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Characteristics associated with problematic pediatric transports to a regional children's hospital

Levels of pediatric emergency care for hospitals in Tennessee include Basic, Primary, General, or Comprehensive Regional Pediatric Center (CRPC). Our urban, tertiary teaching children's hospital is a CRPC and performs continuous review of transports to our emergency department (ED). Transported patients arrive by EMS ground-transport, helicopter, fixed wing aircraft, or private vehicle.

Our CRPC documents *problematic transports*, defined as those during which a preventable and potentially adverse event occurred. Any healthcare provider may identify a patient as having a preventable, potentially adverse event during their transport. Data on each of these patients and the transport are entered into a secure REDCap© database to track and trend these events [1]. Data recorded included patient age, gender, method of transportation, name of referring facility, and type of problem. These categories are based on AAP Guidelines, with special focus on common and/or life threatening issues [2].

Our objective was to identify patient and transport characteristics associated with *problematic transports*, and specifically, to investigate associations of patient and transport characteristics with hemodynamic instability during transport. We chose hemodynamic instability as the outcome for a multivariable logistic model because it is a frequent cause of problematic transports and one that might be prevented with education and training.

We analyzed CRPC patient transport data for calendar years 2011 through 2016. Patient and transport (e.g., type of referring facility and mode of transport) characteristics were evaluated as frequencies. We also identified 5 broad categories of problematic transports, and these broad categories were then divided into 37 subcategories, for which frequency statistics were also measured. Finally, a multivariable logistic regression model was performed to examine adjusted associations of available predictor variables with hemodynamic instability.

During the six-year study period 44,856 patients were transported to our facility, of which 667 (1.5%) were problematic transports. Characteristics of the 646 patients with complete records are presented in Table 1. The five broad categories of problematic transports and their frequencies as a percentage of problematic transports were airway (13.65%), circulation (14.67%), patient assessment (36.26%), medication error (18.55%), and mode-of-transport (17.19%). Table 2 displays the subcategories and their frequency of occurrence, with the Top 5 problems comprising 35.3% of the total. These 5 problems were "Patient should have come via emergency medical service, pov (personal vehicle) was inappropriate", "Improper immobilization", "Failure to completely assess the patient", "Maintenance of iv/io (intravenous/intraosseous) access", and "Patient should have come via specialty care team". In a multivariable logistic model that included the covariates age, gender, and location of referring facility, age was associated with the subcategory of "unrecognized hemodynamic instability during transport", such that each increase in age of 1 year was associated with a 10% increased odds of hemodynamic instability (aOR 1.1 [95% CI 1.0, 1.2]).

Our analyses suggest that 1.5% of patient transports to our children's hospital are problematic, most often involving patients transported for trauma. Inaccurate patient assessment is the most frequent identified problem. Additionally, increasing age was associated with unrecognized hemodynamic instability, perhaps because older patients can verbally communicate despite their hemodynamic instability. Alternatively, transport personnel may be more vigilant in younger patients, enabling earlier recognition and intervention for compensated shock.

A study strength was the rigor with which the CRPC staff reviewed and entered patient data. In addition, a CRPC representative contacted the transport crew and hospital to ascertain the transport circumstances and provide real time incident ascertainment and education. A possible

Table 1
Characteristics of 646 problematic pediatric transports amongst 44,856 transports to a children's hospital ED during years 2011–2016.

Characteristic	
Male, n (%)	381 (59)
Median age, years [IQR]	4 [1, 11]
Age range	2 d–23 years
EMTALA[a] violations (n)	2

[a] Emergency medical treatment and labor act.

Table 2
Frequency of problems occurring during 44,856 pediatric transports to a children's hospital emergency department during years 2011–2016.

Problem	%
The transporting crew intubated outside of protocol	0.46
Esophageal ETT	0.46
Right main-stem ETT	1.24
Failed airway - intubation was unsuccessful	1.86
Traumatic Intubation	0.77
Incorrect ETT size	1.08
End tidal colorimetric/capnography device not utilized	0
Failure to use a back-up airway device (LMA, etc.)	0.31
No O_2 applied	0.31
BVM should have been utilized	0.93
Appropriate airway medications were not utilized (bronchodilators on intubated Asthmatics)	2.11
Other - not listed	4.12
Airway total	**13.65**
Improper CPR performance	0.15
The crew failed to recognize the patient was in shock	3.1
The patient needed blood (not available/does not carry blood)	1.55
The patient needed an IV/IO and the crew did not attempt one	1.39
Maintenance of IV/IO	5.73
Other - not listed	2.75
Circulation total	**14.67**
AMS - no glucose checked	2.48
Under-recognized/undertreated seizure activity	1.55
Failure to completely assess the patient	7.59
Thermoregulation measures not taken	0.77
Tension PTX or hemothorax and no chest tube or needle decompression (maybe because the crew does not carry one)	0
Improper immobilization (c-spine, long spine, fracture)	8.2
Trauma UPGRADE on arrival due to failure to recognize the severity of the injury	2.63
Other - not listed	13.04
Assessment total	**36.26**
Incorrect resuscitation (PALS) meds or doses given	1.39
Improper RSI meds given (based on receiving facility)	0.62
Mannitol of 3% NS needed for increased ICP and not given or not available	0.46
Improper sedation	1.39
Improper/no pain meds given	2.32
No sedation/pain meds after RSI	0.77
Narcan or reversal agent indicated but not administered	0.31
Patient was placed on insulin drip, blood sugar dropped too fast	1.7
General medication - i.e.: wrong med, inappropriate med, med not given	3.56
Wrong dose of medication given	3.51
Other - not listed	2.52
Medication total	**18.55**
Patient should have come via EMS (POV was inappropriate)	9.29
Patient should have come via Air-Medical (EMS was inappropriate)	2.48
Patient came via Air-Medical and should have come via EMS (Air was inappropriate)	0.93
Patient should have come via Specialty Care Team (ex. neonatal team or ground critical care team)	4.49
Mode of transportation total	**17.19**

limitation includes potential for a Hawthorn Effect, because the transport crews and hospitals may have altered their behavior during the course of data collection as they were aware of data collection [3]. Also, because CRPC members provide follow up in real time, the incidence of problematic events may have decreased over time. This is a desired outcome consistent with the CRPC mission to improve pediatric emergency care through ongoing monitoring and feedback. However, while the overall incidence decreased over the course of the study, problematic transports continued to occur at unpredictable rates. Finally, because there is a subjective component to choosing mode of transport, mode-of-transport problems may be decreased by more objective criteria.

In conclusion, we have identified characteristics associated with problematic pediatric transports to a children's hospital ED. Problematic transports are not rare, as they occur approximately every 3 days. The most common patient is the young male child, and choice of mode of transportation is the most frequent variable associated with these transports. Overall, the top five causes comprise 35.3% of all the problems encountered. Age was associated with circulatory problems during transport after adjustment for gender and location of referring facility, such that each increase in age of 1 year was associated with a 10% increased odds of hemodynamic instability. This knowledge might facilitate targeted education toward agencies that transport critically ill children.

Author disclosure statements

Dr. Arnold had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. The authors have no conflicts of interest to disclose.

Conflicts of interest

None.

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Naloxone prescriptions from the emergency department: An initiative in evolution

It is well known that the United States is currently in the midst of an Opioid Epidemic. Drug overdose has become a leading cause of death in the United States [1]. To help address the epidemic, the United States Department of Health and Human Services has made expanded use and distribution of naloxone one of their priority areas to combat opioid abuse [2]. Specialty societies have also endorsed the expansion of naloxone education and distribution [3].

Our institution developed a hospital-based naloxone distribution program in 2011 to expand distribution and use of naloxone to patients at risk of overdose visiting our emergency department (ED). In the original iteration of our program we conducted training and prescribing of naloxone at the bedside in the ED. As the program expanded to include our ED, inpatient units, and all health-system clinics, it transitioned to the provider simply writing a prescription to be filled in the pharmacy where training would also be completed.

We conducted a retrospective chart review for all ED encounters where a naloxone prescription was generated from January 4 to August 31, 2017. Each encounter was abstracted for: patient age, sex, ED diagnosis, if the naloxone prescription was brought to our attached outpatient pharmacy, and if the naloxone training and education was provided by an outpatient pharmacist. The primary outcome was the proportion of patients that obtained naloxone from our pharmacy after receiving a prescription in the ED. We also planned to compare successful naloxone obtainment between patients with an ED diagnosis of overdose and patients with an alternative diagnoses and between patients given naloxone plus additional prescriptions and patients given only a naloxone prescription. This study received IRB exempt status.

A naloxone prescription was provided by the ED for 55 unique patient encounters during the study period. The mean age of the patients was 48 years old and 75% were male (Table 1). Among the 55 naloxone prescriptions written, 14 (25.5%) prescriptions were documented as received at the outpatient pharmacy. Ultimately, only 10 (18.2%) prescriptions were obtained. We did not identify a difference in successful prescribing of naloxone between patients with a primary ED diagnosis of heroin overdose versus other diagnoses. It is notable, we identified about a 10% higher rate of successful prescribing for patients given additional prescriptions plus a naloxone prescription (Table 2).

Given the opioid epidemic's burden on the healthcare system and the frequency of patients presenting to the hospital, the ED is poised to be actively involved in this public health response. Community-based naloxone programs have been active for two decades, but prescribing naloxone for home use is a newer concept in Emergency Medicine [4]. In the community, a patient is provided overdose and naloxone education and typically receives naloxone immediately [5]. This could

Table 1
Demographics.

Demographic	Number of patients (n = 55)
Age (mean, SD)	48 (12)
Male (%)	41 (74.5)
Primary diagnosis of heroin overdose (%)	22 (40)
Alternative primary diagnosis (%)	33 (60)
Received other prescriptions plus naloxone prescription (%)	25 (45.5)
Received only a naloxone prescription (%)	30 (54.5)