

NOVA SCOTIA 811 TELEPHONE TRIAGE AND LOWER ACUITY PEDIATRIC EMERGENCY
DEPARTMENT VISITS AT THE IWK HEALTH CENTRE

by

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ABSTRACT

Growth in Emergency Department (ED) demand is occurring across the developed world, with increases in both urgent and non-urgent ED visits.

Telephone triage systems allow a caller to speak with a healthcare professional for advice and guidance on whether a problem requires an ED visit, primary care, or self-care at home.

Telephone triage may have the potential to decrease non-urgent pediatric ED visits by directing callers with lower acuity problems to a non-ED care option.

On July 29, 2009 the Nova Scotia (NS) Department of Health and Wellness introduced a provincial telephone triage system, Nova Scotia 811. In the year following implementation, 811 was associated with a modest decrease of 3.6% in the proportion of lower acuity visits at the IWK tertiary care pediatric ED. This study is the first to assess the impact of a regional telephone triage system on pediatric ED visits in a publicly funded healthcare system.

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CHAPTER 1: INTRODUCTION

“Telehealth line saved thousands of ER trips.” cbc.ca/Nova Scotia

In an August 3, 2010 press conference, a spokesperson for the Nova Scotia Department of Health and Wellness reported that by using the Nova Scotia 811 telephone triage service, *“thousands of callers were saved unnecessary trips to the hospital”* (1). The statement raises two important questions: what is an unnecessary trip to the hospital, and does telephone triage save hospital visits? This study aims to address these questions through the lens of an academic pediatric emergency department.

1.1 ED AS THE ENTRY POINT INTO THE HEALTH CARE SYSTEM

The Canadian Association of Emergency Physicians (CAEP) defines emergency medicine to encompass *“the timely evaluation, diagnosis, treatment and disposition of all patients with injury, illness and/or behavioural disorders requiring expeditious care, 24/7/365”*(2). Growth in ED demand continues across the developed world, in part as a reflection of its role as the main, and often default, entry point of the health care system (3). ED visits in the US increased at more than double the rate of population growth between 1993 and 2003 (4), with a similar trend observed in Ontario between 2008 and 2015 (5). In a review of the literature on urgent care by Turner et.al., the authors noted year on year increases in demand for urgent and emergency care over the past 40 years, which was consistent across developed countries (6). Increased ED demand has been reported in many countries, including Canada, at levels that are described as *“significant and unsustainable”* (7).

In their review, Turner et.al. noted that *“despite the serious concerns about rising demand for emergency and urgent care and the impact that this has on health services, there is remarkably little empirical evidence that can fully explain why this trend in behavior has occurred”*(6). It

appears that the increased demand is not in keeping with population growth, the aging population, or increased medical complexity, and is likely influenced by a range of factors: timely access to primary care, healthcare needs, social and economic factors including lack of social supports, convenience, and individual decision-making (6).

Historically emergency departments (ED's) were developed to provide treatment for unanticipated injury, illness or life-threatening conditions, though beginning in the 1960's to 1970's there were occasional reports of non-emergency use of the ED (8). By 1993 it was estimated that 43% of ED visits were for non-urgent conditions (8), while a more recent systematic review found that this group of patients accounted for 37% of all ED visits (9). In the pediatric emergency medicine literature, the rate of non-urgent visits shows similar patterns (10–12), with a 2019 systematic review finding the proportion of non-urgent pediatric ED patients to be 41% +/- 15% (13). In pediatrics, growth in ED utilization appears to be associated with an increase in the number of both urgent and non-urgent visits (14). There is considerable variability in these estimates, in part due to definition of ED visit urgency, which itself is highly variable.

1.2 DEFINING NON-URGENT ED VISITS

One of the primary challenges in researching non-urgent, “unnecessary” or “inappropriate” ED utilization is the lack of an agreed upon definition of what constitutes a necessary or appropriate reason for attending an ED (9,13,15). A recent definition suggests that “...*non-urgent ED visits are typically defined as visits for conditions for which a delay of several hours would not increase the likelihood of an adverse outcome*” (9). Although conceptually intuitive, this definition is difficult to operationalize in research, policy, or individual patient decision-making.

In 2008 Mistry, et. al. reviewed the current methods defining non-urgent ED visits, noting that the “*accurate and consistent classification of non-urgent ED visits has remained a challenge*” (16). Other researches found that no two studies used exactly the same definition of non-urgent visits (9), with a 2011 review identifying 51 different definitions used in the published literature (17). Part of the difficulty in defining urgency stems from the complexity of an ED visit. Beginning with the patient’s symptoms and decision to attend the ED, triage and physician assessment, investigations, treatment, and ultimately diagnosis and disposition, there is no single or aggregate measure that easily captures visit urgency across the spectrum of ED patient presentations.

Aiming for a degree of clarity, Mistry et.al. describe six general methods to define a non-urgent ED visit: Implicit Criteria, Explicit Criteria, Resource Use, Procedure Codes, Diagnosis or ICD Code, and Nurse Triage Category. The Implicit Criteria method, based on retrospective expert review of the complete medical chart, integrates triage information, presenting complaint, ED interventions, procedures, diagnosis, and disposition (decision on hospital admission or discharge) to determine the urgency of an ED visit (16). The Explicit Criteria method is similar though uses pre-defined components of the ED visit, typically the presenting complaint, resource use, and disposition, requiring review but not expert assessment of the chart (16). These two methods share reasonable agreement and have the best potential to serve as a standard but are less suitable for large scale analysis due to the required resources of time and personnel.

Resource Use, Procedural Codes, ED Diagnosis and Nurse Triage Assessment can be defined as limited data methods which are suitable for use with large administrative datasets. These methods typically rely on readily available administrative data, but risk over-simplification of a complex process by using limited information. Resource use assessment assumes that more urgent visits require greater use of diagnostic and therapeutic resources, thus represent more urgent visits. Procedure codes are frequently used in ED billing and have similar characteristics

to resource utilization. Diagnosis or ICD codes are routinely collected and have been used by insurance companies for determining levels of urgency, though are hindered by reliability of ED discharge diagnoses (16).

ED nurse triage occurs at the beginning of every ED visit, integrating important components of visit urgency in order to prioritize care in the ED (16). ED triage is based on the presenting complaint, physiologic criteria, and a brief physical examination, and uses a standardized assessment tool to assign a triage score reflecting the urgency or acuity of the presenting problem. The Canadian Triage Acuity Scale (CTAS) is used by most Canadian ED's, assigning a triage score of one through five, from the highest acuity score of one, to the lowest, five (18). A nurse triage score based on a standardized assessment tool is assigned and recorded in initial phase of every ED visit, ensuring consistency and availability as a measure of visit urgency. Lower acuity triage scores have been used in several research studies as a measure of non-urgent ED visits (13).

In their systematic review, Durand et. al. additionally separate urgency classifications into those applied prospectively, intended to direct or prioritize clinical care, and those applied retrospectively, which are primarily used in a policy or research context, aiming to understand the factors associated with non-urgent ED visits (17). There is further ambiguity as the terms used to describe an ED visit as *urgent* or *non-urgent* may not represent the same intent when used by researchers, policy makers, and clinicians (17). Durand and Mistry note additional confusion around the concept of *non-urgent* and *inappropriate* (or "*unnecessary*") ED visits, with some researchers, authors and policy makers failing to distinguish between these very different terms (16,17). Visit urgency relates to the severity of the medical problem or the patient's condition, while appropriateness considers the social and psychological context of the visit, including a patient's access to care (16,17). Richardson and Hwang noted in a 2001 review of access to care and emergency medicine: "*From the perspective of an individual with limited*

resources, for whom an ED visit may be the only available source of healthcare, a non-urgent ED visit may be far more appropriate than seeking no care at all” (15).

Despite multiple methods of urgency classification, each having advantages and disadvantages, ambiguity remains as how best to define a non-urgent ED visit. The lack of an agreed upon definition of a non-urgent ED visit has important implications for research and policy development (16). In addition, if researchers and administrators are unable to clearly define the urgency or appropriateness of an ED visit, one could assume that patients will similarly face uncertainty in deciding when to access ED care. Recognizing the challenge in categorizing ED visits, the following section considers individual and system-related factors associated with non-urgent pediatric ED visits.

1.3 FACTORS ASSOCIATED WITH NON-URGENT ED VISITS

Numerous researchers have investigated the reasons for ED attendance for non-urgent conditions, with various explanations in both general and pediatric populations. A systematic review from 2013 concluded that “*...it is challenging to summarize what drives the decision to seek ED care for non-urgent conditions. The limited evidence suggests that younger age, greater convenience of the ED compared to other ambulatory care alternatives, referral to the ED by a healthcare provider, and negative perceptions of non-ED care sites all play a role in decisions to seek care in the ED for non-urgent problems” (9).*

In pediatric studies, the lack of timely access to a primary care provider is the most important driver of non-urgent ED visits in pediatric patients, with multiple contributing factors: difficult scheduling, longer waiting times, and limited available hours or appointment times (11,13,19–22). Having a primary care provider does not necessarily reduce non-urgent ED visits; it is the lack of timely access to care that is associated with non-urgent ED use (13,19,23). Another important reason for non-urgent ED visits in pediatric patients is referral to the ED by another

health professional. These visits are often due to inappropriate telephone referral, which itself may be the result of limited access to primary care (9,24,25). Convenience is commonly cited as a reason for non-urgent ED visits (9), though convenience may imply access to care when needed, rather than simply ease or preference.

Perception of urgency is another important factor in non-urgent ED visits, even though the visit or concern may be considered non-urgent by health professionals (26). In pediatric ED patients, parents often over-estimate the urgency of a medical problem when compared to the triage and ED physician assessment (27). Stockwell et.al. found that perception of urgency was the main contributor to ED attendance, accounting for 60% of non-urgent visits in a study completed in 1997. When the study was repeated in 2006, perceived urgency accounted for only 20% of non-urgent visits, with lack of primary care access and referral to the ED by another provider becoming the main reasons for non-urgent ED visits (28).

The quality of care available in the ED is another important reason for non-urgent visits, though there is limited research around this question (29). Kubicek, et.al. studied a group of children from predominantly low-income, minority families in Los Angeles presenting to a pediatric ED for a non-urgent medical problem. Although perception of an urgent medical problem was an initial concern in 63%, an additional factor underlying the visit was timely access to high quality care available in the ED, despite almost all having a primary care provider (30). Other studies of non-urgent pediatric patients found that quality of care was a frequently cited reason for their ED visit, particularly in vulnerable populations (11,31,32). In addition to access to care, Stockwell et.al. also found that quality of care available in the ED was an increasingly important motivator of non-urgent ED visits in their study population (28).

Several researchers have identified patient and family characteristics associated with non-urgent ED presentations. These include lower levels of education and health literacy (33), lower socio-economic status (19), race, younger age, female patients (13), geographic proximity

to the ED (13,34), and public versus private insurance, particularly in the US (23). Season and timing have been associated with non-urgent ED visits, with time outside of regular working hours, weekends, holidays, and winter season associated with increased non-urgent ED visits (12,35).

Although healthcare staff may have the perception that ED use for non-urgent conditions is an inappropriate use of the system and resources provided, a 1991 study found that 50% of non-urgent patients were seeking reassurance alone, without the expectation of tests or procedures (36). A 2015 study from France found that parents of non-urgent pediatric patients identified the ED as the setting best able to immediately soothe their anxiety and distress (37). In a study from the British Columbia Children's Hospital, 90% of parents attending the pediatric ED considered their child's illness to be of mild to moderate severity, suggesting a desire for ED care not solely due to illness severity or urgency (38). Many parents of children being seen in the ED for non-urgent conditions felt their attendance was appropriate given the immediate need for reassurance that the child was safe (24,39). A study from the Netherlands found that parents seek to exclude life-threatening illness, and that parental worry may reflect an increasingly risk-averse society. The authors found that visiting a doctor was the only way to reassure patients and parents, and that telephone consultation alone was not sufficient (40).

From published literature, it can be concluded that the most important driver of non-urgent pediatric ED visits is the timely availability of high-quality care available in the pediatric ED, coupled with the limited availability of non-ED care or primary care options. These are important factors to consider if policy makers seek to address non-urgent ED visits in the pediatric population.

1.4 REDUCING NON-URGENT ED VISITS

Although non-urgent pediatric patients may be an important contributor to ED demand, the diverse range of reasons for non-urgent visits presents a challenge in addressing this phenomenon. In a review of various interventions to reduce non-urgent visits, Morgan et. al. considered the evidence on patient level interventions, and on system-related changes. Their review suggested a broad range of effectiveness and conflicting results, with the greatest reductions occurring through financial incentives and managed care (41), factors of less importance in jurisdictions with well-functioning, publicly funded healthcare. Although patient or parent education is often suggested as an important intervention to reduce non-urgent ED visits, many authors found that lack of knowledge is not an important contributor to non-urgent ED attendance (11,38,41).

Various programs have been implemented with the goal of reducing non-urgent ED visits, though little high-quality evidence is available, with many interventions lacking evidence of effectiveness (6,42). In a systematic review focusing on system level interventions, Ismail et.al. concluded there was minimal impact on ED visits from walk-in clinics, general practice cooperatives providing after-hours service, emergency nurse practitioners, and telephone triage (42). The following section reviews the literature on the impact of telephone triage and emergency department utilization.

CHAPTER 2: TELEPHONE TRIAGE

Telephone triage is the process by which a patient or guardian can speak with a healthcare professional with the goal of triage to the most appropriate level of care. The American College of Physicians noted that telephone triage systems have become “*a key tool for patients accessing the health care system*” (43). Early telephone triage systems, especially in the US, were introduced as a means of demand management and cost control, with nurses screening callers to determine who needed to access care (43). As telephone triage became more widespread, the systems have become standardized, and the rationales for its use have expanded. Most current telephone triage systems employ registered nurses using computer-aided decision support software with the goal of directing patients to their required level of care: triage to the emergency department, to primary care, or self-care without a healthcare visit (44).

Gatekeeping and demand management remain a focus for telephone triage systems, particularly in those jurisdictions with a for-profit healthcare system (45,46). In publicly-funded health care systems, additional reasons have been cited for telephone triage, including more efficient utilization and coordination of health care professionals (47,48), accessibility and consistency of health care advice (45,49), and rationalization of limited health care resources by directing the patient to the most appropriate care (44,50). Other reasons for telephone triage include documentation of telephone contacts (51), medico-legal risk protection (52), as well as physician satisfaction and burn-out prevention by reducing after-hours calls (51).

In a review of Canadian telephone triage systems, Stacey et.al noted that “*teletriage is not a medical procedure, it is an administrative innovation that channels potential clients to the appropriate health services*” (44). Although most Canadian jurisdictions have implemented telephone triage systems, there remain gaps in the evidence supporting the impact of these systems on urgent care provision (6,44). In a review of different models of delivering urgent

care by Turner et.al. the authors noted: “Given that a primary objective of telephone triage and advice services has been to improve and simplify access to urgent care, there is remarkably little evidence about the impact of these services” (6).

2.1 LITERATURE REVIEW OF TELEPHONE TRIAGE AND THE ED

The published literature was reviewed to determine the evidence of the impact of telephone triage on Emergency Department utilization. A broad search strategy modeled on that used by Turner, et.al. in their evidence review of different models of delivering urgent care (6) was used to search Medline for studies published from 2000 to 2019. The search was conducted using Pub-Med on January 30, 2019.

The Pub-Med search identified 1,789 publications, subsequently reduced to 140 on review of title and abstracts from the initial list. Full text review of papers further reduced the number of included studies to 63. From citations and reference lists, an additional ten studies were identified for a total of 73 papers published between 2000 and 2019 meeting the inclusion criteria: general telephone triage systems, excluding those directed to specific clinical programs. The included papers, with a brief summary of their findings, are listed in the Appendix. Most of the identified publications were based on retrospective observational studies from a single health center or health region. The search identified several narrative and systematic reviews, as well as *review of reviews*. The studies were not analyzed quantitatively, and quality was not formally assessed.

Organization of the Literature Review: The objective of the review is to better describe the impact of telephone triage services on emergency medicine, particularly related to ED utilization. To this end, the impact of telephone triage can be considered a function of the referral recommendations with assessment of appropriateness (including over-triage to emergency services) and safety (or under-triage to a lower level of care, risking patient harm),

patient compliance, and satisfaction with the telephone triage service or recommendations. Studies on the utilization of emergency medical services consider the broad impact of telephone triage on the system of emergency care. There were few studies where cost or economic aspects were considered.

Appropriateness: Most of the studies looking at appropriateness of referrals were cross-sectional studies from a single region or health center. One of the primary difficulties in determining the appropriateness of a telephone triage referral is the lack of a clear definition of what is considered an appropriate ED visit (53). Reported rates of over-referral, or referral to a higher level of care than needed, ranged widely from 2.4% (48) to as high as 33% (54), with the degree of variation likely accounted for by the definition of appropriate as well as study design. In a systematic review by Blank, et.al., accuracy or appropriateness of ED referrals was found to be between 44% and 98% with a mean of 75% (53). Telephone triage recommendations, however, may be no more discerning than patient self-referral to the ED (55–57). A US study identified specific symptom algorithms that resulted in higher rates of non-urgent ED referrals (54). One review noted that in publicly-funded health systems where there is no patient-borne cost of over-referral, telephone triage tends to default to a more cautious approach of over-referral in order to avoid unsafe recommendations, at the potential system cost of increasing non-urgent ED referrals (44).

Safety: Appropriateness and safety are opposites in terms of telephone triage recommendations, with over-referral potentially serving as a margin of safety, while under-referral to a lower level of care risks compromising the safety of telephone triage (58). A review by Huibers, et.al. noted that studies using simulated patient scenarios tend to show higher levels of under-referral while observational studies found lower rates of unsafe recommendations or under-referral (59). Huibers' systematic review found a range of unsafe referral between 0.023% to 22% across studies, with observational clinical studies showing an average rate of safe referral of 97% (59). In their review of studies on the appropriateness and

safety of telephone triage, Blank et.al. found under-referral in 0.2 to 50% of calls, with potential harm in 1.3% to 3.2% of triage recommendations (53). A study from the Netherlands found decreased recognition of urgency and poorer quality communication in more urgent or critical calls (49). Using an outcome-based definition of hospitalization following a non-urgent triage recommendation, rates of unsafe under-referral in a Danish retrospective study were 0.04%, or 1 in 2500 calls (45). Rates of under-referral may be contributed to by a change in the patient's clinical condition with an eventual requirement for more urgent care (60).

Compliance: Compliance indicates the degree to which callers follow the recommendation of the telephone triage service. Most studies of telephone triage compliance were retrospective, cross-sectional studies of a health region, or based on analysis of an administrative database. In a review specifically looking at caller compliance with telephone triage recommendations, Purc-Stephenson, et.al. found overall compliance across studies to be 62% (60). In their systematic review, Blank, et.al. reported an overall rate of compliance with telephone triage of 77% (53). Studies of patient compliance with telephone triage generally found higher rates of compliance with triage to the ED or self-care, particularly when triage recommendations matched callers' initial intentions (60). A database study capturing calls and healthcare visits across a large Canadian health region found actual patient compliance with an ED recommendation was only 52% (61).

Various reasons for lack of compliance were noted, including recall problems, lack of understanding of advice, change in symptoms, lack of trust in the telephone recommendation or wanting a second opinion, as well as lack of accessibility of the advised option (60). A small Canadian study found that 12% of patients recalled a recommendation to seek urgent care when this was not the recommendation provided by telephone triage (62). In a British study, Njeru et.al. noted a difference in patient agreement and compliance with telephone triage recommendations depending on language proficiency, with lack of proficiency predictably having a negative effect on compliance (63). Ultimately patient compliance is an important

factor in all aspects of telephone triage: if patient compliance is poor, the utility and safety of telephone triage are compromised.

Satisfaction: Most studies of patient satisfaction used cross-sectional surveys of different patient populations. Rates of patient satisfaction were generally high, with studies noting a correlation between satisfaction and a match between caller intention and triage recommendation (64,65), though one US study reported much higher rates of satisfaction (93% to 99%) than compliance with the telephone triage recommendations (80%) (66). With the correlation between satisfaction and caller compliance, patient satisfaction could have important impacts on the safety of telephone triage as well as on care utilization.

Utilization: ED utilization, as it relates to telephone triage, represents the aggregate impact of the appropriateness of the referral, patient compliance, and availability of the telephone triage recommended care. Of studies reporting the impact of telephone triage on ED utilization, several relied on the difference between initial caller intention for ED care versus telephone triage recommendations, without the ability to follow up on the actual caller decision (67–70). One US study suggested that telephone triage could potentially increase ED utilization due to a lack of primary care alternatives to the ED (71). Two studies using time series analysis from the UK found no difference in urgent care utilization with the addition of a telephone triage system to a large health region (72,73). A study from New Zealand found a 1.1% increase in ED patient visits following the piloting of a national telephone triage service (74). Conversely, a US study using time series analysis found a decrease in ED use with the introduction of a telephone triage system (75). A study assessing the impact of a telephone triage system introduced in a single pediatric ED in the US found a small decrease in the proportion of lower acuity ED visits in publicly insured Medicaid patients, with no change in visits in the non-insured patient population (76).

Several reviews looking at health care utilization and telephone triage concluded that there was no significant impact of telephone triage on ED utilization (6,42,44,77–81). The reviews by Carrasquero and Van den Heede suggested that telephone triage may defer rather than prevent an ED visit, delaying ED care rather than solving the patient’s problem (78,81).

Conclusions from the Literature Review: Despite the widespread use of telephone triage across health systems, there is limited evidence to suggest an impact on emergency medicine and emergency department utilization. Telephone triage recommendations are generally appropriate, though not necessarily more discerning than patient self-referral. Telephone triage appears to be safe for most callers, with small potential for unsafe recommendations. Patient compliance with telephone triage recommendations is approximately 75%, and most studies found a high level of patient satisfaction. Studies looking broadly at the impact of telephone triage on ED utilization ranged from finding no impact, decreased utilization, or increased ED visits, with most studies and reviews finding no significant impact. Variations in findings can likely be accounted for by differing study designs and study populations, as well as differences in telephone triage processes operating in diverse healthcare systems. Although telephone triage systems are intended to direct patients to the most appropriate level of care, there is limited evidence on whether there is an impact of these systems on lower acuity pediatric ED visits.

CHAPTER 3: STUDY QUESTION AND METHODOLOGY

On July 29, 2009, the Nova Scotia Department of Health and Wellness introduced a provincial telephone triage system, Nova Scotia Health Link 811. A reasonable hypothesis is that telephone triage should be an effective intervention to reduce non-urgent ED visits in the pediatric population. Non-urgent ED visits are frequent in pediatrics, and often the result of a parental perception of medical urgency and a lack of timely primary care access. If telephone triage systems can accurately determine whether or not a patient requires ED care, there is the potential to decrease non-urgent ED visits by directing callers with non-urgent problems to a non-ED care option.

A reliable and readily available method of categorizing the urgency of ED visits is an important initial step in researching the impact of telephone triage on the pediatric ED. In clinical use, a nurse triage acuity score is assigned at the beginning of every ED visit, with the goal of prioritizing care. Although there is no single method of defining non-urgent ED visits, nurse triage assessment scores integrate multiple aspects of an ED patient presentation into a single measure which is amenable to large scale analysis. Nurse triage scores have been used in a number pediatric ED studies (13), and have shown good correlation with measures of ED visit urgency (82).

In 2015 Petrie suggested a broader categorization of ED visits based on acuity and schedule-ability (83). In this model, illustrated in Figure 1, cohorts A and B include patients with unexpected illness or injury, appropriate ED patients despite a lower triage acuity in cohort B (2). While patients in cohort C may receive a higher triage acuity score due to complexity, this cohort, as well as cohort D, could likely be better served in a scheduled, non-ED care environment (83). This categorization can be helpful in better understanding the factors underlying an ED visit in the broader context of access to care within the healthcare system. Looking specifically at the pediatric population, Jun et.al observed that *“younger people tend to*

present more frequently to EDs for injury and less-urgent illness such as fever, cough, nausea or vomiting” (26), primarily cohorts A and B. While acuity is a function of the presenting medical problem, telephone triage has the potential to address schedule-ability by directing patients to the most appropriate level of care. This study categorizes ED visits by nurse triage scores as lower acuity and higher acuity, based on the Canadian Triage and Acuity Scale (CTAS).

Emergency Department Cohorts	Unforeseen Unscheduled	Predictable Schedulable
CTAS 1,2,3	Time Dependency: high Symptom Duration: hours to days Examples: major trauma, respiratory distress Cohort A	Time Dependency: possibly low Symptom Duration: weeks to months Examples: incomplete work-up, blocked feeding tube Cohort C
CTAS 4,5	Time Dependency: moderate Symptom Duration: hours to days Examples: minor trauma, fever, sore throat Cohort B	Time Dependency: low Symptom Duration: weeks to months Examples: prescription refill, second opinion, chronic pain Cohort D

FIGURE 1: Acuity and Schedule-ability (83)

The conceptual framework (Figure 2) illustrates the impact of 811 telephone triage on lower acuity visits at the IWK ED and provides a foundation for the current study. Although acuity is a function of ED triage and strictly applicable only to those patients attending an ED, it is a reasonable supposition that patients directed to primary care or self-care by telephone triage would be of lower acuity. As illustrated, telephone triage has the potential to increase or decrease lower acuity ED visits. If callers with a lower acuity problem receive an appropriate triage to self-care or primary care, are compliant, and have access to the recommended care, lower acuity ED visits could potentially be reduced. If callers with a lower acuity problem better served by self-care or primary care are directed to the ED through an inappropriate triage, are non-compliant with a non-ED care recommendation, or if the recommended care is unavailable, telephone triage could lead to increased lower acuity ED visits.

How Does Telephone Triage Impact Lower Acuity ED Visits?

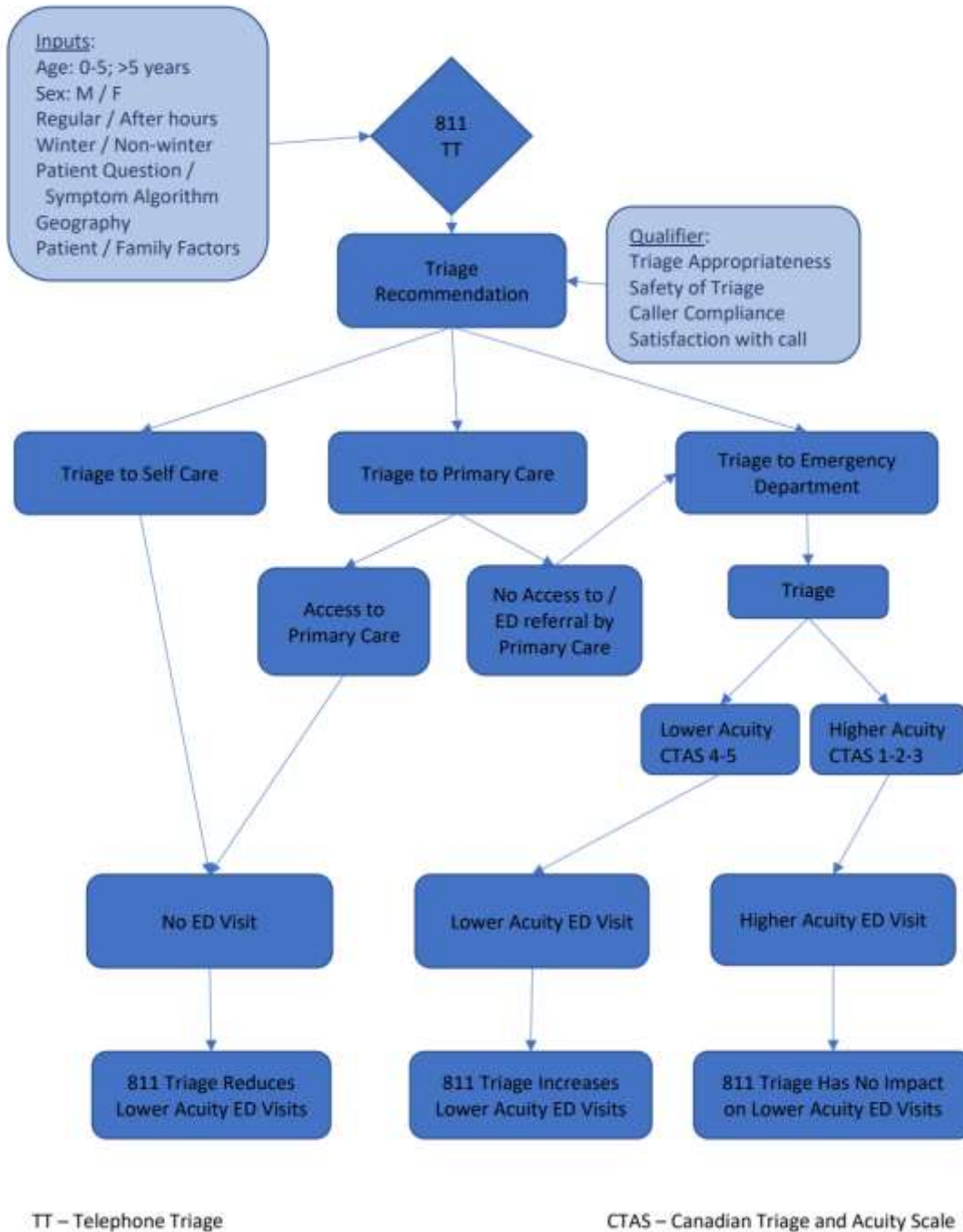


FIGURE 2: Impact of Telephone Triage on Lower Acuity ED Visits

3.1 OBJECTIVE OF THE PROPOSED STUDY

The objective of the study is to determine whether the implementation of 811 telephone triage in Nova Scotia was associated with a change in lower acuity visits at the IWK pediatric ED.

Study Question: Did the proportion of lower acuity visits at the IWK pediatric ED change after implementation of 811 telephone triage in Nova Scotia?

3.2 DATA AND STUDY POPULATION

The IWK serves as the only tertiary care pediatric hospital for the Maritime Provinces. The IWK ED provides care to pediatric patients based on geographic proximity for those in the Halifax region, in addition to those who chose to travel to, or are referred to the IWK ED.

3.3 STUDY DESIGN

The study assesses the impact at the population level of the implementation of 811 on lower acuity ED visits at the IWK Health Centre ED, using a comparison of visits prior to, and after implementation of 811 in a serial cross-sectional study. The study population consists of all pediatric patients triaged and registered at the IWK ED during the study time period, with the study unit of analysis being the ED patient visit. The exposure is the implementation of 811 telephone triage, with the control group being ED visits prior to the implementation of 811. The outcome measure is a lower acuity ED visit, and the summary measure is the proportion of lower acuity ED patient visits.

Lower acuity patients are defined by nurse triage scores recorded at the beginning of each ED visit using the Canadian Triage and Acuity Scale (CTAS). With a CTAS score of one indicating the

highest acuity and five the lowest, this study uses CTAS triage acuity scores of four (less urgent) and five (non-urgent) to define lower acuity ED visits. Higher acuity visits are defined by CTAS scores of one, two and three.

The IWK ED Visits Dataset is derived from administrative data provided by the IWK Decision Support Services to the Canadian Institute for Health Information (CIHI) for the National Ambulatory Care Reporting System. These data are collected and transcribed by trained nosologists from paper ED charts using nationally accepted standards. A subset of this dataset, the IWK Visits Dataset, has been stored separately since April 1, 2007, and used primarily for quality assurance and physician performance metrics in the IWK ED. The study dataset captures all pediatric ED visits to the IWK during the study period, with the data reliably recorded at the time of patient registration.

The study dataset includes the following fields:

- Unique visit ID number (anonymized)
- Temporal variables: Date and time of ED visit triage and registration
- Demographic data: sex and age.
- Triage assessment: CTAS score (1 – 5) assigned at ED admission

3.4 STUDY TIME PERIOD

The analysis compares the difference in the proportion of lower acuity to total ED patients presenting to the IWK ED, before and after the implementation of 811. The dataset includes 12 months of patient visit data prior to the implementation of 811, and 12 months after implementation of 811, following a transition period. The transition period is considered as the time between August 1, 2009 and December 31, 2010. This period corresponds to the introduction of 811 and the coincident H1N1 global influenza pandemic, and represents two processes:

1. The roll-out of 811: August and September 2009 were the first months of the 811 service with a possible impact on the exposure (calls) as the Nova Scotia population became familiar with telephone triage.

2. H1N1 influenza pandemic: H1N1 affected both the exposure (calls) and outcome (lower acuity ED visits).

Exposure: Call volumes for October, November, and December 2009 were several-fold higher than the volumes before and after the influenza pandemic (84).

Outcome: The health care system was modified during the H1N1 pandemic with external influenza clinics established in the Halifax region to specifically manage H1N1. Patients attending these clinics would typically be seen in an ED but were re-directed or self-attended an alternate site. The number of ED visits during these months does not reflect the total volume of urgent care visits, and the impact of this system-wide change on IWK ED visits is impossible to determine from the study dataset. The demand for ED care increased while the system for providing urgent care was temporarily altered.

By January 1, 2010, the influenza pandemic had subsided, at which point both 811 call volumes and the urgent care system returned to baseline. The transition period between August 1, 2009 to December 31, 2009 was an anomaly in both in 811 call volumes and in the provision of ED care, and this period is excluded from the analysis.

3.5 METHOD OF ANALYSIS

Contingency tables (2 x 2 tables) are used to calculate and compare the proportion of lower acuity to total ED visits before and after the implementation of 811. Contingency table analysis calculates the difference in proportions of lower acuity visits in 811 exposed and non-exposed time periods ($P_1 - P_0$). Confidence intervals for the difference in proportions are calculated using the method for two proportions described by Altman et. al. (85).

Contingency Table Format

	Outcome		
Exposure	Lower Acuity Visit	Higher Acuity Visit	Total Visits
E ₁ : 811 exposed	a	b	
E ₀ : 811 non-exposed	c	d	
Total			

- a = number with outcome of interest (lower acuity visit), with exposure (811)
- b = number without outcome of interest, with exposure
- c = number with outcome of interest, without exposure
- d = number without outcome of interest, without exposure

$$P_1 = a / (a + b)$$

$$P_0 = b / (c + d)$$

Addressing Potential Confounding: As health-related outcomes often have multiple contributors, there is potential for multiple confounders (86). The literature suggests several factors associated with lower acuity or non-urgent pediatric ED visits, any of which could be confounders in the analysis. These factors include younger age, winter season, time outside of

regular working hours (12), geographic proximity to an ED (34), sex, low health literacy and lower levels of educations (33), low income (19), insurance status (23), and telephone triage decision algorithm (87).

While various techniques can be used to assess for confounding, stratification is the simplest method (88). Stratification involves examining the primary association with side by side contingency tables, assessing the outcome of interest at different levels of a potential confounding factor (86). The difference in proportion of lower acuity visits between 811 exposed and non-exposed was calculated using separate contingency tables for two levels of the following factors in the dataset: sex (male versus female), age (0 to less than 5 years (59 months) versus 5 to 15 years), presentation during regular working hours (8AM to 5PM Monday through Friday) versus non-regular working hours (weekends and time 17:01 through 7:59), and season, winter season (January through March) versus non-winter season (April through December). A change in the difference in proportions ($P_1 - P_0$) of more than 10 percent between the crude and stratum specific ($P_1 - P_0$) would suggest confounding or effect measure modification (86).

The Cochran-Mantel-Haenszel method is used to calculate an estimate of the difference in proportions, adjusting for confounding in a stratified analysis (86,88). The formula is used with the dichotomous outcome variable (low acuity versus higher acuity visit) and the dichotomous level of risk factors from the stratified analysis (sex, age, hours, season), calculating a weighted average of ($P_1 - P_0$) (86). The Cochran-Mantel-Haenszel formula is not applicable if effect measure modification is suspected, though can be helpful in ascertaining whether a difference between the crude and stratified analyses is the result of confounding or effect measure modification (88).

Example Table for Stratified Analysis: Sex stratified by male / female

Male	Outcome		
Exposure	Lower Acuity Visit	Higher Acuity Visit	Total Visits
E ₁ : 811 exposed	a	b	
E ₀ : 811 non-exposed	c	d	
Total			

Female	Outcome		
Exposure	Lower Acuity Visit	Higher Acuity Visit	Total Visits
E ₁ : 811 exposed	a	b	
E ₀ : 811 non-exposed	c	d	
Total			

The stratum specific difference in proportion of lower acuity to total visits, and the Cochran-Mantel-Haenszel estimate of $(P_1 - P_0)$ is calculated for each of the factors: Sex, Age, Hours, Season (89).

The study results are presented as the difference between the proportion of lower acuity visits to total ED visits before and after the implementation of 811, expressed as a percentage with 95% confidence intervals. Presenting the study outcome as the difference in proportion of lower acuity visits in the 811 exposed and non-exposed groups provides a clear measure for considering potential impact of 811 telephone triage on the IWK ED (90).

3.6 ETHICS

The study poses no potential risk to individual patients or patient information. The analysis uses de-identified data and aggregate analysis with no link to the original patient visits. Approval has been received from the IWK research ethics board.

CHAPTER 4: RESULTS

4.1 STUDY POPULATION

The dataset used in the analysis consists of a total of 55544 pediatric patient visits over the 24 months of the study period: prior to the implementation of 811 from August 1, 2008 to July 31, 2009, and following implementation of 811 from January 1 to December 31, 2010. These data are summarized in Table 1. The data excludes a transition period corresponding to the first months of operation of 811, and the 2009 global H1N1 influenza pandemic (August 1, 2009 to December 31, 2009), a period unrepresentative of the functioning of 811 and of the system of ED care in Nova Scotia.

Slightly more than half of ED visits for both time periods were male, and a similar proportion were under the age of 5 years of age (0 to 59 months). Lower acuity visits, defined as a having a nurse triage CTAS score of 4 or 5, accounted for 65.6% of total ED visits over the study period.

4.2 LOWER ACUITY VISITS

Contingency table analysis (Table 2) determined the proportion of lower acuity to total ED visits over the two study periods: before the implementation of 811 telephone triage (September 1, 2008 to July 31, 2009); and after 811 implementation (January 1, 2010 to December 31, 2010).

The proportion of lower acuity visits in the 12 months prior to implementation of 811 was 0.674 compared to 0.638 during the 12 months following implementation. The difference in proportion of lower acuity ED visits following the implementation of 811 telephone triage in Nova Scotia was -0.0358 , or a reduction in the proportion of lower acuity to total ED visits by 3.58% (95% confidence interval 2.79% to 4.37%).

4.3 STRATIFIED ANALYSIS

Stratified analysis was undertaken using separate contingency tables for two levels of the variables of sex (male / female), age (0-59 months / 5-15 years), hours (regular working hours / after hours and weekends), and season (winter / non-winter months), shown in Table 3 through Table 6. A difference of 10% or greater between the stratified analysis and the unadjusted or crude difference in proportions would suggest confounding or effect measure modification, or both (86).

The stratified analysis demonstrates a difference in proportions (P_1-P_0) of less than 10% between the crude or unadjusted (-3.6%) and the stratified difference in proportion for sex (male: -3.6% versus female: -3.5%) and hours (regular: -3.5% versus after-hours: -3.6%). The Cochran-Mantel-Haenszel weighted averaged for the (P_1-P_0) is the same as the unadjusted or crude difference in proportions suggesting there is no confounding by the factors of sex (male / female) or hours (regular / after hours).

The stratified analysis indicates a difference of greater than 10% between the unadjusted and stratified difference in proportions for age (0-59 months: -4.6% versus 5-15 years: -2.5%) and season (winter: -4.1% versus non-winter: -3.3%). For both age and season, there is a difference between the separate strata, with the unadjusted (P_1-P_0) falling between those values, suggesting heterogeneity of effect, or effect measure modification (86,91). When the adjusted or pooled estimates for age and season are calculated using the Cochran-Mantel-Haenszel formula, the adjusted (P_1-P_0) for age (-3.6%) and season (-3.5%) are similar to the crude difference in proportions (-3.6%). This would suggest that the difference between strata are due to effect measure modification with no confounding by age or season (86,91).

4.4 TABLES: DATA AND STRATIFIED ANALYSIS

TABLE 1: Summary of study data

	Total Visits	Lower Acuity (CTAS 4/5)	Male (%)	Female (%)	Under 5 (%)	Over 5 (%)
811 exposed	27053	17256	54.8	45.2	53.2	46.8
811 non-exposed	28491	19192	54.2	45.8	53.1	46.9
Total	55544	36448	54.5	45.5	53.2	46.8

TABLE 2: Contingency Table for Unadjusted Dataset

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion - Low
811 exposed	17256	9797	27053	0.638
811 non-exposed	19192	9299	28491	0.674
Total	36448	19096	55544	0.656

Difference in Proportion ($P_1 - P_0$): -3.58% (95% confidence interval -2.79% to -4.37%)

TABLE 3: Stratified Analysis for Sex

Male

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	9247	5590	14837	0.623
811 non-exposed	10192	5259	15451	0.660
Total			30288	

Female

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	8009	4207	12216	0.656
811 non-exposed	9000	4040	13040	0.690
Total			25256	

Male (P_1-P_0) (95% CI): -3.6% (95% confidence interval: 2.5% to 4.7%)

Female (P_1-P_0) (95% CI): -3.5% (95% confidence interval: 2.3% to 4.7%)

Difference from Crude: 2.8%

CMH Estimate: -3.6%

TABLE 4: Stratified Analysis for Age

Age 0 – 59 months (Less 5 years)

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	8910	5473	14383	0.619
811 non-exposed	10105	5086	15191	0.665
Total			29574	

Age 5 – 15 years

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	8346	4324	12670	0.659
811 non-exposed	9087	4213	13300	0.683
Total			25970	

Under 5 (P_1-P_0) (95% CI): -4.6% (95% confidence interval: 3.5% to 5.7%)

Over 5 (P_1-P_0) (95% CI): -2.5% (95% confidence interval: 1.4% to 3.6%)

Difference from Crude: 28% for age 0-59 months

CMH Estimate: -3.6%

TABLE 5: Stratified Analysis for Hours

Regular Hours

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	9439	5071	14510	0.651
811 non-exposed	10544	4830	15374	0.686
Total			29884	

After-Hours

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	7817	4726	12543	0.623
811 non-exposed	8648	4469	13117	0.659
Total			25660	

Reg. Hours (P_1-P_0) (95% CI): -3.5% (95% confidence interval: 2.4% to 4.6%)

After (P_1-P_0) (95% CI): -3.6% (95% confidence interval: 2.4% to 4.8%)

Difference from Crude: 2.8%

CMH Estimate: -3.6%

TABLE 6: Stratified Analysis for Season

Winter

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	4783	2886	7669	0.624
811 non-exposed	5021	2535	7556	0.665
Total			15225	

Not Winter

	Lower Acuity	Higher Acuity	Total ED Visits	Proportion
811 exposed	12473	6911	19384	0.643
811 non-exposed	14171	6764	20935	0.677
Total			25256	

Winter ($P_1 - P_0$) (95% CI): -4.1% (95% confidence interval: 2.6% to 5.6%)

Not Winter ($P_1 - P_0$) (95% CI): -3.3% (95% confidence interval: 2.4% to 4.2%)

Difference from Crude: 14% for winter season

CMH Estimate: -3.5%

CHAPTER 5: DISCUSSION

Telephone triage is the process by which a caller or caregiver consults a with health professional by telephone regarding a health question or concern, with the goal of receiving healthcare advice and determining the most appropriate level of healthcare required. This study examines the impact of the implementation of Health Link 811, Nova Scotia's province wide telephone triage system, on the proportion of lower acuity visits at the IWK pediatric ED. The study dataset includes all pediatric visits at the IWK ED, one year before and after the implementation of telephone triage. Lower acuity visits are defined as those with an ED nurse triage CTAS score of 4 or 5. The implementation of 811 was associated with a modest decrease in the proportion of lower acuity ED visits of 3.6% (95% confidence interval 2.8% to 4.4%).

Stratified analysis found no confounding by the factors of sex, age, hours, or season, though there was evidence of effect measure modification or heterogeneity in the impact of telephone triage for younger children and during the winter months. Studies have identified a high proportion of lower acuity ED visits in younger patients, perhaps reflecting a greater need for reassurance in parents of young children (12,37,38). It is conceivable that telephone triage could provide reassurance to parents of younger children with mild illness, resulting in a greater impact in younger versus older children. The heterogeneity of effect of telephone triage between different pediatric age groups observed in this stud has not been reported previously.

As noted by Jun et.al., pediatric ED visits are frequent for "*less-urgent illness such as fever, cough, nausea or vomiting*" (26), often the result of common viral pathogens. Telephone triage could reduce lower acuity ED visits due to uncomplicated viral illness in children, with a greater impact during winter months when many viral pathogens are typically present in the population. It is notable that during the first year of the operation of 811, the most frequently sought advice included calls regarding fever, cough, and vomiting in the pediatric age group (84), typically symptoms associated with common viral illnesses.

5.1 TELEPHONE TRIAGE AND PUBLISHED PEDIATRIC ED RESEARCH

Although most Canadian jurisdictions have telephone triage systems, the published evidence suggests there is no clear impact of telephone triage on pediatric emergency departments (6,44). A review of the literature found that telephone triage recommendations are generally appropriate, though may over-triage to a higher level of care than required in up to one third of calls, or under-triage in a small proportion, thereby threatening caller safety. Researchers found a high level of patient satisfaction, and reasonable patient compliance with approximately three quarters of callers following telephone triage recommendations. Studies looking broadly at the impact of telephone triage on ED utilization generally found no significant impact of telephone triage on ED utilization. There are however few studies looking specifically at the impact of telephone triage on lower acuity pediatric ED visits.

This is the first population-based study to assess the impact of a regional telephone triage system on lower acuity pediatric ED visits in a publicly funded healthcare system. A study from Texas by Howell, et.al. used similar methodology to this study, but in a different healthcare system and context (76). The authors were interested in the impact of telephone triage on uninsured versus publicly insured (Medicaid) children in a single pediatric ED using a site-specific telephone triage system. While overall patient volumes (both higher and lower acuity) increased, there was a 2.4% decrease in the proportion of lower acuity visits in the publicly insured patients (though no difference in uninsured patients) associated with the implementation of their telephone triage system (76). Because of the focus on insurance status as well as the site-specific telephone triage system in a community with more than one pediatric ED, it would be difficult to compare the results from a single center in Texas to a population based study of a regional telephone triage in the publicly funded healthcare system in the Province of Nova Scotia. These differences in context aside, the authors similarly found a modest reduction in the proportion of lower acuity ED visits associated with the implementation of telephone triage in their pediatric ED (76).

5.2 CONTEXT OF 811 IMPLEMENTATION

While the implementation of 811 in 2009 meant that all Nova Scotians had access to telephone triage, it is important to note that not all patients call for advice prior to an ED visit. Several studies suggest that the proportion of ED visits associated with a telephone triage call is relatively small. In a prospective study from a single hospital in Australia, only 1.7% of ED patients had contacted telephone triage prior to coming to the ED (56), while a retrospective Australian study from another center found this proportion to be 6.5% (92). In a Canadian study, patients associated with a call to the province-wide telephone triage system accounted for only 1.3% of patient visits in an urban ED in Saskatchewan (93). An Australian ED survey of lower acuity pediatric patients found that 20% had called the regional telephone triage prior to their ED visit (57). Unpublished data from a voluntary patient survey done at the IWK ED found that 8.3% of patients completing the survey were referred to the IWK ED by 811, though the survey completion rate was only 36% (94). Though these studies identified a relatively small number of ED patients associated with a telephone triage interaction, they were unable to determine the number of calls redirecting patients to non-ED care. In a report on the first year of operation of Nova Scotia 811, 16% of callers were directed to the ED. The report, however, did not separate the proportion of ED referrals by age or geographic region of the callers (84). The impact of a healthcare system intervention such as 811 will partly depend on the uptake in the target population, information not available in the study data.

This study found that in the 12 months following the implementation of 811 the total and lower acuity ED visits at the IWK ED decreased, while the number of higher acuity visits increased. As the study outcome is a change in proportion of lower acuity visits, the difference could represent either a decrease in lower acuity visits, or an increase in the number of higher acuity patients appropriately directed to the ED by the telephone triage service. Given that there are limited, if any, care options for higher acuity pediatric patients in the Nova Scotia healthcare system other than an ED, it is unlikely that 811 would identify and re-direct previously unserved higher acuity pediatric patients. In addition to the IWK ED, there is one general ED and one

urgent care centre where pediatric patients may also be seen. In the 12 months before and after the implementation of 811 there was no difference in the number of pediatric patients seen at the two centres combined (personal communication, Senior Medical Director Nova Scotia Health Authority, Emergency Program of Care). In addition, any higher acuity pediatric patients requiring ED care seen in primary care or walk-in clinics within the IWK catchment would typically be referred to the IWK ED for management. The change in visit proportions would therefore more likely represent a decrease in lower acuity patients presenting to the pediatric ED associated with the implementation of telephone triage. It is a reasonable assertion that common pediatric medical concerns that could lead to a lower acuity ED visit may be amenable to non-ED care on the advice of telephone triage.

5.2.1 811 AND ACCESS TO CARE

A key objective of the implementation of 811 was to *“improve access to primary healthcare services”* in Nova Scotia (84). The Andersen Aday model of healthcare utilization from 1974 highlights the importance of multiple factors involved in access to care, at both the system and population level (95). According to this model, access to care requires that the services are available *“whenever and wherever the patient needs them and that the point of entry to the system is well-defined”* (95).

Telephone triage services can advise on the entry point for care, directing a patient to the ED or a primary care provider, an effective intervention if the patient has access to the required provider at the required time. Primary care access has been a persistent challenge in Nova Scotia, with 6.5% of the population having no family physician in 2011 (96). A study from Ontario found that patients with timely access to primary care were less likely to visit ED’s compared with those who were unable to access care when needed, or those who experienced problems with physician access (97). In their 2015 report on healthcare innovation in Canada, Naylor, et.al. noted that only 22% Canadians were able to access a same or next day primary

care appointment, the lowest rate across 10 developed economies surveyed by the Commonwealth Fund (98). A comparison across member countries of the Organisation for Economic Co-operation and Development (OECD) found that Canadians reported a high degree of difficulty in accessing out of hours care, and the highest proportion reporting ED utilization (99). The effectiveness of a telephone triage system in improving access to primary care will therefore, in part, depend on timely availability of primary care services.

Beyond the system of care itself, patient and family characteristics can also facilitate or impair access to healthcare (95). A study from Ontario found that *“low education and income...were independently associated with a modest increase in risk of both high-urgency and low-urgency ED visits”* (100). Compared to most member countries of the OECD, Canada has a greater degree of income related inequality in healthcare access, with higher income individuals being more likely to see a physician than their lower income counterparts (101). The ability of a telephone triage system to improve access to primary care will additionally depend on addressing barriers to accessing care, including barriers to telephone triage itself. Given the number of Nova Scotians who currently lack a primary care provider (102), combined with difficulties in timely availability of care (98,99), improving access to primary healthcare services will remain a challenge despite the implementation of a provincial telephone triage system.

5.2.2 811 AND LOWER ACUITY ED VISITS

This study uses a lower acuity score on nurse triage assessment to categorize ED visits, a methodological choice with advantages and disadvantages. The CTAS scale used in most Canadian ED's is a standardized assessment tool which reflects a combination of presenting symptoms, physiologic parameters, and a brief physical exam. Canadian pediatric ED studies have found a correlation between CTAS score and admissions, ED resource use, and some correlation with length of stay in the ED, suggesting acuity on CTAS triage scoring is a valid measure of visit urgency (82,103). At the IWK ED the standardized CTAS triage assessment tool was consistently applied across the entire study time period, with the CTAS score assigned and

recorded at the beginning of each ED visit. Although the CTAS tool underwent some revisions in 2008, Doan et. al. in their study of ED volumes and patient flow between 2002 and 2011 found no evidence of an impact of these changes in trends of acuity in their pediatric ED (14).

Lower acuity scores on nurse triage assessment does, however, have important limitations in categorizing ED visits for the purpose of research. Although methods used in research to define an urgent versus non-urgent visits are typically applied in retrospect (16,17), patients present to an ED with a spectrum of acuity which can be challenging to dichotomize. In the clinical setting, triage acuity is assessed looking forward and often based on limited information in the context of the patient's perspective at the time (83), the perception of which may differ when viewed in retrospect (17). The nature of triage necessitates rapid decision-making in a process designed to be conservative, potentially classifying visits at a higher level of acuity in order to prioritize patient safety (16). Petrie's categorization of ED visits based on acuity and schedule-ability (Figure 1) provides a more clinically oriented perspective, and considers the additional context of a patient's ability to access care (83). The model highlights limitations of categorizing ED visits based on nurse triage assessment alone, but also illustrates the complexity and data requirements of ED visit categorization in a research context. Considering these limitations, CTAS score as a method of ED visit categorization as used in this study is a reasonable choice, using a validated and consistently applied measure across a large dataset (16).

5.2.3 LOWER ACUITY ED VISITS IN A HEALTHCARE CONTEXT

Recognizing that ED's were conceived to manage medical emergencies, the research literature currently describes visits in terms of urgency (9). The terminology of urgent versus non-urgent visit better describes the urgency or acuity of the patient's presenting problem, while terms like necessary or appropriate reflect the visit in the broader context of the healthcare system (16,17). Returning to the Canadian Association of Emergency Physicians' definition, emergency medicine seeks to provide *"timely evaluation, diagnosis, treatment and disposition of all*

patients with injury, illness and/or behavioural disorders requiring expeditious care, 24/7/365" (2). The definition goes further in noting that *"These conditions are often undifferentiated and include, but are not limited to those that are life threatening, acute and urgent"* (2). Although there is a lack of agreement on how best to define ED visit urgency, it should be clearly noted that *non-urgent* (or lower acuity) and *inappropriate* are not equivalent terms, especially when considered in the context of a patient's access to care (16,17). There is no clear definition of an *"unnecessary"* ED visit.

More recently the discourse around lower acuity or non-urgent ED visits has shifted toward the discussion of "avoidable visits". Analysing a US national database consisting of over 14 million adult ED visits using a conservative definition of an avoidable visit (no diagnostic testing, no procedures, and no medications), Hsia and Neidzweicki found the proportion of avoidable ED visits to be only 3.3% (104). The authors suggest that avoidable ED visits highlight the need for greater access to healthcare services, and that broad policy initiatives aimed to deter avoidable visits are potentially risky (104). The Canadian Institute for Health Information (CIHI) characterizes avoidable ED visits as Family Practice Sensitive Conditions (105). Based on nationally reported Canadian ED data, the proportion of avoidable ED visits in the pediatric population ranged from 24% to 36% across different age groups (105). The report notes, however, that *"some of these potentially avoidable ED visits may result from challenges with access to primary health care"* (105). A lower acuity pediatric ED visit must be considered in the context of a patient's access to care across the healthcare system, a system which may include the option of telephone triage.

5.2.4 DECREASED LOWER ACUITY PEDIATRIC ED VISITS

Although the objectives in the implementation of 811 aimed to promote self-care, provide reliable health information, reduce travel to receive care, increase system capacity, and to improve access to primary care (84), the “*original narrative*” around the implementation of 811 included the assertion that telephone triage would keep patients out of the ED and ease emergency room overcrowding (106,107).

ED crowding is not only of concern in Canada but has become a major global healthcare issue and a worldwide public health problem (12). According to the Canadian Association of Emergency Physicians (CAEP), “*Emergency department overcrowding is defined as a situation where the demand for care exceeds the ability of an emergency department (ED) to provide care within appropriate time frames.*” (108). In a 2007 survey of Canadian ED’s, 62% reported that crowding was a major or severe problem over the past year (109).

To better understand ED crowding Asplin et.al. developed a conceptual model considering crowding from the perspective of ED patient flow (110). The authors suggested that ED crowding is associated with all ED processes, with contributions from department input (patients presenting to the ED), throughput (ED processes of assessment and treatment), and output following ED care (patient disposition of either hospital admission or discharge on completion of ED assessment and treatment) (110). The Canadian Association of Emergency Physicians states that: “*Contrary to popular perceptions, ED overcrowding is not caused by inappropriate use of ED’s, or by high numbers of lower acuity patients presenting to the ED; the inability of admitted patients to access in-patient beds from the ED is the most significant factor causing ED overcrowding in Canadian hospitals*” (108). This view is echoed in a recent systematic review (7), and supported by a Canadian study of adult and general emergency departments suggesting that low complexity patients (lower acuity, ambulatory, non-admitted) were not a significant factor in ED crowding (111).

Although admitted patients are an important cause of crowding in adult and general EDs, the factors contributing to pediatric ED crowding appear to differ. Several pediatric ED studies found that volume of patients as well as ED process factors are more important contributors to crowding than hospital admissions from the ED requiring inpatient beds (112–115). In a single-center pediatric ED study from the US, Weiss et.al. noted that the strongest predictor of crowding in their department was a composite of total registered patients (ED census) and the number of patients in the waiting room (113). Another study of a busy US pediatric ED found that an increase in patient arrivals by 20% of the average daily census resulted in a 27% increase in the time to see a physician and a 9% increase in average ED length of stay, similarly suggesting a link between patient volume and ED crowding (112). In a pediatric ED study from British Columbia the authors noted an increase in patient volumes between 2002 and 2011 which was associated with worsening parameters of ED flow or markers of ED crowding (14). The number of patients of all acuity levels increased over the time span of the study, however, making it difficult to determine the contribution of lower acuity patients to crowding in their pediatric ED (14).

Although this study does not assess the impact of 811 on pediatric ED crowding, it found a modest decrease in the proportion of lower acuity ED visits at the IWK ED associated with the implementation of 811 telephone triage. A decrease in lower acuity pediatric patients could have a favorable effect by reducing overall ED patient volumes, suggesting that telephone triage may have the potential to improve crowding in the pediatric ED. Given the different factors associated with ED crowding in pediatric departments, however, telephone triage is unlikely to mitigate crowding in adult or general ED's.

5.3 STUDY STRENGTHS AND LIMITATIONS

This study is the first population-based assessment of the impact of a regional telephone triage system on the proportion of lower acuity pediatric ED visits in a publicly funded health care system. The large dataset reliably captures demographic, temporal, and triage assessment data for each ED visit. Patient visit information and triage category are collected and recorded prospectively on arrival to the ED, and not subject to the influence of other factors such as ED wait times or the perception of a busy or crowded ED.

By analyzing a full year of visits before and after the implantation of 811, typical seasonal peaks and valleys in pediatric ED activity would be included in both the pre- and post-implementation time periods. Although the severity and timing of seasonal viral outbreaks varies from year to year, potentially impacting ED patient volumes, this information is unavailable for the years of the study. While total ED visit numbers fluctuate month to month, as well as year to year, the proportion of lower acuity visits should be less variable than absolute ED visit numbers.

Not all potential confounding variables are available in the dataset, including factors associated with ED visits such as lower health literacy, lower income, and lower levels of education. Although potentially contributing to ED utilization (100), these factors would not change significantly in number or distribution over the brief time span of the study. These factors could, however, impact a family's knowledge and utilization of the 811 service. Any influence of geographic proximity to the IWK ED would not be impacted by telephone triage as a recommendation for ED care would not direct a patient specifically to the IWK.

The dataset cannot determine whether an ED visit was initiated by self-referral, provider-referral, patient transfer, or on the recommendation of 811. The implementation of 811 occurred at the population level, and the analysis considers the impact on lower acuity visits in the pediatric population represented by the IWK ED catchment.

5.4 STUDY IMPLICATIONS

This study contributes to understanding the impact of telephone triage systems on pediatric emergency departments. The results can inform further research and health policy on telephone triage.

CHAPTER 6: CONCLUSIONS

On July 29, 2009 the Nova Scotia (NS) Department of Health and Wellness introduced a provincial telephone triage system, Nova Scotia 811. In the first year following implementation, 811 was associated with a modest decrease of 3.6% in the proportion of lower acuity visits at the IWK tertiary care pediatric ED. This study is the first to show an effect of telephone triage on lower acuity pediatric ED visits in a publicly funded health care system. The study also found a greater impact of telephone triage in younger children and during winter months, an observation that has not previously been reported.

The reduction in the proportion of lower acuity pediatric ED visits would suggest that telephone triage may be effective in directing lower acuity pediatric patients to non-ED care options. A decrease in lower acuity pediatric ED patients could potentially mitigate crowding in the pediatric ED, though this effect is unlikely to apply to adult or general ED's. As the role of telephone triage is to direct patients to the most appropriate level of care, the effectiveness of telephone triage will in part depend on the timely availability of primary care.

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APPENDIX: SUMMARY OF TELEPHONE TRIAGE (TT) LITERATURE REVIEW

Author / Country	Year	Study Design	Population	Purpose	Main Findings
Al-Abdullah Canada (55)	2009	Prospective, observational cohort	Pediatric Telephone Triage (TT) ED referrals	Appropriateness	No difference between appropriateness of self-referred (63%) and TT (56%) referred patients; physician referrals more appropriate (80%).
Anderson UK (116)	2015	Prospective, observational	TT ED Referrals	Appropriateness	GP reviewing calls recommended non-ED care in 73% of callers referred to ED (though included after-hours GP care)
Backman Sweden (117)	2012	Prospective, cross-sectional	Non-urgent ED patients	Appropriateness	Of non-urgent ED patients, 49% sought healthcare advice prior to visit, 8% of those referred by TT
Barber UK (118)	2000	Case-Control	Pediatric TT ED referrals	Appropriateness	Single center study found 80% of TT referrals appropriate, varying by insurance coverage
Blank Various (53)	2012	Systematic Review	TT referrals for ED care	Appropriateness Compliance Safety	Rapid review of 54 studies. Accuracy (appropriateness) of referrals 44-98% (mean 75%). Under-referral (safety) 0.2- 50% with potential for harm 1.3-3.2%. Studies using simulated scenarios found higher rates of unsafe disposition compared with clinical studies. Mean rate of compliance 77%.
Bolton Australia (119)	2002	Cross-sectional, telephone survey	TT callers	Utilization	Random telephone survey of 314 TT callers suggested TT has potential to reduce ED utilization
Bunik US (67)	2007	Prospective, Cross-sectional	TT callers, pediatrics	Utilization	Caller's self-reported intention to seek ED care (46%) versus TT recommendation (22%) suggesting potential for reduced ED use.
Bunn Various (77)	2004	Systematic Review	TT callers	Utilization Safety	Cochrane review of 9 studies suggesting no impact on ED use, decreased after- hours GP use, with unclear impact on safety or patient satisfaction
Carrasquero Various (78)	2011	Systematic Review	TT callers	Utilization	Meta-analysis of 55 studies on impact of TT on health services. Overall impact unclear: may defer ED use rather than prevent.
Custer US (71)	2003	Cross Sectional	TT callers referred to ED	Utilization	TT appeared to contribute to non-urgent ED referrals with one third of TT referrals to ED due to lack of primary care access

De Coster Canada (61)	2010	Cohort, retrospective data linkage	TT callers	Compliance	One-year data for Calgary: 132,537 callers, 13.6% recommended ED, compliance 52.3% ED for attendance
Doctor US (54)	2014	Cohort, retrospective	TT referrals for ED care	Appropriateness	ED referrals by TT reviewed by physicians: one third were non-urgent / inappropriate ED referrals. Certain symptom algorithms resulted in higher rates of over-referral to ED.
Giesen Netherlands (120)	2007	Simulation	Simulated TT calls	Safety	Using simulated patients, TT underestimated urgency in 19% of calls (sensitivity for detecting urgent conditions 0.76)
Gamst-Jensen Denmark (45)	2017	Mixed Methods, Cross-sectional, Qualitative	TT callers	Safety	Using a very strict definition of under-triage (non-urgent recommendation followed by ED and admission) – 0.04%. Qualitative study suggested that communication problems contribute to under-triage.
Gibson Australia (121)	2018	Population-based / Observational Cohort,	TT callers referred to ED	Appropriateness Compliance	Study looked at compliance of all TT callers referred to ED: overall compliance 66.5%. Slightly fewer TT referrals of lowest triage category suggesting appropriate referrals (7.7 vs. 16.9%), though lower proportion of higher urgency triage (7.0 vs 8.3) suggesting possible over-referral to ED.
Grant US (122)	2002	Simulation	Simulated patients	Utilization	Using 99 simulated patients, ED referrals by TT (13%), Walk in Clinic (5%), GP clinic (0%). Small study of simulated patients suggested TT may increase ED volumes.
Graber New Zealand (74)	2003	Time series	ED patients	Utilization	Anticipated decrease in ED volume from caller self-reported intention - though noted increase in ED visits by 1.1% during pilot TT
Griffin New Zealand (123)	2017	Retrospective cohort	TT referrals to ED	Compliance	Using health service use database, compliance with ED referral decreased with driving distance: 40 minutes (12.5%) vs. 5 minutes (39.4%). Of those not recommended ED care, similar differences based on distance. Ability to pay may have been a confounding factor.

Gustafsson Sweden (64)	2016	Cross-sectional	TT callers triaged to self-care	Satisfaction	Patient satisfaction was lower with self-care recommendation compared to medical care recommendation. 66.1% of patients were recommended a lower level of care than the patient would have pursued suggesting reduction in health care services use.
Hagan Canada (68)	2000	Cross-sectional	TT callers	Utilization	Older telephone survey study of TT callers with high rates of self-care triage (67%). Of patients recommended self-care, 89% would have presented to higher level of care suggesting decreased service use.
Hansen Norway (124)	2011	Simulation	Simulated patients	Appropriateness Safety	Using written scenarios, nurses appropriately determined level of urgency in 78% of scenarios, with 12% under-triaged and 18% over-triaged.
Hanson Australia (69)	2004	Cross sectional	TT callers, pediatric	Utilization	Older study of a single center pediatric ED TT: although 75% of those surveyed would have sought ED care, only 19.7% were recommended ED care.
Hirsh US (125)	2007	Cross sectional	TT callers, pediatric	Safety	Using a definition of hospitalization within 24 hours of a non-urgent TT recommendation, the rate of under-referral was 0.03% to 0.09% of all calls. This information was helpful in reviewing specific symptom protocols.
Hogenbirk Canada (126)	2005	Audit	TT callers	Appropriateness	Audit of 73 recorded calls by RN, NP and GP. At least one assessed 92% of calls as appropriate, with all in agreement in 56%. Of those deemed not appropriate, most were over-referrals to the ED.
Howell US (76)	2015	Retrospective Cross-sectional	Uninsured / publicly insured pediatric ED patients	Utilization	Single center TT noted 1% decrease in ED visits by uninsured patients and 2.4% in Medicaid patients – though overall increase in non-urgent visits with the difference in ED visits possibly due to access to care rather than appropriate triage.
Huibers Various (59)	2011	Systematic Review	TT callers	Safety	Systematic review of 34 studies on safety of TT – found a wide range of error: .023 to 22% across all study types. Of the 13 observational studies of actual TT patients 97% of patient contacts were safe; higher error rates were noted in simulated patients.

Huibers Netherlands (49)	2012	Cross-sectional	Recorded TT calls	Appropriateness Safety	Review of 6739 recorded TT calls: proper estimation of urgency in 91% with appropriate advice in 96%. More urgent calls were associated with higher rates of poor advice. 18.8% of callers were over-referred. Higher quality consultation / communication was associated with more appropriate advice.
Ismail Various (42)	2013	Systematic Review	TT callers	Utilization	Review of primary care interventions on ED utilization, including 11 studies of TT: no impact of TT on ED utilization, no impact on safety, high levels of patient satisfaction
Keatinge Australia (70)	2005	Cross-sectional	TT callers, pediatric	Utilization	Small survey with low completion rate: of 101 patients surveyed 50% required no other care; 8% were seen in the ED though by self-report 53% would have sought ED care in the absence of TT.
Kelly UK (127)	2010	Cross-sectional	Unscheduled care users	Satisfaction	Postal survey of users of unscheduled care in region of Wales. Users of TT had high level of satisfaction with the service and advice, though reduced with slow response time.
Kempe US (128)	2006	Observational cohort	TT callers	Compliance Safety	Database of 32,000 TT calls linked to service use: 74% compliance with ED and self-care, under-referral of 1:599 calls.
Kempe US (51)	2000	Retrospective cohort	TT callers referred to ED, pediatric	Compliance Appropriateness	Cohort of pediatric TT callers (21%) referred to ED: compliance 87%. Appropriateness determined retrospectively: 91%. Study did not look at under-referral.
Kempe US (66)	2003	Cross-sectional	TT callers, pediatric	Compliance Safety	Using follow up telephone survey of pediatric TT callers, 70% compliance / agreement with ED and home disposition, 50% for PCP. Under referral with hospitalization 0.3% (1:481).
Kempe US (129)	2000	Cross-sectional	TT callers, pediatric	Satisfaction Compliance	Follow up telephone survey of pediatric TT callers: compliance 80%, satisfaction with different aspects of call: 93 to 99%.

Lake Various (79)	2017	Review of Reviews	Systematic Reviews	Compliance Safety Utilization Appropriateness	8 of 10 systematic reviews noted poor quality of evidence with poor study designs and poor reporting of results. Appropriateness of referrals mean 75%. Compliance with TT advice mean 62 to 77% with higher levels associated with more and less urgent disposition. Studies on safety suggested 97% safe contacts with observational studies, but lower with simulated patients. Overall high levels of patient satisfaction. Studies noted potential cost savings but poor methodology. Several studies found potential to increase ED utilization.
Lambert UK (130)	2013	Cross-sectional	TT callers	Cost	Follow up survey of TT callers – cost analysis based on intention prior to TT advice suggesting cost savings from TT.
LaVela US (131)	2012	Cross-sectional	TT callers, veterans	Satisfaction	Survey noted lower satisfaction for more urgent calls (unclear why).
LeClerc Canada (62)	2003	Cross-sectional	TT callers	Compliance	Follow up survey of TT callers: 12% recalled advice to seek further care when disposition was for self-care.
Lee US (46)	2003	Randomized Trial	TT callers, pediatric	Compliance	Calls randomized to nurse versus pediatrician: compliance (based on claims data) was similar between groups for ED and self-care (approximately 75% for all groups), lower for primary care follow up. 5% of self-care, and 15% of primary care callers presented to the ED. No difference between nurse and MD telephone triage.
Leibowitz Various (80)	2003	Systematic Review	Primary care service models	Utilization	Systematic review of older studies on the impact on care of primary care reform. Of studies the six studies (all prior to 2000) on telephone triage, no impact was found on ED utilization, through there were decreased calls to primary care, and decreased primary care utilization
Mark UK (132)	2003	Time series	Primary care cooperative	Utilization	Pre / post study of health care utilization of a large primary care cooperative in London: on a background of increasing out of hours care, noted decrease in out of hours calls though a steady increase in ED utilization.

Marklund Sweden (48)	2007	Prospective observational cohort	TT callers	Appropriateness Compliance Cost	Prospective cohort followed for compliance with recommendations (81% for self-care, 100% for ED care, 91% for primary care). Care appropriate in 97.6% (over-referral in 2.4%) based on review of documentation. Cost savings were presumed based on intentions to seek care prior to TT advice.
Martinsson Sweden (133)	2018	Computer modeling of cross-sectional data	TT callers	Utilization Cost	Using cross-sectional study day, computer modeling suggested that nurse TT recommendation has an important impact on choice of care, except where intention was ED: minimal impact of TT when pre-call intention is ED care. A cost savings of 3.3% of health care costs was estimated for all callers using TT.
McAteer Scotland (134)	2016	Cross-sectional	Health region	Utilization	The survey noted that just under half had never used the TT service, the most common reason lack of need or preference for own GP. One third contacted another health provider after the NHS24 call – 23.3% of those going to the ED. Satisfaction with the service was high. Difficult to determine impact of TT on service utilization.
Meer Switzerland (135)	2012	Prospective cohort / Surveillance	ED patients	Appropriateness	Study of ED patients with non-urgent conditions re-triaged by telephone triage. The triage was compared with physician assessment retrospectively. Probability of appropriate triage was 0.807; over-triage in 13.9%, potential for harm in 4.6%. There was poor inter-observer agreement of triage classification.
Moore US (65)	2002	Cross-sectional	TT callers	Satisfaction Compliance	Follow up survey of TT callers in the context of a managed care organization: satisfaction 80%, compliance 88%. Caller satisfaction correlated with compliance with TT recommendation.
Moscato US (136)	2007	Cross-sectional, nested sampling	TT callers	Satisfaction	Follow up survey of TT callers: high rates of satisfaction and caller expectations (80%). Satisfaction was mainly related to aspect of communication: clarity, caring, competence.

Munro UK (137)	2005	Cross-sectional survey, time series analysis	Service providers, regional ED, EMS	Utilization	Postal surveys of provider groups before / after implementation of regional TT with time series analysis: there was a reduction in GP call demand, no impact of TT on ED utilization or EMS calls.
Ng Australia (56)	2012	Prospective cohort	ED patients	Appropriateness	Prospective study of ED patients comparing appropriateness (based on resource use in the ED) of self- (74%) vs TT (73%) vs GP referred (90%). GP referrals had the highest rate of appropriateness, with TT and self-referred similar. Of the 1.7% of ED patients (720) who were TT callers, half were not recommended ED care, perhaps a reflection of primary care access.
Niemann Switzerland (138)	2004	Cross-sectional survey	TT callers	Compliance	Two phase study: initial question of pre-call intention in addition to follow up survey of callers. Overall compliance with recommendations varied: 80% compliance for self-care, 60% compliance for ED care with the difference being due to poor understanding or change in condition. Of patients attending ED care, 56% were recommended ED care, 44% a lower level of care. Compliance was higher when TT recommendation matched pre-call intentions.
Njeru UK (63)	2014	Retrospective cohort	TT callers	Compliance, utilization	Retrospective cohort of TT callers comparing low English proficiency (LEP) with language proficient callers: TT recommendations for LEP vs. non-LEP calls: higher frequency of urgent recommendation (49% vs. 39%); lower caller agreement (20.9% vs. 30.1%); lower compliance with recommendations: 60.9% vs. 69.4%
North US (139)	2011	Cross-sectional	TT callers	Utilization	Surrogate calls were more frequent with age and more frequent for males (54%), a reversal of self-call proportions. Emergency disposition was recommended for 26% of all calls versus 38% of surrogate calls – likely representing a higher degree of urgency. Not clear the impact on ED services of surrogate versus self-calls.

North US (140)	2010	Cross-sectional, comparative	TT callers	Safety	With the intent of determining severity of TT calls versus other types of medical access, retrospective comparison of hospitalization rates for office versus TT versus ED for same complaint in different age groups. For pediatric patients, TT callers were similar to ED disposition with admission rates of 3% versus 4% for the same complaint; over 65 years, 4% versus 35%. Admission for office visits was less than 1%. It was not possible to determine whether low adverse event rates from TT were related to low acuity of calls.
O'Cathain UK (141)	2014	Cross-sectional postal survey	Population	Satisfaction, Compliance	Postal survey of TT in UK noted high level of satisfaction (91%) and compliance (86%) – though a high rate of referral to immediate care (69%) including GP, urgent care and ED, as well as EMS.
O'Cathain UK (72)	2007	Cross-sectional postal survey	Population	Utilization	Postal survey to health region where TT and walk in clinics added to after-hours care options. Despite increase TT calls and walk in clinic use, there was no change in traditional after-hours health care utilization (GP, ED).
O'Cathain UK (142)	2000	Cross-sectional	TT callers	Satisfaction, Compliance	Follow up telephone survey of TT callers with additional postal survey follow up: high rates of satisfaction with TT (95%) and compliance with recommendations (86%).
O'Cathain UK (143)	2003	Simulation	Case Scenarios	Utilization, Safety	119 case scenarios assessed by different nurses using different CDSS systems: sensitivity for ED attendance recommendation: .49 to .78 and specificity .33 to .59 across nurses / systems. The study highlights the difficulty in making a system which is sensitive (safe) and specific (appropriate).
O'Connell US (144)	2001	Time Series	Managed care patients	Utilization, Cost	Using billing data to track service, study of before / after services utilization with introduction of TT system in managed care organization: decrease in ED (4.3%) and MD (5.4%) visits, though increase in urgent care utilization. High rates of patient satisfaction and cost savings noted in single managed care system studied.

O'Connell US (145)	2001	Cross-sectional	TT callers	Compliance, satisfaction	Large telephone follow-up survey of TT callers: 90% satisfaction, and 90% self-reported compliance (though 66% compliance using billing data).
O'Connell US (75)	2002	Retrospective cohort	TT callers	Compliance	One year data matching TT recommendation with billing data: Compliance rates were variable: 79.2% for ED recommendation, 57.4% for PCP, and 65.8% for self-care.
Pope UK (146)	2017	Mixed Methods, Qualitative	TT callers, providers	Utilization, Satisfaction	Mixed methods: analysis of call data, focus groups, surveys and observation. NHS 111 resulted in work substitution to non-clinical call handlers though 20% referred to clinical staff, 11.3% for ambulance services and 8.1% recommended for ED care. Difficult to determine impact on costs, clinical services and outcome. High rates of patient satisfaction noted.
Purc-Stephenson Various (60)	2012	Systematic Review	Various	Compliance	Based on 13 studies, overall compliance with TT recommendations 62%: emergency services 63%, office care: 44%, self-care: 78.9%. Reasons for non-compliance: recall problems (didn't understand the advice), change in symptoms, trust (wanting a second opinion), and accessibility of the advised option. Compliance higher when recommendations matched initial intentions.
Rahmqvist Sweden (147)	2011	Case-control	TT callers	Satisfaction	Case-control study of callers who received a lower level urgency recommendation than their intention versus those which matched intentions: callers with lower urgency recommendation had a lower rate of satisfaction and higher ED attendance. Small study with 43% response rate.
Snooks UK (148)	2009	Cross-sectional postal survey	TT Callers	Appropriateness	Postal survey of TT callers (NHS Direct Wales) with 50% response rate. Appropriateness of disposition determined by algorithm and clinical panel: 90% of dispositions assessed as appropriate, one in six referrals for further care unnecessary, and under referral was assessed in 1.4 to 3.3% though in these cases patients deemed the advice appropriate. The impact on ED care of over-referrals was not assessed.

Sprivilis Australia (92)	2004	Data linkage / Cross-sectional	ED Referrals	Appropriateness	Of ED patients, 6.5% had contact with TT prior to ED. Compliance with ED recommendation 61%. The study found no difference in the appropriateness of TT referred and non TT referred ED visits.
Stacey Canada (44)	2003	Review / Economic analysis	Various	Cost Utilization	Review of TT systems with economic analysis. The average cost of Canadian TT call was similar to the system cost of a GP visit. In an analysis of ten studies, TT resulted in decreased medical contacts with no impact on ED volume or safety. Satisfaction with TT ranged from 54 to 90%.
Stewart UK (149)	2006	Cohort	ED Patients, pediatric	Appropriateness	Matched cohort of PED attendances and TT callers: 13.8% of callers recommended ED attendance, 65%. Of total ED patients, 3.2% had contact the TT service prior to attendance, with no difference in triage category of self-versus TT-referred, and lower rates of admission for TT-referred.
Tran Australia (150)	2017	Cohort	TT callers over 45	Compliance	Retrospective, data-linked study of TT compliance by adults 45+ years of age: similar to previous studies with compliance for ED 69%, primary care 65% and self-care 78%. Compliance was higher when recommendations matched caller intent.
Turbitt Australia (57)	2015	Prospective Cross-sectional	Non-urgent pediatric ED patients	Utilization	Prospective survey of non-urgent PED patients: 20% had called TT prior to ED visit, 70% of whom were recommended ED care, 22% of those not recommended ED care came due to concern or change in condition. The study was not able to assess the impact of TT on ED utilization.
Turner UK (73)	2013	Time Series	Population	Utilization	Times series analysis of urgent care utilization pre / post NHS 111 TT introduction: no change in urgent care or ED utilization with TT introduction, though 2.9% increase in ambulance calls.

Turner Various (6)	2015	Review	Various	Safety Compliance Satisfaction Utilization	Rapid review of TT based on 87 papers. Overall high rates of safety of referrals (97%) though lower rates with simulated scenarios as well as higher urgency calls. Compliance ranged from 44 to 78%, overall, 62%, with higher compliance when recommendation for immediate care, or when matched pre-call intention. Satisfaction with TT generally high, ranging from 55 to 97%. Costs were not consistently assessed, and generally based on caller intention pre/post call. Appropriateness of disposition ranged between 44 to 98%, with one study suggesting 33% of ED referrals unnecessary. Impact on overall health services was unclear: some studies suggest a deferral of work rather than prevention of medical contact with studies generally showing no impact on urgent care services.
Van den Heede Various (81)	2016	Review of reviews	Various	Utilization	Narrative review of 23 studies published between 2010 and 2015: there is a lack of evidence on the effectiveness of TT in reducing ED utilization. One study noted: <i>this system in reality delays the visit rather than resolving the problem.</i> Telephone consultation appears to be safe, to have a negative impact on patient satisfaction, and a negligible effect on ED utilization – with one study showing a small but insignificant increase in ED utilization.
Wheeler Various (58)	2015	Review	Various	Safety	Narrative review looking at process aspects of telephone triage systems, including aspects of decision making and staffing. The authors concluded that under referral was the result of inadequate assessments, and that common errors have not been reduced by the addition of Computerized Decision Support Systems. Over-referrals can be considered a margin of safety.