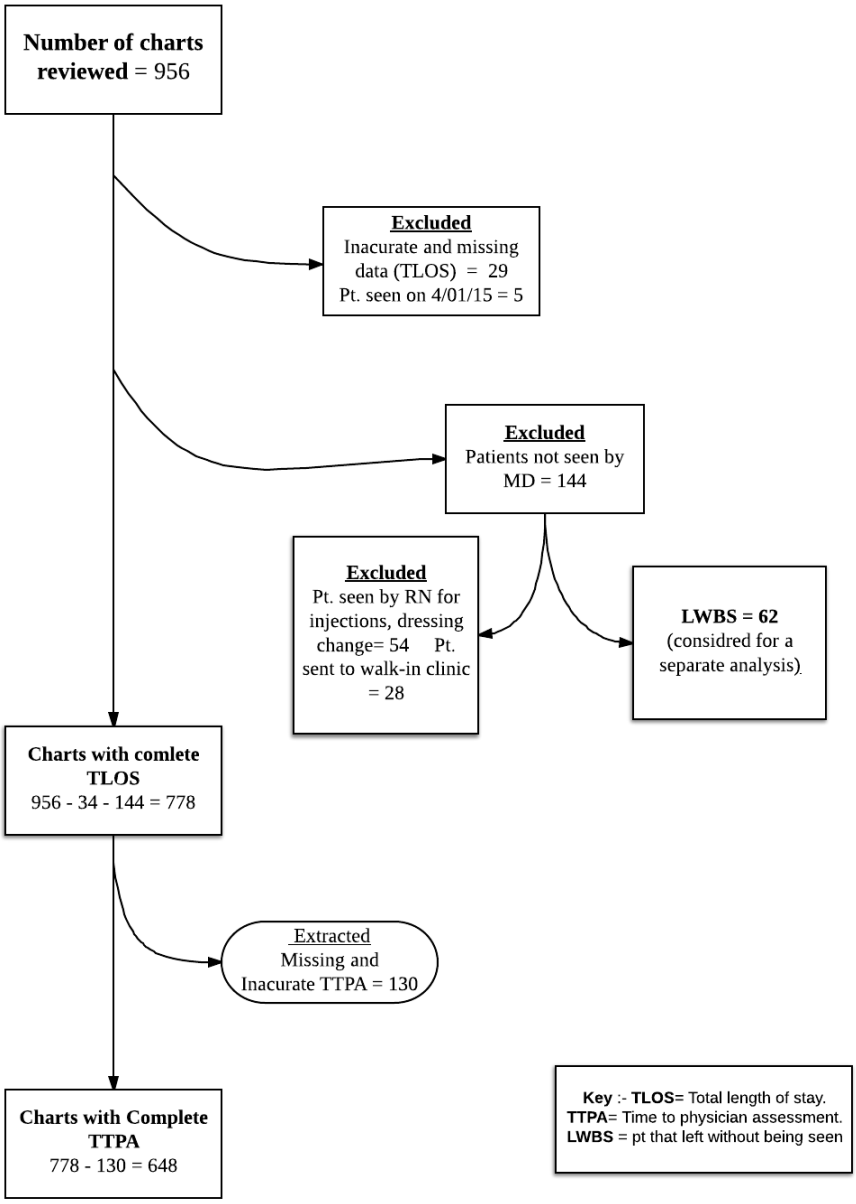

Figure 2: Overview of Data Considered for Analysis

3.11 Data Coding

Data was coded for analysis as shown below:

- Age
- Gender- Male=1, Female=2
- Time of arrival, categorized into Period of arrival (Night - 12 midnight to 6 am = 1; Morning - 6am to 12 noon =2; Afternoon- 12 noon to 6 pm =3; Evening - 6pm to 12 midnight =4)
- Day of arrival or Day of visit (DOA), Monday =1, Tuesday=2, Wednesday=3, Thursday=4, Friday=5, Saturday=6, Sunday=7
- Mode of arrival (MOA)- Walking=1, Ambulance-=2, Wheelchair=3, Carried=4
- Season of arrival (SOA)- (Winter=1, Spring=2, Summer=3, Fall=4)
- Triage level (CTAS 1-5), coded as CTAS 1 and 2 combined as= 1, CTAS 3=2, CTAS 4=3, CTAS 5=4).
- Walk-in available (Yes=1, No= 2)
- Physician other duties (Yes=1, No=2)
- Having primary provider (Yes=1, No= 2, NA=3)
- Investigation (Yes=1, No=2)
- Consultations (Yes=1, No=2)
- Procedures (Yes=1, No=2)
- Monitoring (Yes=1, No=2)

3.12 Data Analysis

To summarize the characteristics of the study population, descriptive statistics (proportion, mean, standard deviation) were computed. There were three main outcomes of interest, all of which are

continuous variables: i) Total Length of Stay, ii) Length of Stay greater than two hours, and iii) Time to physician's assessment. Log transformation of continuous variables was performed to ensure their distributions are approximately normal with constant variance.

Univariates regression analysis was conducted for each outcome variable, followed with multiple linear regression analysis of the statistically significant variables from the univariates analysis.
For continuous outcomes, individual bivariate regression was computed, and then a multiple linear regression was performed, using a stepwise method with a backward elimination to determine the association between the outcomes and the independent covariates. Robust estimation and bootstrap methods were used to compute the standard errors and 95% confidence interval of regression coefficients. Only covariates with a significance level less than 0.05 were retained. Similarly, for the dichotomous outcome, logistic regression using a stepwise method with backward elimination was used to find out associated factors. Robust estimation and bootstrap methods were used for computing the odds ratio (OR) and 95% confidence interval. Interaction term analysis was also examined between the covariates from the multiple linear regressions' analysis. Effects of the various independent variables on the main outcome were determined as well as admission and referral rates. Data obtained for patients that left the ER without being seen by the doctor (LWBS) was analyzed separately.

Data cleaning was performed using STATA 14 (Stata Corp LP, College Station, Texas, USA) and MS Excel 2013. SPSS version 25 was used to conduct the univariates and multivariate regression analysis.

CHAPTER 4

4.0 Results

4.1 Introduction

This chapter presents the results obtained from the analysis of data extracted from the outpatient visit records of patients who attended the Meadow Lake Hospital ER during the study periods. Results were categorized into the following sections as briefly described below:

Section 1. This section presents demographic and descriptive analysis of ER attendees, showing the frequencies and percentages. Details are presented in Table 1 below.

Section 2. This section presents bivariate analysis of some of the variables, which was conducted to find any significant relationship between them.

Section 3. This section presents results obtained from physician assessment time analysis. It shows the mean time to physician assessment, percentile, and median time to physician assessment time. Bivariate analysis was also conducted to find the effects of individual covariates on time to physician assessment time. Univariates and multivariate regression analysis were further conducted to see individual and combined effects of all covariates computed on physician assessment time.

Section 4. This section presents results of analysis of the total time spent by patients at the emergency department to complete their visits (i.e. total length of stay). The mean, percentile, and median of total length of stay were presented. It further presents bivariate analysis on the

effects of individual variables on total length of stay. The section ends with results of univariates and multivariate regression analysis conducted with all variables to examine their effects on the patient's total length of stay at the emergency department. It also presents the results of interactions term analysis between statistically significant covariates from multiple linear regression analysis; see Tables 7 – 10 below for details.

Section 5. This section presents logistic regression analysis of total length of stay at the ER. It was conducted to identify variables that could make patients spend up to two hours or more at the emergency department during their visits. Odd ratios and 95% CI were obtained. It also presents results of interactions term analysis between statistically significant covariates from multiple logistic regression analysis and presented in Tables 11 and 12.

Section 6. This section presents data analysis of a subsection of patients who left the emergency department without being seen by the ER physician. It presents a descriptive analysis of this group of patients and categorizes them according to the ER variables (e.g. mode of arrival, CTAS level).

4.2 Descriptive Results

Data for analysis was available for 778 ER visits. Females accounted for 54.2% (n=422) of attendance compared to 45.8% (n=356) for males (Table 1).

Age distribution ranged from 42.3% (n=329) were aged less than 30 years, while 22.9% were aged 60 years and above. Patients aged 30–59 years accounted for 34.8% of ER attendance throughout the period of study (Table 1).

The majority of patients resided in Meadow Lake (n=402 or 51.7% of ER users), closely followed by patients from neighboring communities with 38.6%. About 10.1% of patients were from other cities within Saskatchewan while about 11 (1.4%) patients indicated they were from outside the province of Saskatchewan (Table 1).

Table 1: Baseline Characteristics of Study Participants

Variables	Frequencies N= 778	Percentages
Gender - Male	356	45.8
Female	422	54.2
Age group (years)		
0 - 9	123	15.8
10 - 19	79	10.2
20 - 29	127	16.3
30 - 39	96	12.3
40 - 49	76	9.8
50 - 59	99	12.7
60 - 69	66	8.5
70 - 79	51	6.6
80 - 89	50	6.4
≥ 90	11	1.4
Place of Residence		
Meadow Lake	402	51.7
Neighb. Communities	283	36.4
Other Saskatch. Cities	82	10.5
Out of province	11	1.4
Mode of arrival (missing = 1)		
Walking	619	79.7

Carried	50	6.4
Ambulance	80	10.3
Wheelchair	28	3.6
Triage level (missing = 4)		
CTAS I	2	0.27
CTAS II	11	1.46
CTAS III	164	21.75
CTAS IV	364	48.28
CTAS V	213	28.25
Primary Provider		
Yes	393	50.5
No	318	40.9
Not provided	67	8.6
Time/Period of arrival		
Morning	188	24.16
Afternoon	310	39.85
Evening	227	29.18
Night	53	6.81
Day of visit		
Monday	122	15.68
Tuesday	113	14.52
Wednesday	85	10.93
Thursday	122	15.68
Friday	108	13.88
Saturday	105	13.5
Sunday	123	15.81
Weekdays/weekend		
Weekdays	551	70.82
Weekend	227	29.18
Season of arrival		
Winter	187	24.04
Spring	201	25.84
Summer	210	26.99
Fall	180	23.14
Disposition		
Home	670	79.76

Admitted	70	8.33
Referred	34	4.05
LAMA	3	0.36
Deceased	1	0.12
LWBS (N=62)	62	7.38

Half of patients (50.7%) had a primary care provider while 41% reported they do not have one. The remaining 8.3% did not indicate whether or not they have a primary provider. Some of them also came from regions outside of Meadow Lake catchment areas (Table 1).

79.9% of the 778 patients included in the analysis arrived the ER by walking, 10.3% (n=80) arrived by ambulance and 3.6 % came on wheelchair. The police brought in only one patient.

On arrival to the ER, the nurses carried out triage on every patient to see how severe their medical conditions were. Most patients seen at the ER during the study period presented with less urgent conditions (CTAS IV), which accounted for 48.3% of all patients seen. Two patients were categorized as CTAS level I (patients requiring immediate resuscitation), and eleven as CTAS level II (emergent cases). Hence, CTAS level I and II were combined for the analysis and accounted for 1.7% of all patients seen at the ER during the study period. Non-urgent cases seen (CTAS V) accounted for 28.2 %. This is similar to data obtained from most ER across Canada, with majority of patients having CTAS level IV and V (Table 1).

During the course of the day, the highest number of patients (n=310 which represents 40% of ER attendees) were seen in the afternoon with peak period between 1 and 2 p.m. Fifty three patients (6.8%) were seen during the night (12 midnight to 6 a.m.), with lowest recorded visit at around

4:00 am. Recorded visits start to rise again and reached a smaller peak at 11:00 am and the highest from 1:00 to 2:00 pm, (Fig. 3 and Table 1).

Visits to the ER were more frequent during weekdays, and attendance peaked on Mondays, Thursdays, and Sunday with 15.7% recorded visits and the lowest recorded visit on Wednesdays (10.9%). Weekend visits accounted for 29.3% of the weekly ER visits. This showed higher ER visits during the weekdays when compared to weekends (Saturday and Sunday according to this study) (Fig. 4).

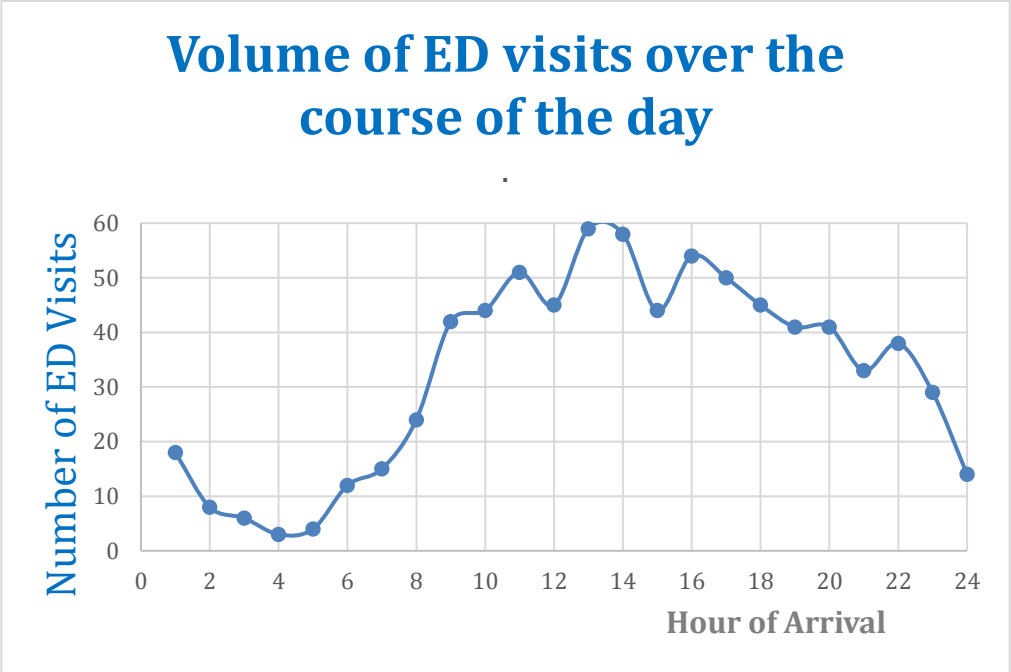

Figure 3: Emergency Department Flow Rate Over 24 Hours Period

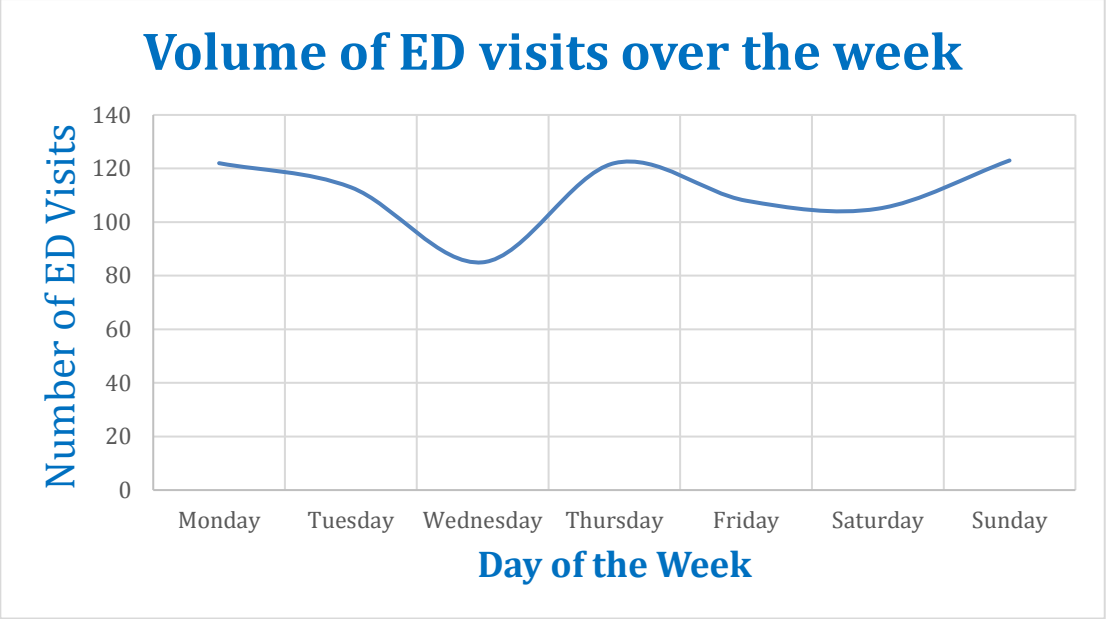

Figure 4: Emergency Department Flow Rate Over Days of the Week

ER attendances recorded were almost similar throughout the four seasons, all close to 24%. However, attendance during summer and spring were slightly higher than other seasons at 27% and 26%, respectively. The lowest attendance was recorded during fall with 23.1% (Table 1).

After the ER visits, patients depart with different dispositions. A total of 670 patients (79.8%) were discharged home after receiving treatment. 8.3% were admitted for in-patient management, and 7.38% left the ER without being seen by the emergency room physician, one patient died at the ER during the study period (Table 1).

4.3 Bivariate Analysis

4.3.1 Mode of Arrival by CTAS Level

Patient's mode of arrival to the emergency department was compared in a bivariate analysis to the severity of their medical conditions. Results showed that more than half (53.9%) of patients

presenting with most severe medical conditions (CTAS I and II) arrived by ambulance. On the other hand, a majority of those patients presenting with less urgent (CTAS IV) and non-urgent medical conditions (CTAS V), 80% and 87%, respectively arrived the emergency department by walking, (Fig. 5). Association between mode of arrival and triage level was statistically significant ($p<0.001$). It shows that patients with more severe medical conditions arrived the ER by ambulance while those with non-urgent conditions arrived themselves by walking.

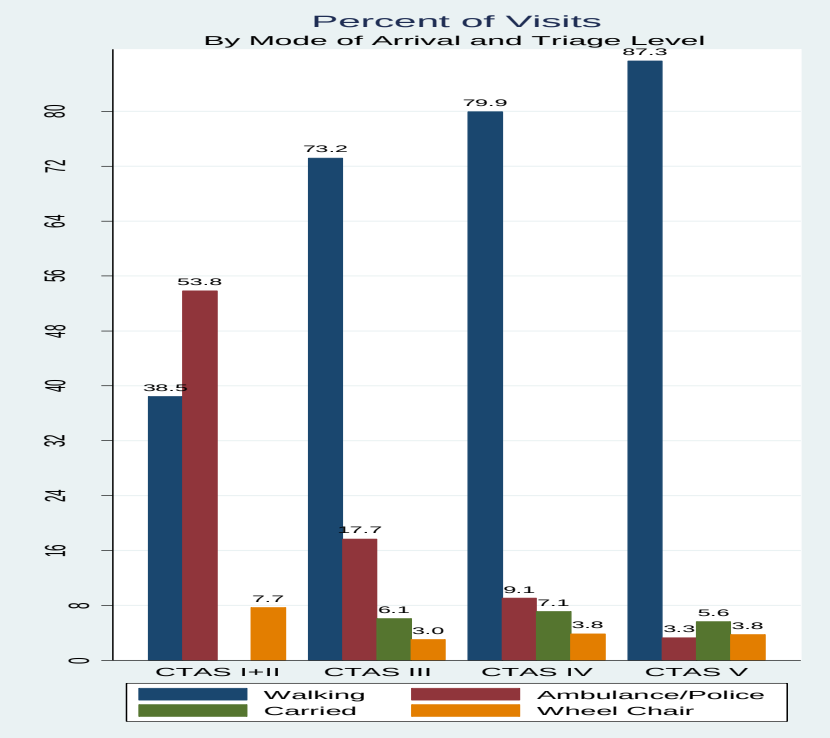

Figure 5: Mode of Arrival to the ER by CTAS level

4.3.2 Mode of Arrival to the ER by Place of Residence

A patient's mode of arrival was also compared with their place of residence and the association was also statistically significant ($p= 0.047$). Detailed results showed that 44 (55%) of the 80 patients arriving the ER by ambulance during the study period were from neighboring communities compared to 26 patients (33%) from Meadow Lake. Overall ER attendance showed

that 52% of ER users were from Meadow Lake compared to 36% from neighboring communities. However, patients arriving to the ER from neighboring communities by ambulance only accounted for 15.6% of all patients from neighboring communities using the ER. Only 6.5% of all patients from Meadow Lake arrived by ambulance. Overall, a significant number of patients still arrived by walking; 74% of all patients from neighboring communities and 83.6% of patients from Meadow Lake walked to the ER. This implies that patients who live far away from the hospital tend to use the ambulance more than those living within the vicinity of the hospital (Fig. 6).

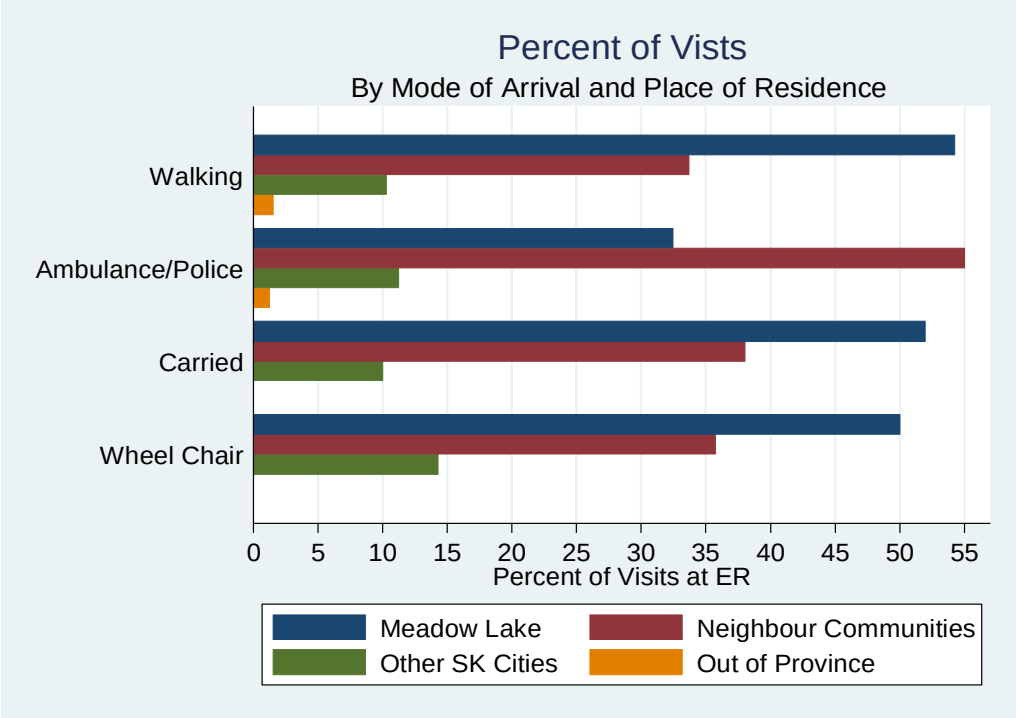

Figure 6: Patients' Modes of arrival according to place of residence

4.3.3 Place of Residence According to CTAS Level

Patients' places of residence were compared with the severity of medical conditions they presented with to the emergency department. Results showed that more patients presenting with

severe medical conditions were from neighboring communities. 38.5% of patients that presented with conditions that required immediate attention or emergent conditions (i.e. CTAS I and II) were from neighboring communities, compared to 30.8% from Meadow Lake. A majority of all other CTAS categories are from Meadow Lake, which is expected as a majority of ER users (52%) are actually from Meadow Lake compared to a third from the neighboring communities (Fig. 7). This association between place of residence and CTAS was statistically significant (p =0.002).

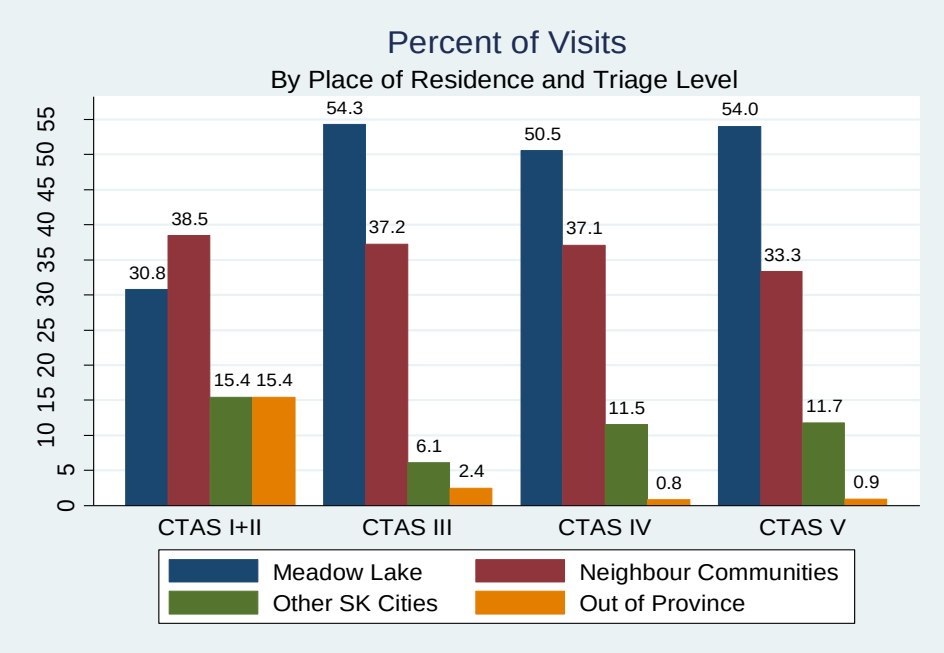

Figure 7: Patients' Places of Residence and CTAS level

4.3.4 Place of Residence According to Primary Care Provider

Places of residence were compared to having a primary provider and results showed that most of the patients from Meadow Lake and those from the neighboring communities have primary providers. More than half (55%) of ER users from Meadow Lake, and 51.6% from neighboring communities do have primary provider while about 44% from both areas indicated they do not

have primary provider. A third of patients from other Saskatchewan cities do have primary provider while 23% do not. This implies that majority of patients attending the Meadow Lake hospital ER do have primary provider, regardless of their place of residence ($p < 0.00001$, Table 2).

Table 2: Having Primary Provider According to Place of Residence

Place of Residence	No	Yes	Not Provided	Total
Meadow Lake	175 (43.9%)	221 (55.4%)	3 (0.8%)	399
Neighb. Communities	124 (43.8%)	146 (51.6%)	13 (4.6%)	283
Other SK Cities	19 (23.2%)	25 (30.5%)	38 (46.3%)	82
Out of Province	0	1 (7.7%)	13 (92.9%)	14
Total	318	393	67	778

Pearson chi-square = 291.2; p < 0.00001

4.3.5 Time of Arrival and CTAS Level

When time of arrival to the ER was compared to the severity of patient's medical condition, results showed that patients presenting to the ER during the afternoon and evening had the highest proportion of all categories of acuity levels (e.g. 61.5% and 30.8% of CTAS I+II, respectively) while the lowest proportions of all acuity levels presented during the night (e.g. 7.7 % of CTAS I+II and 6.0% of CTAS IV). These findings are consistent with the ER's daily patient flow rate, which peaks during the day and nadir during the night; this relationship has statistical significance ($p= 0.03$ Fig. 8).

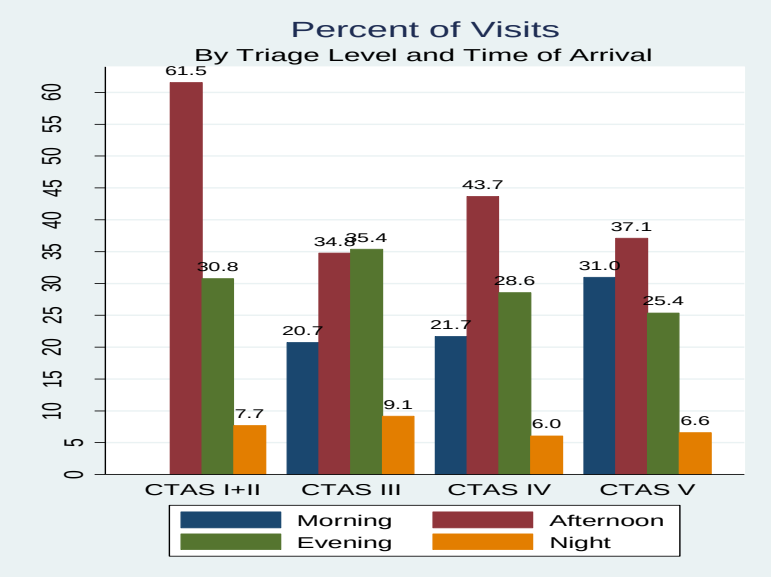

Figure 8: Patients' Time of Arrival According to CTAS Level

4.3.6 Season of Arrival and Triage Level

When season of arrival was compared with level of severity of medical conditions, the relationship was statistically significant (p= 0.018 Fig. 9). Results showed that the proportion of patients with higher acuity occurred more during fall, with 2.9% of all patients seen during fall with CTAS I and II. This is almost twice the proportion of patients with same acuity level seen during spring (1.54%) and winter (1.68%). The proportion of patients seen with less urgent conditions (CTAS IV) was similar across all seasons (ranges between 46% and 49%). Likewise, about a third of patients seen during spring and winter (30.3% and 35.8%, respectively) presented with non-urgent conditions (CTAS V). This implies that the majority of patients seen at the Meadow Lake hospital ER throughout the year present with less or non-urgent conditions (CTAS IV and V).

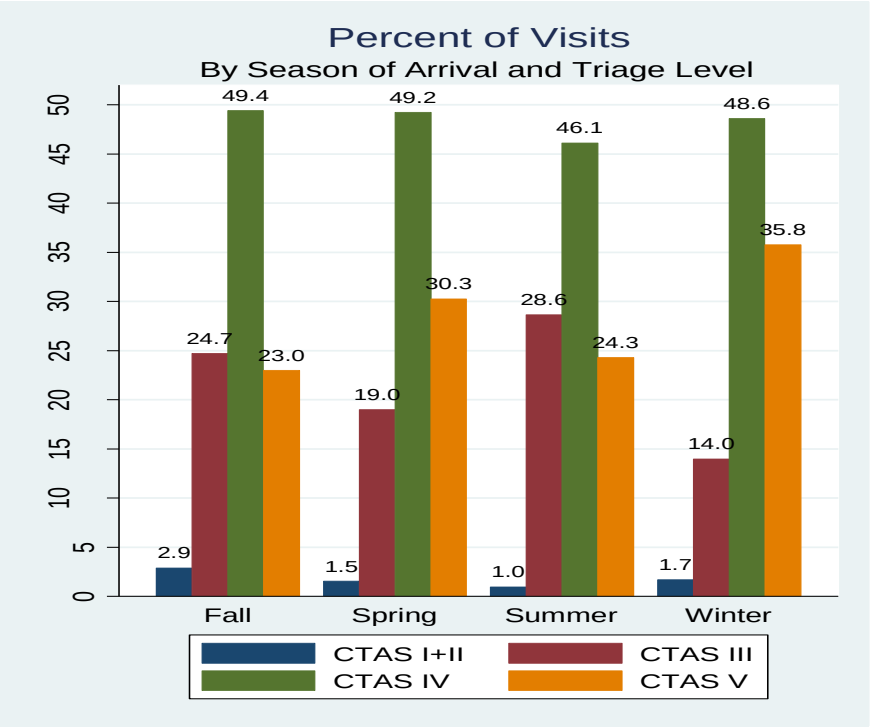

Figure 9: Patients' Season of Arrival According to CTAS Level

Summary

The bivariate analysis results presented above showed that most patients arriving at the Meadow Lake hospital ER by ambulance were found to have more serious medical conditions (higher acuity) and a majority (38.5%) of them were from the neighboring communities. Most of patients with higher acuity, and even those with other acuity levels, presented to the ER during the afternoon time compared to other time of the day. In general, a majority of patients (48.3%) presenting to the Meadow Lake Hospital ER throughout the year were categorized as less urgent (CTAS IV). There was no significant difference in distribution of those with or without primary providers among all patients seeking medical attention at the Meadow Lake hospital ER.

4.4 Time to Physician Assessment Time

4.4.1 Summary of Time to Physician Assessment Time. Results showed that patients waited for an average of 86.41 minutes (s.d - 2.96) before being attended to by the ER physician. The median time to physician assessment was 61 minutes (95% CI: 56–67 minutes) that is half the patients spent less than 61 minutes waiting for physician assessment while the remaining half spent more than that before being seen. The emergency room physician assessed about 10% of patients within 14 minutes of arrival (95% CI: 11–17 minutes) and about 90% of all patients within 196 minutes (95% CI: 184 – 215 minutes) of arrival to the ER (Table 3).

Table 3: Physician Assessment Time Mean, Percentile Distribution and 95% C.I

	Mean (minutes)	S.D	95% Confidence interval
TTPA	86.4	2.96	80.6 - 92.2
Percentile	Time (min)		95% CI
10	14		11 - 17
20	24		20 - 27
30	34		30 - 37
40	47		40 - 52
50	61		56 - 67
60	83		72 - 90
70	106		96 - 117
80	138		127 - 152
90	196		184 - 215

4.4.2 Physician Assessment Time: Bivariate Analysis

The average time to TTPA was also determined for individual independent variables to determine the effect or influence each variable had on the physician assessment time. ANOVA analysis was used to obtain the p-values with Bonferenis post-hoc testing to obtain the relationships within the groups (Table 4).

4.4.2.1 TTPA According to Time of Arrival

Analysis of the total time spent waiting to be seen by a physician according to the period of arrival showed that there is statistical difference between the physician assessment time for those arriving in the afternoon and those arriving at every other time of the day. Afternoon arrivals had an average time to physician assessment of 104 minutes, which is more than the time spent waiting to see the physician by patients arriving at every other time of the day (ANOVA, p-value = 0.0001). This could be related to the peak patient flow during the afternoon; hence, patients will generally wait longer to be seen.

4.4.2.2 TTPA According to Mode of Arrival

There are significant differences between time to physician assessment and mode of arrival (ANOVA, p = 0.0004). Those arriving by wheelchair spent the longest time before physician assessment (117 minutes), while those arriving by ambulance had the shortest time to physician assessment time (58 minutes). However, the group analysis only found statistical differences between the physician assessment time of those arriving by ambulance and those arriving by walking and on wheelchair (Table 4).

4.4.2.3 TTPA According to Season of Arrival

Patients using the ER during spring spent more time waiting to see the physician than those who arrived during all other seasons. However, time to physician assessment for those arriving in spring showed statistical difference only to those who came during fall and winter. There is also a statistical difference between those patients seen at the ER during fall when compared to those seen during summer (those who came in fall spent less time than those arriving during winter), (ANOVA, p= 0.0001 Table 4).

4.4.2.4 TTPA According to Level of Acuity (CTAS level)

There are significant differences between time to physician assessment time and triage level (ANOVA, p= 0.0003). Within the group, those patients with CTAS IV waited longer to see the physician when compared to patients with other acuity levels. However, the TTPA for those with CTAS IV was statistically different only with patients with CTAS I & II. Those with CTAS I & II spent the least amount of time waiting for physician assessment, which was statistically different from those patients with CTAS III, IV and V.

Table 4: Time to Physician Assessment Time Bivariate Analysis

Covariates	Mean TTPA (min.)	St Err.	95% CI	p-value (ANOVA)*
Period of arrival				**0.0001**
Morning	76.5	4.6	67.5 - 85.6	
Afternoon	103.7	6.2	91.5 - 115.9	
Evening	80.7	4.8	71.3 - 90.0	
Night	52.3	7.7	37.2 - 67.4	
Mode of Arrival				**0.0004**
Walking	90.3	3.1	84.2 - 96.3	
Ambulance	57.7	7.6	42.9 - 72.5	
Carried	67.2	8.5	50.6 - 83.9	
Wheelchair	117.1	16.9	83.9 - 150.2	
Season of arrival				**0.0001**
Fall	59.8	3.9	52.2 - 67.4	
Spring	109.4	6.3	97.2 - 121.7	
Summer	98.4	6.8	85.1 - 111.7	
Winter	70.9	5.4	60.3 - 81.4	
Triage level				**0.0003**
CTAS I & II	30.6	5.8	19.2 - 41.9	
CTAS III	74.9	5.9	63.2 - 86.5	
CTAS IV	93.9	4.3	85.45 - 102.3	
CTAS V	92.8	5.9	81.3 - 104.3	

Summary

The bivariate analysis of time to physician assessment time showed that patients arriving the ER via ambulance, as well as patients with higher acuity (CTAS I and II) spent the least amount of time waiting for physician assessment. This is similar to occurrences in most ERs across Canada and in agreement with results presented above which showed that more patients with higher acuity tend to use the ambulances to the ER. Patients arriving the ER at night spent the least amount of time waiting for physician assessment when compared to patients using the ER at any other time of the day, this correlates to the daily ER patient flow pattern being the lightest at night. Patients using the ER during fall spent the least amount of time waiting for physician assessment and this coincides with the season when the ER experienced the lightest patient flow.

4.4.3 Multiple Regressions

4.4.3.1 Time to Physician Assessment (TTPA) Regression Analysis

Linear regression analysis was carried out for time to physician assessment time starting with univariates, then multivariate linear regressions to obtain variables with statistical significance. Further interaction analysis was carried out among the significant variables obtained to determine which of them has significant interactions.

4.4.3.2 Univariates Regression Analysis: TTPA

Data from univariates analysis found that, triage level (severity of patients' medical conditions), time of arrival to the ER, day of visit, season of arrival, and mode of arrival to the ER all have statistically significant effects on the time to physician assessment time (TTPA) as discussed below (Table 5). Patients arriving to the ER via ambulance spent a shorter time waiting for physician initial assessment compared to those arriving by walking. There was no statistical

difference between patients arriving to the ER walking and those carried in or arriving in a wheelchair (p= 0.09 and 0.112, respectively).

Considering a patient's level of acuity when using those with conditions requiring immediate resuscitation and emergent conditions (CTAS I and II) as reference, those with urgent, less, and non-urgent conditions (CTAS III, IV and V, respectively) waited longer for their initial assessment by the ER physician. This indicates that the physician assessment time was shorter based on the level of severity of a patient's medical condition.

When patients arriving the ER during morning hours (6 a.m. till 12 p.m.) were considered as reference, patients reporting to the ER during any other time of the day spent longer time waiting for an ER physician's initial assessment. These effects were statistically significant with p values of 0.005, <0.0001 and 0.007 for afternoon, evening and night, respectively.

Patients presenting to the ER on Friday and Saturday spent less time before being seen by the physician when those presenting on Monday were considered as reference (p= 0.031 and 0.013, respectively).

Based on season of arrival to the ER, patients seen during all other seasons spent more time waiting to see the ER physician compared to those patients seen during fall. There were statistical differences between fall, spring, and summer (P < 0.0001 for both), but no statistical difference between fall and winter (p=0.344).

Age, gender, a physician's other duties, and availability of a walk-in clinic at the Meadow Lake Primary Healthcare Clinic did not show significant effect on time to physician assessment time (Table 5).

Table 5: Univariates Regression Analysis: Time to Physician Assessment (TTPA)

Time To Physician Assessment Univariates Regression Analysis			
Covariates	**Estimates (Coef.)**	**Std Err (s.e)**	**p-value**
Age	0.035	0.001	0.383
Gender			
Female			
Male	0.043	0.035	0.224
Physician other duty			
No	Ref.		
Yes	-0.054	0.112	0.631
Walk-in available			
Not available	Ref.		
Available	0.131	0.082	0.111
Triage Level			
CTAS 1/II	Ref.		
CTAS III	0.393	0.1409	**0.005**
CTAS IV	0.509	0.1381	**<0.0001**
CTAS V	0.499	0.1398	**<0.0001**
Time of Arrival			
Morning	Ref.		
Afternoon	0.198	0.0707	**0.005**
Evening	0.298	0.0674	**<0.0001**
Night	0.186	0.0692	**0.007**
Day of Arrival			
Monday	Ref.		
Tuesday	0.016	0.0659	0.813
Wednesday	-0.092	0.0672	0.172
Thursday	-0.036	0.0617	0.559
Friday	-0.136	0.063	**0.031**
Saturday	-0.166	0.0664	**0.013**
Sunday	0.006	0.0437	0.919
Season of Arrival			
Fall	Ref.		
Winter	0.048	0.0503	**0.344**
Spring	0.288	0.0489	**<0.0001**
Summer	0.209	0.0478	**<0.0001**
Mode of Arrival			
Walking	Ref.		
Ambulance	-0.211	0.0581	**<0.0001**
Wheelchair	0.146	0.092	0.112
Carried	-0.12	0.0709	0.090

Summary

Univariates analysis found that patients with higher acuity, those arriving to the ER in ambulances, those seen during morning hours, and those using the ER during fall all spent less time waiting for a physician's initial assessment (effect showed statistical significance). Patients presenting to the ER on Fridays and Saturdays also waited for a shorter time for an ER physician's initial assessment than other days of the week.

4.4.3.3 Multivariate Regression Analysis: TTPA.

All five covariates (triage level, time of arrival, day of arrival, season or arrival, and mode of arrival) with statistical significance from the univariates analysis were considered for a multiple linear regression analysis. Results from multivariate analysis showed that all five covariates still showed statistically significant effects on time to physician assessment time in the presence of all other covariates. A breakdown of results revealed that in the presence of all other covariates, patients with urgent, less urgent, and non-urgent medical conditions (CTAS III, IV and V) spent more time waiting for physician initial assessment compared to those with more severe conditions with (CTAS I and II) ($p = 0.009$, 0.001 and 0.001, respectively) after controlling for time, day, season, and mode of patients' arrival to the ER.

Patients presenting to the ER during the morning hours (6:00 am to 12:00 pm), spent less time waiting for physician assessment compared to those presenting at other times of the day (afternoon, evening and night) when other covariates were taken into consideration ($p= 0.015$, <0.0001 and 0.007, respectively). Findings are similar to that obtained from univariates analysis above, both have statistical significance (Tables 5 and 6). Results obtained for the day patients presented to the ER, after controlling for other covariates (triage level, time, season and mode of

arrival to the ER), those presenting on Mondays waited longer to be assessed by the ER physician than those presenting on any other day of the week, with statistical significance only seen on Wednesdays, Fridays and Saturdays (p= 0.042, 0.015 and 0.01, respectively). Compared to univariates analysis, patients seen on Fridays and Saturdays alone tend to see physician earlier than those seen on Mondays.

Table 6: Multivariate Regression Analysis: Time to Physician Assessment (TTPA)

Multivariate Regression Analysis: TTPA (Time to Physician Assessment)			
Covariates	**β (coefficient)**	**Std Err (s.e)**	**p-value**
TOA_grp			
Morning	Ref		
Afternoon	0.165	0.0677	0.015
Evening	0.288	0.0642	<0.0001
Night	0.179	0.0658	0.007
Day of Visit			
Monday	Ref		
Tuesday	-0.004	0.0622	0.950
Wednesday	-0.129	0.0635	0.042
Thursday	-0.068	0.0585	0.243
Friday	-0.142	0.0585	0.015
Saturday	-0.159	0.062	0.010
Sunday	-0.053	0.0561	0.341
Season of Arrival			
Winter	Ref		
Spring	0.229	0.0465	<0.0001
Summer	0.170	0.0459	<0.0001
Fall	-0.040	0.0488	0.401
Mode of Arrival			
Walking	Ref		
Ambulance	-0.126	0.0569	0.027
Wheelchair	0.105	0.086	0.223
Carried	-0.103	0.0672	0.124
Triage Level			
CTAS I+II	Ref		
CTAS III	0.35	0.1338	0.009
CTAS IV	0.445	0.1321	0.001
CTAS V	0.442	0.1349	0.001

Patients presenting during summer and spring spent more time waiting for initial physician assessment with patients seen during winter as reference (p= <0.0001 for both). Those seen during fall spent less time than those presenting during winter, but findings showed no statistical significance (p=0.401). This also follows the seasonal traffic pattern of patients at the Meadow Lake Hospital ER being highest during summer and spring.

Patients arriving in an ambulance spent less time waiting for physician assessment when compared to those arriving by walking (p=0.027) after adjusting for time, day of arrival, season of arrival, and severity of medical conditions at the time of presentation. Patients that were carried (usually children carried by their parents) also spent less time than those arriving on foot to see the ER physician but with no statistical significance (p=0.124). Interactions were examined between all covariates with a statistically significant effect on time to physician assessment; however, no significant interactions exist between them.

Summary

Multiple linear regression analysis found that patients with more severe medical conditions (compared with those with less urgent conditions), those arriving in an ambulance (compared to those that walked to the ER), those that came during the morning hours (compared to other times of the day), those seen on Wednesdays, Fridays and Saturdays (compared to those seen on Mondays), and those seen during winter (compared to those seen during summer and spring), spent less time waiting at the ER before being seen by the ER physician after controlling for all other covariates.

4.5 Total Length of Stay at the Emergency Department

4.5.1 Summary of Total Length of Stay at the ER

Overall average time spent by patients to complete their visits when they presented to the Meadow Lake Hospital ER was determined and results showed that patients spent average of 163.3 minutes (95% CI: 153.1–173.6 minutes). About half of the patients completed their visits at about 131 minutes (95% CI: 125–143 minutes), 10% of patients completed their visits in approximately 45 minutes (95% CI: 38–47 minutes) and 90% completed their visits after about 324 minutes of arrival to the ER (95% CI: 296–358 minutes). Table 7 below presents percentiles of total time spent to complete an ER visit, with standard deviation and confidence interval.

Table 7: Distribution of Total Length of Stay at the ER

	Mean (minutes)	Std. dev	95% Confidence interval
TLOS	**163.3**	5.2	153.1 – 173.6
Percentile	**Time (min)**		**95% CI**
10	45		38 - 47
20	63		58 - 70
30	87		82 - 94
40	111		103 - 118
50	131		125 - 143
60	159		151 - 167
70	191		179 - 202
80	235		222 - 258
90	324		296 - 358

4.5.2 Total Length of Stay (Bivariate Analysis)

Bivariate analysis was carried out for individual variables and total length of stay at the ER (TLOS), ANOVA analysis was used to obtain the p-values, and Bonferenis post-hoc testing to obtain the relationships within the groups (Table 8).

Total length of stay according to mode of arrival was considered, and results showed that the total length of stay for patients that arrived at the ER by ambulance was statistically different from those arriving by walking or those being carried. Those arriving by ambulance spent more time to complete their ER visits than patients who used all other modes of arrival. Those walking also had statistically different mean TLOS when compared to those carried and those arriving by ambulance. Those carried spent the least amount of time to complete their visits; their mean TLOS is statistically different from those arriving via wheelchair, ambulance, and walking (p= 0.0001). Average total length of stay for those that arrived by ambulance was estimated to be around 240 minutes, while those that arrived by walking spent about 157 minutes to complete their ER visits. Previous analysis results showed that most patients with higher acuity (more severe medical conditions, CTAS I, II & III) arrived at the ER by ambulance, and most would require more medical interventions and consults. Therefore, these patients will spend more time at the ER than other patients with less severe medical conditions.

Our results showed that patients with higher acuity (CTAS I-III) have longer total length of stay at the ER. The TLOS of those with urgent conditions (CTAS III) was statistically different from those with less and non-urgent medical conditions (CTAS IV and V, both p= 0.0001). Patients with CTAS III, spent an average of about 204 minutes to complete their ER visits, compared to 160 minutes and 140 minutes spent by patients with CTAS IV and V, respectively.

Total length of stay at the ER, with period of arrival, does not show statistical difference (p= 0.062). Patients arriving at night spent the longest time, followed by those seen in the afternoon. Our data showed that a number of patients with alcohol intoxication or chronic pain seen at night ended up passing the night at the ER. This might be responsible for the prolonged total length of stay compared to other patients seen during other time of the day.

Table 8: Total Length of Stay Bivariate Analysis

TLOS/Covariates	Mean TLOS (min.)	St Err.	95% CI	p-value (ANOVA)*
Period of arrival				
Morning	161.3	8.1	145.4 - 177.2	0.062
Afternoon	168.4	6.2	156.3 - 180.6	
Evening	154.2	7.8	138.9 - 169.5	
Night	179.9	27.9	125.1 - 234.7	
Mode of Arrival				**0.0001**
Walking	156.9	4.6	147.9 - 165.9	
Ambulance	240.2	21.8	197.5 - 282.9	
Carried	110.6	10.1	90.8 - 130.4	
Wheelchair	185.2	19.9	146.2 - 224.3	
Season of arrival				**0.0001**
Fall	135.4	8.7	118.4 - 152.5	
Spring	184.9	9.7	165.9 - 203.9	
Summer	187.7	10	168.1 - 207.4	
Winter	139.6	9.6	120.7 - 158.4	
Triage level				**0.0001**
CTAS I & II	200.3	43.8	114.6 - 286.1	
CTAS III	204.6	10.8	183.4 - 225.9	
CTAS IV	160.8	6.3	148.5 - 173.1	
CTAS V	140.2	7.9	124.7 - 155.7	

According to season of arrival, the total length of stay of those seen during summer was the highest at 187.7 minutes and was statistically different from those arriving during fall and winter (135.4 and 139.6 minutes, respectively). Those arriving during fall spent the least amount of time to complete their visit (about 135 minutes); the TLOS was statistically different from those arriving during spring and summer (p= 0.0001) and not with those presenting during winter. The analysis presented in Table 1 showed that the ER traffic is highest during summer and lowest during fall; this could explain why patients spent longest time to complete their visits during summer and shortest during the fall.

Summary

Bivariate analysis showed that patients with higher acuity (CTAS I to III), patients arriving the ER in an ambulance and patients presenting during summer spent more time to complete their ER visits. However, periods of arrival do not have significant effect on total length of stay at the ER.

4.5.3 Regression Analysis: Total Length of Stay at the ER (TLOS)

4.5.3.1 Univariates Regression Analysis

Results obtained from univariates analysis showed that a patient's age, triage level (severity of medical condition), mode of arrival, time of arrival, season of arrival, patients requiring investigations, monitoring, and specialist consultation during their ER visits had a significant effect on the total time spent to complete their ER visits (Table 9).

A patient's age was found to have a statistically significant association (p= 0.001) with ER total length of stay, as age increases, patients spent more time to complete their visits. Its known that the older the patient, the more their comorbidities, hence they might present with more complex conditions requiring longer time to complete their assessments, investigations and treatment.

Those with non-urgent medical conditions (CTAS V) spent a shorter amount of time to complete their visit compared to patients with other CTAS levels (CTAS I-IV) who had more severe or complex medical conditions. This is probably because those with more severe medical conditions require more medical care, including investigations, imaging, monitoring and specialist consultation and even admission or transfer to tertiary centers.

Results also showed that patients arriving by ambulance spent a shorter amount of time to complete their ER visits when compared to those arriving the ER by walking ($p < 0.0001$). This is contrary to results obtained with bivariate analysis that found that patients arriving via ambulance to have longer length of stay (Table 8). The difference would have resulted from the effects of other variables. A logical explanation for this finding is that patients arriving by ambulance are usually seen first based on prioritization of level of illness, transferred to referral center, or admitted to the ward.

Patients presenting to the ER during the afternoon periods spent more time to complete their ER visits compared to those arriving during the evening hours ($p = 0.008$). An extended length of stay in the afternoon could be explained by the ER traffic, which is usually more during the afternoon (Table 10).

Patients seen during spring and summer spend more time to complete their ER visits compared to those seen during fall season ($p < 0.0001$ and 0.001, respectively).

Patients requiring extra ER services like investigation (lab test, x-rays), specialist consultation and monitoring (like rehydration, patients with chest pain) during their ER visits, spent more time to complete their visits compared to those that does not require similar services ($p < 0.0001$ for all three covariates). This is expected because it will basically take more time to wait for lab results, physician reassessments, get feedback from specialists, and complete ER treatments like intravenous fluid administration.

Summary

Univariates analysis showed eight covariates having a statistically significant effect on the total time taken by patients to complete their ER visits at the Meadow Lake Hospital emergency room. It showed that older patients, patients with higher acuity level, patients seen during the afternoon, those presenting during summer and spring, and those requiring extra ER services (investigations, specialist consultations and monitoring) spent a longer time at the ER to complete their visits. Those arriving via ambulance spent a shorter time to complete their ER visits when compared to those that arrived by walking.

Table 9: Univariates Regression Analysis: Total Length of Stay (TLOS)

Total Length of Stay Univariates Regression Analysis			
Covariates	**Estimates (Coef.)**	**Std Err (s.e)**	**p-value**
Age	4.4		0
Log (age)	0.13	0.03	**0.001**
Gender: Female	Ref.		
Male	0.010	0.0245	0.691
Investigations: No	Ref.		
Yes	0.246	0.0236	**<0.0001**
Consultations: No	Ref.		
Yes	0.283	0.0442	**<0.0001**
Procedures: No	Ref.		
Yes	0.018	0.0453	0.697
Monitoring: No	Ref.		
Yes	0.310	0.0232	**<0.0001**
Primary Provider: Not provided	Ref.		
Yes	-0.030	0.0449	0.507
No	-0.054	0.0456	0.240
Physician other duties: No	Ref.		
Yes	0.037	0.0359	0.305
Wail-in Available: No	Ref.		
Yes	0.019	0.025	0.445
Triage level: CTAS V	Ref.		
CTAS I/II	0.197	0.0942	0.036

CTAS III	0.174	0.0342	**<0.0001**
CTAS IV	0.084	0.0284	**0.003**
Time of Arrival: Evening	Ref.		
Morning	0.053	0.0336	0.116
Afternoon	0.079	0.0297	**0.008**
Night	0.000	0.0499	0.994
Day of Arrival: Sunday	Ref.		
Monday	0.018	0.0433	0.677
Tuesday	-0.014	0.0442	0.743
Wednesday	-0.06	0.0478	0.210
Thursday	-0.029	0.0433	0.506
Friday	-0.031	0.0447	0.494
Saturday	-0.022	0.0451	0.624
Season of Arrival: Fall	Ref.		
Winter	-0.016	0.0347	**0.0652**
Spring	0.150	0.0341	**0.0001**
Summer	0.116	0.0338	**0.001**
Mode of Arrival: Walking	Ref.		
Ambulance	-0.117	0.0489	**0.0001**
Wheelchair	0.098	0.0643	**0.127**
Carried	0.226	0.14	**0.016**

4.5.3.2 Multiple Regression Analysis

All eight covariates with statistical significance in Table 10 were considered for multiple regression analysis. The results showed that only five covariates (season of arrival, time of arrival, need for investigations, consultations with specialists, and monitoring during ER visits) showed statistically significant effects on total time required to complete ER visits in the presence of all other covariates. Patients seen during summer and spring spent more time to complete their ER visits when compared to those seen during fall, after controlling for consultations, monitoring, investigations and time of arrival to the ER ($p<0.0001$ and 0.007, respectively). Those seen during winter spent less time to complete their visits when compared to fall, but this relationship was not statistically significant ($p= 0.738$). Summer and spring showed

longer TLOS than fall and winter (Table 8) and this correlates to the time of the year (summer and spring) when ER recorded its highest visits (Table 1).

After controlling for a patient's season of arrival, investigations, and time of arrival, patients requiring monitoring and specialist consultations during ER visits, spent more time to complete their visits (p <0.0001 and 0.001, respectively) when compared to those who do not require monitoring or specialist consultations. Obviously, more time is required to provide these extra services; hence patients that required one or more of these services will spend more time to complete their visits.

After controlling for other variables, season of arrival, monitoring, and specialist consultations during ER visits, there was a significant interaction between investigation and a patient's time of arrival to the ER (Table 10).

Table 10: Multivariate Linear Regression Analysis: TLOS (minutes)

Covariates	β (coefficient)	Std Err (s.e)	p-value
Season of Arrival			
Fall	Ref		
Winter	-0.01	0.0302	0.738
Spring	0.137	0.0296	<0.0001
Summer	0.079	0.0295	0.007
Consultation			
No	Ref		
Yes	0.129	0.0403	0.001
Monitoring			
No	Ref		
Yes	0.233	0.0246	<0.0001
Investigations			
No	Ref		
Yes	0.163	0.0424	<0.0001
TOA_grp			

Evening (6pm-12am)	Ref		
Morning	-0.003	0.0381	0.947
Afternoon	0.115	0.0317	<0.0001
Night	-0.094	0.0554	0.091
TOA_grp (evening*Investigation)			
Morning*Investigation	0.004	0.0589	0.953
Afternoon*Investigation	- 0.120	0.0531	0.024
Night*Investigation	0.129	0.0870	0.139

Interactions

Interaction terms were examined between all the five variables mentioned above with statistical significance. Data showed that the most significant interaction was between time of arrival to the ER and patients requiring investigations during their ER visits. Results obtained from the interactions analysis, showed that patients seen during the morning period requiring investigations (Morning*investigation), spent about 0.049 minute more to complete their ER visits when compared to those patients seen in the afternoon and do not require investigations (Equation 1 below). Similarly, those seen in the afternoon requiring investigations (Afternoon*investigation), spent 0.043 minutes more to complete their ER visits compared to those who also came in the afternoon not requiring any investigation. Those seen at night requiring investigations (Night*investigation), spent 0.292 minutes more to complete their ER visits compared to those also seen at night and not requiring any investigations.

Interaction Equations

Equation1: (Morning*Investigation-Yes) – (Afternoon*No investigation)

$(-0.003 + 0.163 + 0.004) - (0.115 + 0 + 0) = 0.164 - 0.115 = (0.164 - 0.115) = 0.049$

Equation2: (Afternoon*Investigation-Yes) – (Afternoon*No investigation)

$(0.115 + 0.163 + (-0.120)\ (1x1)) - (0.115 + 0 + (-0.120)\ (1x0)) = 0.158 - (0.115+0)$

$= 0.158 - 0.115 = 0.043$

Equation 3: (Night*investigation-Yes) – (Night*No investigation)

$(-0.094 + 0.163) + 0.129(1x1) - (-0.094+0 + 0.129\ (1x0) = 0.198 - (-0.094)$

$= 0.198+0.094 = 0.292$

This implies that patients requiring investigations spent longer time to complete their ER visits compared to those not requiring investigations, regardless of the time of the days they arrived the ER.

Summary

Multivariate analysis found that when all covariates were taken into consideration, patients arriving the ER during spring and summer (compared to those seen during fall), those requiring monitoring, and those requiring specialist consultations (compared to those not requiring similar services) spent longer time to complete their ER visits. However, significant interactions exist between times of arrival and patients requiring investigations, after controlling for other variables. Regardless of time of arrival, those requiring investigation ended up spending more time to complete their ER visits compared to those who did not require investigations.

4.6 Logistic Regression

Logistic regression was performed to consider why patients could spend two hours or more to complete their visits at the Meadow Lake Hospital's emergency department. In this study, the two-hour mark was used because the median time to complete the ER visits was around two hours (median = 131 minutes), and 128 minutes as reported by CIHI, 2005.

4.6.1 Univariates

Univariates analysis was first computed followed by multivariate analysis with variables that have statistical significance. Results showed that the following seven variables have statistically significant effects on whether patients will spend up to two hours or more to complete their ER visits: triage level, mode of arrival, time of arrival, season of arrival, patients requiring investigations, specialist consultations, and monitoring during their ER visits (Table 11). Results showed that the higher the acuity level, the more likely for patients to spend up to two hours or more to complete their ER visits. Patients presenting to the ER as CTAS I or II and III have six times and two time the odds of spending up to two hours or more to complete their ER visits respectively, as opposed to those with CTAS V (OR = 5.87, p= 0.023 and OR=1.85, p= 0.004, respectively). This is because patients with higher acuity usually require more ER services (investigation, specialist consultations, monitoring) and spend more time to complete their ER visits.

Patients arriving the ER by ambulance have twice the odds of spending two or more hours to complete their ER visits (OR = 2.0, p= 0.007), while those carried were less likely to spend two hours or more to complete their visits when compared to those arriving on foot (OR=0.49, p= 0.021). This indicates that patients arriving via ambulance do have higher acuity and also require more ER services than those who arrive by walking with less or non-urgent medical conditions

Patients arriving the ER during the afternoon (when the ER flow is the highest) have about twice the odds (OR=1.66, p= 0.004) of spending two hours or more to complete their ER visits when compared to those arriving the ER during the evening periods. Patients using the ER during spring and summer have about twice the odds of spending two hours or more to complete their

ER visits (OR=2.4 and 1.6, p< 0.0001 and 0.017, respectively) when compared to those using the ER during fall. This follows the MLH ER attendance pattern, which was found to be higher during summer and spring and lower during fall.

Patients requiring investigations (x-rays and labs), specialist consultations, and monitoring during their ER visits are three times, six times and five times, more likely respectively to spend up to 2 hours or more to complete their ER visits (OR=3.0, 5.7, and 4.8 and p<0.0001, respectively) when compared to patients not requiring similar services. These are significant reasons responsible for more time spent to complete ER visits at the MLH ER, as it follows that patients requiring these services tend to have other factors that could make them spend more time e.g. higher acuity, probably arriving by ambulance.

Table 11: Univariates Logistic Regression Analysis: with TLOS ≥ 2 hours

Covariates	Odd Ratio	p-value
Age	0.547	0.92
Log (age)		
Gender		
Female (Ref.)	Ref.	
Male	0.882	0.387
Investigation type		
None (Ref.)	Ref.	
Yes	3.023	**<0.0001**
Consultations		
No	Ref.	
Yes	5.745	**<0.0001**
Procedures		
No	Ref.	
Yes	1.135	0.641
Monitoring		
No	Ref.	
Yes	4.767	**<0.0001**
Primary Provider		

NA	Ref.	
Yes	0.913	0.737
No	0.785	0.376
Physician other duties		
No	Ref.	
Yes	1.007	0.975
Walk-in Available		
No	Ref.	
Yes	0.967	0.823
Triage level		
CTAS V	Ref.	
CTAS I/II	5.874	0.023
CTAS III	1.851	**0.004**
CTAS IV	1.49	**0.022**
Time of Arrival		
Evening	Ref.	
Morning	1.246	0.167
Afternoon	1.659	**0.004**
Night	0.744	0.320
Day of Arrival		
Sunday	Ref.	
Monday	1.387	0.211
Tuesday	1.14	0.620
Wednesday	0.764	0.342
Thursday	0.809	0.408
Friday	0.675	0.138
Saturday	1.5	0.139
Season of Arrival		
Fall	Ref.	
Winter	0.872	0.512
Spring	2.397	**<0.0001**
Summer	1.636	**0.017**
Mode of Arrival		
Walking	Ref.	
Ambulance	2.007	**0.007**
Wheelchair	1.71	0.194
Carried	0.496	**0.021**

Summary

The univariates logistic regression analysis shows that patients with higher acuity, those arriving to the ER in ambulances, those arriving during the afternoon, spring and summer seasons, as well as those requiring extra ER services like investigations, consultation with a specialist, and monitoring during their ER visits are more likely to spend up to two hours or more to complete their ER visits at the MLH ER (Table 11).

4.6.2 Multivariate Logistic Regression Analysis

All variables above with statistical significance were considered for multiple regression analysis. Results showed that time of a patient's arrival to the ER, season of arrival, patients requiring investigations (laboratory test and imaging), specialist consultations and monitoring during their ER visits, have statistically significant effects on whether patients will spend up to two hours or more to complete their ER visits.

Patients seen during spring and summer are about three times and two times more likely to spend up to two hours or more (OR=2.65 and 1.53, $p < 0.0001$ and 0.065, respectively) to complete their ER visits compared to those using the ER during the fall after controlling for consultation, investigation, monitoring and time of arrival to the ER. This is consistent with the analysis above, which found that ER visits increase during the spring and summer and are lowest during fall. This could explain why patients will need to stay longer to complete their ER visits during spring and summer due to high ER patient flow. Patients requiring investigations and specialist consultations during their ER visits were two and three times more likely to spend up to two hours or more to complete their ER visits compared to those patients who do not require investigations or specialist consultations (OR= 1.88, p= 0.001 and OR= 2.99, p= 0.009, respectively).

After controlling for other variables, season of arrival, investigations, and consultations with a specialist during a patient's ER visits, there was a significant interaction between monitoring and a patient's time of arrival to the ER (Table 12).

Table 12: Multivariate Logistic Regression Analysis with TLOS ≥ 2 hours

Covariates	β (coefficient)	Std Err (s.e)	OR {Exp (B)}	95% CI	p-value
Season of Arrival					
Fall	Ref.				
Winter	-0.154	0.2316	0.857	0.544 - 1.350	0.506
Spring	0.975	0.2343	2.650	1.674 - 4.194	<0.0001
Summer	0.425	0.2299	1.529	0.984 - 2.492	0.065
Consultation					
No	Ref.				
Yes	1.095	0.4192	2.990	1.315 - 6.801	0.009
Investigations					
No	Ref.				
Yes	0.630	0.1847	1.878	1.307 - 2.696	0.001
Monitoring					
No	Ref.				
Yes	1.127	0.3325	3.087	1.609 - 5.923	0.001
TOA_grp					
Evening (6pm-12 am)	Ref.				
Morning	-0.226	0.2672	0.798	0.473 - 1.347	0.398
Afternoon	0.635	0.2263	1.888	1.211 - 2.942	0.005
Night	- 1.253	0.4892	0.286	0.110 – 0.745	0.010
TOA_Even*Monitoring					
Morning*Monitoring	0.669	0.5042	1.953	0.727 – 5.247	0.184
Afternoon*Monitoring	-0.366	0.4385	0.693	0.294 – 1.638	0.404
Night*Monitoring	1.855	0.8545	6.393	1.198 –34.124	0.030

Interaction terms analysis was conducted between all the five variables with statistical significance. Results revealed that the most significant interaction was between time of arrival and patients requiring monitoring during their ER visits. Results obtained showed that patients seen during morning hours and requiring monitoring (Morning*Yes Monitoring) have about six

times the odds of spending up to two hours or more to round up their ER visit compared to those seen in the morning and not requiring monitoring (Morning*No Monitoring), refer to Equation 4 below. Also patients seen during the afternoon who require monitoring (Afternoon*Yes Monitoring) have two times the odd of spending up to two hours or more to round up their ER visit compared to those seen in the afternoon and not requiring monitoring (Afternoon*No Monitoring), see Equation 5 below. Finally, patients seen during night periods that required monitoring (Night*Yes Monitoring) have 20 times the odds of spending up to two hours or more to complete their ER visits compared to those seen at night and not requiring monitoring (Night*No Monitoring), see Equation 6 below.

From the above results, all patients requiring monitoring during their ER visits are usually more likely to spend more time to complete their ER visits compared to those who do not require monitoring, regardless of the time of the day they presented to the ER.

Equation 4: (Morning*Yes Monitoring) / (Morning*No monitoring)

$$OR = e^{(-0.226 + 1.127 + 0.669)(1x1)} / e^{(-0.2260 + 0 + 0.669(1x0))} = e^{1.57}/e^{-0.226} = e^{1.57 - (-0.226)} = e^{1.796} = 6.03$$

Equation 5: (Afternoon*Yes Monitoring) / (Afternoon* No monitoring)

$$OR = e^{(0.635 + 1.127) + -0.366(1*1)} / e^{(0.635 + 0 + (-0.366)(1*0)} = e^{1.396}/e^{0.635} = e^{(1.396 - 0.635)} = e^{0.761} = 2.14$$

Equation 6: (Night*Monitoring-Yes) /(Night* No monitoring)

$$OR = e^{(-1.253 + 1.127) + 1.855(1*1)} / e^{(-1.253 + 0 + (1.855)(1*0)} = e^{1.729} / e^{-1.253} = e^{(1.729 - (-1.253)} = e^{2.982} = 19.73$$

Summary

Multivariate logistic regression analysis found that patients arriving at the ER during spring and summer and those requiring special ER services like investigations and specialist consultations are more likely to spend up to two hours or more to compete their ER visits. However, significant interactions exist between time of arrival and need for monitoring during the ER visits. Those requiring monitoring are more likely to spend up to two hours or more to complete the ER visits, than those not requiring monitoring regardless of time of the day they present to the ER.

4.7 Patients Who Leave the ER Without Being Seen (LWBS)

Data obtained for patients that leave the MLH ER without being seen was analyzed separately. A total of 62 patients left the emergency department without being seen by the physician on duty during the period of this study; the results are as described below.

4.7.1 Gender. A majority of patients that left without being seen were 38 females (61.3%), with males accounting for only 38.7 % (24 patients).

4.7.2 Age. Majority of patients leaving the ER without being seen were aged 0–9 years (24.2%). 17.4 % were aged 10–19 years and 20–29 years (59.7% were less than 30 years old). Only 8% were aged 60 years and above (Table 13).

Table 13: LWBS Baseline Characteristic Tables

Variables	N= 62	Percentages
Gender		
Male	24	38.71
Female	38	61.29
Age group (yrs.)		
0 - 9	15	24.19
10 - 19	11	17.74
20 - 29	11	17.74
30 - 39	5	8.06
40 - 49	7	11.29
50 - 59	8	12.9
≥ 60	5	8.06
Place of Residence		
Meadow Lake	22	35.48
Neighb. Communities	27	43.55
Other Saskatch. Cities	13	20.97
Mode of Arrival		
Ambulance	2	3.22
Walking	50	80.65
Carried	6	9.68
Wheelchair	4	6.45
Primary Provider		
Yes	32	51.61
No	23	37.1
Out of town/NA	7	11.29
Time of Arrival		
Morning	8	12.9
Afternoon	34	54.84
Evening	20	32.36
Night	0	0
Season of Arrival		
Winter	6	9.68
Spring	15	24.19
Summer	30	48.39
Fall	11	17.74
Triage Level		
CTAS I & II	0	0
CTAS III	2	3.33
CTAS IV	33	55
CTAS V	25	41.67

4.7.3 LWBS According to Places of Residence

Patients that left the ER without being seen were classified according to their place of residence. Results showed that about 43.6% of them live in the neighboring communities, 35.5% live in Meadow Lake, while 21% came from other Saskatchewan cities (Table 13).

4.7.4 LWBS According to Mode of Arrival

When patients that left the Meadow Lake Hospital ER were classified according to their mode of arrival, results showed that about 80.7% of them arrived at the ER by walking, 9.7% were carried, 6.5% arrived in a wheelchair and two patients (3.2%) were brought in by ambulance. The two patients who came by ambulance were classified as CTAS IV and V (Table 13).

4.7.5 LWBS According to Time of Arrival

LWBS patients were classified according to the time they arrived at the emergency department. Results found that a majority, 54.8% of them, arrived the emergency in the afternoon, 32.3% in the evening and 12. 9% came in the morning. This coincides with the time the ER had a peak flow of patients; hence some of these patients could be tired of waiting and decide to leave (Table 13).

4.7.6 LWBS According to Season of Arrival

When LWBS patients were classified according to the season of the year they presented to the Meadow Lake Hospital emergency department, results found that a majority, 48.4% of them, came to the ER during the summer, 24.2% during spring, 17.7% in fall and 9.7% during winter. This also coincides with the seasons (summer and spring) that recorded the highest number of ER

visits. ER congestion can explain why some of these patients left without being seen by the ER physician (Table 13).

4.7.7 LWBS According to Triage Level

When LWBS were considered according to the severity of their medical conditions, two entries were missing. Results showed that 33 (55%) of these patients were classified as CTAS IV (i.e. less urgent conditions), 25 (41.67 %) as CTAS V (non-urgent medical conditions), and only two (3.33%) classified as CTAS III. No patient classified as CTAS I & II left without being seen (Table 13).

4.7.8 Primary Provider Frequency among LWBS

When LWBS patients were categorized according to whether or not they have primary providers, results revealed that 51.6% of them reported having primary provider while 37.1% do not. Patients with primary providers could leave the ER with intention of booking an appointment to see their doctors at the clinic (Table 13).

4.8 LWBS Mean Total Length of Stay at the ER

The average time spent by patients that left the ER without being seen by the ER physician was determined. Results revealed that they spent average of 153 minutes (95% CI: 126–180 minutes) before leaving the emergency department (Table 14).

Table 14: Mean length of stay of LWBS patients

Mean of TLOS for LWBS	Mean (min.)	Std. Err.	95% C.I.	
In minutes	153	14	126	180

4.9. LWBS Total Length of Stay According to CTAS Level

When the average total length of stay by LWBS patients was considered according to the severity of their medical conditions, it was found that those with CTAS III waited longer than others; these patients spent 256 minutes (4.27 hours) before leaving the ER while those with CTAS IV and CTAS V left after 175 minutes (2.92 hours) and 126 minutes (2.1 hours) respectively (Table 15).

Table 15: Mean Length of Stay of LWBS Patients According to CTAS Level

LWBS by CTAS	Mean (min)	Std. Err.	95% C.I.	
CTAS III	256	109	43	468
CTAS IV	175	19	138	211
CTAS V	126	19	89	164

Summary

Our results showed that a majority of patients that left the MLH ER without being seen during the study period were females, mostly aged 30 years or below. Most are from neighboring communities and arrived the ER by walking, seen during the afternoon, and mostly during summer and spring. Most of them have primary providers and presented with less and non-urgent medical conditions. A majority of these patients stayed for an average of two hours or more before deciding to leave.

CHAPTER 5

5.0 Discussions

5.1 Introduction

Data obtained from this study was used to determine a patient's wait time and length of stay at the Meadow Lake Hospital emergency room. It also identified the various factors that contribute to the variations in patient wait time, total length of stay at the ER, and further characterized those patients that left the ER without being seen by the ER physician. This chapter presents our findings and compared them with the literature.

5.2 Characteristics of Patients Using the ER

Our study results showed that a majority of patients attending the MLH ER were females, which is contrary to findings in urban ERs, where majority of patients were male. However, age distributions in the MLH ER follow the same pattern, with a majority (26%) of patients less than 20 years old and 14% above 70 years old compared with 31% less than 20 years and 16.5% above 65 years in most Canadian urban ERs (CIHI, 2005). Most of our patients presented with less urgent, non-urgent, and urgent conditions, in that order, and arrived by walking. This is similar to findings from most Canadian hospital ERs. Fewer patients presented with very critical conditions (CTAS I) and arrived by ambulance, and only 0.27% of patients presented to MLH ER with conditions classified as CTAS I. 10% arrived via ambulance, compared to 0.5% with CTAS I, and 12% arriving via ambulance in most Canadian urban ERs (CIHI, 2005). A majority of patients seen at the MLH ER do have primary care providers, which is contrary to results from most urban hospitals where most patients have no primary care providers and have less access to primary healthcare services (Altmayer et al, 2005). However, some researchers found that lots of

patients with primary providers also attend the ER to convenience and easy accessibly (Chan et al, 2001; Han et al, 2007; Moineddin et al, 2011).

Our data showed that the MLH ER is mostly busy during the afternoons and evenings, as well as summer and spring, and recorded the lowest visits during nighttime and fall. This is similar to the ER flow rate in most urban ERs across Canada and North America, with more visits recorded around midday and during summer (CIHI, 2005; Chan et al, 2001). A similar pattern of attendance was also recorded based on the day of arrival to the MLH ER, when compared to other Canadian ERs, with most patients seen during the week compared to weekends (Chan et al. 2001; CIHI, 2005). However, a record high of 29% weekend ER attendance was recorded in this study.

Disposition patterns in our rural hospital follow the same trend as other Canadian urban (Alberta and Ontario) ERs, where a majority (about 80%) of patients seen were discharged home after their ER encounter. The admission rate for in-patient care was 8.3% through MLH ER compared to 11% and 8% in Ontario and Alberta hospitals ER, respectively (CIHI, 2005; CIHI 2007).

5.3 Time to Physician Assessment Time (TTPA)

Average wait time to see the physician at the MLH ER was estimated to be 86.41 minutes (1.44 hours) and median time to be 61 minutes. The wait time estimates obtained from our study are lower than the 2.4 hours and 3.3 hours obtained from small community and urban high-volume ERs respectively (CIHI, 2012). Although no data was available for low volume rural hospital ERs, when compared to that from urban ERs in Saskatchewan, the average wait time at the MLH ER was still lower than the 1.6 hours and 2.4 hours from Saskatoon's City Hospital and St. Paul's

hospital respectively (Willoughby, Chan, & Strenger, 2010). However, the median wait time in a low-volume ER like that of MLH was estimated by CIHI to be 1–25 minutes and between 30–51 minutes from other rural ERs. Both of these numbers are lower than the median wait time of 61 minutes from our study. Our findings are not surprising as wait times in most rural and low-volume ERs are usually lower when compared to high-volume or urban ERs (CIHI, 2005; CIHI, 2007; CIHI, 2012; Hutten-Czapski, 2010)

5.4. Variations in Time to Physician Assessment Time (TTPA)

Regression analysis from our study found that patients with higher acuity and those arriving via ambulance have shorter wait times compared to those with lower acuity and those arriving at the ER by other means, like walking. This is similar to reports from both urban and rural hospitals across Canada. As stated in the CIHI report, regardless of ER location and volume, patients with higher acuity, as well as those arriving via ambulances, have lower time to physician assessment than those with lower acuity (CIHI, 2005; CIHI, 2007).

The time of the day, day of the week and season of arrival to the ER also showed statistically significant influence on the time spent waiting for physician assessment. We found that patients arriving at the ER in the morning, during certain days of the week (Wednesday, Fridays and Saturdays), and in the fall have shorter wait time compared to any other time of the day, day of the week or season. This coincides with the times the MLH ER recorded its lowest attendance. There was no similar data available for rural ERs, but urban data as reported by CIHI showed that wait times were lower during periods when the ER was less busy (CIHI, 2005; Chan et al, 2001). We did not find any association between physician assessment time and age, gender, physician

other duties and availability of walk-in at the Meadow Lake clinic. These parameters were not reported in most ER wait time studies as factors responsible for ER wait time variations.

5.5 Total Length of Stay at the ER (TLOS)

Results from our study estimated the average total length of stay at the MLH ER at 163 minutes (2.72 hours), which is lower than the five hours reported from five major high volume (urban) Saskatchewan ERs (Royal University Hospital, Saskatoon City Hospital, St. Paul's Hospital, Regina General Hospital, and Pasqua hospital) (Willoughby, Chan, & Strenger, 2010). It's also lower than the CIHI estimates of 4.4 hours from urban ERs across Canada (CIHI, 2012).

The median length of stay estimate of 131 minutes at the MLH ER is comparable to the median length of stay of 128 minutes reported by CIHI from Canadian ERs in general. It is, however, twice as high as those from a low-volume ED with median time of 61 minutes and half of the time reported for a high-volume ED (203 minutes) from the Canadian hospital ER data of 2003–2004 (CIHI, 2005). We also found that 90% of MLH ER visits were completed in about 5.4 hours compared to eight hours reported by mainly high-volume ERs across Canada (CIHI, 2005; CIHI 2012). CIHI reports, as well as other researchers' findings, have pointed out that wait time and length of stay in low-density community (rural) ERs are generally lower than those from urban or high-volume ER (CIHI, 2005; 2007, 2012).

5.6 Variations in Total Length of Stay at the ER

Analysis (Bivariate and univariates) of our data showed that patients with conditions classified as high acuity (CTSA I-III) spent longer time (about 3.4 hours) to complete their ER visits compared to those with low acuity patients (CTAS IV, V) that spent average of about 2.66 hours.

High acuity patients also have higher odds of spending up to two hours or more compared to low acuity patients. This is similar to rural ER data of 3.66 hours for high acuity and 1.83 hours for low acuity patients in Ontario hospitals. It is, however, quite a bit lower than those from high-volume urban ERs that reports five to six hours for high acuity patients **(**Hutten-Czapski, 2010). Our data analysis showed inconsistent findings for length of stay based on mode of arrival, with bivariate analysis showing longer stays for those arriving via ambulance and univariates showing shorter stays for the same category of patients. However, no relationship was found with multiple regression and logistic regression analysis. This is contrary to findings from other urban and rural ERs where patients arriving via ambulance with higher medical acuity consistently spent longer time to complete their ER visits (CIHI, 2007; CIHI, 2012).

We also found that patients requiring specialist consultations, investigations, or monitoring during their ER visits have longer stays. Logistic regression also showed that they have higher odds of spending up to two hours or more to complete their ER visits. However, length of stay for patients requiring investigations and monitoring also varied with time of arrival (analysis showed significant interactions between these variables) to the ER. Overall findings showed that regardless of the time of arrival, those requiring investigations and monitoring still spend a longer time to complete their ER visits. Various ER wait time studies have also related investigations, monitoring, and consultations as internal factors that increase ER length of stay (Yoon, Steiner & Reinhardt, 2003; Schull et al, 2002; CIHI, 2007). Though no rural hospital data is available, urban ER data also showed a similar pattern across Canada with patients having more needs during their visits having to stay longer (CIHI, 2005; CIHI, 2007).

Patients seen at the MLH ER during summer and spring when the ER received more users have longer ER stays than those seen during other seasons. The odds of spending up to two hours or more for their visits is also at least twice that of other seasons. Researchers have also found that patterns of disease presentations in the ER vary according to seasons with longer stays during the peak seasons (CIHI, 2005). Urban ERs in Ontario also showed this pattern with increased length of stay during summer when more patients use the ER (Chan et, al, 2001; CIHI, 2005).

It's worthy to mention some other important findings from our study. Patients are less likely to spend up to two hours or more whenever walk-in clinics are available at the Meadow Lake Primary Healthcare Clinic, and more likely to spend up to two hours or more on days when ER physicians have other medical duties (e.g. in-patient rounding, obstetric call). Previous studies pointed out that accessibility to alternative levels of care, like close by walk-in clinics and primary healthcare services, helps decongest the ER and reduces lengthy ER stays (Newfoundland and Labrador, 2012; Moineddin et al, 2011; Sempere-Selva et al, 2001). Its is also important to note the peculiarity of rural and community ERs, in which the physicians are, in most cases, called in from home or long-term care facilities to see ER patients. Hence, the chances of waiting up to two hours or more could be higher. This aspect was highlighted in one of CIHI's publications as a contributing factor to prolonged ER wait time in rural hospitals ER (CIHI, 2012).

5.7 Patients that Left the ER Without Being Seen (LWBS)

Results from our study estimated the rate at which patients left the MLH ER without being seen by a physician at about 7.38%, which is quite high compared to most previous estimates (mainly

from urban ERs). An average rate of 3% was reported in the CIHI data of 2003–2004 (CIHI, 2005). A downtown Toronto hospital emergency unit study estimated the LWBS rate as 3.57% (Monzen et al, 2005). Reports from outside Canada also recorded a rate closer to other Canadian ER results; a rate of 4.2% was estimated in Swiss study conducted at the Geneva University Hospital (Grosgurin et al, 2013). It's not clear why the MLH experiences such a high LWBS rate.

5.7.1 Characteristics of Patients Who Leave the ER Without Being Seen

A majority of LWBS patients from our study were females, while studies from some urban ERs in Toronto and New Brunswick did not find any significant variations based on gender but obtained similar age distributions mostly young patients aged less than 30 years (Monzen et al, 2005; Fraser et al, 2017). Previous studies confirmed that higher rates of LWBS were recorded during peak ER periods or when the ER seems to be overcrowded. This is similar to findings from our study where most patients left during the afternoon periods or summer when the MLH ER is usually busier (Woodward, Zimmerman, Isom, & Summers, 2014; Rowe et al, 2006; Monzen et al, 2005). Our results also showed that more than half of LWBS patients do have a regular primary provider (51.6%) and live far away from the hospital. This is contrary to most study findings that majority of these patients do not have primary providers, have limited access to primary healthcare, and usually live close by, within 20 km to the hospital ER (Monzen et al, 2005; Fraser et al, 2017). Studies found that most of the LWBS patients arrived the ER by walking, and usually with less urgent or non-urgent medical conditions (Baker, Stevens & Brook, 1991; Monzen et al, 2005). Similar results were obtained in our study, with most of LWBS patients arriving by walking and presenting with either less or non-urgent medical conditions. The only two patients that left without being seen who arrived by ambulance, presented with less

urgent and non-urgent medical conditions. No patient with CTAS I or II left without being seen during the study period.

5.7.2 Length of Stay at the ER Before Leaving

Results from this study showed that the LWBS patients from the MLH ER waited for an average of 153 minutes (2.55 hours) before deciding to leave, which is close to the estimated time by some related studies. Most of these studies are from urban or high-volume ERs. An estimated length of stay of 2.48 hours was reported in a Toronto ER study, and another Canadian study by Fernandes and his colleagues reported that most of these patients leave within two hours of presentation to the ER (Monzen et al, 2005; Fernandes, Daya, Barry & Palmer, 1994). In comparison to our wait time estimates of 86 minutes, LWBS patients from the MLH ER stayed about twice as long before deciding to leave. How long LWBS patients waited for before leaving correlates with how severe their medical conditions were. Those with non-urgent conditions (CTAS V) left after 126 minutes (2.1 hours) while those with urgent conditions (CTAS III, only 2 patients) waited longer, 256 minutes (4.27 hours) before deciding to leave. Patient chart review from this study, as indicated by the ER nurses, showed that most patients left because they were tired of waiting and could not wait any longer. This is consistent with several other studies reviewed (mostly from urban hospitals) that prominently documented that patients were fed up with waiting. Some reported feeling better while waiting, while others opted to go to the clinic some other time (Rowe et al, 2006; Monzen et al, 2005; Fraser et al, 2017). There have been concerns about LWBS patients as researchers have found that the delay in care have been attributed to adverse outcomes (Rowe et al, 2006).

CHAPTER 6

6.0 Study Limitations, Conclusion and Recommendations

This chapter summarizes our research findings, highlights some study limitations as well as strengths, and makes recommendations to stakeholders and for future research opportunities.

6.1 Findings

This study showed that most patients presenting to the MLH ER, had less urgent (CTAS IV) or non-urgent (CTAS V) medical conditions at 48% and 28%, respectively. On average, patients presenting to the MLH ER had to wait for 86.41 minutes (1.44 hours) before being attended to by the ER physician, compared to an average of 2.4 hours or 3.3 hours spent waiting for physician assessment at the emergency departments of small community or high-volume urban hospitals respectively. On the other hand, the average length of stay to complete an ER visit at the MLH ER was about 163.3 minutes (2.72 hours), lower than the average of 4.4 hours in urban hospitals across Canada and the average of five hours from major Saskatchewan hospitals reported in previous studies.

Variations in wait time at the MLH ER were found to be dependent on the following factors: patients' mode of arrival, day of arrival, time of arrival, season of arrival and CTAS level. While ER total length of stay was dependent on a patient's time of arrival, season of arrival and severity of their medical condition, the need for investigations, monitoring and consultations with specialists in other health facilities during their ER visits.

The rate of patients leaving without being seen (7.8%) at the Meadow Lake ER is higher than most rates obtained from different studies reviewed and that reported by CIHI, which ranges between 3–4.6% (CIHI, 2005).

6.2 Study Limitations

Similar to most retrospective studies, the main limitation of this study was related to data collection. A number of data were missing, which cut across all variables. It includes, triage level, nurse's assessment time, physician assessment time, and disposition time. Some data were poorly recorded while some others were not legible enough for proper identification. As a retrospective study, recollecting these missing data was not possible. This might have some influence on the data interpretation and generalization of the results obtained.

6.3 Strengths of this Study

The major strength of this study was the consideration of a wide range of time across all four seasons of the year. This gives the study an edge over several other ER wait time retrospective studies, which mostly considered ER data over a period of one or two weeks.

6.4 Conclusion

It is reasonable to draw a conclusion that most patients presenting to the MLH ER were not meant to be seen at the ER, since larger proportions of patients seen and those that left without being seen presented with either less or non-urgent medical conditions.

6.5 Recommendations and Future Studies

Based on results obtained from this study, and the various challenges encountered during data collection, some recommendations were made and classified into two categories, management (hospital management and regional health authority) and ER service providers.

6.5.1 Management:

Ensuring adequate data documentation: hospital management and regional heath authority should provide policies and strategies to reduce wait time and improve quality of service, as well as quality data for ER research. Quality data is paramount to groundbreaking ER research. The quality improvement team should lay emphasis on the importance of time documentations to all ER staff, including nurses and doctors, to provide robust ER data for future studies. This includes all time segments such as arrival time, initial nurse and physician assessment time, disposition, and admission time. EMS staff should communicate the actual time of arrival of patients via ambulance directly to the record clerk as soon as they arrive the ER.

ER restructuring and staffing: the regional health or provincial authority should provide adequate staffing to the ER or assign an extra physician or experienced nurse practitioner coverage during the MLH ER's peak periods (afternoon and evenings). This will improve patient flow and also reduce ER overcrowding and wait times. They should also look into expanding the ER capacity by increasing the number of examination rooms. This is will also reduce wait times resulting from ER bed availability.

Provision of alternative level of care: this could be achieved by improving accessibility to the Meadow Lake Primary Healthcare Clinic. Providing more staffing, opening up more walk-in

appointment slots, and providing after-hours services (or even a half-day service on Saturday morning) will also reduce ER overcrowding as well as ER wait times.

Providing adequate patient education: the hospital management should provide incentives to patients by way of adequate education about ER services. Emphasis should be placed on the need to use the ER for urgent cases and discourage its use for conditions that could wait or be attended to at the clinic. The public should be encouraged to see their primary provider or go to the walk-in clinic for minor or chronic conditions.

At the ER, up-to-date information about the wait time should be provided. This will improve patient confidence and satisfaction if they know how long they will wait before seeing the doctor and how long their ER visit will last.

6.5.2 Providers

ER service providers (nurses, and physicians) also have roles to play in improving wait time at the MLH ER and ensuring quality ER data for researches meant to improve the ER's quality of care. Providers should endeavor to always remember to document time of assessments, discharge, or admission time; this will provide accurate ER data for future researches. Registered nurses should constantly inform patients how long they have to wait to see the doctor. This communication should be done at intervals whenever more emergent cases will be causing them to wait longer. This will improve a patient's ER experience and will reduce the rate of patients leaving the ER without being seen. Nurses should also be empowered to be able to refer patients to the clinic or ask them to return whenever the ER is less busy. Physicians should provide standing orders to their patients who need repeated ER visits for issues such as pain management

and management of some acute on chronic conditions.

6.5.3 Future Studies

There is lots of room for future research on ER wait times in rural hospitals; more so that there is sufficient researches and data available from rural ERs across Canada.

The Meadow Lake Hospital management should spearhead researches to reduce ER wait times and the rate of LWBS at the MLH ER.

A qualitative follow-up of studies to see if LBWS patients actually seek medical attention after leaving the ER and to also evaluate their health outcomes as a result of leaving the hospital without seeing the ER physician.

A real-time ER wait time study and assessment of patients' ER experiences will also help in improving the quality of care at the Meadow Lake Hospital ER.

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8.1 Appendix A: PNHR Confidentiality Agreement Form

Prairie North Health Region
Confidentiality Agreement

Under the provisions of Saskatchewan (SK) legislation *The Health Information Protection Act, The Local Authority Freedom of Information and Protection of Privacy Act,* and any other applicable privacy legislation (e.g. Alberta legislation specific to Lloydminster), Prairie North Health Region (PNHR) has a duty to establish policies and procedures to protect confidential information in its custody and control. PNHR is obligated to ensure compliance with such legislation by persons providing services within PNHR, including employees, physicians, PNRHA Board members, volunteers, students, and contractors.

As an individual providing service to Prairie North Health Region, I understand that I may have access to confidential information in many formats (including paper, electronic/digital and spoken communication). Such information includes, but is not limited to, information relating to:

- Patients (such as health records, conversations, admitting/registration information, patient financial information, etc.);
- Prairie North Health Region employees, physicians or volunteers (such as employment records, disciplinary actions, etc.);
- Prairie North Health Region business information (such as financial and statistical records, strategic plans, internal reports, memos, contracts, peer review information, communications, proprietary computer programs, source code, proprietary technology, etc.); and
- Prairie North Health Region's business partners and service providers.

CATEGORIES OF CONFIDENTIAL INFORMATION

Personal Health Information: As defined under *The Health Information Protection Act (SK) - (HIPA)* includes, but not limited to:

- Information with respect to the physical or mental health of the individual;
- Information with respect to any health service provided to the individual;
- Information that is collected in the course of providing health services to the individual (intentionally or incidentally);
- Registration information

Personal Information: As defined under *The Local Authority Freedom of Information and Protection of Privacy Act (SK) - (LA-FOIP)* includes, but not limited to:

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- Information related to race, creed, religion, colour, sex, sexual orientation, family status, marital status, disability, age, nationality, ancestry or place of origin of the individual;
- Information that relates to the education, criminal or employment history of the individual, or information relating to financial transactions in which the individual has been involved;
- Any identifying number, symbol or other particular assigned to the individual;
- The home or business address, home or business telephone number, fingerprints or blood type of the individual;
- Information that relates to health care that has been received by the individual or to the health history of the individual;
- Name of the individual where it appears with other personal information or where disclosure of the name would reveal personal information about the individual.

Other Categories of Confidential Information: As defined under other specific legislation, including *The Local Authority Freedom of Information and Protection of Privacy Act (SK)* may come under specific categories of confidentiality and includes, but not limited to:

- Information contained in a record that was obtained in confidence from:
    - The Government of Canada or its agencies, Crown corporations or other institutions; the Government of Saskatchewan or a government institution; the government of another province or territory of Canada or its agencies, Crown corporations or other institutions;
- Information relating to law enforcement and investigations under the Criminal Code of Canada;
- Information that may impact economic or other financial interests, such as:
    - Trade secrets; financial, commercial, scientific, technical information in which the local authority has a proprietary interest; information which could interfere with contractual negotiations; information which could prejudice the economic interest of the local authority.

CONFIDENTIALITY OBLIGATIONS

I acknowledge and agree that my right to collect, use, view and disclose Confidential Information is subject to the following conditions:

1) I will only collect Confidential Information on a need-to-know basis to perform my duties as defined by my relationship with PNHR or as required by law.
2) I will only use/view Confidential Information for the purposes for which I have been granted access, and will only disclose that information as permitted by legislation and/or PNHR policy;
3) I understand that I need to obtain a patient's consent to disclose information to a third party, unless there is a legislated requirement to disclose without consent.
4) I understand that under no circumstance shall I share any Confidential Information that I see/hear with any other person unless legally entitled to;
5) I understand that communicating anything from a patient's personal health information, an employee's/physician's personal information or PNHR privileged

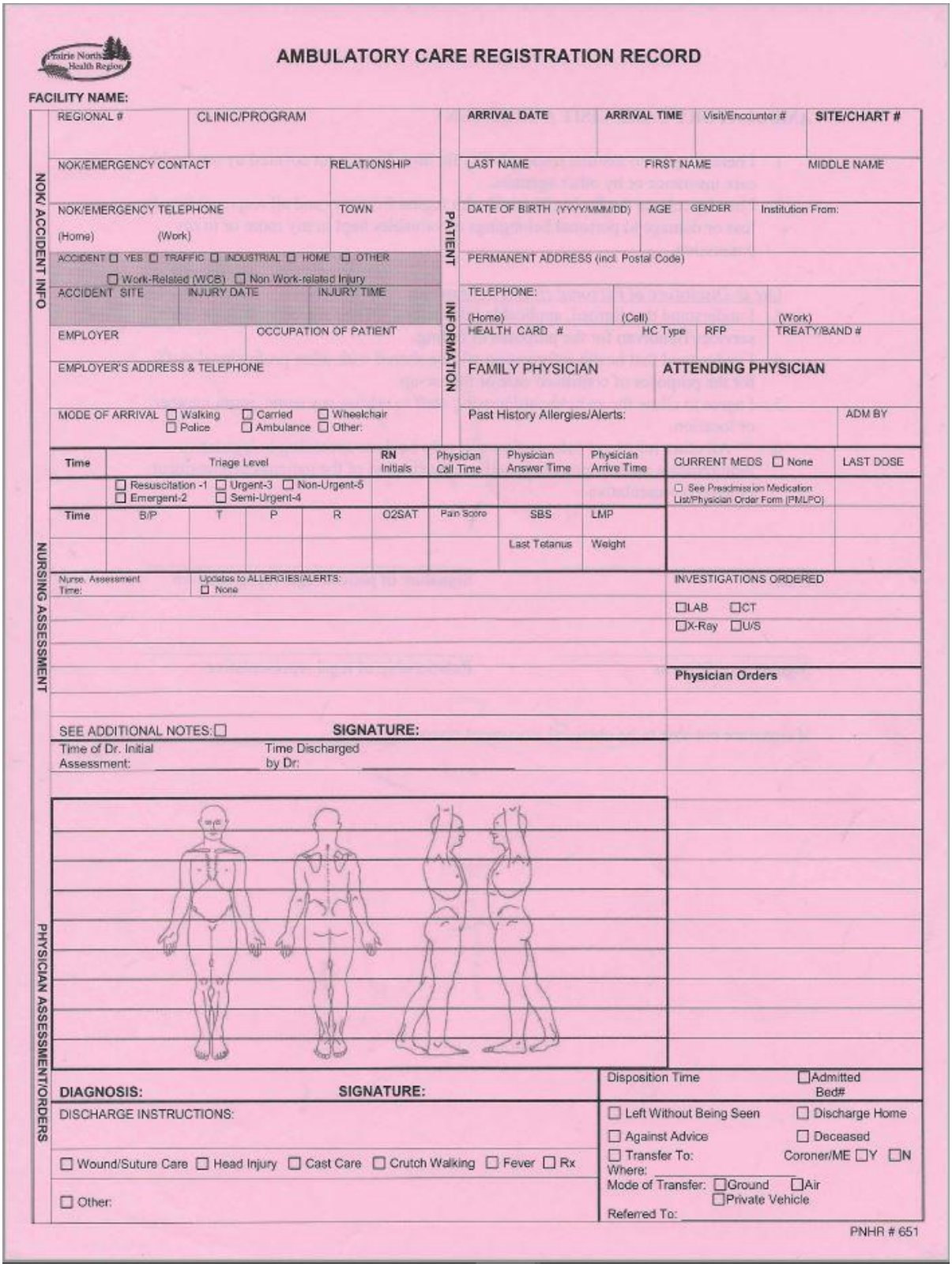
business information, even if I do not identify the subject individual by name, is unauthorized disclosure (this includes information shared on a social media site);

6) I understand that unauthorized use includes looking up any information on my spouse, family members, friends, acquaintances, co-workers, etc. This includes looking up birth dates, phone numbers and addresses for personal use;
7) I will not access my own personal health information held by PNHR, unless I make my request according to approved policies on Patient Access to Information;
8) I understand that simply looking at (viewing) personal information/personal health information without an authorized need-to-know (whether in a paper format or electronically) is considered inappropriate use;
9) I understand that looking up a patient's personal health information out of curiosity/general interest is prohibited and is unauthorized disclosure;
10) I understand that I will not dispose of any documents (paper or digital) containing Confidential Information into unsecured garbage bins and will ensure such documents are shredded or otherwise securely destroyed;
11) I will not in any way divulge, copy, release, sell, loan, review, alter or destroy any Confidential Information except as properly authorized within the scope of my duties with PNHR;
12) I understand that my privileges/access rights are subject to periodic review and that monitoring and auditing of compliance with such rights will be carried out;
13) I understand that there could be severe consequences if I breach confidentiality in conflict with PNHR policy and applicable legislation, resulting in disciplinary action up to and including employment termination and/or legal action;
14) I understand that my name may be released by PNHR to a complainant as part of full disclosure in a proven case of breach of confidentiality.
15) I agree to review and comply with all legislation and Prairie North Health Region policies respecting privacy and security, as amended from time to time.
16) I acknowledge my obligation to report to the PNHR Privacy Office any practice by another person that violates these obligations or puts PNHR, its personnel, or its patients at risk of improper access, use or disclosure of Confidential Information.

SECURITY OBLIGATIONS

1) I agree to utilize the information provided on the PNHR computer network for the sole purpose of performing my legitimate duties with the Region;
2) I agree I am responsible and accountable for all activities conducted on the computer network under my PNHR user account;
3) I will safeguard and will not disclose or share my passwords, User IDs, clearance badges, access cards, keys, access codes or devices assigned to me (or created by me) that allow me to access confidential information. I accept responsibility for all activities undertaken using such access codes and devices;
4) If I generate, create or print any paper documents or electronic documents containing Confidential Information, I agree to thoroughly destroy or erase such documents when they are no longer needed;

8.2 Appendix B: Outpatient Sheet



AMBULATORY CARE REGISTRATION RECORD

FACILITY NAME:

NOK/ ACCIDENT INFO

REGIONAL # | CLINIC/PROGRAM

NOK/EMERGENCY CONTACT | RELATIONSHIP

NOK/EMERGENCY TELEPHONE | TOWN

(Home) (Work)

ACCIDENT ☐ YES ☐ TRAFFIC ☐ INDUSTRIAL ☐ HOME ☐ OTHER

☐ Work-Related (WCB) ☐ Non Work-related Injury

ACCIDENT SITE | INJURY DATE | INJURY TIME

EMPLOYER | OCCUPATION OF PATIENT

EMPLOYER'S ADDRESS & TELEPHONE

MODE OF ARRIVAL ☐ Walking ☐ Carried ☐ Wheelchair ☐ Police ☐ Ambulance ☐ Other:

PATIENT INFORMATION

ARRIVAL DATE | ARRIVAL TIME | Visit/Encounter # | SITE/CHART #

LAST NAME | FIRST NAME | MIDDLE NAME

DATE OF BIRTH (YYYY/MMM/DD) | AGE | GENDER | Institution From:

PERMANENT ADDRESS (incl. Postal Code)

TELEPHONE: (Home) (Cell) (Work)

HEALTH CARD # | HC Type | RFP | TREATY/BAND #

FAMILY PHYSICIAN | ATTENDING PHYSICIAN

Past History Allergies/Alerts: | ADM BY

NURSING ASSESSMENT

Time	Triage Level	RN Initials	Physician Call Time	Physician Answer Time	Physician Arrive Time
	☐ Resuscitation -1 ☐ Urgent-3 ☐ Non-Urgent-5 ☐ Emergent-2 ☐ Semi-Urgent-4				

Time	B/P	T	P	R	O2SAT	Pain Score	SBS	LMP
							Last Tetanus	Weight

CURRENT MEDS ☐ None | LAST DOSE

☐ See Preadmission Medication List/Physician Order Form (PM/LPO)

Nurse. Assessment Time:

Updates to ALLERGIES/ALERTS: ☐ None

INVESTIGATIONS ORDERED

☐LAB ☐CT

☐X-Ray ☐U/S

Physician Orders

SEE ADDITIONAL NOTES:☐ SIGNATURE:

Time of Dr. Initial Assessment: _____ Time Discharged by Dr: _____

PHYSICIAN ASSESSMENT/ORDERS

DIAGNOSIS: SIGNATURE:

DISCHARGE INSTRUCTIONS:

☐ Wound/Suture Care ☐ Head Injury ☐ Cast Care ☐ Crutch Walking ☐ Fever ☐ Rx

☐ Other:

Disposition Time ☐Admitted Bed#

☐ Left Without Being Seen ☐ Discharge Home

☐ Against Advice ☐ Deceased

☐ Transfer To: Coroner/ME ☐Y ☐N

Where: _____

Mode of Transfer: ☐Ground ☐Air ☐Private Vehicle

Referred To: _____

PNHR # 651