THE PREVALENCE AND CHARACTERISTICS OF NON-TRANSPORTED PATIENTS IN NOVA SCOTIA

By

Steven Carrigan

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Abstract

Background: Emergency Medical Service (EMS) systems provide patients with emergency care and transportation to a healthcare facility. Non-transport occurs, when a patient is not transported and represents an often undefined yet potentially significant risk for poor clinical outcomes.

Objectives: This study aimed to determine the prevalence of non-transport and potentially adverse non-transport and identify associated characteristics.

Methods: A secondary analysis of pooled cross-sectional, population-based administrative data from the Nova Scotia EMS system in 2014 was conducted, using logistic regression.

Results: Of 74,293 emergency responses, 18.9% (n=14,072) were non-transport and of those 5.6% (n=798) were potentially adverse. The characteristics statistically significantly and independently associated with both were: age, paramedic clinical impressions, number of co-morbidities, and incident location type.

Conclusions: The results of this study provide timely information to policy makers and practitioners on the scope of non-transport, areas of concern and directions for future study.

List of Abbreviations Used

ALS	Advance Life Support
BLS	Basic Life Support
BP	Blood Pressure
CAD	Computerized Aided Dispatch
CSD	Clinical Support Desk
CTAS	Canadian Triage Acuity Scale
ED	Emergency Department
EHS	Emergency Health Services
EMS	Emergency Medical Service
EENT	Ear, Eyes, Nose, Throat
ePCR	Electric Patient Care Record
GLC	Blood Glucose Level
HR	Heart Rate
MCC	Medical Communications Centre
MIN	Medical Incident Number
NOBI	No One Brought In
O2	Oxygen
OB/GYN	Obstetrics/Gynecological
OLMOP	Online Medical Oversight Physicians
RR	Respiratory Rate
Temp	Temperature

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Chapter 1 - Introduction

Emergency Medical Service (EMS) systems are a fundamental component of all healthcare systems in Canada. The EMS system in each province, territory, or municipality endeavours to bring the right care, to the right patient, at the right time, in environments and locations from the downtown core of major cities to the deep woods of provincial interiors and remote coastal and island communities. EMS systems provide emergency assessment and treatment followed by transportation by ambulance to a healthcare facility emergency department (ED) for seriously ill or injured patients.

Although the design of EMS systems is traditionally intended to transport the patient, non-transport is a possible outcome of an EMS response. A non-transport response outcome means that, for a variety of reasons, a patient is not transported to a healthcare facility. This response outcome is often referred to as a NOBI, "No One Brought In" in Nova Scotia or more commonly "non-transport".

A non-transport represents an often undefined yet potentially significant risk for poor clinical outcomes, as it is very difficult for EMS systems to know what the ultimate outcome was for patients with a non-transport response.

Existing research regarding non-transport is focused on the risk or safety of the non-transport from the standpoint of paramedic ability to triage/select appropriate cases for non-transport, hospital related patient outcomes such as subsequent hospital visits or admissions, and paramedic initiated non-transport (1-11). The majority of these studies have relied on hospital chart reviews or interviews with healthcare staff (2,3,12,13). Previous studies have not broadly examined the patient, operational and environmental

characteristics of both non-transport and transported patients at the same time, using EMS patient charts (14,15). Prior non-transport studies primarily focused on the adult population and used convenience samples over short time frames (typically several months) rather than a broad sample of an EMS population over an extended timeframe (14,15). Restricting the time frame of a study to only several months or weeks limits the generalizability of the study to that time; studies covering a full calendar year remove any seasonal variation. Most of the non-transport studies use data from municipally-based EMS systems that serve individual communities with one or two hospitals. This limits the generalizability of those studies to similar EMS systems or community settings. A study was necessary to determine the scope of non-transport and relevant associations with a broad study setting that allows an analysis of the non-transport response outcomes across the full spectrum of community types and at the provincial/state level.

This study addressed these gaps in the literature and aimed to enhance knowledge which is of value to healthcare professionals and policy makers in the area of EMS care.

This study began by examining the EMS literature on non-transport from North America, Europe and Australia to provide background on EMS non-transport and to identify what is and is not known about EMS non-transport, including the prevalence in EMS systems in other jurisdictions, the types of non-transport, patient characteristics associated with non-transport and the impact of non-transport on EMS systems and patients. Building on this, non-transport outcomes were examined in detail within the context of the Nova Scotia EMS system. A secondary analysis of pooled cross-sectional, population-based administrative data from the EMS Electronic Patient Care Record

(ePCR) database, collected by paramedics during ambulance dispatch and routine patient care and charting, was conducted.

Results of this study provide timely information to healthcare policy-makers and practitioners who are considering innovative programs to provide additional options to patients with a non-transport response outcome, such as referring them for follow-up care beyond an EMS system. The results of the study may also contribute to deriving clinical decision-making rules for potential non-transport patients and identifying the under-triage (i.e., false negative) and over-triage (i.e., false positive) rates of EMS patients in Nova Scotia.

This thesis is organized into seven chapters. Chapter 2 covers the literature review of EMS non-transport and the rationale for conducting the study. Chapter 3 describes the research objectives. Chapters 4 explains the study methods. Chapter 5 presents the results of the study. Chapter 6 discusses the key findings, strengths, limitations and implications of the study. Chapter 7 provides the conclusion.

Chapter 2 - Background

2.1 Non-Transport

EMS systems often provide contradictory messages. They encourage the public to call 911 when experiencing an emergency but highlight the burden of inappropriate calls where an ambulance arrives and the patient was not having a life-threatening emergency. The primary purpose of EMS systems is, at the basic level, to provide emergency assessment and treatment to patients, and to transport them by ambulance to a healthcare facility ED for the definitive care provided by a physician-led assessment and treatment team.

Although the design of EMS systems is traditionally intended to transport the patient, non-transport is a possible outcome of an EMS response. A non-transport response outcome means that, for a variety of reasons, a patient is not transported to a healthcare facility.

A non-transport is thought to represent an undefined yet potentially significant risk for poor clinical outcomes in EMS systems, and furthermore, it is very difficult for EMS systems to know the ultimate patient outcome of a non-transport disposition to even accurately assess the risk (1-5). However, there may be some cases, depending on the patient, their clinical issue and the EMS system in which they occur, where a non-transport may be a desirable response outcome, perhaps with certain additional follow-up or other safety mechanisms (6).

Non-transport is one of a number of patient care issues faced by EMS systems that are unique to the pre-hospital care setting, which occurs when a patient refuses assessment,

treatment or ambulance transport to a hospital. The rate of non-transport has been reported to be as high as 40% of all EMS calls in one study, with most studies reporting non-transport rates of less than 20% (1-5).

The majority of these studies were carried out in urban settings in the United States, with basic life support systems (BLS) and emergency call volumes of less than 30,000. BLS EMS systems focus on assessment, stabilization of the patient and transport. The structure of the systems in these studies impacted the non-transport rates, due to the level of care provided, which may emphasize the importance of transport, or, in some cases, more strongly discourage what are perceived as unnecessary transports. Studies conducted in urban settings are unable to capture the impact on non-transport rates on providing care in rural and remote settings where EMS systems may act as proxies for primary care, or as a safety net, potentially driving up the non-transport rate. Two well-conducted studies, completed in the 1990s reported non-transport rates between 5% and 10% (2,3). These studies were conducted in larger settings with a mix or urban and suburban, but none covered the full spectrum of community types (urban, suburban, rural, and remote). These studies provided a better picture of the spectrum of community settings EMS care is provided in, but not the full picture. A recent study in the Nova Scotia study setting, focused on older patients (65 or more years old), reported that 18% of cases had a non-transport response outcome (5).

The choice not to be transported is the right of the patient or their authorized representative to make. The majority of reasons for non-transport reported in the literature were that the patient thought that transport was not necessary or the situation had been resolved. Several studies focused on the reasons that patients choose not to be transported,

and some of the most common cases were when the individual who made the 911 call was incorrect as to the nature of the situation, or cases where the patient was not experiencing an urgent clinical condition and following assessment/treatment they decided transport was not required (3). An often anecdotally cited reason for non-transport is the burden associated with the financial cost of ambulance transportation, but studies indicated that only a small percentage of non-transports were related to financial concerns (3,16).

Each individual member of the public has his or her own perception of what constitutes an emergency. Furthermore, the public may not be immediately associating calling 911 for help with transport to an ED. In contrast, transport to an ED is the outcome of most EMS clinical protocols/guidelines that outline the recommended response to pre-hospital medical emergencies (17). It is also possible that EMS paramedic crews may send unintended messages that the patient does not need to be transported (18). The arrival of EMS providers and the provision of clinical assessment and initial treatment often de-escalates what was originally perceived to be an emergency. This is especially true when the communication from EMS paramedics on scene directly or indirectly implies that the patient is not experiencing an emergency. Several studies reported that the decision to refuse transport is often not limited to the patient, but rather, a mutual decision made between the EMS crew and the patient (18-21). It is the right of the patient to refuse transport, but there is substantial evidence that actions and messaging of EMS providers can influence the decisions of patients regarding transport to a hospital or not (22). A significant influence on such decisions is the real or perceived overcrowding of EDs and the desire of both paramedics and patients to avoid them (22). It has also been noted that contact with online medical oversight physicians (OLMOP), who provide clinical advice

and oversight for paramedics and are available 24/7 in most EMS systems, is likely to increase the rate of transport for high-risk patients who initially refuse emergency medical care (22-24). The emergency nature of these situations can present a significant likelihood of potentially adverse decisions. Some studies had indicated that as many as 50% of patients who required hospital admission but refused transport meet mandatory transport guidelines (23). These studies indicate that a potentially significant portion of patients who refuse transport could be classified as at risk of requiring additional medical care and may have been undertriaged by the EMS system.

2.2 Non-transport Impact

Regardless of the situation or reason, not transporting a patient who has accessed an emergency service to a healthcare facility can result in poor outcomes in the clinical and potentially legal realm (3,19,22-27). A non-transport represents a situation where patients are not being fully assessed in a controlled healthcare setting. In EMS systems, non-transport is a complex issue, and whether a non-transport is the best response outcome of an EMS patient interaction is dependent on the particular circumstances of the patient, the operational structure of the individual EMS system, and the environment in which it occurs. For example, a non-transport may be a suitable response outcome if the patient is not in need of emergency medical care, the 911 call was made mistakenly, the patient overestimated the severity of their circumstances, or the assessment and treatment provided by paramedics fully resolved the emergency (28).

Ideally, an individual would make an accurate assessment of the level of care they require, and all 911 emergency medical calls would end with an appropriate response

outcome. Due to the chaotic nature of EMS systems, with patients and the general public's varied perceptions of what is an emergency and the lack of accessibility to any level of care in many rural communities, this ideal is not a reasonable expectation. The more likely situation in an EMS system is for a reassessment of urgency to be made when paramedics arrive and in discussion with the patient. In such circumstances the decision regarding a non-transport may be made mutually, and should not be considered a potentially adverse response outcome. Another scenario would be when a non-transport was the response outcome of a patient/paramedic interaction and the patient later sought emergency medical care for the same issue either by calling 911 again or by arriving at an ED through other means.

In most EMS systems, little is known about the patient care pathway, trajectory or healthcare outcomes of non-transport patients following their interaction with the EMS system. This knowledge gap is due to limited data linkages between community, EMS and hospital-based health information systems (29). If patients are not transported, they may access the EMS system again, which is referred to as "relapse" (30). A number of studies had indicated that many patients involved in non-transport later seek some form of clinical care and, in a few cases, are hospitalized or die (2,3,12,13), but the magnitude of the risk is unclear. EMS systems use quality assurance programs and research to determine the safety of non-transport, in part by measuring the relapse rate of patients, where patients seek medical care for the same issue within a specific timeframe, either back to the EMS system or to the broader health system. One 2005 study, conducted in a small urban setting, documenting the health outcomes of patients of all ages who refused transport, 48% sought further medical care, and 6.5% required hospital admission (25). In another study

conducted in 2001, 20% of the EMS patients who refused transport did seek subsequent ED care related to their initial EMS complaint, of the patients who later sought ED care only 2% were later admitted to a hospital and less than 1% of those died (13). Compared with similar rates for all EMS patients in the study setting (14.7% were admitted and 6.8% died), these rates suggest that the patients who refuse EMS care might have reduced need for further medical care (13). Overall, studies had described an overall later hospital admission rate of between 2% and 10% for patients who initially had a non-transport (1-4,13,25,31,32). Most of these studies had sample sizes less than 1,000 cases. These studies relied on chart reviews or patient interviews to determine the hospital outcomes of patients. This can result in instrument and/or recall bias, because charts may not contain all the data required to determine patient history and outcomes, and individuals being interviewed may not correctly remember past events. The use of these resource intensive methods can limit the number of cases reviewed. This may limit the strength of any conclusions because the conclusions would be generalizable only to the type of situations that occurred in those cases, and a small sample size may limit the power of the study to detect the effects of differences in the sample population.

2.3 Non-transport Issues

An important issue for EMS systems is the sensitivity to being overburdened with a high volume of patients complaining of low-acuity conditions (24,33-38). Studies had indicated that up to 40% of EMS transports are for minor clinical conditions that do not require advanced life support (ALS) where highly trained paramedics provide a broad range of treatment options beyond stabilization and transport (6,7,39-41). Studies have also

reported that EMS "misuse" or unintended use of various types was common in some communities and patient populations (35,36). For example, communities with limited access to family physicians frequently use EMS systems as a substitute and populations who are not required to pay for ambulance response or transport regularly see high rates of non-transport (36). In some EMS systems, there is an impression that inappropriate EMS calls consume the time and limited resources, potentially leading to higher acuity patients waiting longer to receive care. As rapid response times are critical for the most seriously ill or injured patients, these delays could result in increased morbidity and mortality. Few studies had examined this issue. In the context of the broader healthcare system, the increasing burden on EMS systems may be a symptom of changing demographics, problems at the acute and/or primary levels of care or as a result of a changing understanding of what constitutes an emergency. As healthcare systems across North America become increasingly strained, EMS systems often act as safety nets for patients who otherwise, would fall between the cracks (24,33-38).

One proposed solution to this issue is to provide the ability to EMS paramedics to identify persons who do not need emergency ground ambulance transport. The majority of EMS systems are designed to transport patients identified by 911 emergency medical requests via ground ambulance unless the patients or their authorized representatives refuse transport or agree it is unnecessary. In practice, as previously noted, these decisions can be influenced by paramedics or made jointly with them. In some EMS systems, paramedics alone or in consulting with online medical oversight physicians can refuse transport (10,11). This concept is referred to as EMS-initiated refusal of transport. Several studies had examined the relapse rate of patients who were refused transport by paramedics. One

study compared paramedic perceived need for transport with the patient's ED outcomes and reported that in 85 cases in which paramedics judged emergency transport was unnecessary, 32% of patients required emergency department care, 18% of patients were admitted, and 5% of admitted patients required intensive care (8). In a similar study, it was reported that EMS paramedics under-triaged as much as 10% of patients, chiefly due to incorrect use of triage guidelines (9). Other studies had assessed the outcomes of patients denied transport by paramedics in EMS systems that allow it. In one such study, more than half of all patients who contacted 911 were not transported, and the majority of the non-transports were paramedic-initiated. Approximately 12% of patients denied transport by EMS were ultimately admitted to a hospital (10). This study also found that the average age of patients who were denied transport was higher than that for those who refused to be transported (66 years and 50.6 years, respectively). A similar difference was also seen in the length of hospital stay at 6 days for those denied and 4.3 days for those who refused (10). There were a limited number of studies examining EMS-initiated refusal, and the evidence was conflicting. Studies to date do not yet sufficiently address safety and liability concerns that may arise with EMS-initiated refusal. The lack of widespread implementation of such EMS-initiated refusal of transport programs or protocols was likely due to concerns regarding potentially inadequate paramedic patient assessment and under-triage, which could result in poor clinical outcomes (6,8-11,42).

2.4 Non-transport Patient Characteristics

Not all patients who refuse transport are equal. Some patients fall into high-risk non-transport categories. These patients are more likely to have serious conditions that are

difficult to assess or could be slow developing and result in poor clinical outcomes if left untreated. Patients who would be considered as high risk for a non-transport response outcome based on a review of the literature and EMS system guidelines include: older adults, pediatric patients, patients under the influence of mind-altering substances, patients in law enforcement custody, patients suffering cardiac or respiratory complaints, patients with dementia or head injury and patients with abnormal vital signs.

For many reasons, patients who are at extremes of age may be at especially high-risk. Pediatric patients are often difficult to assess and seemingly common symptoms or presentations may mask signs of shock or serious illness (12,13,15,37,42,43). However, few studies had focused on this patient population in relation to non-transport. Several studies had focused on elderly patients who refuse transport (44-47). Patients who are 65 or older are more likely to call EMS back within two days of their first call for help and are more likely to die within one week of their original request for service (15). When EMS paramedics respond to a "lift-assist" call to put an elderly patient back into bed after a fall, the underlying reason for the patient's fall is often unknown. Symptoms of frailty, such as weakness, an inability to stand or bear weight, and confusion, as well as morbid obesity, may indicate that the patient has further unidentified clinical issues that should be addressed in an ED or primary care (45). Another reason for elderly patient non-transport might be that they are influenced by EMS paramedics or other caregivers to believe their emergency does not require transport. In one study, 20% of older patients who refused transport did so because they believed the EMS paramedics implied transport was unnecessary, and 50% said contact with a medical oversight physician in addition to the responding paramedics could have changed their mind (46). Importantly, as many as 70%

of patients 65 years of age or older who initially refuse transport require follow-up care, with 32% requiring hospital admission. Moreover, 39% of those admitted patients may need intensive care (44). It should be noted that the need for further medical care and/or admission to a hospital ED does not necessarily indicate that the patient is suffering an emergency which required transportation at the times of the non-transport or that the non-transport is high risk. A further reason why older patients refuse care might be financial, although most existing studies indicate this is the case only in a small percentage of cases (3,16). It cannot be fully discounted as a contributing factor. Elderly patients are often on a fixed income and the cost of transport may reinforce other reasons to refuse transport. To date, most studies that had examined such issues had been focused on a particular age group (adult or senior). Most of these studies were also conducted in urban EMS systems where access to healthcare is more readily available than in other community settings.

Another high-risk non-transport group is patients under the influence of mind-altering substances. It is often difficult to determine the acuity of someone under the influence (48). The mind-altering and anesthetic qualities of these substances mask symptoms, such as pain, neurological damage or abnormal vital signs, even if patients had serious injuries or illnesses. Patients in the care and custody of law enforcement or the justice system can also present challenges. If criminal activity was suspected, law enforcement may influence EMS paramedics to have a patient "medically cleared" for incarceration or further questioning (49). There are numerous poor clinical outcomes in which patients in police custody are assumed to be over-dramatizing symptoms. It is subsequently discovered that they suffered from conditions that were lethal when untreated, such as hypoglycemia or heart problems (50-53). These cases are generally well

reported in the media. However, few studies had adequately addressed this issue, and the prevalence of such cases is unknown.

Other high-risk non-transports are patients suffering cardiac or respiratory complaints, who are at particular risk for later hospital or intensive care unit admission after the refusal of transport (25,31,54). One review suggested that psychiatric complaints, dementia, abnormal pulse (<50 or >110 beats/min) or blood pressure (systolic blood pressure <90 or >200), head injury, and age older than 55 years are high-risk criteria for poor clinical outcomes and, therefore, should be considered for mandatory EMS transport guidelines (54). This study was a secondary analysis of a large sample to allow for analysis of many different EMS variables. The focus of the study was transported patients and characteristics associated with high-risk poor clinical outcomes. High-risk characteristics for transported patients may or may not indicate a similar level of risk for patients with non-transport response outcomes.

In contrast, some patients can be considered low-risk for a non-transport response outcome. Non-transport arises from a variety of situations, and the risk of missing hospital-based intervention in some situations may be minimal. For example, studies showed that some diabetic patients may be safely treated in the field within the right parameters (50-53). Other examples of potentially low-risk non-transport are when an established referral process for patients who refuse transport exists, either to primary care resources or specific programs such as falls assessment clinics (12,30,39-41,55,56). Examples of such programs are few, and there is limited evidence of their effectiveness or safety. Several studies had also noted that a significant number of non-transport involve motor vehicle accidents, where the 911 emergency medical call was made by a bystander, law enforcement, or other

first responder agency rather than the patient. In one study, 11.3% of patients who refused transport were deemed by the paramedic as having no medical need, and most of these occurred when someone else called 911 after a motor vehicle accident, which is referred to as third party EMS activation (25,31). Another study found that patients who were involved in a motor vehicle accident and refused EMS transport had minimal need for further evaluation (31).

2.5 Current Focus of Non-transport Research

Existing research regarding non-transport is focused on the risk or safety of the non-transport from the standpoint of paramedic triage, patient hospital related outcomes, and paramedic initiated non-transport (1-11). The majority of these studies have relied on hospital chart reviews or interviews with healthcare staff (2,3,12,13). A few have broadly examined both the patient, operational and environmental characteristics of non-transport patients and transported patients at the same time (14,15), or used EMS patient charts. Non-transport studies have primarily focused on the adult population and used convenience sampling over short time frames (several months), rather than a broad sample of an EMS population over an extended timeframe (14,15). Restricting the time frame of a study to only several months or weeks limits the generalizability of the study to that time; studies covering a full calendar year remove any seasonal variation. Most of the non-transport studies use data from municipally-based EMS system which serve individual communities with one or two hospitals. This limits the generalizability of those studies to similar EMS systems or community settings. A broader study setting would allow for an analysis of the

non-transport response outcomes across the full spectrum of community types and at the provincial/state level.

Chapter 3 – Research Objectives

The primary objectives of the study were to determine the prevalence of patients not transported to the emergency department (non-transport) in the province of Nova Scotia and to identify patient, operational and environmental characteristics associated with the non-transport. The secondary objectives were to determine the prevalence of potentially adverse non-transport and identify characteristics associated with potentially adverse non-transport. Potentially adverse non-transports were defined as EMS responses that were followed by relapse, a non-transported patient with a repeat call to the EMS system within 48 hours for a related complaint, and the response outcome for the relapse was either transport or death. Non-adverse non-transport outcomes were defined as EMS responses that did not lead to relapse or that led to relapse but the response outcome for the relapse was non-transport. Analyses for the secondary objectives provided a proxy for the risk associated with non-transport and the safety of the non-transport decision during the first patient interaction.

Non-transport response outcomes are a common but little studied phenomenon in the EMS setting, particularly across a province-wide EMS system with urban, suburban, rural and remote communities. This study used data on the entire EMS emergency patient population, both transported and non-transported patients, for an entire calendar year in Nova Scotia.

Chapter 4 - Methods

4.1 Study Setting and Study Population

This study was a secondary analysis of pooled cross-sectional, population-based administrative data of patients who had accessed the Emergency Health Services (EHS) Medical Communications Centre (MCC) for pre-hospital emergency care over a one-year period. The setting for this study was Nova Scotia. The EMS ground ambulance system serves a catchment area of 55,000 square kilometres and a population of approximately 920,000. The province contains a mix of urban, suburban, rural and remote island and coastal communities. The annual call volume is approximately 140,000 (2013-14), of which approximately 60% are emergency calls, and the remainder are transfer calls between healthcare facilities. These calls result in roughly 100,000 patient transports (2013-14) and 15,000 non-transports (56). A staffing mix of primary, intermediate, and advanced care paramedics work in the ground ambulance system with a single EMS agency providing both BLS care, supporting patients with life-threatening illness until they received care in a hospital, and ALS care, offering patients with further care, including advance circulation and airway management. In Nova Scotia, Online Medical Oversight Physicians (OLMOPs) provide retrospective, concurrent and prospective clinical medical oversight/leadership for the EMS system and provide clinical advice to paramedics 24/7 as defined by patient need in susbsets of patients seen. Clinical advice is also provided by a Clinical Support Desk (CSD) at the EMS MCC staffed by advance care paramedics or registered nurses. During the time frame of this study, a flat rate user fee of $146.55 was charged for emergency ambulance transports, while no fee was charged for non-transports. By policy, paramedics do not discuss the cost of ambulance transport with patients (56).

The target population for this study is Nova Scotians calling 911 for emergency medical assistance in any given year. The sample population is patients calling 911 in Nova Scotia for emergency medical assistance between January 1, 2014, and December 31, 2014. Multiple reasons were behind the choice of a population-based sample of all EMS calls in a one-year period. Including all EMS patients during the study period ensured that the sample is representative of pre-hospital patients in all of Nova Scotia in that year. A population-based sample assured that the study reviewed data from all emergency calls and analyzed cases with all acuities and from all communities of Nova Scotia (rural, urban, and suburban). The year-long study period avoided seasonal fluctuation of EMS volumes or other variation in EMS operations and provided a sufficient sample size to allow for sub-analyses of non-transport sub types.

4.2 Data source

The data for both objectives of this study was obtained from the Electronic Patient Care Record (ePCR), collected by paramedics during ambulance dispatch and routine patient care and charting. Service standards established by the Government of Nova Scotia require that paramedics document all EMS responses for which they had been dispatched, including transported and non-transported patients, through charting in an ePCR (55). The ePCR follows the patient interaction from the request for medical assistance through to the response outcome, either non-transport or transport and if transported, to the transfer of patient care to ED staff. The collection process for specific variables (e.g., patient disposition) is dependent on charting by individual paramedics, and as such is susceptible to human error. Each EMS response is assigned a unique identifier, the Medical Incident

Number (MIN), unique to the incident rather than the patient. The MIN is generated by the Computerized Aided Dispatch (CAD) system when each EMS call is initiated. The CAD records every call that comes into the EHS Medical Communication Centre, collecting information on the patient/ambulance location, patient status, dispatch determinant, and response and transport time stamps. Some data points in the ePCR, including incident locations and incident time stamps, such as paramedic arrival time at the emergency scene, are recorded in the CAD, and automatically inserted into the ePCR. Each completed ePCR is uploaded to a central server and stored in the EHS administrative database. All charting by paramedics is via a tablet-based ePCR, and all call data are automatically entered or recorded by the call takers into the CAD for all 911 calls in the province for emergency medical assistance. Data points such as time stamps, interventions, paramedic clinical impression, triage level, demographics, vital signs, etc., are electronically queryable on all ambulance calls (5,30).

For the secondary objectives, relapse was used to create a measure for potentially adverse non-transport. In the absence of access to hospital-based data, the study used repeat calls to EHS within 48 hours after the first call recorded in the ePCR database. Personal identifying information was required to conduct this search. This was done by EHS information technicians, and the personal identifiers were not in my possession. This method has been used in previous and ongoing studies (5,30). To ensure the proper identification of the relapse within the non-transport population for the secondary objectives, EHS used the MIN and patient identifiers to identify repeat calls within the ePCR database. The repeat call observations were captured in the study dataset, as it captured all EMS calls that occurred in the period. The repeat call MIN was matched with

those observations along with chief complaint of the original and repeat call to identify whether or not the repeat call was a case of relapse (repeat call within 48 hours for a similar clinical issue). The MIN was collected in the study data set to ensure proper identification of repeat calls and to verify and remove duplicate records. The MIN is linked to the incident, not the patient. It contains no personal health information; it is sequentially generated each day and could only be linked back to an individual patient, using other information held within the EMS databases not being accessed for this study. Both the CAD and ePCR databases are audited from a clinical and data quality perspective and were used in a number of studies in the past (5,30).

The inclusion criterion for this study was emergency calls to 911 for emergency medical assistance, for which a patient record was completed. Emergency medical calls included all emergency ("lights and sirens", known as Code 1) and urgent ("no lights and siren'', known as Code 2) ambulance calls within Nova Scotia. Exclusion criteria were air ambulance responses, Extended Care Paramedic Program responses (long term care facility focused responses without vehicles with transport capability), Collaborative Emergency Centre cases (overnight coverage in hospital EDs by paramedics), no patient found, obvious death (patient death with no assessment done), calls handed off to another agency, inter-facility transfers or other scheduled responses (e.g., return to residence from the hospital).

Data cleaning involved removal of duplicate cases. I also investigated unusual values, excluding cases within improbable values (i.e., biologically improbable vital signs or sex unknown), and examined likely reasons for missing values. I identified variables

with <10% missing data and removed observations with these variables. Appendix A explains data cleaning steps for the relapse data.

There were 148,502 EMS requests for service in Nova Scotia between January 1, 2014, and December 31, 2014. Cases were not included in the dataset based on the exclusion criterion (n=66,569) when queried. After I received the data I removed cases through the data cleaning process (n=3,849), and by removing cases with missing values for the variables used in the study (n=3,811), the sample size for this study was 74,293, (see Appendix B).

4.3 Variables

4.3.1 Dependent Variable for the Analysis of the Primary Objectives: Non-Transport

The dependent variable for the analysis of the primary objectives of this study was non-transport, which was constructed as a binary outcome: transported to a hospital or not. This dependent variable was based on eight possible response outcomes, which are utilized in the Nova Scotian EMS system and relevant to this study (Table 1 and Figure 1).

These non-transport response outcomes are based two Department of Health and Wellness policy based forms the patient signs in the ePCR indicating their decision not to be transported. The patient either signs a refusal of care form in cases where the paramedics believe the patient should be transported but the patient refuses, or a non-transport form in cases where the paramedics and patient are in agreement that the patient does not need to go to the hospital by ambulance (6). In this latter group it is defined by established treatment protocols such as the management of patients with hypoglycemia where they

present with symptomatic low blood sugars, and EHS provides an appropriate alternative non-ED disposition. Other examples include referral of the patient to local healthcare resources rather than transport to the ED (e.g. referring a senior who has fallen, found to be clinically stable, and referred to a local 'Falls Clinic'). In essence, the 'non-transport' form defines a patient group in which the patient is being assessed, treated and released with a structured treatment plan or disposition. For the 'refusal of care' form, no active treatment or structured dispositions have been provided to the patient.

Organized by the level of patient interaction, non-transport response outcomes would start with cases where the patient declines assessment and transport. These cases are usually those where the patient was not experiencing an emergency, such as a patient who fainted in a store and a passerby called 911. In these cases, an ePCR would be completed but the detail within it may be limited because without an assessment no clinical information would be collected beyond what the paramedic observed about the case. In cases where the patient was assessed by paramedics the non-transport response outcomes would include:

- transport not required, where patients are assessed by paramedics and the paramedics and the patient agree that transport is not required. These could include wellness checks, post fall assessments and other situations where there is no clear injury, the patients do not want to go to the hospital, and the paramedics agree there is little risk of them not being transported;
- transport by other means, where following assessment, the patient agrees they should go to a hospital but are not transported by ambulance, these would include patients with perceived minor injuries, pediatric patients where parents are willing

to transport and paramedics believe it is safe to do so, and potentially patients in custody; or

- refusal of treatment, where the patient feels they do not require treatment or transport following an assessment by paramedics, even if the paramedics feel they should be.

In non-transport cases where the patient is assessed and treated by paramedics, the case may be that the patient refuses transport, determining by themselves that the situation does not require transport to a hospital, or that the patient was assessed and treated according to a protocol which allows for the patient not to be transported, such as some hypoglycemic patients, with the patients informed agreement that they do not require transport. If the patient requested to be transported, regardless of the protocol, they would have been transported.

Among the transport response outcomes, the most common response outcome are cases where patients are assessed and treated by paramedics and transported to a hospital. The other common transport response outcomes are cases where patients are assessed, but refused a recommended intervention or treatment, such as a patient with neck pain following a motor vehicle accident, refused the treatment offered by paramedics to immobilize their neck, but consented to transport to a hospital.

4.3.2 Dependent Variable for the Analysis of the Secondary Objectives: Potentially Adverse Non-Transport

The dependent variable for the analysis of the secondary objectives of this study was the potentially adverse non-transport, defined as relapsed (within 48 hours) patients

subsequently transported by ground ambulance, air medical transport or were deceased based on the response outcome (see Table 2 and Figure 2).

This variable was constructed as a binary outcome, potentially adverse non-transport or not. This variable was used to indicate the safety of the non-transport decision for the first 911 call. A key aspect of this variable was the categorization of the patients regarding whether or not they had had a repeat EMS call for the same complaint within 48 hours (relapse). If a patient had a relapse and the response outcome was transport or the patient was deceased, the first non-transport would be considered potentially adverse. If the patient had a relapse and the response outcomes was non-transport once more, the first non-transport was considered non-adverse. If there was no relapse after a non-transport response outcome, it was considered non-adverse (with the limitation that the data in this study are unable to indicate whether the patient sought medical care beyond the EMS system).

4.3.3 Independent Variables

The independent variables included in the analyses were patient, operational and environmental characteristics. The independent variables for the primary and secondary objectives are outlined in Table 3. Several independent variables had considerable amounts of missing data (>10%). After examining the missing data, it is clear that in some cases the missing data is potentially missing due to incomplete charting, but in many cases the high volume of missing observations would be attributable to clinical and operational practice. For example, glucose measurements would only be taken if there was a clinical indication that they were required, or a second set of vital signs would generally only be

taken for high acuity or complex patients. This was addressed by identifying any variables that contained a substantial amount of missing data (>10%), and creating a category "missing" for those variables. If a variable had >40% missing data, the variable was removed from the final analysis, leaving the observations to reduce the risk of bias (see Appendix C). Several independent variables in this study were selected to explore related characteristics. If these variables were too highly correlated it could affect the analysis results. To test the correlation between related variables I used Pearson and Spearman correlations. Based on the correlation analysis results, I excluded the variables "clinical protocol" and "paramedic type" from this study.

Independent Variables for Primary Objectives

The study included variables previously found to have significant associations or noted confounders in the literature. Specifically, patient characteristics included in the analysis were: age, sex, chief complaint, paramedic-documented clinical impression, co-morbidities, and vital signs. It is important to note that 'paramedic documented clinical impression' cannot be extrapolated to a formal diagnosis, as this is outside the scope and role of the provider. Rather the paramedic clinical impression is to provide a sense of the scope of the emergency event that the paramedic is responding to. Operational characteristics included in the analysis were: paramedic level and response mode. Environmental characteristics included in the analysis were: day of call, month of call, time of day of 911 call, and location of call (incident location). For the logistic regression analysis, the number of categories in the variables, age, patient complaint, paramedic-documented clinical impression and location of call, were reduced by combining similar

categories and observations because of the sample size concern in some categories (Table 3). The study also examined the interaction between age and sex because previous studies suggested the relationship between age and relapse may differ by sex.

Independent Variables for Secondary Objectives

The study included variables previously found to have significant associations or noted confounders. Specifically, patient characteristics included in the analysis were: age, sex, chief complaint, paramedic-documented clinical impression, co-morbidities, and vital signs. Operational characteristics included in the analysis were: paramedic level and response mode. Environmental characteristics included in the analysis were: day of call, month of call, time of day of 911 call, and location of call (incident location). For the logistic regression analysis, the number of categories in the variables, age, patient complaint, paramedic-documented clinical impression and location of call, were reduced by combining similar categories and observations because of the sample size concern in some categories (Table 3). The study also examined the interaction between age and sex because previous studies suggested the relationship between age and relapse may differ by sex.

4.4 Analysis

Descriptive analysis

The study described the distribution of each variable and the distribution of each variable by non-transport and potentially adverse non-transport. I conducted a descriptive

analysis to understand how the cleaned sample used for the analyses was different from the intended sample that included observations with missing data (>10%) in any variable (see Appendix D).

Analyses for Primary Objectives

Analysis to determine the prevalence of patients not transported to the emergency department (non-transport) in the province of Nova Scotia

I calculated the prevalence of non-transport as the number of non-transports divided by the number of total 911 calls in Nova Scotia, overall and by the patient, operational and environmental characteristics. I examined whether these characteristics differ between transported and non-transported patients using chi-square test.

Analysis to identify patient, operational and environmental characteristics associated with the non-transport

Using logistic regression, I identified variables associated with the non-transport (Table 6). I ran unadjusted models for each variable. I then ran a series of multiple logistic regression models for non-transport to adjust for the patient, operational and environmental characteristics and interaction terms. For model selection, I first ran adjusted models for the patient, operational and environmental characteristics as separate groups, and determined the best fit model for each group by adding the variables to the adjusted models one at a time (i.e., forward selection; see Appendix E for a summary of the models'

progression). I then combined the best-fit patient, operational, and environmental models in one model and kept variables and any interaction terms that remained statistically significant and from those selected a combination of variables that fit the data well according to Hosmer-Lemeshow goodness-of-fit test to find the most parsimonious model.

Analyses for Secondary Objectives

Analysis to determine the prevalence of potentially adverse non-transport

I calculated the prevalence of potentially adverse non-transports as the number of relapsed non-transport cases which were subsequently transported or deceased, divided by the number of total non-transports, overall and by the patient, operational and environmental characteristics. I examined whether these characteristics differ between transported and non-transported patients using chi-square test.

Analysis to identify patient, operational and environmental characteristics associated with potentially adverse non-transport

Using logistic regression, I identified variables associated with the potentially adverse non-transport (Table 10). I ran unadjusted models for each variable. I then ran a series of multiple logistic regression models for potentially adverse non-transport to adjust for the patient, operational and environmental characteristics and interaction terms. For model selection, I first ran adjusted models for the patient, operational and environmental characteristics as separate groups, and determined the best fit model for each group by

adding the variables to the adjusted models one at a time (i.e., forward selection; see Appendix F for a summary of the models' progression). I then combined the best-fit patient, operational, and environmental models in one model and kept variables and any interaction terms that remained statistically significant and from those selected a combination of variables that fit the data well according to Hosmer-Lemeshow goodness-of-fit test to find the most parsimonious model.

For all analyses, I considered $p<0.001$ as statistically significant given the large sample size using Stata 10.

TABLE 1. DEPENDENT VARIABLE FOR THE ANALYSIS OF THE PRIMARY OBJECTIVES: NON-TRANSPORT

Non-Transport	
	Assessment Refused
Assessed	
	Transport Not Required
	Transported by Other Means
	Treatment refused
Treated	
	Transport Refused
	Transport Not Required
Transport	
	Refused Treatment
	Treated

FIGURE 1. DEPENDENT VARIABLE FOR ANALYSIS OF THE PRIMARY OBJECTIVES: NON-TRANSPORT
January 1, 2014 - December 31, 2014

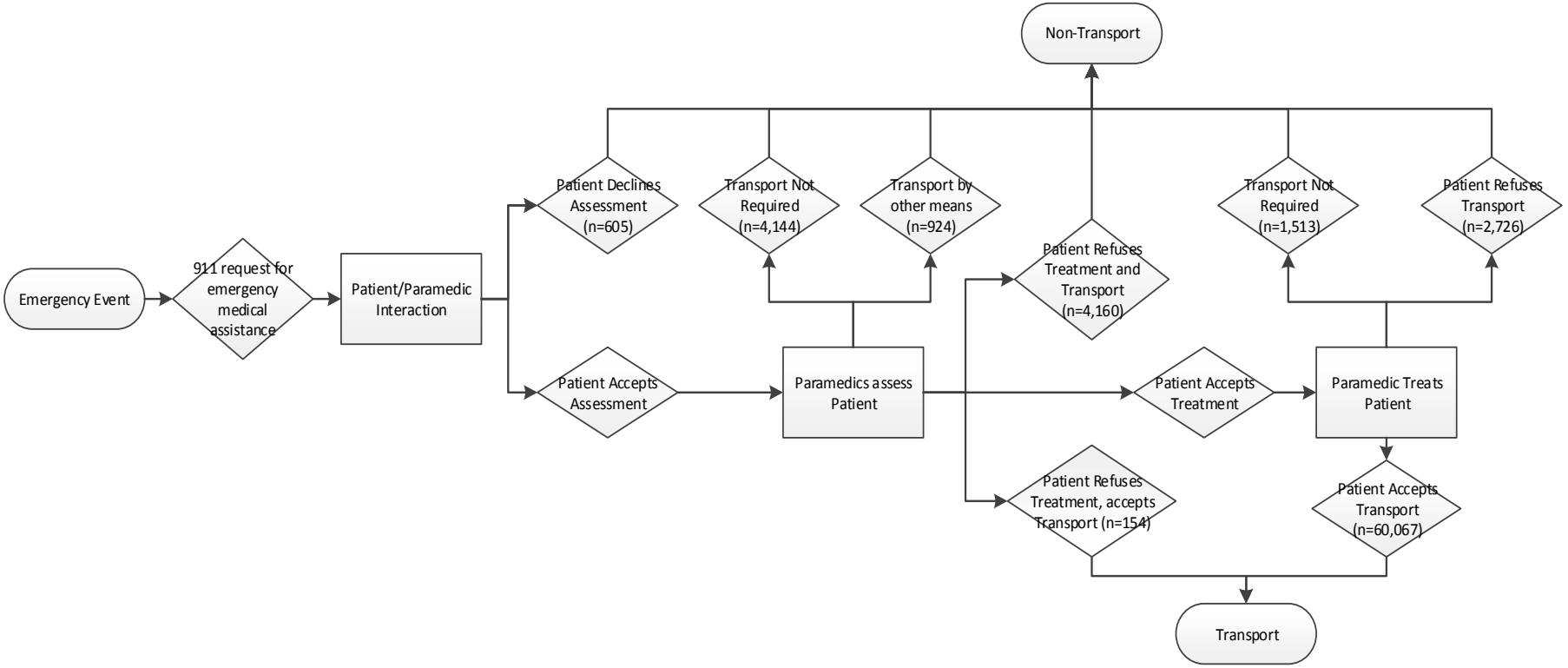

TABLE 2. DEPENDENT VARIABLE FOR THE ANALYSIS OF THE SECONDARY OBJECTIVES: POTENTIALLY ADVERSE NON-TRANSPORT

Potentially Adverse Non-Transport Status
Potentially Adverse Non-Transport
Relapse, with Transport Response Outcome
Relapse, Patient deceased
Non-Adverse Non-Transport
No Relapse
Relapse, with Non-Transport Response Outcome

FIGURE 2. DEPENDENT VARIABLE FOR ANALYSIS OF THE SECONDARY OBJECTIVES: POTENTIALLY ADVERSE NON-TRANSPORT January 1, 2014 - December 31, 2014

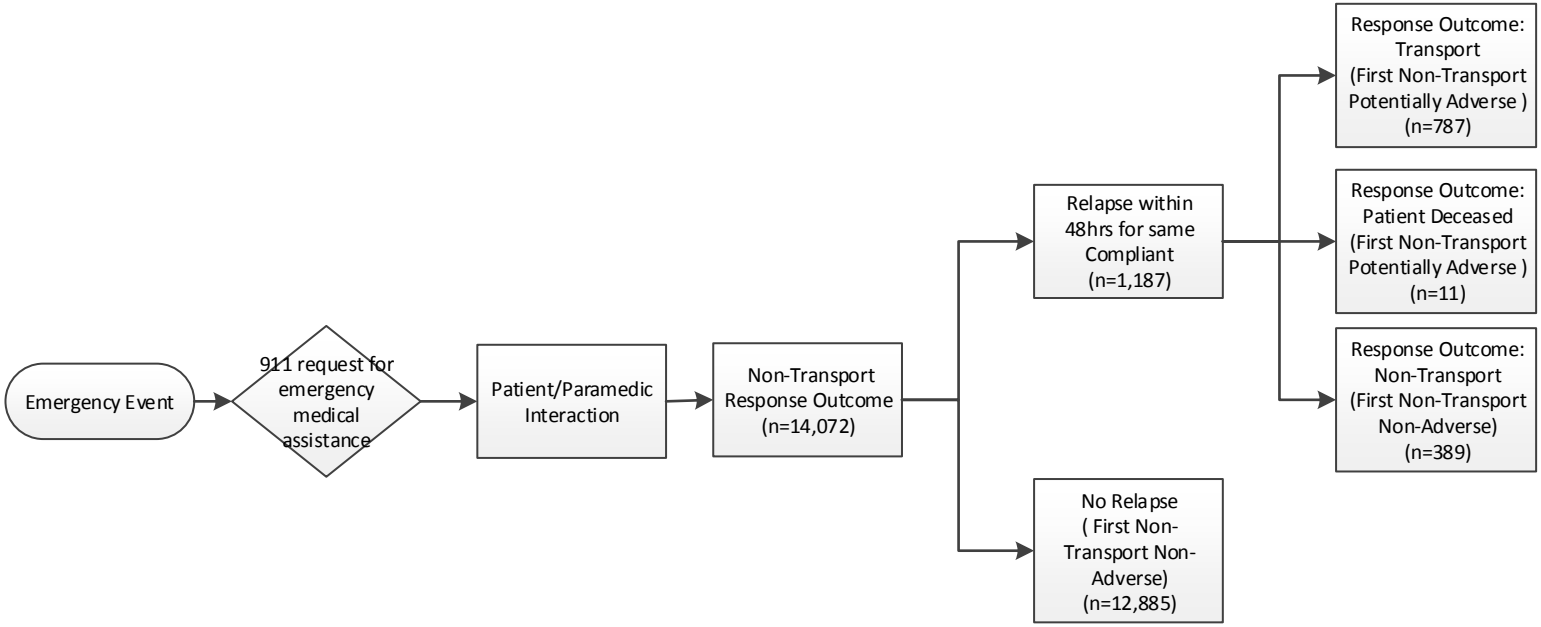

TABLE 3. INDEPENDENT VARIABLES TABLE

Information for the following variables will be abstracted for each EMS patient interaction included in the study and used for the analysis of non-transport with these variables and potentially adverse non-transports with these variables.			
Variable	**Description**	**Rationale for using**	**References**
Patient Characteristics			
Age	Patient age at time of call: • Child (0-5 y.o.) • Adolescent (6 -15 y.o.) • Teen (16-20 y.o.) • Young Adult (21–35 y.o.) • Adult (36-50 y.o.) • Middle Age Adult (51-65 y.o.) • Old (66–75 y.o.) • Old old (76-85 y.o.) • Oldest old (85+ y.o.) Categories for Primary Analyses: • Child (0-15 y.o.) • Young Adult (16–35 y.o.) • Adult (36-50 y.o.) • Middle Age Adult (51-65 y.o.) • Old (66–85 y.o.) • Oldest old (85+ y.o.) Categories for Secondary Analyses: • Child/Young Adult (0-35 y.o.) • Adult (36-65 y.o.) • Old (66+ y.o.)	Several studies have examined age in relation to non-transport and indicated that there is an impact, but these studies have focused on one age group, pediatric or senior. Operational evidence also supports its inclusion in the study, as non-transport trends depending on age group. Age will be used to describe the differences in the dependent variables and whether age has any impact on non-transport or potentially adverse non-transports.	3,5,9,14,21,28,38,39,40-43
Sex	Patient Sex • Male • Female	No studies or operational evidence has indicated that sex has a significant association with non-transport. It will be included in this study as a variable which is	

		commonly included in studies as a potentially associated or confounding variable. Sex will be used to describe the differences in the dependent variables based on sex and whether sex has any impact on non-transport or potentially adverse non-transports.	
Patient Chief Complaint	Categories for Primary Analyses: • Cardiovascular • Gastrointestinal • Diabetic Problem • Neuro • Respiratory • Overdose / Poisoning • Trauma • Wellness check • Other • Non-specific • Pain • Psychological Categories for Secondary Analyses: • Specific • Wellness check • Other • Non-specific	Studies have indicated that the clinical issue that prompted the call to 911 for emergency medical assistance are associated with non-transport. This is also supported by operational evidence which indicates that particular clinical issues are more likely to be non-transported, or should be considered potentially adverse non-transports. The clinical issue will be determined through two measures, the chief complaint assigned by the medical dispatch system and the clinical impression as determined by the responding paramedics. Patient Complaint and Paramedic documented clinical impression will be used to describe differences in the dependent variables based on clinical issue and whether the clinical	1-4,15,22,50
Paramedic Clinical Impression	Paramedic clinical impression of patient condition • Cardiac Arrest • Cardiovascular • Chest Pain • EENT • Environmental		

	• Gastrointestinal • Glycemic • Neuro • OB/GYN • Non-specific • Palliative or End-of-Life Care • Pediatric • Psychological • Respiratory • Shock/Sepsis • Skin • Substance Misuse / Intoxication • Toxicology • Trauma • Wellness/Med Check Categories for Primary Analyses: • Cardiovascular • Gastrointestinal • Glycemic • Neuro • Respiratory • Toxicology • Trauma • Wellness/Med Check • Other • Non-specific Categories for Secondary Analyses: • Specific • Wellness check • Other • Non-specific	issue has any impact on non-transport or potentially adverse non-transports.	
Canadian Triage and Acuity Scale (CTAS)	Acuity level of patient condition, using a standardized scale. First documented CTAS by paramedics: • 1(Resuscitation)	There is limited evidence from studies that the severity of the patient's condition as determined by the first documented triaging of the patient by	1-4

	• 2 (Emergency) • 3 (Urgent) • 4 or 5 (Less Urgent)	the responding paramedics has an impact on non-transport, but operational evidence supports the idea that the clinical severity does have an impact. Operationally, it would be highly unlikely for a patient triaged as a 1 or 2 would not be transported. This variable will be used to describe differences in the dependent variables based on clinical severity and whether clinical severity has any impact on non-transport or potentially adverse non-transports.	
Co-morbidities	Count of co-morbidities • 0 to 2 • 3 or 4 • 5 or 6 • >7	There is some weak evidence from studies that not transporting patients with multiple co-morbidities could result in potentially adverse outcomes. The count of co-morbidities will be used to describe the severity of the patient's condition based on the number of potentially complicating co-morbidities. Operationally, patients with multiple co-morbidities are inherently complicated and difficult to diagnosis. This will allow me to describe differences in the dependent variables	15,22,50

		based on the number of co-morbidities and whether the number of co-morbidities has any impact on non-transport or potentially adverse non-transports.	
Blood Pressure	Blood Pressure of patient, at first, measure/last measure • <120 or >140 • >120 or <140 • <80 or >90 • >80 or <90	Several studies and EMS clinical protocols indicate that not transporting patients with abnormal vital signs could result in potentially adverse outcomes. Vital signs collected by paramedics will be used to describe patient's condition based on common vital signs, and whether they were in or out of the normal range at the first and last measure. These will allow me to describe differences in the dependent variables based on the normality of vital signs and when they were taken and whether the vital signs have any impact on non-transport or potentially adverse non-transports.	6,15,22,50
Heart Rate	Heart Rate of patient at first measure/last measure • <50 or >110 beats/min • >50 or <110 beats/min		
Respiratory Rate	Respiratory Rate of patient at first measure/last measure • <12 or >20 breaths/minute • >12 or <20 breaths/minute		
Temperature	Temperature of patient at first measure/last measure • <36 to >39 °C • >35.9 to <39.1 °C		
GLC	Blood Pressure of patient, at first, measure/last measure • <4.4 to >6.1 mmol/L • >4.4 to <6.1 mmol/L		
O2 Saturation	O2 Saturation of patient, at first, measure/last measure • <90% • >90%		
Clinical Protocol	Clinical Protocol selected by paramedics to treat patient: Drop down selection	There is limited evidence from studies that the number of interventions used or the clinical	6,15,22,50

Interventions	Count of interventions • 0 • 1-2 • 3-4 • 5-6 • >6	protocol applied has an impact on non-transport. Operationally some protocols would recommend transport or in a few cases non-transport, complex protocols or multiple interventions would also point to complicated patients who it would be potentially adverse to not transport. Clinical protocol and the count of interventions will be used to describe the care provided to patients based on the clinical protocols selected by the responding paramedics and the number of interventions administered. This will allow the study to describe differences in the dependent variables based on the care provided and whether the care provided had any impact on non-transport or potentially adverse non-transports.	
Operational Characteristics			
Paramedic level	Paramedic Crew Type: • Advance Life Support • Basic Life Support	There is limited evidence from studies that the level of care available has an impact on non-transport. Operationally, the level of care may allow for assessment and treatment which would deescalate an emergency situation.	1-4

		Paramedic level will be used to describe the level of care assigned/available to the patient based on the type of paramedic crew which responded. This will allow me to describe differences in the dependent variables based on the level of care and whether the level of care had any impact on non-transport or potentially adverse non-transports.	
Duration of patient contact	Time at scene for paramedics from arrival to depart: • 0 to 20 Minutes • 21 to 40 Minutes • 41 to 60 Minutes • Greater than 60 Minutes • Missing	There is no clear evidence that the time on scene has an impact on non-transport, but it is a measure of the level of care provided and the complexity of the situation. The duration of patient contact will be used to describe the level of response assigned to the patient call. This will allow me to describe differences in the dependent variables based on the duration of patient contact and whether the duration of patient contact had any impact on non-transport or potentially adverse non-transports.	
Response Mode	• Code 1 (lights & siren) • Code 2 (no lights & siren) • Not Indicated	There is no clear evidence that the response mode assigned to the call has an impact on non-transport, but it is	

		related to patient severity. The response mode will be used to describe the level of response assigned to the patient call. This will allow me to describe differences in the dependent variables based on the level of response and whether the level of response had any impact on non-transport or potentially adverse non-transports.	
OLMOP Contact	OLMOP contact choices: • Yes • No • Missing	One study specifically examined the impact of OLMOP contact on non-transport and indicated that it increased the rate of transport. In the Nova Scotia context, the CSD provides another operational layer (requirement to contact either is laid out in policy). OLMOP contact will be used to describe whether or not a call was placed to OLMOP or CSD or both. This will allow me to describe differences in the dependent variables based on the level of response and whether the level of response had any impact on non-transport or potentially adverse non-transports.	11-13
Environmental Characteristics			
Day of call	Day of the week		51,54

Month of call	Month	There is little evidence in studies on whether temporal variables have an impact on non-transport specifically, but there is evidence that it does impact the operation of EMS systems. Operationally the time, day, date and month have a significant impact on the number of EMS responses. These variables will be used to describe when the 911 call for emergency medical assistance was received. These will allow me to describe differences in the dependent variables based on when the call was received, by date, day, month, season and time, and whether when the call was received had any impact on non-transport or potentially adverse non-transports.	
Time of day of 911 call received	Time of day emergency call is received in MCC: • Early Morning (0-4) • Morning (5-8) • Late Morning (9-12) • Afternoon (13-16) • Night (17-20) • Late Night (21-24)		
Incident location	Type of location incident • Airport/Strip • Hospital • Industrial • Jail/ Detention Facility • Lake, River, Ocean • Medical Clinic • Nursing Home • Other... • Recreation / Sport Facility • Residence / Home • School	Several studies indicate that the type of incident location is associated with non-transport, particularly public locations. Operationally there is evidence that some community types and locations are more likely to have non-transport response outcomes. These variables will be used to	1-4,15,22,45-49

	• Senior Center • Street / Highway • Woods / Wilderness Categories for Primary Analyses: • Healthcare Facility • Jail/ Detention Facility • Nursing Home/Senior Centre • Other • Residence / Home • Street / Highway Categories for Secondary Analyses: • Public Facility • Other • Residence / Home	describe the location of the 911 call incident/scene and the rurality of the location. This will allow me to describe differences in the dependent variables based on incident location and whether the incident location has any impact on non-transport or potentially adverse non-transports.	

Chapter 5 – Results

5.1 Descriptive Statistics by Non-Transport

Of the 74,293 EMS emergency responses between January 1, 2014, to December 31, 2014, a total of 14,072 (18.9%) EMS emergency responses resulted in a non-transport response outcome and 60,221 (81.1%) patients were transported to a hospital by EMS. Table 4 reports the number of cases and percentage for each EMS response outcome, which make up the dependent variable for analysis to meet the primary objectives. Table 5.1 reports the descriptive statistics for the 74,293 observations in the final sample comparing between non-transport and transport response outcomes.

The results of the descriptive analysis for the primary objectives confirmed the expected difference in response outcomes by patient age as reported in previous studies. As expected from prior studies and paramedic practice, non-transport was more likely for lower acuity conditions and was more common in situations where the patient was in detention or on a street or highway. An unexpected key finding was the lack of difference in response outcomes by reported vital signs.

In terms of patient characteristics, non-transported and transported patients differed by age, chief complaint, paramedic clinical impression and interventions, but did not differ by sex, vital signs, or co-morbidities. Of note, non-transported patients tended to be younger than transported patients, 3.4% (n=505) of child patients 0-5 years old had a non-transport response outcome versus 1.5%, (n=920) transported. This was similar for adolescent patients 6-15 years old (4.1%; n=574 vs. 2.3%; n=1373) and teen patients 16-20 years old (6.2%; n=875 vs. 4.2%; n=2506). Among the EMS responses resulting in a non-transport, the most common paramedic clinical impression were for lower acuity

clinical issues, non-specific (38.7%; n=5,452), wellness check (19.2%; n=2,699), psychological (5%; n=712), and glycemic (4.5%, n=635). In terms of operation characteristics, non-transported and transported patients did not differ by paramedic crew type or response mode. In terms of environmental characteristics, non-transported and transported patients differed by incident location type, but did not differ by day, month, or time of call. Of interest, compared to EMS response with a transport response outcome, a greater proportion of responses with non-transport response outcomes was in a jail/detention facility (3.1%, n=434 vs. 0.8%, n=479), or on a street/highway (5.4%, n=763 vs. 2.4%, n=1432).

Table 5.2 reports the descriptive statistics for the 74,293 observations in the study population with the categories for the identified variables aggregated for the analysis due to the low number of observations in several of the categories used in the descriptive analysis.

5.2 Patient, Operational and Environmental Characteristics Associations with Non-transport

The results of the unadjusted and adjusted logistic regression analyses for the primary objectives further confirmed the expected difference in response outcomes by patient age, that non-transport response outcomes were more likely for lower acuity or psychological conditions and incident location type was jail/detention or on a street or highway, and that non-transport response outcomes were less likely for patients with multiple co-morbidities. Key unexpected findings were the limited association of non-transport with the time of call and vital signs. Overall the results were as expected based

on previous studies and anecdotal observations that are rarely confirmed with empirical data.

Unadjusted analysis showed that non-transport was statistically significantly associated with all patient, operational and environmental characteristics, except for sex, paramedic crew type, and day of call ($p<0.001$) (Table 6). Of interest, the results indicated that child patients 0-15 years old were potentially more likely to have non-transport response outcome than middle age adults 51-65 years old (odds ratio [OR]: 2.2; 99.9% confidence interval [CI]: 1.9 - 2.5). Relative to trauma-related paramedic clinical impressions, glycemic issues (OR: 4.8; 99.9% CI: 3.9 - 5.7) and wellness checks (OR: 6.5; 99.9% CI: 5.7 - 7.3) appeared to be more likely to have a non-transport response outcome, potentially supporting the assertion in other studies. As expected, the greater the number of co-morbidity was, less likely the patients to have a non-transport response outcome (for example, relative to patients with 0-2 co-morbidities, patients with >7 co-morbidities had OR 0.37; 99.9% CI 0.34 - 0.42). Of interest, non-transport was more likely at a jail or detention facility (OR: 4.1; 99.9% CI: 3.2 - 5.1) or a street or highway location (OR: 2.4; 99.9% CI: 2.1 - 2.8) compared to a patient residence or home, which is as expected.

5.3 Final Logistic Regression Model for Non-Transport

The most parsimonious adjusted model indicates that the statistically significant patient, operational and environmental characteristics associated with non-transport were age, paramedic impressions, co-morbidities count, response mode, and incident location type (Table 6). The age-sex interaction term was not statistically significant and was excluded from the final model. After adjustment, I found that the younger the patient was

the greater the likelihood of non-transport. Child patients 0-15 years old were 1.7 times more likely to have non-transport response outcome (99.9% CI: 1.5 - 2.0) relative to middle-aged adults, slightly less than unadjusted, but greater than the likelihood for old and oldest old patients. Compared to middle age adults 51-65 years old the likelihood of oldest old patients 85 years old or more (OR: 0.8; 99.9% CI: 0.7 - 0.9) to have a non-transport was less. This confirms findings of previous descriptive studies, but the strength of the positive association with child patients was surprising and greater than expected. Relative to trauma paramedic clinical impressions, both those with glycemic issues (OR: 6.7; 99.9% CI: 5.5 - 8.2) and those with wellness checks (OR: 8.6; 99.9% CI: 7.5 - 9.8) remained statistically significant, after adjustment, and were more likely to have a non-transport. This result supports the findings of other studies, based on hospital data, that non-transport response outcomes were more likely for low acuity clinical conditions or less urgent responses. Of interest, with the adjusted model psychological paramedic clinical impressions were 3.7 times more likely to have non-transport response outcomes than trauma cases (99.9% CI: 2.9 - 4.7). The effects of co-morbidities, the greater the number of co-morbidity was, less likely the patients to have a non-transport response outcome, remained statistically significant after adjustment (for example, relative to patients with 0-2 co-morbidities, patients with >7 co-morbidities had OR: 0.47; 99.9% CI: 0.42 - 0.53). Non-transport remained more likely during responses to jail or detention facility (OR: 2.9; 99.9% CI: 2.2 - 3.7) or a street or highway (OR: 1.8; 99.9% CI: 1.5 - 2.1) relative to a patient residence or home after adjustment. The coefficients in the adjusted models were smaller than unadjusted coefficients.

The Hosmer-Lemeshow goodness of fit test for the final model fit indicated the final model fit the data well ($p = 0.0243$).

5.4 Descriptive Statistics by Potentially Adverse Non-Transport

Of the 14,072 (18.9%) EMS responses that resulted in a non-transport, a total of 1,187 (8.4%) patients with a non-transport relapsed to the EMS system within 48 hours of their initial EMS call for the same or similar clinical issue. Of all non-transports, 798 (5.6%) relapsed and were subsequently transported or deceased, indicating that the original non-transport was a potentially adverse non-transport. Table 7 reports the number of cases and percentage for each non-transport that made up the dependent variable. Table 8.1 reports the descriptive statistics for the 14,072 non-transport observations in the study population compared between potentially adverse non-transport and non-adverse non-transport.

The results of the descriptive analysis for the secondary objectives had several unexpected findings including the difference between potentially adverse non-transport and non-adverse non-transport by patient age and number of co-morbidities. Also, a significant proportion of potential adverse non-transports were for specific clinical conditions.

In terms of patient characteristics, potentially adverse non-transport and non-adverse non-transport patients differed by age, sex, chief complaint, paramedic clinical impression and co-morbidities, but did not differ by vital signs, or interventions. Of note, patients with a potentially adverse non-transported response outcome were more often

women (59.7%; n=477) than men (40.2%, n=321). A higher proportion of EMS patients 66 years old and older had a potentially adverse non-transport response outcome compared to non-adverse (64.9%, n=518 vs. 40.9%, n=5,762). For potentially adverse non-transport response outcomes, the number of potentially adverse non-transports with paramedic clinical impression for specific clinical conditions was surprising, because they would be the conditions most likely to require transport, respiratory (9.7%; n=77), trauma (6.1%; n=49), gastrointestinal (5.9%, n=47). Potentially adverse non-transport response outcomes had greater proportions of higher numbers of co-morbidities, three or four co-morbidities 30.3% (n=242) verses 20.7% (n=2742) for non-adverse non-transport. In terms of operational characteristics, non-transported and transported patients did not differ by paramedic crew type or response mode. In terms of environmental characteristics, potentially adverse non-transport and non-adverse patients did not differ by day, month, or time of call or incident location type. Table 8.2 presents the descriptive statistics for the 14,072 observations in the potentially adverse non-transport population with the categories for the identified variables aggregated for the analysis due to the low number of observations in several of the original categories.

5.5 Patient, Operational and Environmental Characteristics Associations with Potentially Adverse Non-transport

The results of the unadjusted and adjusted logistic regression analyses for the secondary objectives highlighted the high likelihood of potential adverse non-transport for patients 66 years or older relative to adult patients 36 to 65 years old and patients with greater than two co-morbidities.

Unadjusted analysis showed that potentially adverse non-transport response outcome was statistically significantly associated with patient age, sex, chief complaint, paramedic clinical impression, the number of co-morbidities, heart rate, and incident location type ($p<0.001$) (Table 9). Of interest, the results indicated that older adults 66+ years old had a higher likelihood of potentially adverse non-transport (OR: 1.9; 99.9% CI: 1.1 - 2.5) compared to adult patients 36-65 years old, the likelihood for young patients 0-35 years old was less (OR: 0.6; 99.9% CI: 0.4 - 0.8). Non-specific paramedic clinical impressions had a lesser likelihood of potentially adverse non-transport (OR: 0.6; 99.9% CI: 0.4 - 0.8) compared to wellness checks. Of interest, the results indicate that the greater the number of co-morbidities was the higher the likelihood of a potentially adverse non-transport was. For example, non-transported cases with 7 or more co-morbidities were 3.9 times more likely to have potentially adverse non-transport outcomes (99.9% CI: 2.7 - 5.4) compared to non-transported cases with 0-2 co-morbidities. The incident location type, other, was less likely to have a potentially adverse non-transport compared to a patient residence or home (OR: 0.5; 99.9% CI: 0.4 - 0.7). The category other includes street/highway locations, remote locations, industrial, and sport/recreational facilities.

5.6 Final Logistic Regression Model for Potentially Adverse Non-Transport

The most parsimonious adjusted model indicates that the statistically significant patient, operational and environmental characteristics associated with potentially adverse non-transport were age, paramedic clinical impression, co-morbidities and incident location type (Table 9). The age-sex interaction term was not statically significant and was excluded from the final model. After adjustment, I found that the older the patient is the

higher likelihood of potentially adverse non-transport. Older adults 66 or older were 1.5 times more likely to have a potentially adverse non-transport (99.9% CI: 1.1 - 2.1) compared to adult patients 36-65 years old, and the likelihood for young patients 0-35 years old was less. Non-specific paramedic clinical impressions remained statistically significant, with a lower likelihood of potentially adverse non-transport (OR: 0.6; 99.9% CI: 0.4 - 0.8) compared to wellness checks. The greater the number of co-morbidities was, the greater the likelihood of potentially adverse non-transport outcomes was. Compared to non-transported cases with 0-2 co-morbidities, for example, non-transported cases with 7 or more co-morbidities remained more likely to have potentially adverse non-transport outcomes (OR: 2.4; 99.9% CI: 1.6 - 3.5) after adjustment. Non-transport cases with the incident location type, other, remained statistically significant and were less likely to have potentially adverse non-transport compared to a patient residence or home (OR: 0.7; 99.9% CI: 0.5 - 0.9).

The Hosmer-Lemeshow goodness of fit test for the final model fit indicated the final model fit the data well ($p = 0.9959$).

TABLE 4. RESPONSE OUTCOMES SUB TYPE VOLUMES
January 1, 2014 - December 31, 2014 (n=74,293)

	N (%)
Total	74293 (100)
Non-Transport	**14072 (18.9)**
Assessment Refused	605 (0.81)
Assessed	*13467*
Transport Not Required	4144 (5.58)
Transported by Other Means	924 (1.24)
Treatment refused	4160 (5.6)
Treated	*4239*
Transport Refused	2726 (3.67)
Transport Not Required	1513 (2.04)
Transport	**60221 (81.1)**
Refused Treatment	154 (0.21)
Treated	60067 (80.85)

TABLE 5.1. CHARACTERISTICS OF STUDY POPULATION BY NON-TRANSPORT STATUS January 1, 2014 - December 31, 2014 (n=74,293)

	Total	Non-Transport	Transport	
	N (%)	N (%)	N (%)	p-value*
Total	74,293 (100)	14,072 (18.9)	60,221 (81.1)	
Patient Characteristics				
Age (years)				<0.0001
Child (0-5 y.o.)	1425 (1.92)	505 (3.59)	920 (1.53)	
Adolescent (6 -15 y.o.)	1947 (2.62)	574 (4.08)	1373 (2.28)	
Teen (16-20 y.o.)	3381 (4.55)	875 (6.22)	2506 (4.16)	
Young Adult (21–35 y.o.)	7998 (10.77)	2035 (14.46)	5963 (9.9)	
Adult (36-50 y.o.)	8836 (11.89)	1726 (12.27)	7110 (11.81)	
Middle Age Adult (51-65 y.o.)	14533 (19.56)	2595 (18.44)	11938 (19.82)	
Old (66–75 y.o.)	11668 (15.71)	2138 (15.19)	9530 (15.83)	
Old old (76-85 y.o.)	12233 (16.47)	1944 (13.81)	10289 (17.09)	
Oldest old (85+ y.o.)	12272 (16.52)	1680 (11.94)	10592 (17.59)	
Sex				0.02
Female	40075 (53.94)	7467 (53.06)	32608 (54.15)	
Male	34218 (46.06)	6605 (46.94)	27613 (45.85)	
Patient Complaint				<0.0001
Abdominal Pain / Flank Pain	5212 (7.02)	269 (1.91)	4943 (8.21)	
Acute Coronary Syndrome	228 (0.31)	6 (0.04)	222 (0.37)	
Allergic Reaction	533 (0.72)	99 (0.7)	434 (0.72)	
Altered Mental Status	2096 (2.82)	97 (0.69)	1999 (3.32)	
Arrhythmia	421 (0.57)	27 (0.19)	394 (0.65)	
Assault	380 (0.51)	119 (0.85)	261 (0.43)	
Back Pain - Non Traumatic	624 (0.84)	57 (0.41)	567 (0.94)	
Barotrauma	4 (0.01)	0 (0)	4 (0.01)	
Burns	118 (0.16)	26 (0.18)	92 (0.15)	
Cardiac Arrest	290 (0.39)	10 (0.07)	280 (0.46)	
CBRN / Hazmat	15 (0.02)	6 (0.04)	9 (0.01)	
Chest Pain (NYD)	4945 (6.66)	393 (2.79)	4552 (7.56)	
Childbirth / Post Partum Care	77 (0.1)	2 (0.01)	75 (0.12)	
Diabetic Problem	1157 (1.56)	571 (4.06)	586 (0.97)	
Electrocution	6 (0.01)	2 (0.01)	4 (0.01)	
End of Life Care	48 (0.06)	6 (0.04)	42 (0.07)	
Environmental (Heat Cold)	85 (0.11)	17 (0.12)	68 (0.11)	
Epistaxis	351 (0.47)	73 (0.52)	278 (0.46)	
Foreign Body Obstruction (Partial / Complete)	134 (0.18)	58 (0.41)	76 (0.13)	
General Malaise	4507 (6.07)	438 (3.11)	4069 (6.76)	
GI Bleed	486 (0.65)	5 (0.04)	481 (0.8)	
Head / Neuro Injury	613 (0.83)	61 (0.43)	552 (0.92)	

Headache	870 (1.17)	115 (0.82)	755 (1.25)	
Major Trauma	681 (0.92)	14 (0.1)	667 (1.11)	
Medical Device Complication	167 (0.22)	23 (0.16)	144 (0.24)	
Minor Trauma	8670 (11.67)	1576 (11.2)	7094 (11.78)	
Nausea / Vomiting	2279 (3.07)	209 (1.49)	2070 (3.44)	
Near Drowning	9 (0.01)	0 (0)	9 (0.01)	
Neonatal Care / Resuscitation	11 (0.01)	3 (0.02)	8 (0.01)	
No Apparent Illness / Injury	2125 (2.86)	1781 (12.66)	344 (0.57)	
Obvious Death	3 (0)	2 (0.01)	1 (0)	
Other	5222 (7.03)	1081 (7.68)	4141 (6.88)	
Overdose / Poisoning	1921 (2.59)	108 (0.77)	1813 (3.01)	
Perinatal Mother Care	70 (0.09)	1 (0.01)	69 (0.11)	
Post Fall Assessment	4350 (5.86)	1798 (12.78)	2552 (4.24)	
Pre-Eclampsia / Eclampsia	3 (0)	1 (0.01)	2 (0)	
Psychological Problem	2453 (3.3)	329 (2.34)	2124 (3.53)	
Pulmonary Edema (CHF)	151 (0.2)	2 (0.01)	149 (0.25)	
PV Bleed / Threatened Abortion	190 (0.26)	15 (0.11)	175 (0.29)	
Respiratory Arrest	24 (0.03)	1 (0.01)	23 (0.04)	
Respiratory Distress	5408 (7.28)	476 (3.38)	4932 (8.19)	
Seizures	2091 (2.81)	289 (2.05)	1802 (2.99)	
Sepsis	512 (0.69)	3 (0.02)	509 (0.85)	
Stroke / CVA / TIA	1084 (1.46)	23 (0.16)	1061 (1.76)	
Syncope	2478 (3.34)	440 (3.13)	2038 (3.38)	
Transfer	1338 (1.8)	13 (0.09)	1325 (2.2)	
Vertigo / Dizziness	1107 (1.49)	118 (0.84)	989 (1.64)	
Violent / Agitated	97 (0.13)	10 (0.07)	87 (0.14)	
Weakness / Fatigue	3189 (4.29)	234 (1.66)	2955 (4.91)	
Wellness check	4987 (6.71)	2831 (20.12)	2156 (3.58)	
Wound Care	298 (0.4)	73 (0.52)	225 (0.37)	
Missing	175 (0.24)	161 (1.14)	14 (0.02)	
Paramedic-documented clinical impression				<0.0001
Cardiac Arrest	723 (0.97)	59 (0.42)	664 (1.1)	
Cardiovascular	6218 (8.37)	328 (2.33)	5890 (9.78)	
Chest Pain	1021 (1.37)	131 (0.93)	890 (1.48)	
EENT	901 (1.21)	244 (1.73)	657 (1.09)	
Environmental	649 (0.87)	111 (0.79)	538 (0.89)	
Gastrointestinal	9343 (12.58)	517 (3.67)	8826 (14.66)	
Glycemic	1450 (1.95)	635 (4.51)	815 (1.35)	
Neuro	7231 (9.73)	582 (4.14)	6649 (11.04)	
OB/GYN	462 (0.62)	29 (0.21)	433 (0.72)	
Non-specific	14651 (19.72)	5452 (38.74)	9199 (15.28)	
Palliative or End-of-Life Care	146 (0.2)	26 (0.18)	120 (0.2)	

Pediatric	187 (0.25)	16 (0.11)	171 (0.28)	
Psychological	4081 (5.49)	712 (5.06)	3369 (5.59)	
Respiratory	5864 (7.89)	499 (3.55)	5365 (8.91)	
Shock/Sepis	824 (1.11)	3 (0.02)	821 (1.36)	
Skin	533 (0.72)	62 (0.44)	471 (0.78)	
Substance Misuse / Intoxication	595 (0.8)	78 (0.55)	517 (0.86)	
Toxicology	1413 (1.9)	85 (0.6)	1328 (2.21)	
Trauma	12845 (17.29)	1804 (12.82)	11041 (18.33)	
Wellness/Med Check	5156 (6.94)	2699 (19.18)	2457 (4.08)	
Canadian Triage and Acuity Scale (CTAS)				<0.0001
Resuscitation (1)	897 (1.21)	14 (0.1)	883 (1.47)	
Emergent (2)	11483 (15.46)	172 (1.22)	11311 (18.78)	
Urgent (3)	30573 (41.15)	1011 (7.18)	29562 (49.09)	
Less Urgent (4 or 5)	23880 (32.14)	5507 (39.13)	18373 (30.51)	
Missing	7460 (10.04)	7368 (52.36)	92 (0.15)	
Co-morbidities				<0.0001
0 to 2	33096 (44.55)	8277 (58.82)	24819 (41.21)	
3 or 4	18799 (25.3)	2984 (21.21)	15815 (26.26)	
5 or 6	11171 (15.04)	1551 (11.02)	9620 (15.97)	
>7	11227 (15.11)	1260 (8.95)	9967 (16.55)	
First Respiratory Rate				<0.0001
Normal (<16 or >20 breaths/minute)	55229 (74.34)	11323 (80.46)	43906 (72.91)	
Abnormal (>15 or <21 breaths/minute)	19064 (25.66)	2749 (19.54)	16315 (27.09)	
First Temperature				<0.0001
Normal (<36 °C or >38 °C)	24078 (32.41)	3234 (22.98)	20844 (34.61)	
Abnormal (>35.9 °C or 38.1 °C)	6139 (8.26)	497 (3.53)	5642 (9.37)	
Missing	44076 (59.33)	10341 (73.49)	33735 (56.02)	
First Glucose				<0.0001
Normal (<4.0 to >6.1 mmol/L)	11001 (14.81)	2115 (15.03)	8886 (14.76)	
Abnormal (>3.9 to <6.2 mmol/L)	29494 (39.7)	4622 (32.85)	24872 (41.3)	
Missing	33798 (45.49)	7335 (52.12)	26463 (43.94)	
First Oxygen Saturation				<0.0001
Normal (<90%)	64435 (86.73)	11291 (80.24)	53144 (88.25)	
Abnormal (>89%)	4164 (5.6)	224 (1.59)	3940 (6.54)	
Missing	5694 (7.66)	2557 (18.17)	3137 (5.21)	
First Blood Pressure Diastolic				<0.0001
Normal (<80 or >90)	20994 (28.26)	4106 (29.18)	16888 (28.04)	
Abnormal (>79 or <91)	43045 (57.94)	7310 (51.95)	35735 (59.34)	
Missing	10254 (13.8)	2656 (18.87)	7598 (12.62)	
First Blood Pressure Systolic				<0.0001

Normal (<120 or >140)	27986 (37.67)	5781 (41.08)	22205 (36.87)	
Abnormal (>119 or <141)	46307 (62.33)	8291 (58.92)	38016 (63.13)	
First Heart Rate				<0.0001
Normal (<50 or >110 beats/min)	61686 (83.03)	11886 (84.47)	49800 (82.7)	
Abnormal (>49 or <111 beats/min)	12607 (16.97)	2186 (15.53)	10421 (17.3)	
Last Respiratory Rate				<0.0001
Normal (<16 or >20 breaths/minute)	23669 (31.86)	1601 (11.38)	22068 (36.65)	
Abnormal (>15 or <21 breaths/minute)	7365 (9.91)	245 (1.74)	7120 (11.82)	
Missing	43259 (58.23)	12226 (86.88)	31033 (51.53)	
Last Oxygen Saturation				<0.0001
Normal (<90%)	2 (0)	0 (0)	2 (0)	
Abnormal (>89%)	29810 (40.12)	1860 (13.22)	27950 (46.41)	
Missing	44481 (59.87)	12212 (86.78)	32269 (53.58)	
Last Blood Pressure Diastolic				<0.0001
Normal (<80 or >90)	6649 (8.95)	420 (2.98)	6229 (10.34)	
Abnormal (>79 or <91)	57390 (77.25)	10996 (78.14)	46394 (77.04)	
Missing	10254 (13.8)	2656 (18.87)	7598 (12.62)	
Last Blood Pressure Systolic				<0.0001
Normal (<120 or >140)	10882 (14.65)	635 (4.51)	10247 (17.02)	
Abnormal (>119 or <141)	17684 (23.8)	883 (6.27)	16801 (27.9)	
Missing	45727 (61.55)	12554 (89.21)	33173 (55.09)	
Last Heart Rate				<0.0001
Normal (<50 or >110 beats/min)	27736 (37.33)	1965 (13.96)	25771 (42.79)	
Abnormal (>49 or <111 beats/min)	4814 (6.48)	178 (1.26)	4636 (7.7)	
Missing	41743 (56.19)	11929 (84.77)	29814 (49.51)	
Interventions				<0.0001
0	31669 (42.63)	10916 (77.57)	20753 (34.46)	
1 or 2	21317 (28.68)	2629 (18.68)	18678 (31.02)	
3 or more	21317 (28.69)	527 (3.75)	20790 (34.52)	
Operational Characteristics				
Paramedic Crew Type				0.006
BLS Crew	19609 (26.39)	3831 (27.22)	15778 (26.2)	
ALS Crew	48650 (65.48)	9169 (65.16)	39481 (65.56)	
Other	6034 (8.12)	1072 (7.62)	4962 (8.24)	
Paramedic Level (Highest on Crew)				0.04
Primary Care Paramedic	19609 (26.39)	3831 (27.22)	15778 (26.2)	
Intermediate Care Paramedic	5790 (7.79)	1043 (7.41)	4747 (7.88)	
Advance Care Paramedic	47883 (64.45)	9008 (64.01)	38875 (64.55)	
Other	1011 (1.36)	190 (1.35)	821 (1.36)	

Duration of patient contact				<0.0001
0 to 20 Minutes	2945 (3.96)	2708 (19.24)	237 (0.39)	
21 to 40 Minutes	11528 (15.52)	6790 (48.25)	4738 (7.87)	
41 to 60 Minutes	15088 (20.31)	2466 (17.52)	12622 (20.96)	
Greater than 60 Minutes	27729 (37.32)	865 (6.15)	26864 (44.61)	
Missing	17003 (22.89)	1243 (8.83)	15760 (26.17)	
Response Mode				<0.0001
Code 1 (lights & siren)	39244 (52.82)	6445 (45.8)	32799 (54.46)	
Code 2 (no lights & siren)	20465 (27.55)	4116 (29.25)	16349 (27.15)	
Missing	14584 (19.63)	3511 (24.95)	11073 (18.39)	
OLMOP Contact				<0.0001
No	70964 (95.52)	11512 (81.81)	59452 (98.72)	
Yes	3329 (4.48)	2560 (18.19)	769 (1.28)	
Environmental Characteristics				
Day of Call				0.023
Sunday	10547 (14.2)	2086 (14.82)	8461 (14.05)	
Monday	10727 (14.44)	1944 (13.81)	8783 (14.58)	
Tuesday	10297 (13.86)	1911 (13.58)	8386 (13.93)	
Wednesday	10731 (14.44)	2040 (14.5)	8691 (14.43)	
Thursday	10546 (14.2)	1949 (13.85)	8597 (14.28)	
Friday	10807 (14.55)	2063 (14.66)	8744 (14.52)	
Saturday	10638 (14.32)	2079 (14.77)	8559 (14.21)	
Month of Call				<0.0001
January	6414 (8.63)	1058 (7.52)	5356 (8.89)	
February	5584 (7.52)	997 (7.08)	4587 (7.62)	
March	6331 (8.52)	1108 (7.87)	5223 (8.67)	
April	5876 (7.91)	1013 (7.2)	4863 (8.08)	
May	6181 (8.32)	1160 (8.24)	5021 (8.34)	
June	6069 (8.17)	1169 (8.31)	4900 (8.14)	
July	6483 (8.73)	1219 (8.66)	5264 (8.74)	
August	6350 (8.55)	1261 (8.96)	5089 (8.45)	
September	6068 (8.17)	1215 (8.63)	4853 (8.06)	
October	6175 (8.31)	1252 (8.9)	4923 (8.17)	
November	6333 (8.52)	1296 (9.21)	5037 (8.36)	
December	6429 (8.65)	1324 (9.41)	5105 (8.48)	
Time of Call				<0.0001
Early Morning (0-4)	9281 (12.49)	2049 (14.56)	7232 (12.01)	
Morning (5-8)	9363 (12.6)	1603 (11.39)	7760 (12.89)	
Late Morning (9-12)	17003 (22.89)	2616 (18.59)	14387 (23.89)	
Afternoon (13-16)	15230 (20.5)	2779 (19.75)	12451 (20.68)	
Night (17-20)	14613 (19.67)	3046 (21.65)	11567 (19.21)	
Late Night (21-24)	8803 (11.85)	1979 (14.06)	6824 (11.33)	

Incident Location Type				<0.0001
Airport/Strip	161 (0.22)	60 (0.43)	101 (0.17)	
Hospital	1954 (2.63)	150 (1.07)	1804 (3)	
Industrial	84 (0.11)	15 (0.11)	69 (0.11)	
Jail/ Detention Facility	913 (1.23)	434 (3.08)	479 (0.8)	
Lake, River, Ocean	7 (0.01)	1 (0.01)	6 (0.01)	
Medical Clinic	386 (0.52)	29 (0.21)	357 (0.59)	
Nursing Home	4771 (6.42)	283 (2.01)	4488 (7.45)	
Other...	26064 (35.08)	5500 (39.08)	20564 (34.15)	
Recreation / Sport Facility	174 (0.23)	27 (0.19)	147 (0.24)	
Residence / Home	35516 (47.81)	6463 (45.93)	29053 (48.24)	
School	354 (0.48)	91 (0.65)	263 (0.44)	
Senior Center	1668 (2.25)	247 (1.76)	1421 (2.36)	
Street / Highway	2195 (2.95)	763 (5.42)	1432 (2.38)	
Woods / Wilderness	46 (0.06)	9 (0.06)	37 (0.06)	

* p-values are from chi-square test that shows whether these characteristics differ between transported and non-transported patients.

TABLE 5.2. CHARACTERISTICS OF STUDY POPULATION BY NON-TRANSPORT STATUS FOR ANALYSIS - January 1, 2014 - December 31, 2014 (n=74,293)

	Total	Non-Transport,	Transport, N	
	N (%)	N (%)	N (%)	
Total	74,293 (100)	14,072 (18.9)	60,221 (81.1)	p-value*
Patient Characteristics				
Age (years)				<0.0001
Child (0-15 y.o.)	3372 (4.54)	1079 (7.67)	2293 (3.81)	
Young Adult (16–35 y.o.)	11379 (15.32)	2910 (20.68)	8469 (14.06)	
Adult (36-50 y.o.)	8836 (11.89)	1726 (12.27)	7110 (11.81)	
Middle Age Adult (51-65 y.o.)	14533 (19.56)	2595 (18.44)	11938 (19.82)	
Old (66–85 y.o.)	25222 (33.95)	4252 (30.22)	20970 (34.82)	
Oldest old (85+ y.o.)	10951 (14.74)	1510 (10.73)	9441 (15.68)	
Sex				0.02
Female	40075 (53.94)	7467 (53.06)	32608 (54.15)	
Male	34218 (46.06)	6605 (46.94)	27613 (45.85)	
Patient Complaint				<0.0001
Cardiovascular	3568 (4.8)	485 (3.45)	3083 (5.12)	
Gastrointestinal	2765 (3.72)	214 (1.52)	2551 (4.24)	
Diabetic Problem	1157 (1.56)	571 (4.06)	586 (0.97)	
Neuro	4658 (6.27)	488 (3.47)	4170 (6.92)	
Respiratory	5432 (7.31)	477 (3.39)	4955 (8.23)	
Overdose / Poisoning	1921 (2.59)	108 (0.77)	1813 (3.01)	
Trauma	9853 (13.26)	1735 (12.33)	8118 (13.48)	
Wellness check	9385 (12.63)	4635 (32.94)	4750 (7.89)	
Other	10306 (13.87)	1751 (12.44)	8555 (14.21)	
Non-specific	9821 (13.22)	2453 (17.43)	7368 (12.23)	
Pain	10781 (14.51)	719 (5.11)	10062 (16.71)	
Psychological	4646 (6.25)	436 (3.1)	4210 (6.99)	
Paramedic-documented clinical impression				<0.0001
Cardiovascular	6941 (9.34)	387 (2.75)	6554 (10.88)	
Gastrointestinal	9343 (12.58)	517 (3.67)	8826 (14.66)	
Glycemic	1450 (1.95)	635 (4.51)	815 (1.35)	
Neuro	7231 (9.73)	582 (4.14)	6649 (11.04)	
Respiratory	5864 (7.89)	499 (3.55)	5365 (8.91)	
Toxicology	2008 (2.7)	163 (1.16)	1845 (3.06)	
Trauma	12845 (17.29)	1804 (12.82)	11041 (18.33)	
Wellness/Med Check	5302 (7.14)	2725 (19.36)	2577 (4.28)	
Other	8658 (11.65)	1308 (9.3)	7350 (12.21)	
Non-specific	14651 (19.72)	5452 (38.74)	9199 (15.28)	
Co-morbidities				<0.0001

0 to 2	33096 (44.55)	8277 (58.82)	24819 (41.21)	
3 or 4	18799 (25.3)	2984 (21.21)	15815 (26.26)	
5 or 6	11171 (15.04)	1551 (11.02)	9620 (15.97)	
>7	11227 (15.11)	1260 (8.95)	9967 (16.55)	
First Respiratory Rate				<0.0001
Normal (<16 or >20 breaths/minute)	55229 (74.34)	11323 (80.46)	43906 (72.91)	
Abnormal (>15 or <21 breaths/minute)	19064 (25.66)	2749 (19.54)	16315 (27.09)	
First Blood Pressure Systolic				<0.0001
Normal (<120 or >140)	27986 (37.67)	5781 (41.08)	22205 (36.87)	
Abnormal (>119 or <141)	46307 (62.33)	8291 (58.92)	38016 (63.13)	
First Heart Rate				<0.0001
Normal (<50 or >110 beats/min)	61686 (83.03)	11886 (84.47)	49800 (82.7)	
Abnormal (>49 or <111 beats/min)	12607 (16.97)	2186 (15.53)	10421 (17.3)	
Interventions				<0.0001
0	31669 (42.63)	10916 (77.57)	20753 (34.46)	
1 or 2	21317 (28.68)	2629 (18.68)	18678 (31.02)	
3 or more	21317 (28.69)	527 (3.75)	20790 (34.52)	
Operational Characteristics				
Paramedic Crew Type				0.006
BLS Crew	19609 (26.39)	3831 (27.22)	15778 (26.2)	
ALS Crew	48650 (65.48)	9169 (65.16)	39481 (65.56)	
Other	6034 (8.12)	1072 (7.62)	4962 (8.24)	
Response Mode				<0.0001
Code 1 (lights & siren)	39244 (52.82)	6445 (45.8)	32799 (54.46)	
Code 2 (no lights & siren)	20465 (27.55)	4116 (29.25)	16349 (27.15)	
Missing	14584 (19.63)	3511 (24.95)	11073 (18.39)	
Environmental Characteristics				
Day of Call				0.023
Sunday	10547 (14.2)	2086 (14.82)	8461 (14.05)	
Monday	10727 (14.44)	1944 (13.81)	8783 (14.58)	
Tuesday	10297 (13.86)	1911 (13.58)	8386 (13.93)	
Wednesday	10731 (14.44)	2040 (14.5)	8691 (14.43)	
Thursday	10546 (14.2)	1949 (13.85)	8597 (14.28)	
Friday	10807 (14.55)	2063 (14.66)	8744 (14.52)	
Saturday	10638 (14.32)	2079 (14.77)	8559 (14.21)	
Month of Call				<0.0001
January	6414 (8.63)	1058 (7.52)	5356 (8.89)	
February	5584 (7.52)	997 (7.08)	4587 (7.62)	
March	6331 (8.52)	1108 (7.87)	5223 (8.67)	

April	5876 (7.91)	1013 (7.2)	4863 (8.08)	
May	6181 (8.32)	1160 (8.24)	5021 (8.34)	
June	6069 (8.17)	1169 (8.31)	4900 (8.14)	
July	6483 (8.73)	1219 (8.66)	5264 (8.74)	
August	6350 (8.55)	1261 (8.96)	5089 (8.45)	
September	6068 (8.17)	1215 (8.63)	4853 (8.06)	
October	6175 (8.31)	1252 (8.9)	4923 (8.17)	
November	6333 (8.52)	1296 (9.21)	5037 (8.36)	
December	6429 (8.65)	1324 (9.41)	5105 (8.48)	
Time of Call				<0.0001
Early Morning (0-4)	9281 (12.49)	2049 (14.56)	7232 (12.01)	
Morning (5-8)	9363 (12.6)	1603 (11.39)	7760 (12.89)	
Late Morning (9-12)	17003 (22.89)	2616 (18.59)	14387 (23.89)	
Afternoon (13-16)	15230 (20.5)	2779 (19.75)	12451 (20.68)	
Night (17-20)	14613 (19.67)	3046 (21.65)	11567 (19.21)	
Late Night (21-24)	8803 (11.85)	1979 (14.06)	6824 (11.33)	
Incident Location Type				<0.0001
Healthcare Facility	2340 (3.15)	179 (1.27)	2161 (3.59)	
Jail/ Detention Facility	913 (1.23)	434 (3.08)	479 (0.8)	
Nursing Home/Senior Centre	6439 (8.67)	530 (3.77)	5909 (9.81)	
Other	26890 (36.19)	5703 (40.53)	21187 (35.18)	
Residence / Home	35516 (47.81)	6463 (45.93)	29053 (48.24)	
Street / Highway	2195 (2.95)	763 (5.42)	1432 (2.38)	

* p-values are from chi-square test that shows whether these characteristics differ between transported and non-transported patients.

TABLE 6. PATIENT, OPERATIONAL AND ENVIRONMENTAL CHARACTERISTICS ASSOCIATIONS WITH NON-TRANSPORT STATUS
January 1, 2014 - December 31, 2014 (n=74,293)

	Unadjusted OR (99.9% CI)	p-value	Adjusted OR (99.9% CI)	p-value
Patient Characteristics				
Age (years)		<0.0001		<0.0001
Child (0-15 y.o.)	**2.17 (1.88 - 2.49)**		**1.72 (1.46 - 2.02)**	
Young Adult (16–35 y.o.)	**1.58 (1.43 - 1.74)**		**1.46 (1.30 - 1.64)**	
Adult (36-50 y.o.)	**1.12 (0.99 - 1.25)**		1.08 (0.95 - 1.23)	
Middle Age Adult (51-65 y.o.)	**1**		1	
Old (66–85 y.o.)	0.93 (0.85 - 1.021)		0.95 (0.86 - 1.05)	
Oldest old (85+ y.o.)	**0.74 (0.65 - 0.82)**		**0.76 (0.67 - 0.87)**	
Sex		0.020		
Female	1			
Male	1.05 (0.98 - 1.11)			
Patient Complaint		<0.0001		
Cardiovascular	**1.52 (1.20 - 1.91)**			
Gastrointestinal	0.81 (0.60 - 1.08)			
Diabetic Problem	**9.41 (7.29 - 12.13)**			
Neuro	1.13 (0.89 - 1.42)			
Respiratory	0.93 (0.74 - 1.16)			
Overdose / Poisoning	**0.58 (0.39 - 0.82)**			
Trauma	1			
Wellness check	**9.42 (7.87 - 11.26)**			
Other	**1.98 (1.64 - 2.38)**			
Non-specific	**3.22 (2.67 - 3.85)**			
Pain	**0.69 (0.56 - 0.85)**			
Psychological	**2.06 (1.71 - 2.48)**			
Paramedic-documented clinical impression		<0.0001		<0.0001
Cardiovascular	**0.36 (0.29 - 0.43)**		**0.53 (0.44 - 0.65)**	
Gastrointestinal	**0.36 (0.30 - 0.42)**		**0.48 (0.40 - 0.57)**	
Glycemic	**4.76 (3.93 - 5.78)**		**6.68 (5.45 - 8.18)**	
Neuro	**0.53 (0.45 - 0.63)**		**0.63 (0.53 - 0.75)**	
Respiratory	**0.56 (0.47 - 0.67)**		0.94 (0.78 - 1.13)	
Toxicology	**0.54 (0.40 - 0.71)**		**0.44 (0.33 - 0.59)**	
Trauma	1		1	
Wellness/Med Check	**6.47 (5.72 - 7.32)**		**8.55 (7.5 - 9.75)**	
Other	1.08 (0.95 - 1.24)		**1.17 (1.02 - 1.34)**	
Non-specific	**3.62 (3.28 - 4.01)**		**5 (4.48 - 5.57)**	
Co-morbidities		<0.0001		<0.0001
0 to 2	1		1	

3 or 4	**0.56 (0.52 - 0.61)**		**0.65 (0.59 - 0.71)**	
5 or 6	**0.48 (0.43 - 0.53)**		**0.57 (0.51 - 0.64)**	
>7	**0.37 (0.34 - 0.42)**		**0.47 (0.42 - 0.53)**	
First Respiratory Rate		<0.0001		
Normal (<16 or >20 breaths/minute)	1			
Abnormal (>15 or <21 breaths/minute)	**0.65 (0.60 - 0.70)**			
First Blood Pressure Systolic		<0.0001		
Normal (<120 or >140)	1			
Abnormal (>119 or <141)	**0.83 (0.78 - 0.89)**			
First Heart Rate		<0.0001		
Normal (<50 or >110 beats/min)	1			
Abnormal (>49 or <111 beats/min)	**0.87 (0.80 - 0.95)**			
Interventions		<0.0001		
0	**1**			
1 or 2	**0.26 (0.24 - 0.29)**			
3 or more	**0.04 (0.04 - 0.05)**			
Operational Characteristics				
Paramedic Crew Type		0.006		
BLS Crew	1.04 (0.97 - 1.12)			
ALS Crew	1			
Other	0.93 (0.82 - 1.04)			
Response Mode		<0.0001		<0.0001
Code 1 (lights & siren)	**1**		1	
Code 2 (no lights & siren)	**1.28 (1.19 - 1.37)**		**1.10 (1.01 - 1.19)**	
Missing	**1.61 (1.49 - 1.74)**		**1.52 (1.39 - 1.66)**	
Environmental Characteristics				
Day of Call		0.0234		
Sunday	1			
Monday	0.89 (0.8 - 1.00)			
Tuesday	0.92 (0.82 - 1.03)			
Wednesday	0.95 (0.84 - 1.06)			
Thursday	0.92 (0.81 - 1.03)			
Friday	0.95 (0.85 - 1.07)			
Saturday	0.98 (0.87 - 1.10)			
Month of Call		<0.0001		
January	1			
February	1.1 (0.93 - 1.29)			
March	1.07 (0.92 - 1.25)			
April	1.05 (0.9 - 1.23)			

May	**1.17 (1.00 - 1.36)**			
June	**1.20 (1.03 - 1.40)**			
July	**1.17 (1.00 - 1.36)**			
August	**1.25 (1.07 - 1.46)**			
September	**1.26 (1.08 - 1.47)**			
October	**1.28 (1.10 - 1.49)**			
November	**1.30 (1.12 - 1.51)**			
December	**1.31 (1.13 - 1.52)**			
Time of Call		<0.0001		
Early Morning (0-4)	1			
Morning (5-8)	**0.72 (0.64 - 0.82)**			
Late Morning (9-12)	**0.64 (0.57 - 0.71)**			
Afternoon (13-16)	**0.78 (0.70 - 0.87)**			
Night (17-20)	0.92 (0.83 - 1.03)			
Late Night (21-24)	1.02 (0.91 - 1.15)			
Incident Location Type		<0.0001		<0.0001
Healthcare Facility	**0.37 (0.28 - 0.48)**		**0.29 (0.22 - 0.38)**	
Jail/ Detention Facility	**4.07 (3.26 - 5.08)**		**2.88 (2.22 - 3.74)**	
Nursing Home/Senior Centre	**0.40 (0.34 - 0.47)**		**0.51 (0.43 - 0.61)**	
Other	**1.2 (1.13 - 1.29)**		1.05 (0.98 - 1.14)	
Residence / Home	1		1	
Street / Highway	**2.39 (2.05 - 2.79)**		**1.79 (1.49 - 2.14)**	
Hosmer_Lemeshow test		NA		0.0243

OR: odds ratio
CI: confidence interval
Significant associations are bolded (P < .001)

TABLE 7. DEPENDENT VARIABLE FOR THE ANALYSIS OF THE SECONDARY OBJECTIVES: POTENTIALLY ADVERSE NON-TRANSPORT- January 1, 2014 - December 31, 2014 (n=14,072)

	N (%)
Total	14,072 (100)
Non-Transport Response Outcome	
Relapse	**1187 (8.5)**
Potentially Adverse Non-Transport	
Relapse, with Transport Response Outcome	787 (5.5)
Relapse, Patient deceased	11 (0.07)
Non-Adverse Non-Transport	
Relapse, with Non-Transport Response Outcome	389 (2.7)
No Relapse	**12885 (91.5)**
Non-Adverse Non-Transport	12885 (91.5)

TABLE 8.1. CHARACTERISTICS OF NON-TRANSPORT POPULATION BY POTENTIALLY ADVERSE NON-TRANSPORT STATUS - January 1, 2014 - December 31, 2014 (n=14,072)

	Total	Potentially Adverse	Non-Adverse	
	N (%)	N (%)	N (%)	p-value*
Total	14072 (100)	798 (5.7)	13274 (94.3)	
Patient Characteristics				
Age (years)				<0.0001
Child (0-5 y.o.)	505 (3.59)	11 (1.38)	494 (3.72)	
Adolescent (6 -15 y.o.)	574 (4.08)	5 (0.63)	569 (4.29)	
Teen (16-20 y.o.)	875 (6.22)	12 (1.5)	863 (6.5)	
Young Adult (21–35 y.o.)	2035 (14.46)	36 (4.51)	1999 (15.06)	
Adult (36-50 y.o.)	1726 (12.27)	53 (6.64)	1673 (12.6)	
Middle Age Adult (51-65 y.o.)	2595 (18.44)	163 (20.43)	2432 (18.32)	
Old (66–75 y.o.)	2138 (15.19)	179 (22.43)	1959 (14.76)	
Old old (76-85 y.o.)	1944 (13.81)	169 (21.18)	1775 (13.37)	
Oldest old (85+ y.o.)	1680 (11.94)	170 (21.3)	1510 (11.38)	
Sex				<0.0001
Female	7467 (53.06)	477 (59.77)	6990 (52.66)	
Male	6605 (46.94)	321 (40.23)	6284 (47.34)	
Patient Complaint				<0.0001
Abdominal Pain / Flank Pain	269 (1.91)	20 (2.51)	249 (1.88)	
Acute Coronary Syndrome	6 (0.04)	0 (0)	6 (0.05)	
Allergic Reaction	99 (0.7)	1 (0.13)	98 (0.74)	
Altered Mental Status	97 (0.69)	9 (1.13)	88 (0.66)	
Arrhythmia	27 (0.19)	1 (0.13)	26 (0.2)	
Assault	119 (0.85)	0 (0)	119 (0.9)	
Back Pain - Non Traumatic	57 (0.41)	6 (0.75)	51 (0.38)	
Burns	26 (0.18)	0 (0)	26 (0.2)	
Cardiac Arrest	10 (0.07)	0 (0)	10 (0.08)	
CBRN / Hazmat	6 (0.04)	0 (0)	6 (0.05)	
Chest Pain (NYD)	393 (2.79)	22 (2.76)	371 (2.79)	
Childbirth / Post Partum Care	2 (0.01)	0 (0)	2 (0.02)	
Diabetic Problem	571 (4.06)	21 (2.63)	550 (4.14)	
Electrocution	2 (0.01)	0 (0)	2 (0.02)	
End of Life Care	6 (0.04)	0 (0)	6 (0.05)	
Environmental (Heat Cold)	17 (0.12)	0 (0)	17 (0.13)	
Epistaxis	73 (0.52)	7 (0.88)	66 (0.5)	
Foreign Body Obstruction (Partial / Complete)	58 (0.41)	0 (0)	58 (0.44)	
General Malaise	438 (3.11)	33 (4.14)	405 (3.05)	
GI Bleed	5 (0.04)	1 (0.13)	4 (0.03)	

Head / Neuro Injury	61 (0.43)	2 (0.25)	59 (0.44)	
Headache	115 (0.82)	3 (0.38)	112 (0.84)	
Major Trauma	14 (0.1)	0 (0)	14 (0.11)	
Medical Device Complication	23 (0.16)	1 (0.13)	22 (0.17)	
Minor Trauma	1576 (11.2)	38 (4.76)	1538 (11.59)	
Nausea / Vomiting	209 (1.49)	17 (2.13)	192 (1.45)	
Neonatal Care / Resuscitation	3 (0.02)	0 (0)	3 (0.02)	
No Apparent Illness / Injury	1781 (12.66)	68 (8.52)	1713 (12.9)	
Obvious Death	2 (0.01)	0 (0)	2 (0.02)	
Other	1081 (7.68)	65 (8.15)	1016 (7.65)	
Overdose / Poisoning	108 (0.77)	5 (0.63)	103 (0.78)	
Perinatal Mother Care	1 (0.01)	0 (0)	1 (0.01)	
Post Fall Assessment	1798 (12.78)	137 (17.17)	1661 (12.51)	
Pre-Eclampsia / Eclampsia	1 (0.01)	0 (0)	1 (0.01)	
Psychological Problem	329 (2.34)	10 (1.25)	319 (2.4)	
Pulmonary Edema (CHF)	2 (0.01)	0 (0)	2 (0.02)	
PV Bleed / Threatened Abortion	15 (0.11)	2 (0.25)	13 (0.1)	
Respiratory Arrest	1 (0.01)	0 (0)	1 (0.01)	
Respiratory Distress	476 (3.38)	69 (8.65)	407 (3.07)	
Seizures	289 (2.05)	13 (1.63)	276 (2.08)	
Sepsis	3 (0.02)	3 (0.38)	0 (0)	
Stroke / CVA / TIA	23 (0.16)	2 (0.25)	21 (0.16)	
Syncope	440 (3.13)	6 (0.75)	434 (3.27)	
Transfer	13 (0.09)	0 (0)	13 (0.1)	
Vertigo / Dizziness	118 (0.84)	4 (0.5)	114 (0.86)	
Violent / Agitated	10 (0.07)	1 (0.13)	9 (0.07)	
Weakness / Fatigue	234 (1.66)	19 (2.38)	215 (1.62)	
Wellness check	2831 (20.12)	204 (25.56)	2627 (19.79)	
Wound Care	73 (0.52)	0 (0)	73 (0.55)	
Missing	161 (1.14)	8 (1)	153 (1.15)	
Paramedic-documented clinical impression				<0.0001
Cardiac Arrest	59 (0.42)	5 (0.63)	54 (0.41)	
Cardiovascular	328 (2.33)	20 (2.51)	308 (2.32)	
Chest Pain	131 (0.93)	4 (0.5)	127 (0.96)	
EENT	244 (1.73)	6 (0.75)	238 (1.79)	
Environmental	111 (0.79)	2 (0.25)	109 (0.82)	
Gastrointestinal	517 (3.67)	47 (5.89)	470 (3.54)	
Glycemic	635 (4.51)	31 (3.88)	604 (4.55)	
Neuro	582 (4.14)	32 (4.01)	550 (4.14)	
OB/GYN	29 (0.21)	2 (0.25)	27 (0.2)	
Non-specific	5452 (38.74)	265 (33.21)	5187 (39.08)	
Palliative or End-of-Life Care	26 (0.18)	1 (0.13)	25 (0.19)	

Pediatric	16 (0.11)	1 (0.13)	15 (0.11)	
Psychological	712 (5.06)	35 (4.39)	677 (5.1)	
Respiratory	499 (3.55)	77 (9.65)	422 (3.18)	
Shock/Sepsis	3 (0.02)	2 (0.25)	1 (0.01)	
Skin	62 (0.44)	5 (0.63)	57 (0.43)	
Substance Misuse / Intoxication	78 (0.55)	3 (0.38)	75 (0.57)	
Toxicology	85 (0.6)	2 (0.25)	83 (0.63)	
Trauma	1804 (12.82)	49 (6.14)	1755 (13.22)	
Wellness/Med Check	2699 (19.18)	209 (26.19)	2490 (18.76)	
Canadian Triage and Acuity Scale (CTAS)				0.002
Resuscitation (1)	14 (0.1)	0 (0)	14 (0.11)	
Emergent (2)	172 (1.22)	21 (2.63)	151 (1.14)	
Urgent (3)	1011 (7.18)	67 (8.4)	944 (7.11)	
Less Urgent (4 or 5)	5507 (39.13)	313 (39.22)	5194 (39.13)	
Missing	7368 (52.36)	397 (49.75)	6971 (52.52)	
Co-morbidities				<0.0001
0 to 2	8277 (58.82)	261 (32.71)	8016 (60.39)	
3 or 4	2984 (21.21)	242 (30.33)	2742 (20.66)	
5 or 6	1551 (11.02)	154 (19.3)	1397 (10.52)	
>7	1260 (8.95)	141 (17.67)	1119 (8.43)	
First Respiratory Rate				0.706
Normal (<16 or >20 breaths/minute)	11323 (80.46)	638 (79.95)	10685 (80.5)	
Abnormal (>15 or <21 breaths/minute)	2749 (19.54)	160 (20.05)	2589 (19.5)	
First Temperature				<0.0001
Normal (<36 °C or >39 °C)	3234 (22.98)	271 (33.96)	2963 (22.32)	
Abnormal (>35.9 °C or 39.1 °C)	497 (3.53)	39 (4.89)	458 (3.45)	
Missing	10341 (73.49)	488 (61.15)	9853 (74.23)	
First Glucose				<0.0001
Normal (<4.4 to >6.1 mmol/L)	2115 (15.03)	95 (11.9)	2020 (15.22)	
Abnormal (>4.5 to <6.2 mmol/L)	4622 (32.85)	354 (44.36)	4268 (32.15)	
Missing	7335 (52.12)	349 (43.73)	6986 (52.63)	
First Oxygen Saturation				<0.0001
Normal (<90%)	11291 (80.24)	659 (82.58)	10632 (80.1)	
Abnormal (>89%)	224 (1.59)	39 (4.89)	185 (1.39)	
Missing	2557 (18.17)	100 (12.53)	2457 (18.51)	
First Blood Pressure Diastolic				<0.0001
Normal (<80 or >90)	4106 (29.18)	213 (26.69)	3893 (29.33)	
Abnormal (>79 or <91)	7310 (51.95)	478 (59.9)	6832 (51.47)	
Missing	2656 (18.87)	107 (13.41)	2549 (19.2)	
First Blood Pressure Systolic				0.342

Normal (<120 or >140)	5781 (41.08)	315 (39.47)	5466 (41.18)	
Abnormal (>119 or <141)	8291 (58.92)	483 (60.53)	7808 (58.82)	
First Heart Rate				<0.0001
Normal (<50 or >110 beats/min)	11886 (84.47)	715 (89.6)	11171 (84.16)	
Abnormal (>49 or <111 beats/min)	2186 (15.53)	83 (10.4)	2103 (15.84)	
Last Respiratory Rate				0.006
Normal (<16 or >20 breaths/minute)	1601 (11.38)	107 (13.41)	1494 (11.26)	
Abnormal (>15 or <21 breaths/minute)	245 (1.74)	23 (2.88)	222 (1.67)	
Missing	12226 (86.88)	668 (83.71)	11558 (87.07)	
Last Oxygen Saturation				<0.0001
Normal (<90%)	0 (0)	0 (0)	0 (0)	
Abnormal (>89%)	1860 (13.22)	143 (17.92)	1717 (12.94)	
Missing	12212 (86.78)	655 (82.08)	11557 (87.06)	
Last Blood Pressure Diastolic				<0.0001
Normal (<80 or >90)	420 (2.98)	29 (3.63)	391 (2.95)	
Abnormal (>79 or <91)	10996 (78.14)	662 (82.96)	10334 (77.85)	
Missing	2656 (18.87)	107 (13.41)	2549 (19.2)	
Last Blood Pressure Systolic				0.033
Normal (<120 or >140)	635 (4.51)	47 (5.89)	588 (4.43)	
Abnormal (>119 or <141)	883 (6.27)	61 (7.64)	822 (6.19)	
Missing	12554 (89.21)	690 (86.47)	11864 (89.38)	
Last Heart Rate				0.02
Normal (<50 or >110 beats/min)	1965 (13.96)	137 (17.17)	1828 (13.77)	
Abnormal (>49 or <111 beats/min)	178 (1.26)	12 (1.5)	166 (1.25)	
Missing	11929 (84.77)	649 (81.33)	11280 (84.98)	
Interventions				0.025
0	13545 (96.25)	754 (94.49)	12791 (96.36)	
1 or 2	502 (3.57)	43 (5.39)	459 (3.46)	
3 or more	25 (0.18)	1 (0.13)	24 (0.18)	
Operational Characteristics				
Paramedic Crew Type				0.221
BLS Crew	3831 (27.22)	238 (29.82)	3593 (27.07)	
ALS Crew	9169 (65.16)	504 (63.16)	8665 (65.28)	
Other	1072 (7.62)	56 (7.02)	1016 (7.65)	
Paramedic Level (Highest on Crew)				0.393
Primary Care Paramedic	3831 (27.22)	238 (29.82)	3593 (27.07)	
Intermediate Care Paramedic	1043 (7.41)	55 (6.89)	988 (7.44)	
Advance Care Paramedic	9008 (64.01)	495 (62.03)	8513 (64.13)	
Other	190 (1.35)	10 (1.25)	180 (1.36)	

Duration of patient contact				<0.0001
0 to 20 Minutes	2708 (19.24)	96 (12.03)	2612 (19.68)	
21 to 40 Minutes	6790 (48.25)	358 (44.86)	6432 (48.46)	
41 to 60 Minutes	2466 (17.52)	211 (26.44)	2255 (16.99)	
Greater than 60 Minutes	865 (6.15)	79 (9.9)	786 (5.92)	
Missing	1243 (8.83)	54 (6.77)	1189 (8.96)	
Response Mode				0.987
Code 1 (lights & siren)	6445 (45.8)	364 (45.61)	6081 (45.81)	
Code 2 (no lights & siren)	4116 (29.25)	233 (29.2)	3883 (29.25)	
Missing	3511 (24.95)	201 (25.19)	3310 (24.94)	
OLMOP Contact				<0.0001
No	11512 (81.81)	610 (76.44)	10902 (82.13)	
Yes	2560 (18.19)	188 (23.56)	2372 (17.87)	
Environmental Characteristics				
Day of Call				0.573
Sunday	2086 (14.82)	125 (15.66)	1961 (14.77)	
Monday	1944 (13.81)	105 (13.16)	1839 (13.85)	
Tuesday	1911 (13.58)	121 (15.16)	1790 (13.49)	
Wednesday	2040 (14.5)	106 (13.28)	1934 (14.57)	
Thursday	1949 (13.85)	117 (14.66)	1832 (13.8)	
Friday	2063 (14.66)	118 (14.79)	1945 (14.65)	
Saturday	2079 (14.77)	106 (13.28)	1973 (14.86)	
Month of Call				0.903
January	1058 (7.52)	64 (8.02)	994 (7.49)	
February	997 (7.08)	56 (7.02)	941 (7.09)	
March	1108 (7.87)	74 (9.27)	1034 (7.79)	
April	1013 (7.2)	61 (7.64)	952 (7.17)	
May	1160 (8.24)	60 (7.52)	1100 (8.29)	
June	1169 (8.31)	67 (8.4)	1102 (8.3)	
July	1219 (8.66)	65 (8.15)	1154 (8.69)	
August	1261 (8.96)	68 (8.52)	1193 (8.99)	
September	1215 (8.63)	63 (7.89)	1152 (8.68)	
October	1252 (8.9)	79 (9.9)	1173 (8.84)	
November	1296 (9.21)	69 (8.65)	1227 (9.24)	
December	1324 (9.41)	72 (9.02)	1252 (9.43)	
Time of Call				0.037
Early Morning (0-4)	2049 (14.56)	125 (15.66)	1924 (14.49)	
Morning (5-8)	1603 (11.39)	92 (11.53)	1511 (11.38)	
Late Morning (9-12)	2616 (18.59)	153 (19.17)	2463 (18.56)	
Afternoon (13-16)	2779 (19.75)	127 (15.91)	2652 (19.98)	
Night (17-20)	3046 (21.65)	167 (20.93)	2879 (21.69)	
Late Night (21-24)	1979 (14.06)	134 (16.79)	1845 (13.9)	

Incident Location Type				<0.0001
Airport/Strip	60 (0.43)	0 (0)	60 (0.45)	
Hospital	150 (1.07)	2 (0.25)	148 (1.11)	
Industrial	15 (0.11)	0 (0)	15 (0.11)	
Jail/ Detention Facility	434 (3.08)	16 (2.01)	418 (3.15)	
Lake, River, Ocean	1 (0.01)	0 (0)	1 (0.01)	
Medical Clinic	29 (0.21)	0 (0)	29 (0.22)	
Nursing Home	283 (2.01)	27 (3.38)	256 (1.93)	
Other...	5500 (39.08)	246 (30.83)	5254 (39.58)	
Recreation / Sport Facility	27 (0.19)	1 (0.13)	26 (0.2)	
Residence / Home	6463 (45.93)	466 (58.4)	5997 (45.18)	
School	91 (0.65)	0 (0)	91 (0.69)	
Senior Center	247 (1.76)	30 (3.76)	217 (1.63)	
Street / Highway	763 (5.42)	9 (1.13)	754 (5.68)	
Woods / Wilderness	9 (0.06)	1 (0.13)	8 (0.06)	

* p-values are from chi-square test that shows whether these characteristics differ between transported and non-transported patients.

TABLE 8.2. CHARACTERISTICS OF NON-TRANSPORT POPULATION BY POTENTIALLY ADVERSE NON-TRANSPORT STATUS FOR ANALYSIS - January 1, 2014 - December 31, 2014 (n=14,072)

	Total	Potentially Adverse	Non-Adverse	
	N (%)	N (%)	N (%)	
Total	14072 (100)	798 (5.7)	13274 (94.3)	p-value*
Patient Characteristics				
Age (years)				<0.0001
Child/Young Adult (0-35 y.o.)	3989 (28.35)	64 (8.02)	3925 (29.57)	
Adult (36-65 y.o.)	4321 (30.71)	216 (27.07)	4105 (30.93)	
Old (66+ y.o.)	5762 (40.95)	518 (64.91)	5244 (39.51)	
Sex				<0.0001
Female	7467 (53.06)	477 (59.77)	6990 (52.66)	
Male	6605 (46.94)	321 (40.23)	6284 (47.34)	
Patient Complaint				<0.0001
Specific	5233 (37.2)	246 (30.88)	4987 (37.6)	
Wellness check	4294 (32.35)	341 (42.73)	4635 (32.94)	
Other	1660 (12.51)	91 (11.4)	1751 (12.44)	
Non-specific	2333 (17.58)	120 (15.04)	2453 (17.43)	
Paramedic-documented clinical impression				<0.0001
Specific	4587 (32.6)	266 (33.33)	4321 (32.55)	
Wellness check	2515 (18.95)	210 (26.32)	2725 (19.36)	
Other	1251 (9.42)	57 (7.14)	1308 (9.3)	
Non-specific	5187 (39.08)	265 (33.21)	5452 (38.74)	
Co-morbidities				<0.0001
0 to 2	8277 (58.82)	261 (32.71)	8016 (60.39)	
3 or 4	2984 (21.21)	242 (30.33)	2742 (20.66)	
5 or 6	1551 (11.02)	154 (19.3)	1397 (10.52)	
>7	1260 (8.95)	141 (17.67)	1119 (8.43)	
First Respiratory Rate				0.706
Normal (<16 or >20 breaths/minute)	11323 (80.46)	638 (79.95)	10685 (80.5)	
Abnormal (>15 or <21 breaths/minute)	2749 (19.54)	160 (20.05)	2589 (19.5)	
First Blood Pressure Systolic				0.342
Normal (<120 or >140)	5781 (41.08)	315 (39.47)	5466 (41.18)	
Abnormal (>119 or <141)	8291 (58.92)	483 (60.53)	7808 (58.82)	
First Heart Rate				<0.0001
Normal (<50 or >110 beats/min)	11886 (84.47)	715 (89.6)	11171 (84.16)	
Abnormal (>49 or <111 beats/min)	2186 (15.53)	83 (10.4)	2103 (15.84)	

Interventions				0.025
0	10916 (77.57)	610 (76.44)	10306 (77.64)	
1 or 2	2629 (18.68)	144 (18.05)	2485 (18.72)	
3 or more	527 (3.75)	44 (3.75)	483 (3.64)	
Operational Characteristics				
Paramedic Crew Type				0.221
BLS Crew	3831 (27.22)	238 (29.82)	3593 (27.07)	
ALS Crew	9169 (65.16)	504 (63.16)	8665 (65.28)	
Other	1072 (7.62)	56 (7.02)	1016 (7.65)	
Response Mode				0.987
Code 1 (lights & siren)	6445 (45.8)	364 (45.61)	6081 (45.81)	
Code 2 (no lights & siren)	4116 (29.25)	233 (29.2)	3883 (29.25)	
Missing	3511 (24.95)	201 (25.19)	3310 (24.94)	
Environmental Characteristics				
Day of Call				0.573
Sunday	2086 (14.82)	125 (15.66)	1961 (14.77)	
Monday	1944 (13.81)	105 (13.16)	1839 (13.85)	
Tuesday	1911 (13.58)	121 (15.16)	1790 (13.49)	
Wednesday	2040 (14.5)	106 (13.28)	1934 (14.57)	
Thursday	1949 (13.85)	117 (14.66)	1832 (13.8)	
Friday	2063 (14.66)	118 (14.79)	1945 (14.65)	
Saturday	2079 (14.77)	106 (13.28)	1973 (14.86)	
Month of Call				0.903
January	1058 (7.52)	64 (8.02)	994 (7.49)	
February	997 (7.08)	56 (7.02)	941 (7.09)	
March	1108 (7.87)	74 (9.27)	1034 (7.79)	
April	1013 (7.2)	61 (7.64)	952 (7.17)	
May	1160 (8.24)	60 (7.52)	1100 (8.29)	
June	1169 (8.31)	67 (8.4)	1102 (8.3)	
July	1219 (8.66)	65 (8.15)	1154 (8.69)	
August	1261 (8.96)	68 (8.52)	1193 (8.99)	
September	1215 (8.63)	63 (7.89)	1152 (8.68)	
October	1252 (8.9)	79 (9.9)	1173 (8.84)	
November	1296 (9.21)	69 (8.65)	1227 (9.24)	
December	1324 (9.41)	72 (9.02)	1252 (9.43)	
Time of Call				0.037
Early Morning (0-4)	2049 (14.56)	125 (15.66)	1924 (14.49)	
Morning (5-8)	1603 (11.39)	92 (11.53)	1511 (11.38)	
Late Morning (9-12)	2616 (18.59)	153 (19.17)	2463 (18.56)	
Afternoon (13-16)	2779 (19.75)	127 (15.91)	2652 (19.98)	
Night (17-20)	3046 (21.65)	167 (20.93)	2879 (21.69)	
Late Night (21-24)	1979 (14.06)	134 (16.79)	1845 (13.9)	

Incident Location Type				<0.0001
Public Facility	1143 (8.1)	75 (9.4)	1068 (8.1)	
Other	6466 (46)	466 (58.4)	5997 (45.2)	
Residence / Home	6463 (45.9)	257 (32.21)	6209 (46.8)	

* p-values are from chi-square test that shows whether these characteristics differ between transported and non-transported patients.

TABLE 9. PATIENT, OPERATIONAL AND ENVIRONMENTAL CHARACTERISTICS ASSOCIATIONS WITH POTENTIALLY ADVERSE NON-TRANSPORT STATUS January 1, 2014 - December 31, 2014 (n=14,072)

	Unadjusted OR (99.9% CI)	p-value	Adjusted OR (99.9% CI)	p-value
Patient Characteristics				
Age (years)		<0.0001		<0.0001
Child/Young Adult (0-35 y.o.)	**0.31 (0.19 - 0.49)**		**0.39 (0.24 - 0.65)**	
Adult (36-65 y.o.)	1		1	
Old (66+ y.o.)	**1.88 (1.43 – 2.47)**		**1.54 (1.15 – 2.07)**	
Sex		<0.0001		
Female	1			
Male	**0.74 (0.64 - 0.86)**			
Patient Complaint		<0.0001		
Specific	0.62 (0.46 - 0.82)			
Wellness check	1			
Other	0.69 (0.46 - 1.03)			
Non-specific	0.64 (0.45 - 0.92)			
Paramedic-documented clinical impression		<0.0001		<0.0001
Specific	**0.73 (0.53 - 1.01)**		0.89 (0.64 - 1.21)	
Wellness check	1		1	
Other	0.54 (0.32 - 0.90)		0.72 (0.43 - 1.21)	
Non-specific	**0.61 (0.44 - 0.83)**		**0.60 (0.44 - 0.83)**	
Co-morbidities		<0.0001		<0.0001
0 to 2	1		1	
3 or 4	**2.71 (2.00 - 3.66)**		**1.74 (1.27 - 2.41)**	
5 or 6	**3.38 (2.39 - 4.79)**		**2.05 (1.41 - 2.96)**	
>7	**3.87 (2.70 - 5.54)**		**2.40 (1.64 - 3.51)**	
First Respiratory Rate		0.706		
Normal (<16 or >20 breaths/minute)	1			
Abnormal (>15 or <21 breaths/minute)	1.03 (0.76 - 1.39)			
First Blood Pressure Systolic		0.342		
Normal (<120 or >140)	1			
Abnormal (>119 or <141)	1.07 (0.84 - 1.37)			
First Heart Rate		<0.0001		
Normal (<50 or >110 beats/min)	1			
Abnormal (>49 or <111 beats/min)	**0.61 (0.41 - 0.91)**			
Interventions		0.0263		
0	1			
1 or 2	0.97 (0.71 - 1.34)			

3 or more	1.53 (0.9 - 2.63)			
Operational Characteristics				
Paramedic Crew Type		0.2213		
BLS Crew	0.09 (0.87 - 1.48)			
ALS Crew	1			
Other	0.13 (0.58 - 1.52)			
Response Mode		0.9869		
Code 1 (lights & siren)	1			
Code 2 (no lights & siren)	1.01 (0.75 - 1.33)			
Missing	1.01 (0.75 - 1.36)			
Environmental Characteristics				
Day of Call		0.5748		
Sunday	1			
Monday	0.89 (0.57 - 1.40)			
Tuesday	1.06 (0.68 - 1.63)			
Wednesday	0.86 (0.55 - 1.34)			
Thursday	1.00 (0.64 - 1.55)			
Friday	0.95 (0.61 - 1.47)			
Saturday	0.84 (0.53 - 1.31)			
Month of Call		0.8667		
January	1			
February	0.92 (0.49 - 1.71)			
March	1.11 (0.62 - 1.98)			
April	0.99 (0.54 - 1.82)			
May	0.84 (0.46 - 1.55)			
June	0.94 (0.52 - 1.70)			
July	0.87 (0.48 - 1.58)			
August	0.88 (0.49 - 1.59)			
September	0.84 (0.46 - 1.54)			
October	1.04 (0.59 - 1.85)			
November	0.87 (0.48 - 1.57)			
December	0.89 (0.49 - 1.59)			
Time of Call		0.0380		
Early Morning (0-4)	1			
Morning (5-8)	0.93 (0.58 - 1.49)			
Late Morning (9-12)	0.95 (0.63 - 1.44)			
Afternoon (13-16)	0.73 (0.48 - 1.12)			
Night (17-20)	0.89 (0.59 - 1.33)			
Late Night (21-24)	1.11 (0.73 - 1.70)			
Incident Location Type		<0.0001		0.0003
Public Facility	0.90 (0.59 - 1.38)		0.91 (0.59 - 1.40)	
Other	**0.53 (0.41 - 0.69)**		**0.70 (0.54 - 0.92)**	

Residence / Home	1		1	
Hosmer Lemeshow Test		NA		0.9959

OR: odds ratio
CI: confidence interval
Significant associations are bolded (P < .001)

Chapter 6 – Discussion

6.1 Discussion of Results

Using the population-based administrative data of EMS responses in Nova Scotia between January 1, 2014, and December 31, 2014, this study demonstrated that 18.9% of EMS responses resulted in a non-transport and that of those non-transports only a small portion, 5.6% may be considered potentially adverse.

The results of this study provide timely information to healthcare decision-makers and healthcare practitioners on the scope of this issue in Nova Scotia and areas of particular concern such as the high use of EMS resources for low-acuity conditions, differences by age, and the higher likelihood of potentially adverse non-transport for older patients and patients with multiple co-morbidities. The results also suggest potential directions for future study such as examining the appropriateness of EMS responses and the understanding among the public about appropriate EMS emergency medical calls. The result may aid clinical decision making for Nova Scotia and other EMS systems by highlighting the likelihood of potentially adverse non-transport for older patients and patients with multiple co-morbidities.

The primary findings of this study of EMS non-transport identified the scope of non-transport and potentially adverse non-transport and identified associated patient, operational and environmental characteristics with them. This study found that 18.9% (n=14,072) of EMS patient had a non-transport response outcome in 2014, which is comparable to the 20% found in previous studies (1-5). Of note, a recent study in the same study setting focused on older patients (65 or more years old) also reported that 18% of

cases were non-transport (5). Non-transport had statistically significant independent associations with age, paramedic clinical impressions, the number of co-morbidities, response mode, and incident location type.

The study found that 8.4% (n=1,187) of EMS patients involved in a non-transport relapsed to EMS, and 5.6% (n=798) required transportation to a hospital following the relapse or were deceased, potentially identifying the original non-transport as potentially adverse. Potentially adverse non-transport had statistically significant independent associations with age, paramedic impressions, co-morbidities, and incident location type.

These findings suggest that, in the Nova Scotia EMS system, non-transport arises from a variety of situations and that the risk of missed interventions may be minimal from a population perspective. EMS systems should continue to examine ways to direct non-emergency EMS emergency medical calls to other avenues, potentially reducing the proportion of non-transport response outcomes.

Of the 14,072 non-transports, the majority were either patients who were assessed and transport is not required (29.3%; n=4,144), or patients who were assessed and treatment and transport were refused (29.6%; n=4,160). This supports existing studies that indicate up to 15% of patients who refused transport are deemed by the paramedic as having no medical need that can be met by the paramedics or emergency department (25,31). Therefore, the non-transport in these cases may have been appropriate. Although 1,187 (8.4%) EMS patients with a non-transport response outcome did seek subsequent EMS care related to their initial EMS call, only 798 (5.6%) non-transports were subsequently transported or were deceased. Compared with studies which examined the outcomes for patients who sought additional care in an ED which showed less than 15% of

those cases were admitted (13), these percentages suggest that many relapsed patients may have a limited need for further medical care, but an important subset would, and it is important to identify those who need further care.

Of note, this study found that the likelihood of a non-transport as well as the likelihood of potentially adverse non-transport differed by age group as was identified in previous studies. The youngest age groups had the highest likelihood of non-transport and the oldest age group had the highest likelihood of potentially adverse non-transports. The differing likelihood of non-transport may be related to the differing indications for obtaining EMS emergency medical care (12,13,15,37,42,43). Reasons for the increased likelihood of non-transport among the youngest patients may include parental concerns or anxiety about children's health and an increased prevalence of acute infections (12,13). Previous studies identified reasons for greater use of EMS resources among older adults may include increased chronic medical conditions and a decrease in immunologic responses, which may indicate patient frailty and contribute to the increased likelihood of potentially adverse non-transport (44,45). The overall higher likelihood of older patients to seek EMS care compared with other age groups may explain their higher likelihood of relapse and potentially adverse non-transport (44,45).

Paramedic clinical impression was shown to be significantly associated with both non-transport and potentially adverse non-transport (Tables 4 and 8). The higher likelihood for glycemic issues is likely due to the clinical practice of treating and not transporting controllable glycemic issues (50-53). Similarly, previous studies pointed out that EMS could be appropriately used for wellness checks but that there is potential that EMS is being over-utilized for these purposes (35,36). This study found that wellness check was the chief

complaint of over 32% of non-transport response outcomes compared to 19% for paramedic clinical impression. This suggests that a portion of wellness check EMS responses identified a clinical condition that required paramedic assessment or treatment, result in a different paramedic clinical impression versus the patient chief complaint. Future research is needed to understand the benefit of EMS wellness checks and awareness among the public about appropriate EMS emergency medical calls.

The number of co-morbidities was shown to be statistically significantly and independently associated with both non-transport and potentially adverse non-transport. The association for potentially adverse non-transports was stronger, suggesting that patient with multiple co-morbidities had a high risk for a potentially adverse non-transport. This finding coupled with the association of older patients with potentially adverse non-transport may be an indication of patient frailty and it may point to an area for consideration in the development of clinical guidelines for non-transport. Further analysis in the setting could benefit from the inclusion of an age-co-morbidity interaction term in the models. If significant, this information, along with other indicators, can be used to potentially identify "frail" patients in the EMS setting, especially for patients who rarely leave their home or residence, or access the broader healthcare system.

The incident location type of the EMS response was shown to be significantly associated with both non-transport and potentially adverse non-transports. In the cases of non-transport, EMS responses to jail/detention facilities and street/highway responses had the greatest likelihood for non-transport. This is in line with the findings of other studies that indicate higher rates of non-transport for patients in custody (49,50) and for motor

vehicle accidents (25,31). Conversely, potentially adverse non-transport was somewhat less likely to occur outside of the patient's home or residence.

6.2 Strengths and Limitations

This study had a number of strengths, including the use of routinely collected secondary data of good quality, the broadness of the study setting, and relevance to healthcare policy.

Using routinely collected data allowed this large cross-sectional study to be conducted with limited resources. No investment was required to create instruments or to conduct primary data collection and the data was routinely collected for both research and quality improvement purposes, thus, no feasibility challenges raised regarding data collection (5,30,59). There was the drawback of having no control over purpose, choice, or method of data collection, which limited the analysis to available data points. The data source is the best choice in the context of the research objectives because dependent and independent variables are easily queryable and there is a well-established and good quality dataset (EHS ePCR) available for analysis. Furthermore, the data quality is supported by good measurement processes and standards (ePCR, EHS Clinical Policies and Clinical Practice Guidelines) (5,30,59).

The study setting and broad study population allowed the examination of many different situations (i.e., location types, clinical conditions, age stratification) providing a more detailed and significant result than previously conducted observational studies in other jurisdictions. The research questions were relevant to health policy making.

Developing a clearer understanding of the characteristics of these patients could allow for the creation of referral options for identified subsets of patients with a non-transport response outcome to ensure that their clinical needs are met.

There were limitations to this study that should be considered. The significant limitations of this study were not knowing patient clinical outcomes beyond EMS, the reliance on paramedic assessment, the completeness of the data set, and the uncertain etiology of the non-transport, meaning this study was not designed to determine why the response outcome was a non-transport.

An important drawback of the study relates to the lack of information about a patient's ultimate clinical outcome following the EMS exposure. For determining the patient complaint, the study relied on paramedic clinical impression, rather than clinical diagnosis. There was no independent validation of the clinical assessment, and this study did not follow the patient beyond their contact with the EMS system. These limiting factors created the greatest risk for bias and could bias the result by over or under estimating (i.e. triaging) the severity of the patient condition.

The heterogeneous environment in the back of the ambulance influences the completeness of the data collected. How and what information is recorded by paramedics is dependent on the patient and their clinical conditions. For low acuity cases, some information is not recorded for a legitimate reason. For example, vital signs such as blood glucose level would not be recorded unless clinically indicated. In addition, the second set of vital signs would not be recorded in lower acuity cases unless there was an indication of a change in the patient's status. Such heterogeneity among cases potentially results in a significant amount of missing data, which needs careful consideration. This study dealt

with missing data from two directions. First, during data cleaning, this study removed observations with missing data in any variable, where the missing data was <10%, in order to remove cases where the data was most likely to be missing in error. Second, this study created missing categories for independent variables with >10% missing data. Excluding variables with significant portions of missing data could bias the results because the removing variables limits what is known about the patient encounter. Removing observations with missing data could bias the results if those observations were substantially different from the study sample.

The majority of missing data in this study, such as vital signs or postal code, was as expected or may be considered not applicable to the observation based on clinical practice and the heterogeneous environment, and it would be reasonable for it to be missing. At the same time, some data were missing due to error or emission, and a potential area for future study would be to examine missing data in the EMS setting and determine the differences between reasonably missing data and unexplained missing data.

Another limitation is that based on the data analyzed in this study, the etiology of the non-transport decision could not be definitively determined. Not knowing the full reasoning behind the non-transport decision could negatively bias the results because the variables examined do not provide the full picture of the patient encounter.

Other less significant limitations of this study were the potential for confounding, the limitations associated with the use of secondary data, the difficulty for the study design to determine causal relationships, the construction of the dependent variable of the secondary objectives and the single EMS system nature of the study. The results may have been confounded by other unexamined patient or environmental factors, and the dataset

analyzed is unable to address potential confounders beyond the EMS system, such as the patient's clinical history, unknown co-morbidities, and hospital-based clinical impression and interventions (25,31,54). This confounding effect could result in a significant over-estimation of the effect of EMS patient, operational and environmental characteristics. Variables not accounted for in the study may have had a more significant effect on non-transport or potentially adverse non-transport. Another limitation was that cross-sectional studies are not able to describe causal relationships, limiting the conclusions that can be drawn from the results. The construction of the dependent variable of the secondary objectives, potentially adverse non-transport is a potential limitation of this study, as the definition relies on the assumption that relapse followed by transport is an adverse outcome. In some cases, it may be, such as cases where the assessing paramedics missed indications of a serious condition while in other it may not such as cases where the patient had a sudden onset of more acute symptoms, subsequent to the first EMS response, and appropriately sought further care. This limitation is why the dependent variable is prefaced as "potentially" adverse. As a single EMS system study generalizability may be limited, if other systems have different clinical EMS policies, different clinical practice cultures around non-transport, and different levels of ED crowding.

6.3 Policy Implications

Results of this study provide timely information to health policy decision-makers and healthcare practitioners who are considering innovative programs to provide additional options to patients who make up 18.9% of all EMS responses. This study was the first Nova Scotia study to examine the epidemiological profile of patients with a non-transport

response outcome. This study took a large provincial dataset and explored the risk factors for non-transport response outcomes, to increase the understanding of the phenomenon and suggest potential directions for future study aimed at providing a greater understanding of patients with non-transport response outcomes. Developing a clear understanding of the patient characteristics could allow for the creation of referral options for identified subsets of patients with a non-transport response outcome to ensure their clinical needs are met. Such policies and programs would provide these patients with more comprehensive care and potentially limit cases of relapse to the EMS or broader healthcare system. Examples of pilot programs currently in place include the referral of patients in rural communities to next day appointments at a primary care clinic or the referral of geriatric patients with a non-transport response outcomes who have fallen to a falls assessment resource for follow-up assessment and care (62,63). This study may support these initiatives and indicates other patient populations or situations where such programs would be of benefit, such as older patients in healthcare or senior care facilities. The results of the study related to patient age and number of co-morbidities provide support for a need to offer these and similar programs that better meet the needs of patients, however they access the healthcare system.

6.4 Clinical Implications

Results of the study may contribute to deriving clinical decision-making rules for potential non-transport patients based on the variables most strongly associated with non-transport and potentially adverse non-transport. For example, the requirement for OLMOP contact could be refined for patients with the highest likelihood for potentially adverse non-transport. The findings of this study also expand the understanding of the undertriage (i.e.

false negative) and overtriage (i.e. false positive) rates of EMS patients in Nova Scotia as outlined in Figure 3. The study will help to identify patients who may have required transport but were not (potentially adverse non-transport). Further study would be required to identify transported patient who did not require transport.

FIGURE 3. UNDERTRIAGE AND OVERTRIAGE IN EMS

		Patient Acute Care Outcome	
		Serious Clinical Issue	No Clinical Disease
Patient	You need to go to the ED	True Positive	False Positive "overtriage" Risk of Adverse Patient Satisfaction Outcome (i.e. ambulance bill)
	You do not need to go to the ED	False Negative "undertriage" Risk of Adverse Clinical Outcome	True Negative

Chapter 7 - Conclusion

This study identified that 18.9% of EMS responses resulted in a non-transport and that of those non-transports a portion, 5.6% may be considered potentially adverse. The results of this study also identified the positive association of younger patients with non-transport and the positive association of older patients with potentially adverse non-transport. This study will aid the development of a clear understanding of the characteristics of non-transported patients and may allow the creation of referral options for these patients to ensure their clinical needs are met. As well, it may aid the development of clinical guidelines in relation to non-transport for Nova Scotia and other EMS systems by highlighting the greater odds of potentially adverse non-transport for older adults and patients with multiple co-morbidities. The higher likelihood of potentially adverse non-transport for older adults and those with multiple co-morbidities points to a potential link with patient frailty that is important for EMS systems to consider.

The results of this study provide timely information to healthcare policy makers and practitioners on the scope of non-transport and areas of particular concern or opportunity such as the use of EMS resources for low-acuity conditions, differences by age, and the higher likelihood of potentially adverse non-transport for old patients and patients with multiple co-morbidities.

The result also suggests potential directions for future study such as examining the appropriateness of EMS responses, the awareness among the public of appropriate EMS emergency medical calls and awareness of healthcare policy makers and practitioners of the types of unmet health care need in communities.

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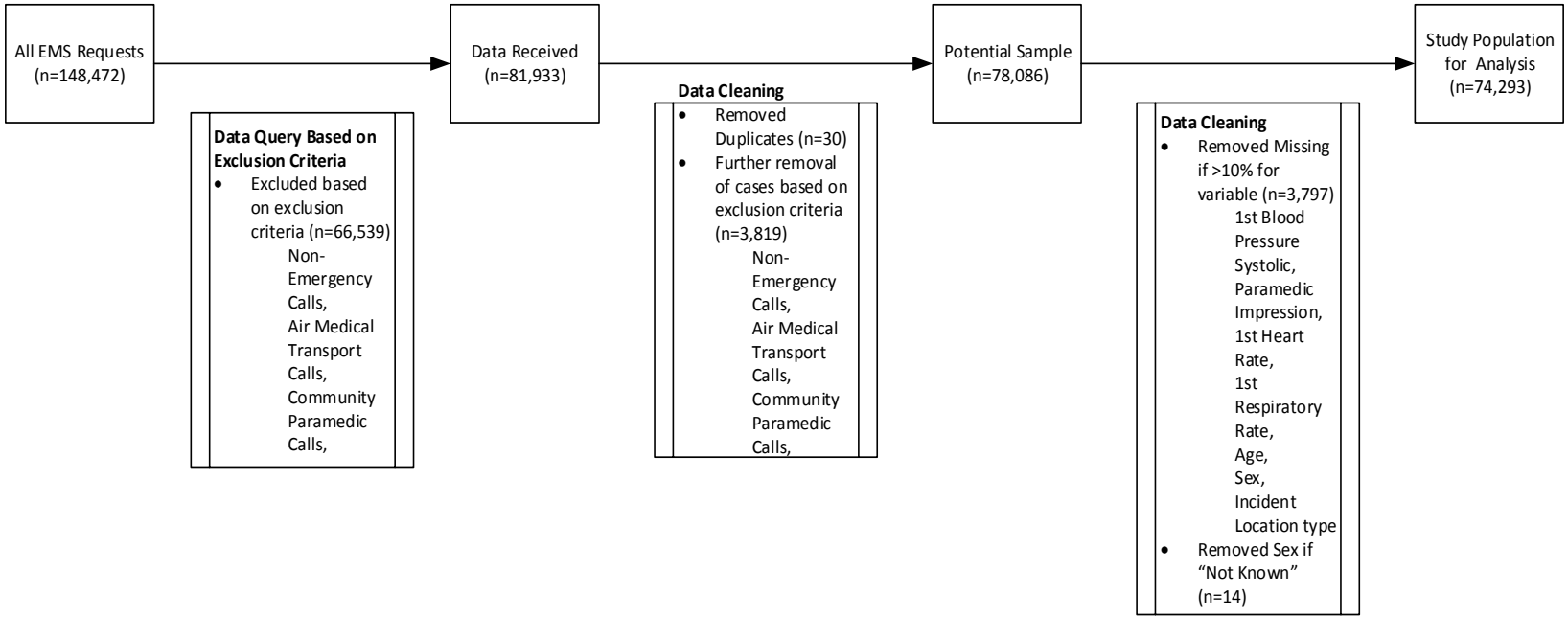
Appendices

Appendix A: Relapse Data Cleaning Steps

To ensure that the relapse cases were legitimate, the relapse outcome was also reviewed to determine what type of EMS service the patient relapsed to. Cases where the relapse response outcome was excluded from the study, were reclassified as not being cases of relapse based on the study exclusion criteria (i.e. Transfer, Air Medical Transport). For the remaining relapse cases the relapse chief complaint and the chief complaint of the initial EMS call were compared to determine whether they match exactly or were plausibly related (i.e. Wellness Check following Chest Pain). This resulted in 3,140 cases of legitimate relapse.

Appendix B: Data Cleaning Steps (January 1, 2014 - December 31, 2014)



Appendix C: Missing Data

Received Sample			Intended Sample		
Variable	**Missing Data**	**Missing Percent**	**Variable**	**Missing Data**	**Missing Percent**
Location of call (Postal Code)	80872	99%	Last Blood Pressure Systolic	48704	62%
Last Temperature	80756	99%	Last Oxygen Saturation	47562	61%
Last Glucose	80377	98%	1st Temperature	47199	60%
Clinical Protocol Selected by Paramedic	73662	90%	Last Respiratory Rate	46213	59%
Last Blood Pressure Diastolic	58187	71%	Last Heart Rate	44671	57%
Last Blood Pressure Systolic	52934	65%	1st Glucose	36798	47%
Last Oxygen Saturation	51777	63%	Call Duration	17965	23%
1st Temperature	51268	63%	Response Mode	15882	20%
Last Respiratory Rate	50402	62%	Last Blood Pressure Diastolic	12222	16%
Last Heart Rate	48789	60%	1st Blood Pressure Diastolic	12222	16%
1st Glucose	40454	49%	Canadian Triage and Acuity Score (CTAS)	9424	12%
EHS Arrived Patient Time	22302	27%	1st Oxygen Saturation	7646	10%
EHS Depart Scene	19004	23%	Clinical Protocol Selected by Paramedic	3576	5%
EHS Available Time	18563	23%	Paramedic Impression	3152	4%
Response Code	17353	21%	Patient Complaint	1360	2%
1st Blood Pressure Diastolic	14603	18%	Age	1108	1%
Canadian Triage and Acuity Score (CTAS)	12332	15%	Sex	727	1%
1st Oxygen Saturation	10288	13%	Incident location type	298	0%
Patient Complaint	10091	12%	Paramedic Crew Level	11	0%
1st Blood Pressure Systolic	6784	8%	Intervention Count	0	0%
Paramedic Impression	4927	6%	1st Blood Pressure Systolic	0	0%
1st Heart Rate	4360	5%	1st Heart Rate	0	0%
1st Respiratory Rate	4092	5%	1st Respiratory Rate	0	0%
Clinical Protocol Selected by Paramedic	4003	5%	Comorbidity Count	0	0%
Age	2404	3%	Medical Oversight Physician Contact	0	0%

Sex	1678	2%			
Location of call	1128	1%	Total	78086	100%
Incident Location type	1066	1%			
Arrive Scene	753	1%			
Paramedic Level	281	0%			
Intervention Count	0	0%			
Comorbidity Count	0	0%			
Response Outcome	0	0%			
Date of Call	0	0%			
Time of Day of Call	0	0%			
Medical Oversight Physician Contact	0	0%			
Total	81933	100%			

Appendix D: Missing Descriptive Statistics

	Number (N = 78086)	% (N= 100)
Patient Characteristics		
Age (years)		
Infant (less than 1 y.o.)	22	0.03%
Young child (1−5 y.o.)	1,407	1.89%
Child (6-10 y.o.)	737	0.99%
Adolescent (11-15 y.o.)	1,213	1.63%
Teen (16-20 y.o.)	3,392	4.55%
Young Adult (21–35 y.o.)	8,014	10.76%
Adult (36-50 y.o.)	8,858	11.89%
Middle Age Adult (51-65 y.o.)	14,576	19.57%
Old (66–75 y.o.)	11,691	15.70%
Old old (76-85 y.o.)	12,270	16.48%
Oldest old (85+ y.o.)	12,291	16.50%
Sex		
Male	34,306	46.07%
Female	40,153	53.92%
Not Known	12	0.02%
Patient Complaint		
Abdominal Pain / Flank Pain	5,224	7.01%
Acute Coronary Syndrome	233	0.31%
Allergic Reaction	534	0.72%
Altered Mental Status	2,098	2.82%
Arrhythmia	423	0.57%
Assault	380	0.51%
Back Pain - Non Traumatic	629	0.84%
Barotrauma	4	0.01%
Burns	118	0.16%
Cardiac Arrest	290	0.39%
CBRN / Hazmat	15	0.02%
Chest Pain (NYD)	4,961	6.66%
Childbirth / Post Partum Care	78	0.10%
Diabetic Problem	1,159	1.56%
Electrocution	6	0.01%
End of Life Care	48	0.06%
Environmental (Heat Cold)	85	0.11%
Epistaxis	352	0.47%
Foreign Body Obstruction (Partial / Complete)	135	0.18%
General Malaise	4,514	6.06%
GI Bleed	487	0.65%

Head / Neuro Injury	614	0.82%
Headache	872	1.17%
Major Trauma	684	0.92%
Medical Device Complication	168	0.23%
Minor Trauma	8,686	11.66%
Nausea / Vomiting	2,286	3.07%
Near Drowning	9	0.01%
Neonatal Care / Resuscitation	12	0.02%
No Apparent Illness / Injury	2,127	2.86%
Obvious Death	3	0.00%
Other	5,240	7.04%
Overdose / Poisoning	1,926	2.59%
Perinatal Mother Care	70	0.09%
Post Fall Assessment	4,352	5.84%
Pre-Eclampsia / Eclampsia	4	0.01%
Psychological Problem	2,460	3.30%
Pulmonary Edema (CHF)	151	0.20%
PV Bleed / Threatened Abortion	191	0.26%
Respiratory Arrest	24	0.03%
Respiratory Distress	5,421	7.28%
Seizures	2,093	2.81%
Sepsis	516	0.69%
Stroke / CVA / TIA	1,087	1.46%
Syncope	2,480	3.33%
Transfer	1,338	1.80%
Vertigo / Dizziness	1,107	1.49%
Violent / Agitated	97	0.13%
Weakness / Fatigue	3,198	4.29%
Wellness check	5,008	6.72%
Wound Care	299	0.40%
Missing	175	0.23%
Paramedic-documented clinical impression		
Cardiac Arrest	724	0.97%
Cardiovascular	6,242	8.38%
Chest Pain	1,024	1.38%
EENT	905	1.22%
Environmental	649	0.87%
Gastrointestinal	9,367	12.58%
Glycemic	1,452	1.95%
Neuro	7,242	9.72%
OB/GYN	465	0.62%
Non-specific	14,675	19.71%
Palliative or End-of-Life Care	147	0.20%

Pediatric	187	0.25%
Psychological	4,093	5.50%
Respiratory	5,875	7.89%
Shock/Sepis	829	1.11%
Skin	536	0.72%
Substance Misuse / Intoxication	597	0.80%
Toxicology	1,415	1.90%
Trauma	12,868	17.28%
Wellness/Med Check	5,179	6.95%
Canadian Triage and Acuity Score (CTAS)		
Resuscitation (1)	901	1.21%
Emergency (2)	11,504	15.45%
Urgent (3)	30,630	41.13%
Less Urgent (4 or 5)	23,959	32.17%
Missing/Not Recorded	7,477	10.04%
Co-morbidities		
0	413	0.55%
1 or 2	32,752	43.98%
3 or 4	18,848	25.31%
5 or 6	11,201	15.04%
>7	11,257	15.12%
First Respiratory Rate		
Normal RR (<16 or >20 breaths/minute)	55,363	74.34%
Abnormal (>15 or <21 breaths/minute)	19,108	25.66%
First Temperature		
Normal Temperature (<36 °C or >39 °C)	26,255	33.62%
Abnormal Temperature (>35.9 °C or 39.1 °C)	3,362	4.31%
Missing/Not Recorded	44,188	62.07%
First GLC		
Normal GLC (<4.4 to >6.1 mmol/L)	10,593	13.56%
Abnormal GLC (>4.5 to <6.2 mmol/L)	28,561	36.57%
Missing/Not Recorded	33,905	49.87%
First O2 Saturation		
Normal O2 Saturation (<90%)	64,589	86.73%
Abnormal O2 Saturation (>89%)	4,172	5.60%
Missing/Not Recorded	5,710	7.67%
First Blood Pressure DIA		
Normal BPD (<80 or >90)	21,041	28.25%
Abnormal BPD (>79 or <91)	43,157	57.95%
Missing/Not Recorded	10,273	13.79%
First Blood Pressure SYS		
Normal BPS (<120 or >140)	28,050	37.67%

Abnormal BPS (>119 or <141)	46,421	62.33%
First Heart Rate		
Normal HR (<50 or >110 beats/min)	61,837	83.04%
Abnormal (>49 or <111 beats/min)	12,634	16.96%
Last Respiratory Rate		
Normal RR (<16 or >20 breaths/minute)	23,707	31.83%
Abnormal (>15 or <21 breaths/minute)	7,381	9.91%
Missing/Not Recorded	43,383	58.25%
Last O2 Saturation		
Normal O2 Saturation (<90%)	2	0.00%
Abnormal O2 Saturation (>89%)	29,869	40.11%
Missing/Not Recorded	44,600	59.89%
Last Blood Pressure DIA		
Normal BPD (<80 or >90)	6,660	8.94%
Abnormal BPD (>79 or <91)	57,538	77.26%
Missing/Not Recorded	10,273	13.79%
Last Blood Pressure SYS		
Normal BPS (<120 or >140)	10,903	14.64%
Abnormal BPS (>119 or <141)	17,713	23.79%
Missing/Not Recorded	45,855	61.57%
Last Heart Rate		
Normal HR (<50 or >110 beats/min)	27,784	37.31%
Abnormal (>49 or <111 beats/min)	4,825	6.48%
Missing/Not Recorded	41,862	56.21%
Interventions		
0	31,755	42.64%
1 or 2	21,362	28.68%
3 or 4	13,755	18.47%
5 or 6	4,941	6.63%
>7	2,658	3.57%
Operational Characteristics		
Paramedic Crew Type		
BLS Crew	19,674	26.42%
ALS Crew	48,748	65.46%
Other	6,049	8.12%
Duration of patient contact		
0 to 20 Minutes	2,953	3.97%
21 to 40 Minutes	11,546	15.50%
41 to 60 Minutes	15,118	20.30%
Greater than 60 Minutes	27,809	37.34%
Missing	17,045	22.89%
Response Mode		

Code 1 (lights & siren)	39,248	52.70%
Code 2 (no lights & siren)	20,470	27.49%
Other	166	0.22%
Missing	14,587	19.59%
OLMOP Contact		
Yes	3,332	4.47%
No	71,139	95.53%
Environmental Characteristics		
Day of Call		
Sunday	10,571	14.19%
Monday	10,755	14.44%
Tuesday	10,325	13.86%
Wednesday	10,747	14.43%
Thursday	10,577	14.20%
Friday	10,833	14.55%
Saturday	10,663	14.32%
Month of Call		
January	6,429	8.63%
February	5,605	7.53%
March	6,349	8.53%
April	5,892	7.91%
May	6,193	8.32%
June	6,082	8.17%
July	6,505	8.73%
August	6,361	8.54%
September	6,080	8.16%
October	6,192	8.31%
November	6,345	8.52%
December	6,438	8.64%
Time of Call		
Early Morning (0-4)	9,293	12.48%
Morning (5-8)	9,380	12.60%
Late Morning (9-12)	17,049	22.89%
Afternoon (13-16)	15,280	20.52%
Night (17-20)	14,647	19.67%
Late Night (21-24)	8,822	11.85%
Incident Location Type		
Airport/Strip	161	0.22%
Hospital	2,021	2.71%
Industrial	84	0.11%
Jail/ Detention Facility	914	1.23%
Lake, River, Ocean	7	0.01%
Medical Clinic	386	0.52%

Nursing Home	4,782	6.42%
Other...	2,611	35.06%
Recreation / Sport Facility	174	0.23%
Residence / Home	35,562	47.75%
School	354	0.48%
Senior Center	1,672	2.25%
Street / Highway	2,197	2.95%
Woods / Wilderness	46	0.06%

Appendix E: Non-transport Status Models for the Variable Selection Process

Patient Characteristics	**Variables**
Patient Characteristics Demo Model 1	Age, Sex
Patient Characteristics Demo Model 2	Age, Sex, Age#Sex
Patient Characteristics Demo Model 3	Age
Patient Characteristics Clinical Model 1	Patient Complaint, Paramedic Impressions
Patient Characteristics Acuity Model 1	Co-morbidities
Patient Characteristics Acuity Model 2	Co-morbidities, Interventions
Patient Characteristics Vital Signs Model 1	Respiratory Rate, Blood Pressure Systolic
Patient Characteristics Vital Signs Model 2	Respiratory Rate, Blood Pressure Systolic, Heart Rate
Patient Characteristics Vital Signs Model 3	Respiratory Rate, Blood Pressure Systolic
Patient Characteristics Model Final	Age, Paramedic Impressions, Co-morbidities
Operational Characteristics	
Operational Characteristics Model 1	Paramedic Crew Type, Response Code
Operational Characteristics Model 2	Response Code
Environmental Characteristics	
Environmental Characteristics Model 1	Time of Day of Call, Location Type
Environmental Characteristics Model 2	Month of Call, Time of Day of Call, Location Type
Environmental Characteristics Model 3	Day of Call, Month of Call, Time of Day of Call, Location Type
Environmental Characteristics Model 4	Month of Call, Time of Day of Call, Location Type
Environmental Characteristics Model 5	Month, Location Type
Patient + Operational Characteristics	
Patient + Operational Characteristics Model 1	Age, Paramedic Impressions, Co-morbidities, Response Code
Patient + Operational + Environmental Characteristics	
Patient + Operational +Environmental Characteristics Model 1	Age, Patient Complaint, Paramedic Impressions, Co-morbidities, Response Code, Month, Location Type
Patient + Operational +Environmental Characteristics Model 2	**Age, Paramedic Impressions, Co-morbidities, Location Type**
The final model is bolded.	

<u>Appendix F:</u> Potentially Adverse Non-transport Status Models for the Variable Selection Process

Patient Characteristics	**Variables**
Patient Characteristics Demo Model 1	Age, Sex
Patient Characteristics Demo Model 2	Age, Sex, Age#Sex
Patient Characteristics Demo Model 3	Age
Patient Characteristics Clinical Model 1	Patient Complaint, Paramedic Impression
Patient Characteristics Clinical Model 2	Paramedic Impression
Patient Characteristics Acuity Model 1	Co-morbidities
Patient Characteristics Acuity Model 2	Co-morbidities, Interventions
Patient Characteristics Acuity Model 3	Co-morbidities
Patient Characteristics Vital Signs Model 1	Respiratory Rate
Patient Characteristics Vital Signs Model 2	Blood Pressure Systolic
Patient Characteristics Vital Signs Model 3	Heart Rate
Patient Characteristics Vital Signs Model 4	No significant vital signs
Patient Characteristics Model Final	Age, Paramedic Impression, Co-morbidities
Operational Characteristics	
Operational Characteristics Model 1	Paramedic Crew Type
Operational Characteristics Model 2	Response Code
Operational Characteristics Model 3	No significant characteristics
Environmental Characteristics	
Environmental Characteristics Model 1	Location Type
Environmental Characteristics Model 2	Time of Call, Location Type
Environmental Characteristics Model 3	Month of Call, Location Type
Environmental Characteristics Model 4	Day of Call, Location Type
Environmental Characteristics Model 5	Location Type
Patient + Operational Characteristics	
Patient + Operational Characteristics Model 1	Age, Paramedic Impressions, Co-morbidities
Patient + Operational + Environmental Characteristics	
Patient + Operational +Environmental Characteristics Model 1	Age, Paramedic Impressions, Co-morbidities, Location Type
Patient + Operational +Environmental Characteristics Model 2	**Age, Paramedic Impressions, Co-morbidities, Location Type**
The final model is bolded.	