Identifying causes of delay in interfacility transfer of patients by air ambulance

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CLINICIAN'S CAPSULE

What is known about the topic?
Many patients in Ontario rely on interfacility transfer, yet, literature about causes of delay in transport is limited.
What did this study ask?
This study characterizes the types of delays experienced in the air transport of medical and trauma patients in Ontario.
What did this study find?
Refueling, waiting for land emergency medical service escort, and staffing- or dispatch-related issues were among the most common causes for delay.
Why does this study matter to clinicians?
Where possible, patients should be stabilized and optimized before arrival of the transport team to avoid a delay in transfer.

ABSTRACT

Objectives: Population density can limit the level of care that can be provided in local facilities in Ontario, and as such, patients with severe illnesses often require interfacility transfers to access specialized care. This study aimed to identify causes of delay in interfacility transport by air ambulance in Ontario.
Methods: Causes of delay were identified by manual review of electronic patient care records (ePCRs). All emergent interfacility transfers conducted by Ornge, the sole provider of air-based medical transport in Ontario, between January 1, 2016 and December 31, 2016 were included. The ePCRs were reviewed if they met one or more of the following: (1) contained a standardized delay code; (2) contained free text including "delay", "wait", or "duty-out"; (3) were above the 75th percentile in total transport time; or (4) were above the 90th percentile in time to bedside, time at the sending hospital, or time to receiving facility.
Results: Our search strategy identified 1,220 ePCRs for manual review, which identified a total of 872 delays. Common delays cited included aircraft refueling (234 delays), waiting for land emergency medical service (EMS) escort (146), and staffing- or dispatch-related issues (124). Other delays included weather/environmental hazards (43); mechanical issues (36); and procedures, imaging, or stabilization (80).
Conclusions: Some common causes of interfacility delay are potentially modifiable: better trip planning around refueling and improved coordination with local EMS, could reduce delays experienced during interfacility trips. To better understand causes of delay, we would benefit from improved documentation and record availability which limited the results in this study.

RÉSUMÉ

Objectif: La faible densité de la population peut limiter le niveau de prestation de soins dans les établissements locaux en Ontario et, de ce fait, les patients gravement malades ont souvent besoin d'être transportés dans d'autres établissements pour recevoir des soins spécialisés. L'étude visait donc à cerner les causes de retard dans les transports de patients, entre établissements, par ambulance aérienne, dans la province.
Méthode: C'est par un examen manuel des dossiers médicaux électroniques qu'ont été relevées les causes de retard. Tous les transports urgents de malades entre établissements, effectués par Ornge, le seul fournisseur de transport médical aérien en Ontario, entre le 1er janvier et le 31 décembre 2016, ont été inclus dans l'analyse. Étaient soumis à l'examen les dossiers satisfaisant à au moins l'un des critères suivants : 1) la présence d'un code normalisé de retard; 2) la mention des mots « retard », « attente » ou « congé après l'atteinte du nombre maximal d'heures de travail » dans du texte libre; 3) la durée totale de transport au-dessus du 75e centile; ou 4) le temps écoulé avant l'arrivée à l'hôpital, le temps passé à l'hôpital ou le temps écoulé avant l'arrivée à l'établissement d'accueil au-dessus du 90e centile.
Résultats: La méthode de recherche a conduit à l'examen manuel de 1220 dossiers et permis de dénombrer 872 retards. Les principales causes de retard comprenaient l'avitaillement en carburant des aéronefs (234 retards), l'attente des équipes terrestres de soins médicaux d'urgence (SMU) (146) et les problèmes de personnel ou de répartition (124). Quant aux autres causes de retard figuraient le mauvais temps ou des risques environnementaux (43), des ennuis mécaniques (36) ainsi

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que des interventions, des examens par imagerie ou la stabilisation de l'état des malades (80).
Conclusions: Certaines causes courantes de retard dans les transports entre établissements sont susceptibles de correction; ainsi, une meilleure planification de l'avitaillement en carburant et une meilleure coordination avec les SMU locaux permettraient de réduire les retards éprouvés durant les transports entre établissements. Enfin, pour mieux comprendre les causes de retard, il faudrait améliorer la qualité de la documentation et détailler davantage les dossiers; leur faiblesse à cet égard a limité la portée des résultats de l'étude.

Keywords: Air ambulance, delays, interfacility transfer, prehospital care

INTRODUCTION

Vast geography and low population density limit immediate availability of specialized trauma and medical care in many areas of Ontario. Because many severely ill patients require a higher level of care than is typically available in regional hospitals and nursing stations in the province, many patients rely on interfacility transfer to access tertiary or quaternary care. Interfacility transfers can be performed by ground transport or by air ambulance. Selection of ground versus air transport depends on a variety of factors, including injury severity, travel distance, resource requirements, regional practice patterns, and provider preferences.[1]

Rapid transfer to definitive care is an essential component of health care in Ontario, yet timely transport to advanced care centers is not consistently available.[2, 3] Where access to rapid transport is available, studies have shown improved outcomes after injury or acute medical decompensation. Air ambulance is often relied upon to expedite interfacility transfers when advanced care is required. Despite this, there has been some debate regarding the value of air ambulance systems, as their use is costly, labor intensive, and not without risk.[4–10] Nonetheless, air ambulance services are accepted as the standard of care in many health care systems, and when deployed effectively, their use is associated with a decrease in time to definitive care relative to the use of ground transport.[4, 11–17]

Although many health care systems rely on air medical transport, the literature surrounding the causes of interfacility transport delay is limited. Understanding patterns of delay is an important first step in improving the timeliness of interfacility transport in Ontario. This study aimed to identify causes of delay in emergent interfacility transport by Ontario's air ambulance system, known as Ornge. This study assesses the types of delays experienced by Ornge in the air transport of medical and trauma patients in a 1-year period to determine the stage and frequency at which each delay is occurring.

METHODS

Study design

This study was a retrospective cohort study of interfacility transfers for medical and trauma patients in the 12-month period from January 1 to December 31, 2016. Our objective was to evaluate the causes and frequency of delays during interfacility transfer of patients transported by air ambulance. This study was approved by the Sunnybrook Ethics Review board.

Setting

Ornge is the sole provider of critical care air medical transport for Ontario's 14 million people. Ontario has a vast land area with a highly variable population density—the population density of the province as a whole is 14.1 persons/km^2, but ranges from 0.2 to 4,334 persons/km^2 when disaggregated by Census Division.[18] Ornge has a total of nine bases that operate aircrafts, and a fleet of eight Pilatus PC-12 airplanes and 12 Leonardo AW-139 helicopters dedicated to medical transport. Ornge is staffed by advanced care and critical care paramedics who are trained in advanced procedures such as intubation and airway management, rapid sequence intubation, needle thoracostomy, and cricothyrotomy.

Data sources

Data were derived using electronic patient care records (ePCRs) of patients transported by Ornge. The ePCR contains patient demographic information as well as reason for transport, patient vital signs, medications administered, and interventions performed while under the care of transporting paramedics. Additionally, this database includes information entered by paramedics about

delays incurred during transport. Delays are recorded in the form of standardized delay codes or in the form of free text where paramedics can provide a written description of delays incurred, or are recorded as both.

Study population

We included all patients who were transported emergently by Ornge air ambulance. Urgent, nonurgent, and routine interfacility transfers were excluded.

Outcome: Identification of delays

Given the large number of patient records and the need for manual review of the ePCRs, we used a screening process to identify patients who were likely to have experienced a delay during their interfacility transfer. This screening process involved four approaches. A full manual review of a patient's ePCR was done if they met one or more of the following criteria: (1) Contained a standardized delay code; (2) Had documentation of a delay in the free text portion of the ePCR, identified by searching the free text call record for "delay", "wait", "duty-out", and common misspellings of the above terms (Note: "duty-out" refers to a forced stoppage of work after a pilot has reached a maximum number of duty hours); (3) Were found to be over the 75th percentile in total transport time, excluding flight time; or (4) Were above the 90th percentile in one or more of the following measures (excluding flight time): time to sending facility, time spent at the sending hospital, time to receiving facility (Figure 1 provides a description of these time-based intervals).

If a patient was screened by any one of the above strategies they had an entire manual review of their ePCR to identify any documented delays in the chart. If patients who were screened to have a delay through one of these strategies but there was no documentation of a delay, there was no delay assigned to that transport. It was possible for patients to have experienced more than one delay.

Transports falling above the 75th percentile in total time (excluding flight time) were selected as it was thought likely that these trips were more likely to have a delay identified. Transports with one or more intervals above the 90th percentile (excluding flight time) were selected in an attempt to capture trips that may have incurred a significant delay within a particular interval but were not captured in search strategy number 3.

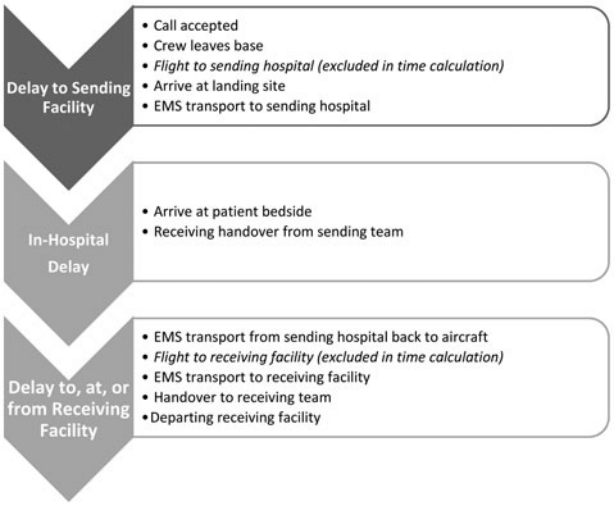

Figure 1. Time intervals in assessing causes of delay in interfacility transfers.

An additional random sample of 100 ePCRs not flagged for review were manually reviewed to validate our multi-pronged search strategy. There were no additional delays identified in this random sample.

Statistical analysis

Each trip was examined for the types of delays incurred and categorized as having delays that fall into one or more of the following categories: delay to sending facility (from time of call request to arrival at patient bedside), in-hospital delays (from arrival at bedside to departing patient bedside), or handover delays (from departure from sending facility to handover at receiving facility). Figure 1 demonstrates the possible components of each of these stages of a trip and the cutoffs for each category.

Assignment of delay codes was conducted by two reviewers. To ensure consistency in delay code assignment, a random sample of 20% of all transports meeting delay search criteria (i.e., 250 of 1,220) was assessed independently by each of the reviewers. Each reviewer assigned each transport one or more delay codes. The delay codings were assessed for congruity (76% congruency was met initially) and discrepancies were deliberated among the two reviewers until a coding strategy was agreed upon for each transport. Categorization of the remaining transports was divided equally between the two reviewers who would discuss any transports with descriptions not obviously fitting into an established category.

RESULTS

From January 1 to December 31, 2016, Ornge conducted a total of 3,797 emergent patient transfers. Of these patient transfers, 1,220 were identified by our search strategy to have their ePCRs reviewed.

Of the 1,220 patient transports, 587 had no information provided about a delay. One transport was delayed because the patient expired. The remaining 632 transfers had 837 identified delays, which translates to an average of 1.32 delays/transport. The range of delays per transport varied from one to four.

The types of delays incurred and their respective frequencies are shown in Table 1. Delays were more likely to occur in the "delay to sending" category (597 delays) than in either the "in-hospital delay" or "delay to, at, or from receiving facility" categories (164 and 76 delays, respectively). The most common delays cited included aircraft refueling (234 delays), waiting for land emergency medical services (EMS) escort to the sending facility (104), and dispatch-related issues (53).

Figures 2–4 demonstrate the frequency of delays and the cumulative percentage of delays at each stage of patient transport.

Table 1. Frequency of delay category as a percentage of total identified delays in emergent patient transport Jan-Dec 2016 and frequency of delays in trips identified to be above the 90th percentile in travel time

	Total number of times identified (% of total)	Number of times >90th percentile n (% of delays >90th percentile)
Delay to sending		
Refuel	234 (28.0)	10 (5.7)
Waiting for land EMS escort	104 (12.4)	23 (13.1)
Dispatch-related	53 (6.3)	10 (5.7)
Crew change/delay to pick-up team member	45 (5.4)	6 (3.4)
Weather or environmental hazards	43 (5.1)	9 (5.1)
Mechanical issues	36 (4.3)	9 (5.1)
Other	27 (3.2)	4 (2.3)
Delay from restocking or loading equipment	18 (2.2)	1 (0.6)
Pilot delay	15 (1.8)	1 (0.6)
Crew completing other patient transport	11 (1.3)	3 (1.7)
Bariatric Issues/size restrictions	11 (1.3)	3 (1.7)
Category total	597 (71.3)	79 (45.1)
In-hospital delay		
Other	50 (6.0)	18 (10.3)
Sending physician doing procedure (including intubation)	32 (3.8)	21 (12.0)
Medically unstable patient and/or delay for starting inotropes, fluids, etc.	25 (3.0)	16 (9.1)
Delays for diagnostic imaging	22 (2.6)	13 (7.4)
Waiting for land EMS escort back to aircraft	16 (1.9)	7 (4.0)
Delay waiting for documentation or handover	12 (1.4)	5 (2.9)
Waiting for blood products	7 (0.8)	0 (0)
Category total	164 (19.6)	80 (45.7)
Delay to, at, or from receiving facility		
Disposition delay and/or receiving team not ready or assembled	33 (3.9)	5 (2.9)
Waiting for land EMS escort to airport	16 (1.9)	4 (2.3)
Other	12 (1.4)	3 (1.7)
Waiting for land EMS escort to receiving facility	10 (1.2)	3 (1.7)
Equipment issue at receiving facility	5 (0.6)	1 (0.6)
Category total	76 (9.1)	16 (9.1)
Total number of delays	837 (100)	175 (100)

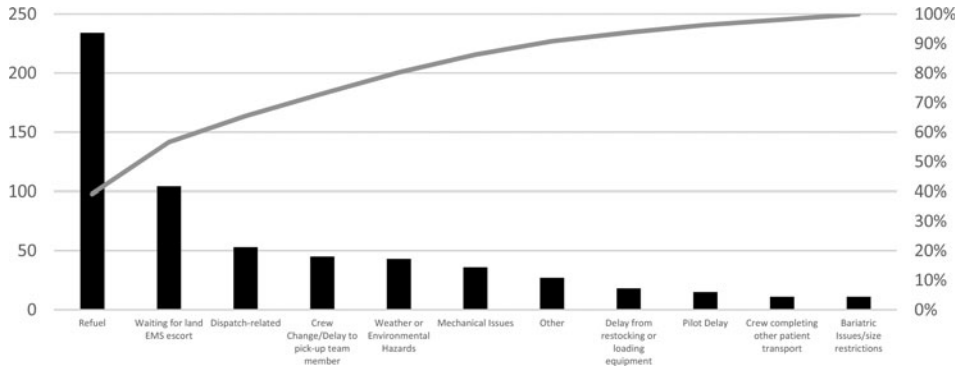

Figure 2. Delay to sending facility.

The patient transports identified to be above the 90th percentile in each time category were examined for the most frequently recorded delays; the time categories included "time to sending facility", "time spent at sending hospital", and "time to, at, or from receiving facility". For each of the abovementioned time categories, there was no information provided in a total of 131 of 196, 107 of 214, and 124 of 226 patient transports above the 90th percentile, respectively. The most common delays associated with each time category are included in Table 1.

DISCUSSION

Our results show that 16.6% of the emergent transports conducted by Ornge in 2016 had at least one delay associated with the transport. Because of our reliance on paramedic documentation, this is likely an underestimation of the total number of trips that experienced delay (587 trips screened by our search strategy had no information provided).

Delays were most commonly described in the initial phase of transport, delay to sending facility, with 71% of delays identified found in this time frame. By far, the most common reason for delay across all phases of travel was "refueling", affecting 234 patient transports (28% of delay codes). The next most common cause of delay was "waiting for land EMS escort". This typically occurred while waiting for an escort to the sending facility (used 104 times, representing 12.4% of delay codes); however, trips were also delayed because of waiting for land EMS escorts from the sending facility back to the aircraft (16 or 1.9%), from the airport to the receiving facility (10 or 1.2%), and from the receiving facility back to the airport (16 or 1.9%). In total, waiting for land EMS was used a total of 146 times, representing 17.4% of all delays used in our study population. Of note, when examining the "delay to sending" time category, "waiting for land EMS escorts" overtook

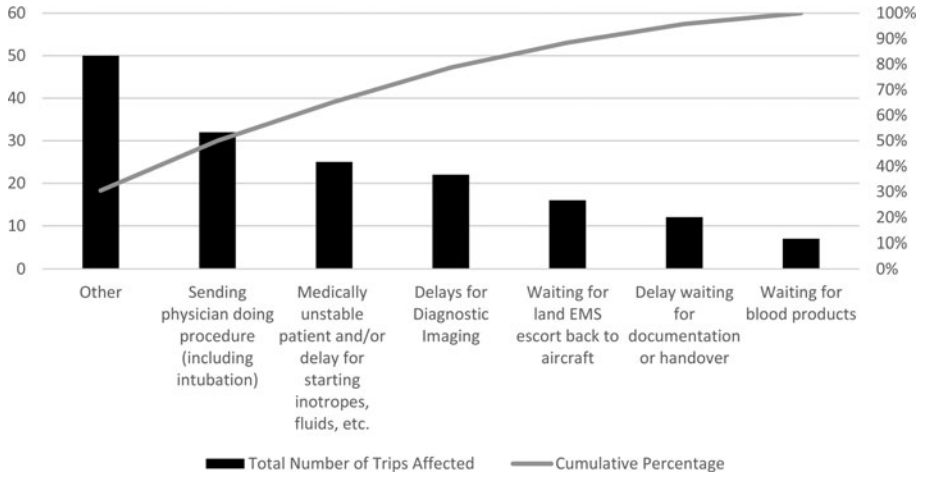

Figure 3. In-hospital delays.

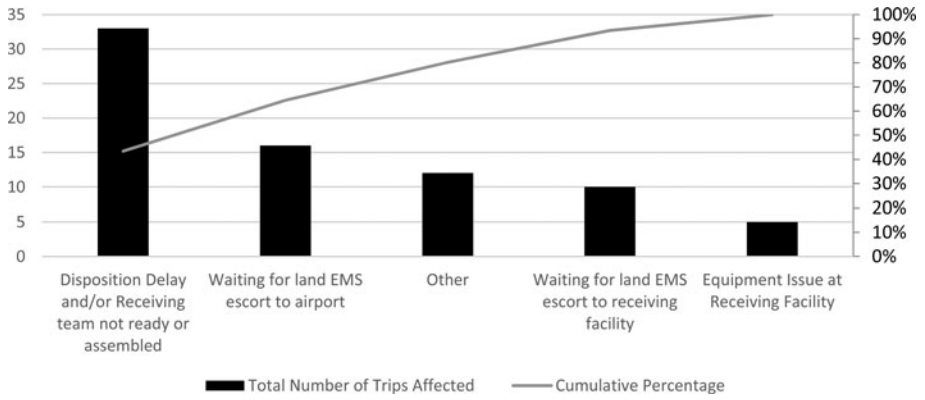

Figure 4. Delay to, at, or from receiving facility.

"refueling" as the most common delay in an examination of the longest trips (over 90th percentile). This may indicate that "waiting for land EMS escorts" is both a frequent and time-consuming source of delay. Refueling, although the most frequent delay incurred, may typically result in a shorter delay.

As such, it appears that reducing time waiting for land EMS escorts is an important potential mechanism for reducing delays in interfacility transport. Potential solutions could involve changing land EMS prioritization, land EMS resource availability, or land EMS to air transport communication strategies. Having land EMS deployment strategies prioritize the transportation of patients undergoing emergent interfacility transports and increasing the resources dedicated to this aspect of their scope of work could reduce delays. With respect to communication, as identified by Nolan et al. (2017), most communication between air and land EMS in our current system is routed through a Central Ambulance Communication Centre (CACC); developing a system where these two services could liaise directly, instead of by means of the CACC, might lead to improved communication with land EMS when it is needed to complement air transport. Future work could involve identifying the locations where delays associated with waiting for land EMS escorts are more frequently experienced to target sites for improvement.

Additional contributing factors to "delays to sending facility" included crew changes, dispatching delays, pilot delays, and being dispatched on a new trip while the crew was completing another patient transport. When taken together, these types of delays were identified on 124 occasions (14.8% of delay codes). Better coordination of crew dispatching and staffing, and of pilots' time limitations, may help to reduce this type of delay.

Many of the delays in the in-hospital delay category were for procedures (including intubation), for the stabilization of medically unstable patients, and delays for diagnostic imaging. From the data examined during this study, it is impossible to determine whether these procedures causing delays were necessary before patient transport. In trauma transfers, only the procedures and imaging necessary for stabilization before transfer from nontrauma centers should be done (particularly with respect to imaging, which is often repeated at a trauma center).[19–21] The literature on limiting imaging before the transport of critically ill medical patients is less robust; however, Usher et al. (2016)[22] showed that complete imaging was only available for 15% of patients transferred to a tertiary referral center, and was associated with an increased duplication in labor on arrival to the tertiary care center. As imaging and investigations are likely to be duplicated on arrival at the receiving facility, only the imaging and investigations that are likely to affect either disposition or management at the sending facility should be prioritized. Of course, some advanced care may be necessary to initiate as early as possible for medical patients before transport (e.g., initiation of antibiotics or inotropes), or patients whose cases evolve before the arrival of the transport team. Regardless, there appears to be room for improvement in ensuring that patients are stabilized and optimized for transport before arrival of the transport team so that these steps do not result in a delay.

The results of this study are limited by several factors, primarily by the lack of source data available. Many of the trips with delay information provided had only limited explanation of delays incurred and, therefore, required assumptions to be made on the part of the

investigators. For example, when the "refueling" delay code was used, it was presumed to be causing a "delay to sending", as this is typically when refueling occurs; however, there is a possibility that any given "refueling" delay occurred at other phases of patient transport. Reminding crews to document delays incurred could lead to improved data collection and, therefore, better identification of areas for improvement. Expanding the list of standardized delay codes and having each code specify which time category it occurred in would lead to more precise delay identification.

Additionally, our methods were only able to identify causes of delay within the interfacility transport process as recognized by paramedics. Our study was only able to identify delays once the transport process had begun, and as such, did not identify delays to initiate transfer, or delays associated with finding an accepting facility. The ePCR database that was used as our data source is updated by paramedics and, therefore, may not recognize delays as perceived by nurses or physicians at the sending or receiving facilities.

In conclusion, some of the common causes of delay in interfacility transport by means of air ambulance are potentially modifiable. Better planning around refueling and crew staffing, improved coordination with land EMS services, and optimizing patients for transport before air ambulance arrival could impact many emergent interfacility trips in Ontario. Finally, given that our analysis to better understand how to limit interfacility delay was limited by the extent and the completeness of available records and documentation quality, we would benefit from improved documentation and record availability.

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Competing interests: None declared.

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