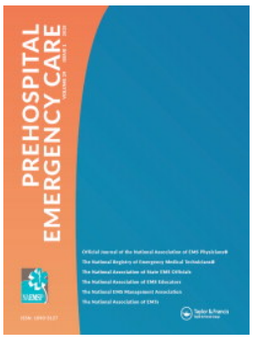

Taylor & Francis
Taylor & Francis Group

Prehospital Emergency Care

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/ipec20

Stuck in Transition: Clinical and Patient Factors Behind Prolonged Paramedic to Emergency Department Transfer of Care

Ryan P. Strum, John McPhee, Michael Wionzek & Russell MacDonald

To cite this article: Ryan P. Strum, John McPhee, Michael Wionzek & Russell MacDonald (17 Jan 2025): Stuck in Transition: Clinical and Patient Factors Behind Prolonged Paramedic to Emergency Department Transfer of Care, Prehospital Emergency Care, DOI: 10.1080/10903127.2025.2451217

To link to this article: https://doi.org/10.1080/10903127.2025.2451217

PREHOSPITAL EMERGENCY CARE
https://doi.org/10.1080/10903127.2025.2451217

Taylor & Francis
Taylor & Francis Group

Stuck in Transition: Clinical and Patient Factors Behind Prolonged Paramedic to Emergency Department Transfer of Care

Ryan P. Strum[a], John McPhee[a], Michael Wionzek[a] and Russell MacDonald[a,b,c]

[a]Toronto Paramedic Services, City of Toronto, Toronto, Ontario, Canada; [b]Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada; [c]Sunnybrook Research Institute, Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada

ABSTRACT

Objectives: Paramedic services face increasing challenges due to delays in patient transfer of care (TOC) at emergency departments (EDs). Prolonged TOC times directly impact paramedic services' ability to provide emergency response, though the patient and clinical factors contributing to these delays remain unclear. We examined TOC times for all transports to the ED and analyzed factors associated with prolonged TOC.

Methods: We conducted a retrospective cohort study using paramedic call data from Toronto Paramedic Services from September 1, 2022, to July 31, 2024. We included all paramedic-transported patient records to EDs following a 9-1-1 call, excluding inter-facility transfers and records with missing TOC timestamps. The TOC times were categorized into four intervals: 0–29, 30–59, 60–89, and ≥ 90 min. We conducted a cohort and subgroup analysis of patients aged 60 years or older using multivariable binary logistic regression models to identify factors independently associated with TOC times exceeding 60 min, using odds ratios (OR) with 95% confidence intervals (CI).

Results: A total of 418,196 patients were transported to EDs, of which 214,612 were 60 years or older. Overall, mean TOC was 39.9 min (SD 54.2). Patients aged 0–17 years had the lowest proportion in longer TOC intervals (5% for 60–89 mins; 2% for ≥ 90 mins), while patients 75 years or older had the highest (9%; 9% respectively). A TOC of at least 60 min was independently associated with older age (60 to 74 years OR 1.19, 1.15–1.22; 75 years or greater OR 1.27, 1.23–1.30), medical complexity (seven to eight diagnoses OR 1.15, 1.10–1.20; nine or greater diagnoses OR 1.29, 1.23–1.36), polypharmacy and specific presenting complaints (altered level of consciousness, respiratory distress, general weakness, head trauma). Medical acuity and receiving a paramedic intervention were not associated with prolonged TOC. Similar findings were determined in the subgroup analysis of older adults.

Conclusions: Prolonged TOC times disproportionately affect older or clinically complex patients, regardless of their acuity or need for paramedic intervention. Our findings highlight the importance for paramedic services, hospitals, and stakeholders to develop targeted care models and collaborations to reduce prolonged TOC.

ARTICLE HISTORY
Received 24 October 2024
Revised 30 December 2024
Accepted 4 January 2025

Introduction

Paramedic offload delay, defined as the time paramedics spend waiting to transfer patient care to the emergency department (ED) staff, is a growing problem in the emergency healthcare system (1–3). These delays not only hinder the availability of paramedics to respond to 9-1-1 emergency calls in the community but also strain ED resources by impairing patient flow in already constrained spaces, such as waiting rooms and hallways) (4, 5). For paramedic services, extended transfer of care (TOC) times can lead to increased response times and may negatively impact patient outcomes (4). For EDs, prolonged TOC is often a sign of strained capacity, which impede timely medical interventions for incoming patients (6).

The root causes of paramedic offload delays are complex and multifactorial, often involving a combination of ED overcrowding, limited bed availability, and insufficient staffing (5–7). Despite the recognition of this issue by EDs and paramedic services, there is still limited understanding of the specific patient populations most affected by these delays and the clinical factors that contribute to prolonged TOC. Addressing these delays is crucial, as they can not only compromise the quality of patient care but also hinder the overall efficiency of paramedic services (5, 6).

In the Province of Ontario (Canada), EDs experienced a record-high number of visits (6.4 million) from April 2023 to March 2024 with paramedic services noting similar trends in record-high utilization (8, 9). Given the growing demand for ED care and ambulance responses, coupled with limited ED diversion strategies, addressing prolonged TOC is essential to ensure timely access to care for potential threats to life.

Our primary objective of this study was to examine the association between relevant clinical and demographic characteristics of all transported patients and prolonged TOC. As

CONTACT Ryan P. Strum strumr@mcmaster.ca

a secondary objective, we conducted a focused analysis of older patients aged 60 and above to explore how these characteristics were associated with prolonged TOC.

Methods

Study Design

We conducted a retrospective cohort study using paramedic call reports from Toronto Paramedic Services (TPS), the paramedic service responsible for Toronto, Canada. We adhered to the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement for the reporting of results (10). Our study was approved by the Sunnybrook Research Ethics Board Information System (SunRISE), reference number 6364.

Population and Setting

All 9-1-1 calls received by TPS between September 1, 2022 and July 31, 2024 were abstracted and those where paramedics transported a patient to an ED were included. Paramedic interfacility transfers (i.e., hospital to hospital) and calls missing a recorded TOC time were excluded. During the study period, there were no alternative destinations for paramedic transport apart from hospitals.

Toronto is Canada's most populous city and the fourth largest in North America. It has a resident population of approximately three million and a daytime population exceeding four million, spanning an area of 630 square kilometers (244 square miles). The TPS is a jointly funded municipal and provincial paramedic service, employing approximately 1,400 paramedics and 140 emergency medical dispatchers, and responds to over 300,000 ambulance requests annually. The TPS operates under the regulation of the Ontario Ministry of Health (MOH) and the Ambulance Act of Ontario to deliver paramedic services. The paramedic scope of practice is defined in the Advanced Life Support Patient Care Standard (ALS PCS), as authorized by the MOH (11). The TPS paramedics transport to 14 different hospitals across the city of Toronto, one of which is a dedicated pediatric hospital. The proportion of patients transported to these hospitals ranges from 5% to 12%, apart from the pediatric hospital that receives 1%.

Variables and Measurement

All patient characteristics included in this study were measured and recorded at the time of paramedic interaction. Characteristics included age, sex, medical acuity, presenting complaint, preexisting medical conditions, medications, paramedic interventions, and paramedic certification level. Medical acuity was categorized using the Canadian Triage and Acuity Scale (CTAS), an ordinal scale ranging from one (resuscitation) to five (non-urgent) (12, 13). The TPS utilizes a modified CTAS scale for patients with an emergent triage acuity (CTAS 2), dividing the category into two sublevels: CTAS 2 A and 2B. This modification is operationally driven to facilitate more equitable patient distribution. Patients designated as 2 A are of slightly higher acuity and must be transported to the nearest emergency department, whereas 2B patients allow for more flexible distribution by being transported to the most appropriate of the three nearest hospitals. The presenting complaint is the clinical condition for which the patient is seeking medical care and is selected by paramedics from a predefined list. Preexisting medical conditions included all diagnoses before the paramedic interaction. Paramedic interventions were defined as any delegated medical act paramedics are authorized to perform independently under the ALS PCS (11). Paramedic certification levels were classified based on the scope of practice, namely primary care, and advanced care (11). The outcome, TOC, represents the time interval from an ambulance's arrival at the ED to the complete transfer of the patients care to ED staff. Ambulance is automatically recorded using an automatic vehicle locating system, which uses global positioning system to timestamp the moment of ED arrival. The TOC time is documented by paramedics after delivering the patient report to the receiving ED staff.

Data Source

We abstracted data from TPS's internal data repository, a patient incidence database that collects and stores all patient, logical, and administrative data for all 9-1-1 calls attended by paramedics. The repository is updated in real time following the completion of each 9-1-1 call, securely storing all electronic patient care reports generated through an electronic information system (Zoll data software). The database stores structured and coded data; no data cleaning was performed.

Statistical Analysis

We reported descriptive statistics of the patient cohort using measures of central tendency. We computed four TOC intervals for specified age groupings using means and standard deviations (SD), grouped as 0 to 29 min, 30 to 59, 60 to 89, and 90 min or greater. We performed a cohort and subgroup analysis of patients 60 years or older using distinct multivariable binary logistic regressions to assess the association between patient characteristics and a TOC interval of at least 60 min. Results were reported as crude and adjusted odds ratios (OR) to show independent associations of each characteristic with 95% confidence intervals (CI). The adjusted model's performance were measured using the area under the receiver operating characteristic curve (14). Data were managed and analyzed in R (v. 4.4.1). Missing data were reported directly and handled using complete case analysis. Characteristics were collapsed into ordinal and nominal categories to facilitate model stability when were non-continuous, and truncated (i.e., <5% per cell of cohort).

Results

During the study period, 427,480 patients were transported to EDs by paramedics following a 9-1-1 call, of whom

418,196 (97.8%) had recorded TOC times and were included in the analysis. Table 1 shows the clinical and non-clinical characteristics of the cohort. The mean TOC time was 39.9 min (SD 54.2), median of 27.6 min and an interquartile range of 26.3. Most patients had triage acuities categorized as urgent (CTAS 3, 50.9%) or emergent (CTAS 2 A or 2B, 41.0%). Primary reasons for transport were dispersed among 61 categories, with the most prevalent being general illness or weakness (8.2%), musculoskeletal trauma (7.5%), and abdominal pain (6.2%). Sex distribution and rates of paramedic interventions were equitably distributed amongst the cohort. The vast majority of patients were transported by primary care paramedics (85.3%). Of patients aged 60 years and older, the mean TOC time was 42.6 min (SD 54.8). Patients were mostly over 75 years old (61.0%), arriving with an urgent (50.5%) or emergent (42.8%) triage acuity, having between three and five medical conditions (45.6%), and attended to by primary care paramedics (85.0%).

Figure 1 shows the mean TOC times of all patients, categorized into five age groups. An ordinal gradient was observed descriptively, with mean TOC time increasing progressively from younger to older age categories. Patients aged 0 to 17 years had the shortest mean TOC time of 30.8 min (SD 12.3), while those aged 60 to 74 years and 75 years or older experienced longer mean TOC times (41.2 min, SD 28.8; 43.4 min, SD 36.8 respectively).

Figure 2 shows the percentage of each age group that falls into four TOC time intervals. The proportion of patients in the older age categories (60 to 74 years, 75 years and older) were the highest percentages in each TOC time interval after 29 min.

Table 2 shows the unadjusted and adjusted logistic regression associations for all patients with a TOC of at least 60 min. After adjustment, prolonged TOC was significantly associated with progressively older age groupings, including 40 to 59 years (OR 1.08, 1.05–1.11), 60 to 74 years

Table 1. Patient and clinical characteristics of all transported patients, and transported patients aged 60 years or greater.

Characteristic	All transported patients (n, %) *N* = 418,196	Transported patients aged > 60 years (n, %) *N* = 214,612
Arrival to Transfer of care, minutes[a]		
Average (SD)[a]	39.9 (± 54.2)	42.6 (± 54.8)
Median	27.6	29.1
IQR (Q1, Q3)	26.3 (17.8–44.1)	28.1 (18.9–47.0)
Age, years		
0–17	20,979 (5.0)	0 (0.0)
18–39	96,218 (23.0)	0 (0.0)
40–59	86,387 (20.7)	0 (0.0)
60–74	83,772 (20.0)	83,772 (39.0)
≥ 75	130,840 (31.3)	130,840 (61.0)
Sex		
Male	208,617 (49.9)	101,730 (47.4)
Female	207,083 (49.5)	112,327 (52.3)
Other/Missing	2,496 (0.6)	555 (0.3)
Medical Acuity, CTAS[b]		
1 – Resuscitation	7,564 (1.8)	4,552 (2.1)
2 A – Emergent (A)	82,880 (19.8)	45,898 (21.4)
2B – Emergent (B)	88,493 (21.2)	45,895 (21.4)
3 – Urgent	212,826 (50.9)	108,318 (50.5)
4 – Less Urgent	22,552 (5.4)	8,858 (4.1)
5 – Non-Urgent	3,881 (0.9)	1,091 (0.5)
Presenting Complaint[c]		
General Illness or Weakness	34,281 (8.2)	23,808 (11.1)
Musculoskeletal Trauma	31,379 (7.5)	15,572 (7.3)
Abdominal Pain	25,809 (6.2)	11,407 (5.3)
Behavioral or Psychological	22,618 (5.4)	3,956 (1.8)
Respiratory Distress	20,523 (4.9)	15,311 (7.1)
Gastrointestinal Problem	12,300 (2.9)	6,211 (2.9)
Altered Level of Consciousness	11,921 (2.9)	7,181 (3.3)
Head or Brain Trauma	11,530 (2.8)	6,415 (3.0)
Other	247,835 (59.3)	124,751 (58.1)
Preexisting Medical Conditions, total		
0–2	221,674 (53.0)	65,404 (30.5)
3–5	139,478 (33.4)	97,958 (45.6)
≥ 6	57,044 (13.6)	51,250 (23.9)
ALS PCS Paramedic Intervention		
Yes	200,078 (47.8)	111,201 (51.8)
No	218,118 (52.2)	103,411(48.2)
Highest Paramedic Certification		
Primary Care Paramedic	356,676 (85.3)	182,330 (85.0)
Advanced Care paramedic	61,507 (14.7)	32,278 (15.0)
Missing/Other	13 (0.0)	4 (0.0)

Note: SD = standard deviation, IQR = Interquartile Range, Q1 = Quartile 1, Q3 = Quartile 3, CTAS = Canadian Triage and Acuity Scale, ALS PCS = Advanced Life Support Patient Care Standard, IV = intravenous.

[a]Represents the time from paramedic arrival at the emergency department until handover of patient care to ED staff.

[b]The emergent acuity class is split into two subsections to assist paramedic services with equitable patient distribution to emergency departments but does not reflect medical acuity.

[c]Represents the foremost clinical condition for which the patient is seeking medical care.

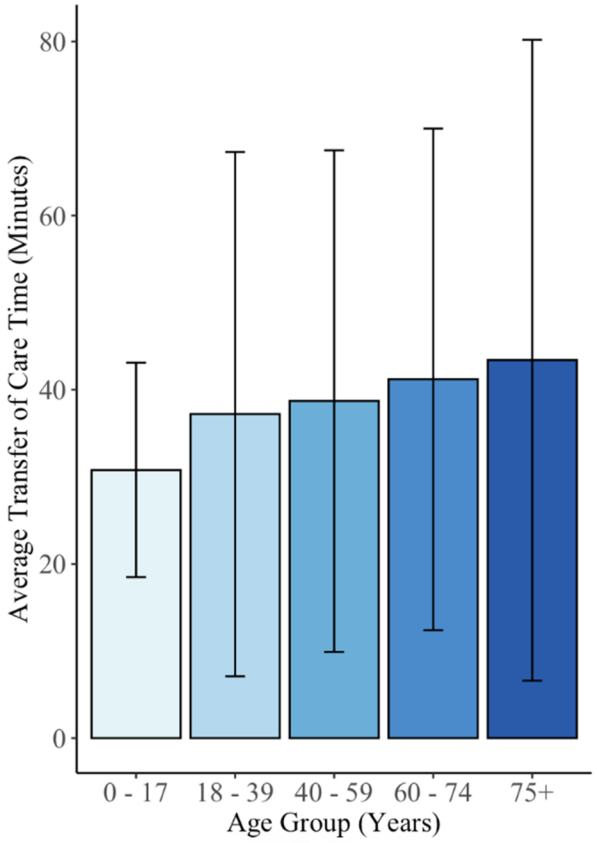

Figure 1. Mean transfer of care time between paramedics and emergency departments, by age category, displayed in minutes with standard deviation bars.

(OR 1.15, 1.11–1.22), and 75 years or older (OR 1.27, 1.23–1.30). No significant association was observed at any level of medical acuity. As the number of preexisting medical conditions increased, so did the odds of prolonged TOC, with the highest odds observed in patients with nine or more conditions (OR 1.29, 1.23–1.36). Specific presenting complaints were also significantly associated with prolonged TOC, including altered level of consciousness (OR 1.69, 1.60–1.79), respiratory distress (OR 1.28, 1.22–1.35), cardiac ischemic pain (OR 1.37, 1.28–1.46), general illness or weakness (OR 1.41, 1.34–1.47), and head or brain trauma (OR 1.28, 1.21–1.37). Receiving a paramedic intervention was not associated (OR 0.94, 0.93–0.95). The adjusted model AUC was 0.70 (0.70–0.71), indicating good classification performance.

Table 3 shows the unadjusted and adjusted logistic regression models for patients aged 60 years or older with TOC at least 60 min. Older adults aged 75 to 79 years (OR 1.05, 1.00–1.09), 85 to 89 years (OR 1.04, 1.01–1.07), and 90 or greater years (OR 1.04, 1.00–1.09) were more likely to experience TOC duration of at least 60 min. In contrast, younger patients of the subgroup aged 60 to 64 years (OR 0.94, 0.90–0.98) and 65 to 69 years (0.95, 0.91–1.00) were less likely to have prolonged TOC. Male sex (OR 1.02, 1.01–1.03), having more than seven preexisting medical conditions (seven to eight conditions OR 1.12, 1.07 to 1.18; nine or greater OR 1.26, 1.19–1.33), and taking at least five medications (five to six medication OR 1.08, 1.02–1.14; seven to eight medications OR 1.12, 1.06–1.18, nine or greater OR 1.21, 1.15–1.28) were also associated

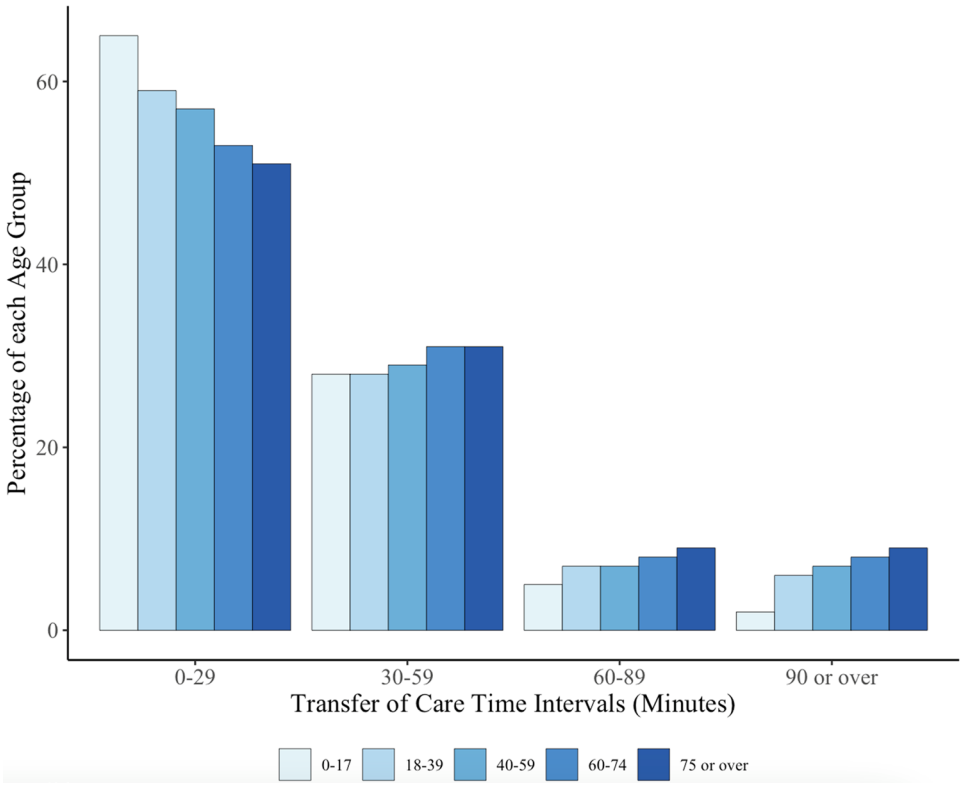

Figure 2. Percentage of age groupings in four transfer of care time intervals.

Table 2. Unadjusted and adjusted associations between patients transported by paramedics and transfer of care of at least 60 min.

Characteristic	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Intercept	–	0.15 (0.14–0.16)
Age, years		
0–17	0.52 (0.49–0.55)	0.50 (0.47–0.53)
18–39	Reference	Reference
40–59	1.12 (1.09–1.15)	1.08 (1.05–1.11)
60–74	1.31 (1.28–1.35)	1.19 (1.15–1.22)
≥ 75	1.47 (1.44–1.51)	1.27 (1.23–1.30)
Sex		
Male	1.05 (1.04–1.07)	1.07 (1.05–1.09)
Female	Reference	Reference
Medical Acuity, CTAS[a]		
1 or 2 A – Resuscitation or Emergent (A)	0.72 (0.71–0.74)	0.71 (0.69–0.73)
2B – Emergent (B)	Reference	Reference
3 – Urgent	0.70 (0.68–0.72)	0.72 (0.71–0.74)
4 or 5– Less Urgent or Non-Urgent	0.34 (0.32–0.36)	0.36 (0.34–0.38)
Preexisting medical conditions, total		
0	0.80 (0.78–0.83)	0.89 (0.86–0.93)
1	0.89 (0.86–0.91)	0.94 (0.91–0.97)
2	Reference	Reference
3–4	1.12 (1.09–1.15)	1.03 (0.99–1.06)
5–6	1.28 (1.24–1.32)	1.08 (1.04–1.12)
7–8	1.41 (1.36–1.47)	1.15 (1.10–1.20)
≥ 9	1.63 (1.56–1.70)	1.29 (1.23–1.36)
Medications, total		
0	0.93 (0.90–0.96)	1.04 (0.99–1.09)
1	0.97 (0.94–1.01)	1.00 (0.97–1.04)
2	Reference	Reference
3–4	1.13 (1.09–1.18)	1.05 (1.01–1.09)
5–6	1.27 (1.23–1.32)	1.10 (1.05–1.14)
7–8	1.37 (1.32–1.43)	1.14 (1.09–1.19)
≥ 9	1.57 (1.52–1.63)	1.23 (1.18–1.28)
Presenting Complaint[b]		
Abdominal Pain	1.02 (0.97–1.07)	0.96 (0.92–1.02)
Altered Level of Consciousness	2.00 (1.89–2.11)	1.69 (1.60–1.79)
Back Pain	1.07 (0.99–1.14)	1.02 (0.95–1.09)
Respiratory Distress	1.57 (1.49–1.65)	1.28 (1.22–1.35)
Cardiac Ischemic Pain	1.65 (1.55–1.76)	1.37 (1.28–1.46)
Cardiac (Other)	1.46 (1.36–1.56)	1.25 (1.17–1.34)
General Illness/Weakness	1.59 (1.52–1.66)	1.41 (1.34–1.47)
Gastrointestinal Problem	1.17 (1.10–1.24)	1.11 (1.04–1.18)
Head or Brain Trauma	1.40 (1.31–1.49)	1.28 (1.21–1.37)
Musculoskeletal Trauma	Reference	Reference
Stroke or TIA (suspected)	0.73 (0.66–0.81)	0.61 (0.55–0.67)
Other Presenting Complaint	1.34 (1.29–1.39)	1.28 (1.23–1.33)
ALS PCS Paramedic Intervention, yes	1.03 (1.01–1.05)	0.94 (0.93–0.95)
Highest Paramedic Certification		
Primary Care Paramedic	1.03 (1.00–1.05)	1.03 (1.01–1.06)
Advanced Care paramedic	Reference	Reference
Concordance statistic[c]	–	0.70 (0.70–0.71)

Note: OR = odds ratio, CI = confidence interval, Reference = reference group, ALS PCS = Advanced Life Support Patient Care Standard.

[a]The emergent acuity class is split into two subsections to assist paramedic services with equitable patient distribution to emergency departments, but does not reflect medical acuity.

[b]Represents the foremost clinical condition for which the patient is seeking medical care.

[c]Reported as the Area Under the Receiver Operating Characteristic Curve (95% CI).

with TOC of at least 60 min. Conversely, medical acuity was not statistically significant, at either higher acuity (CTAS 1 or 2 A OR 0.69, 0.67–0.72) or lower acuities (CTAS 3 OR 0.81, 0.79–0.84; CTAS 4 or 5 OR 0.50, 0.47–0.54). Specific presenting complaints were linked with extended TOC, such as altered level of consciousness (OR 1.31, 1.21–1.41), respiratory distress (OR 1.25, 1.18–1.33), cardiac ischemic pain (OR 1.33, 1.23–1.44), and head/brain trauma (OR 1.19, 1.10–1.29). Receiving a paramedic intervention was not significantly associated (OR 1.00, 0.99–1.02). The adjusted model AUC was 0.67 (0.67–0.68), indicating it is a satisfactory classifier of at least one hour TOC given these patient characteristics.

Discussion

Timely transfer of care from paramedics to ED staff is essential to maintain a paramedic service's ability to maintain readiness to respond to 9-1-1 calls. This study determined that prolonged TOC times from paramedics to ED staff were more prevalent among older patients, particularly those with higher medical complexity and polypharmacy. These findings suggest that delays in TOC are influenced by patient characteristics and complexity, in addition to contributing ED factors and capacity.

Our findings are consistent with previous studies that suggest older patients are more likely to experience

Table 3. Unadjusted and adjusted associations between patients aged 60 years or greater and transfer of care at least 60 min.

Characteristic	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Intercept	–	0.20 (0.18–0.20)
Age, years		
60–64	0.90 (0.86–0.95)	0.94 (0.90–0.98)
65–69	0.93 (0.89–0.98)	0.95 (0.91–1.00)
70–74	Reference	Reference
75–79	1.06 (1.02–1.11)	1.05 (1.00–1.09)
80–84	1.03 (0.98–1.07)	1.01 (0.96–1.05)
85–89	1.07 (1.03–1.12)	1.04 (1.01–1.07)
≥ 90	1.08 (1.03–1.12)	1.04 (1.00–1.09)
Sex		
Male	1.02 (1.00–1.04)	1.02 (1.01–1.03)
Female	Reference	Reference
Medical Acuity, CTAS[a]		
1 or 2 A – Resuscitation or Emergent (A)	0.68 (0.66–0.71)	0.69 (0.67–0.72)
2B – Emergent (B)	Reference	Reference
3 – Urgent	0.79 (0.77–0.82)	0.81 (0.79–0.84)
4 or 5– Less Urgent or Non-Urgent	0.49 (0.46–0.52)	0.50 (0.47–0.54)
Preexisting medical conditions, total		
0	0.96 (0.90–1.01)	0.97 (0.92–1.04)
1	0.96 (0.91–1.00)	0.97 (0.93–1.02)
2	Reference	Reference
3–4	1.04 (1.00–1.08)	0.99 (0.95–1.03)
5–6	1.15 (1.10–1.20)	1.04 (0.99–1.09)
7–8	1.27 (1.22–1.34)	1.12 (1.07–1.18)
≥ 9	1.46 (1.39–1.53)	1.26 (1.19–1.33)
Medications, total		
0	1.02 (0.96–1.08)	1.05 (0.99–1.12)
1	1.03 (0.98–1.10)	1.04 (0.98–1.10)
2	Reference	Reference
3–4	1.05 (1.00–1.11)	1.03 (0.98–1.09)
5–6	1.13 (1.08–1.19)	1.08 (1.02–1.14)
7–8	1.20 (1.14–1.27)	1.12 (1.06–1.18)
≥ 9	1.37 (1.31–1.44)	1.21 (1.15–1.28)
Presenting Complaint[b]		
Abdominal Pain	1.02 (0.95–1.09)	0.99 (0.84–1.00)
Altered Level of Consciousness	1.33 (1.24–1.43)	1.31 (1.21–1.41)
Back Pain	0.97 (0.89–1.06)	0.96 (0.88–1.05)
Respiratory Distress	1.30 (1.23–1.38)	1.25 (1.18–1.33)
Cardiac Ischemic Pain	1.35 (1.25–1.46)	1.33 (1.23–1.44)
Cardiac (Other)	1.19 (1.10–1.29)	1.19 (1.09–1.29)
General Illness/Weakness	1.38 (1.31–1.46)	1.34 (1.27–1.42)
Gastrointestinal Problem	1.11 (1.02–1.20)	1.08 (0.99–1.17)
Head or Brain Trauma	1.22 (1.13–1.32)	1.19 (1.10–1.29)
Musculoskeletal Trauma	Reference	Reference
Stroke or TIA (suspected)	0.55 (0.49–0.62)	0.59 (0.53–0.66)
Other Presenting Complaint	1.19 (1.13–1.26)	1.21 (1.15–1.27)
ALS PCS Paramedic Intervention, yes	1.02 (1.00–1.04)	1.00 (0.99–1.02)
Highest Paramedic Certification		
Primary Care Paramedic	1.06 (1.03–1.10)	1.04 (1.01–1.08)
Advanced Care paramedic	Reference	Reference
Concordance statistic[c]	–	0.67 (0.67–0.68)

Note: OR = odds ratio, CI = confidence interval, Reference = reference group, ALS PCS = Advanced Life Support Patient Care Standard.

[a]The emergent acuity class is split into two subsections to assist paramedic services with equitable patient distribution to emergency departments, but does not reflect medical acuity.

[b]Represents the foremost clinical condition for which the patient is seeking medical care.

[c]Reported as the Area Under the Receiver Operating Characteristic Curve (95% CI).

prolonged TOC (15). However, unlike previous studies, we did not observe an association between any triage acuity and higher TOC times (15). This may reflect the significant variability in TOC times across all acuity levels, which ranged from a few minutes to several hours. Our adjusted analysis suggests that TOC is a multifaceted issue influenced by a broader set of factors, rather than triage acuity alone, highlighting the complexity of these delays. Our study expands on prior research by providing important insights into the relationships between prolonged TOC delays and patient characteristics, thereby enhancing our understanding of this patient group with models that demonstrated strong discriminatory ability.

Prolonged offload delays result from a complex interplay of system, patient and operational factors, with no specific singular cause. One significant contributor is ED boarding, where admitted patients remain in the ED until hospital beds become available, occupying space needed for incoming patients to the ED. Another key issue is ED overcrowding, where limited staff, space, and resources prevent timely handovers from paramedics to overburdened ED staff. The triage prioritization process inherent to EDs also impacts paramedic TOC time. Critically ill patients, whether newly arriving or already present in the ED, often require prioritization for life-saving interventions. In such cases, resources may be temporarily reallocated from triage staff, delaying the triage of incoming paramedic-transported patients and contributing to delays as they enter the ED queue system (16). In parallel, triage challenges can be amplified in circumstances when paramedics arrive with complex patients who require very detailed triage, continuous monitoring, or ongoing paramedic care.

Prolonged TOC delays can have serious consequences for patients and paramedic services. Older patients, who are more likely to experience these delays, may not be able to wait in common areas (e.g., waiting room chair) due to their need for a bed, ongoing paramedic care, or assistance for basic functions (e.g., assistance with walking, impaired cognitive capacity to make decisions). Extended offload times for these patients can potentially worsen their conditions, lower patient satisfaction, and at times cause distress and discomfort if waiting or being assessed in generally public areas (e.g., hallways, ED triage areas) (6, 15). Prolonged offload delays also strain paramedic services, limiting their availability to respond to new 9-1-1 emergencies within the community (4). Given the majority of paramedic transports are older adults (60 years or greater) and the demographic shift of the population to the more elderly cohorts in the coming decade, the impacts of delays could become even more prevalent (17, 18).

Addressing prolonged TOC times requires a multifaceted and comprehensive approach. Firstly, strengthening collaborations between EDs and paramedics could streamline patient flows (19). One strategy could include dedicating an ED nurse to primarily manage patients arriving at the ED by paramedics or implementing a standardized offload delay time benchmark (20). Increasing ED capacity and resources, particularly for managing geriatric care, may improve ED capacity to receive patients. Increasing ED resources during peak times of paramedic arrivals may also be a prudent strategy. Implementing new paramedic models of care, such as treat-and-refer, treat-and-discharge, and transporting to alternative destinations, could reduce TOC times by decreasing transport volumes of non-emergent cases to the ED when ED-based care isn't required (2, 21).

Further research is needed to understand patient needs and develop tailored care models for differing patient

cohorts, particularly for geriatric patients. Analyzing clinical frailty and living circumstances could provide deeper insights. Incorporating ED data would enable an evaluation of patient outcomes related to prolonged TOC delays, including morbidity, mortality, and length of stay. Exploring innovative service models could also alleviate ED congestion and enhance overall healthcare system efficiency.

Limitations

Due to the inherent nature of cohort study designs, a causal relationship between characteristics and prolonged TOC could not be determined. Minor inaccuracies due to manually recorded TOC times are possible. Our findings are specific to a single large metropolitan area serviced by a single paramedic service that attends multiple receiving hospitals. As such, the findings may not be applicable to other settings. Incorporating emergency department-level factors, such as staffing levels, bed availability, and crowding metrics, could further enhance model performance; however, was beyond the scope of this study. Other patient characteristics that could potentially be associated with prolonged TOC, such as race or ethnicity, may exist; however, these factors are not captured in the patient care reports for analysis. Lastly, while there are variations in mean TOC times among hospitals, these differences are unlikely to have a significant impact on our findings. We did not include specific analyses of TOC metrics for individual hospitals, as they would align with the study's objectives. Our focus was on maintaining a system-wide, multi-centre approach; detailed hospital-level analyses were beyond the scope of this research.

Conclusions

Prolonged TOC times disproportionately affect older or clinically complex patients, regardless of their acuity or need for paramedic intervention. Our findings highlight the importance for paramedic services, hospitals, and stakeholders to develop targeted care models and collaborations that reduce incidence of prolonged TOC.

Acknowledgments

The authors would like to thank emergency medical dispatchers and paramedics at Toronto Paramedic Services for their dedication to providing timely and expert patient care.

Authors' Contributions

RPS, JM and RM led the conceptualization of the study. RPS conducted the analysis and wrote the initial and final drafts. All authors supported the interpretation of results and contributed to the final draft of the manuscript.

Declaration of Generative AI in Scientific Writing

The authors did not use a generative artificial intelligence (AI) tool or service to assist with preparation or editing of this work. The author(s) take full responsibility for the content of this publication.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

Funding

None.

ORCID

Ryan P. Strum http://orcid.org/0000-0003-1902-4734
Russell MacDonald http://orcid.org/0000-0001-6938-3925

Data Availability Statement

All relevant data are within the manuscript. The minimum dataset cannot be shared in a publicly accessible repository due to the legal health data restrictions in Ontario, Canada.

References

1. Schwartz B. Transfer of care and offload delay: continued resistance or integrative thinking? Can J Emerg Med. 2015;17(6):679–84. doi:10.1017/cem.2014.62.
2. Li M, Vanberkel P, Carter AJE. A review on ambulance offload delay literature. Health Care Manag Sci. 2019;22(4):658–75. doi:10.1007/s10729-018-9450-x.
3. Paramedic Chiefs of Canada. Statement on hospital offload delays in Canadian Hospital Emergency Departments. [Internet]; 2022. [cited Feb 21 2024]. Available from https://www.paramedicchiefs.ca/wp-content/uploads/2022/07/PCCStatementonOffloadDelaysJuly2022Final.pdf
4. Blanchard IE, Williamson TS, Hagel BE, Niven DJ, Lane DJ, Dean S, Shah MN, Lang ES, Doig CJ. The association between paramedic service system hospital offload time and response time. Can J Emerg Med. 2023;25(9):736–41. doi:10.1007/s43678-023-00521-2.
5. Cooney DR, Millin MG, Carter A, Lawner BJ, Nable JV, Wallus HJ. Ambulance diversion and emergency department offload delay: resource document for the national association of EMS physicians position statement. Prehosp Emerg Care. 2011;15(4):555–61. doi:10.3109/10903127.2011.608871.
6. Carter AJE, Gould JB, Vanberkel P, Jensen JL, Cook J, Carrigan S, Wheatley MR, Travers AH. Offload zones to mitigate emergency medical services (EMS) offload delay in the emergency department: a process map and hazard analysis. CJEM. 2015;17(6):670–8. doi:10.1017/cem.2015.15.
7. Gravel F, Bélanger V, Gosselin S. Offload ambulance delays: a small piece of a bigger puzzle. Can J Emerg Med. 2023;25(9):716–7. doi:10.1007/s43678-023-00574-3.
8. Canadian Institute for Health Information. NACRS emergency department visits and lengths of stay [Internet]. 2024. [cited 2024 Sep 30]. Available from: https://www.cihi.ca/en/nacrs-emergency-department-visits-and-lengths-of-stay.
9. Strum RP, McLeod B, Mondoux S, Miller P, Costa AP. Post-pandemic growth in 9-1-1 paramedic calls and emergency department transports surpasses pre-pandemic rates in the COVID-19 era: implications for paramedic resource planning. Prehosp Emerg Care. 2024;28:1–8. doi:10.1080/10903127.2024.2372452.
10. von EE, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative Strengthening the reporting of observational studies in epidemiology (STROBE) statement: guidelines for reporting observational studies. BMJ. 2007;335(7624):806–8. doi:10.1136/bmj.39335.541782.AD.
11. Emergency Health Regulatory and Accountability Branch. Advanced life support patient care standards - version 5.3

[Internet]. Ministry of Health; 2024. Available from https://ontariobasehospitalgroup.ca/wp-content/uploads/2024/02/ALS-PCS-5.3-final.pdf.
12. Bullard MJ, Unger B, Spence J, Grafstein E, the CTAS National Working Group. Revisions to the Canadian emergency department triage and acuity scale (CTAS) adult guidelines. CJEM. 2008;10(2):136–51. doi:10.1017/s1481803500009854.
13. Emergency Health Regulatory and Accountability Brach. Prehospital Canadian triage & acuity scale [Internet]. Ministry of Health and Long-Term Care; 2016. [cited 2024 Feb 22]. Available from: https://files.ontario.ca/moh_3/moh-manuals-prehospital-ctas-paramedic-guide-v2-0-en-2016-12-31.pdf.
14. Hond Ad, Steyerberg EW, Calster Bv. Interpreting area under the receiver operating characteristic curve. Lancet Digit Health. 2022;4(12):e853–5–e855. doi:10.1016/S2589-7500(22)00188-1.
15. Stewart D, Lang E, Wang D, Innes G. Are emergency medical services offload delay patients at increased risk of adverse outcomes? CJEM. 2019;21(4):505–12. doi:10.1017/cem.2018.478.
16. Abu-Alhaija DM, Johnson KD. The emergency nurse responses to triage interruptions and how these responses are perceived by patients: an observational, prospective study. Int Emerg Nurs. 2023;67:101251. doi:10.1016/j.ienj.2022.101251.
17. Strum RP, Mowbray FI, Worster A, Tavares W, Leyenaar MS, Correia RH, Costa AP. Examining the association between paramedic transport to the emergency department and hospital admission: a population-based cohort study. BMC Emerg Med. 2021;21(1):117. doi:10.1186/s12873-021-00507-2.
18. Government of Canada SC. A portrait of Canada's growing population aged 85 and older from the 2021 Census [Internet]; 2022. [cited 2024 Sep 30]. Available from: https://www12.statcan.gc.ca/census-recensement/2021/as-sa/98-200-X/2021004/98-200-X2021004-eng.cfm.
19. Scharf BM, Garfinkel EM, Sabat DJ, Cohn EB, Linton RC, Levy MJ. Impacts of an EMS hospital liaison program on ambulance offload times: a preliminary analysis. Prehosp Disaster Med. 2022;37(1):45–50. doi:10.1017/S1049023X2100128X.
20. Crilly J, Johnston AN, Wallis M, O'Dwyer J, Byrnes J, Scuffham P, Zhang P, Bosley E, Chaboyer W, Green D, et al. Improving emergency department transfer for patients arriving by ambulance: a retrospective observational study. Emerg Med Australas. 2020;32(2):271–80. doi:10.1111/1742-6723.13407.
21. Emergency Health Regulatory and Accountability Brach. Patient care model standards [Internet]. Ministry of Health; 2023. Available from: https://files.ontario.ca/moh_3/moh-standards-patient-care-model-standards-1-1-en-2023-01-27.pdf.