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Impact of physician-less pediatric critical care transport: Making a decision on team composition

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ABSTRACT

Purpose: To explore the impact of a physician non-accompanying pediatric critical care transport program, and to identify factors associated with the selection of specific transport team compositions.
Materials and methods: Children transported to a Canadian academic children's hospital were included. Two eras (Physician-accompanying Transport (PT)-era: 2000–07 when physicians commonly accompanied the transport team; and Physician-Less Transport (PLT)-era: 2010–15 when a physician non-accompanying team was increasingly used) were compared with respect to transport and PICU outcomes. Transport and patient characteristics for the PLT-era cohort were examined to identify factors associated with the selection of a physician accompanying team, with multivariable logistic regression with triage physicians as random effects.
Results: In the PLT-era (N = 1177), compared to the PT-era (N = 1490) the probability of PICU admission was significantly lower, and patient outcomes including mortality were not significantly different. Associations were noted between the selection of a physician non-accompanying team and specific transport characteristics. There was appreciable variability among the triage physicians for the selection of a physician non-accompanying team.
Conclusions: No significant differences were observed with increasing use of a physician non-accompanying team. Selection of transport team compositions was influenced by clinical and system factors, but appreciable variation still remained among triage physicians.

1. Introduction

The majority of pediatric primary acute care is not provided by specially-trained healthcare providers or performed in dedicated pediatric facilities. Patient outcomes are improved by building access to regionalized specialty services [1,2], and are often accessed through inter-hospital medical transport services [3-8]. Transport standards suggest that critically ill children should ideally be moved by specialized pediatric transport teams, assuring improved patient care and outcomes [9,10].

In recent years, specialized pediatric critical care (PCC) transport teams without an accompanying physician have become commonplace in many North American programs [7,8]. Little evidence exists to support an ideal transport team composition, in particular when it comes to the need for a physician-presence on a PCC transport team.

Referral physicians in Alberta, Canada consult pediatric intensivists in one of two provincial children's hospitals to aid in the stabilization and transfer of critically ill or injured children. The intensivists have to decide, based on the information provided by the referral physicians, the most appropriate team to transport the individual pediatric patient: an Advanced Life Support (ALS: paramedic) team; a transport team based in an independent rotary transport organization (STARS; Shock Trauma Air Rescue Service), which consists of a dedicated transport nurse, a flight paramedic, and the option for an emergency medicine physician (either senior resident or fully trained emergency medicine physician); a PCC physician non-accompanying transport team; or a PCC transport team accompanied by a physician [11].

Abbreviations: PCC, Pediatric Critical Care; ALS, Advanced Life Support; PICU, Pediatric Intensive Care Unit; PT, Physician accompanying transport; PLT, Physician-less transport; STOL, Stollery Children's Hospital; IQR, Interquartile Range; CI, confidence intervals; HR, heart rate; RR, respiratory rate; SpO_2, oxygen saturation; SBP, systolic blood pressure; PRISM, pediatric risk of mortality; LOS, length of stay; RT, respiratory therapist; RN, registered nurse.

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The Stollery Children's Hospital (STOL) (Edmonton, Canada) is an academic children's hospital and a Western Canadian quaternary care center with a large catchment area that includes Central and Northern Alberta, Northwest Territories, eastern Yukon, and western Nunavut, including at least 750,000 children under 17 years of age. It built a Pediatric Intensive Care Unit (PICU)-based, dedicated PCC transport team in 1996. The transport team was staffed by physicians with added emphasis on pediatric critical care in the interhospital setting (PICU consultants, senior PICU fellows, or senior residents in anesthesiology or emergency medicine who had completed their PCC training for 1–2 months), respiratory therapists and nurses, all with extensive experience and training in the assessment and management of critically ill or injured children. Since January 2008, the transport team has increasingly sent physician non-accompanying transport teams as opposed to physician accompanying transport teams. For the study purpose, we defined 2000 to 2007 as a Physician Transport Era (PT-era) and 2010–2015 as a Physician-Less Transport Era (PLT-era).

The purposes of this study were 2-fold: 1) To explore the impact of the increasing use of physician non-accompanying PCC transport teams on patient outcomes (i.e., PT-era to PLT-era); and 2) to identify factors associated with the selection of a PCC transport team that did or did not include a physician in the PLT-era cohort.

2. Materials and methods

2.1. Data used

We accessed two databases: (1) a hospital-based transport database (existed since 1998); and (2) a hospital-based PICU discharge summary database (existed since August 2002). Less than 1% of values for recorded variables are missing, except those for vital signs during transports in the transport database, for which approximately 5% of recorded variables had missing values.

2.2. Patients and transports

We included children under 17 years of age who were transported by the PCC transport team to the STOL from STOL's primary catchment area between 2000 and 2015. We excluded transports from other provinces, international transports, newborn infants transported by a neonatal transport team, non-emergent pediatric transfers, and patients who were transported from other hospitals to the STOL by non-PCC transport teams such as ALS (paramedic) or STARS. We excluded transports in 2008 and 2009 as a washout period. For the analysis of outcomes after PICU admissions, transports (patients) admitted between August 2002 to December 2015 were examined. For the second study purpose, we examined the differences in transport and patient demographics between physician non-accompanying transports and physician accompanying transports in the PLT-era (2010–2015).

2.3. Distance calculation

Geolocation of 6-character postal codes for individual residential address and referral hospitals allowed us to calculate two distances: (1) patient's residence to the STOL; and (1) referral hospitals to the STOL. We calculated straight-line distances for the distance with an air ambulance used, and road distances were calculated when ground ambulances were used. We also took into account the changed location of receiving airports in the calculations; it was moved from the city center airport to the international airport in 2013, both of which are located in Edmonton. Additional details of the distance calculation can be found in the Supplemental Document (Details of Distance Calculation).

2.4. Vital sign changes during transports

For vital sign changes (heart rate (HR); respiratory rate (RR); oxygen saturations (SpO_2); and systolic blood pressure (SBP)), we classified all vital sign values measured at the beginning and end of transport relative to age-appropriate normal values for the given patients. We then categorized the patients into three groups: (a) patients whose vital sign values improved (from the outside of the normal range to within the normal range) or remained within the normal range (from the normal range to the normal range) during transport; (b) patients whose vital sign values deteriorated during transport (from the normal range to the outside of the normal range); and (c) Others (remained outside of the normal range throughout the transport) [12].

2.5. Statistical analysis

We adopted a retrospective cohort design in this study. First, we compared characteristics of the transports and the transported patients' demographics, including times of the transport, day, distances, modalities of the transports (i.e., Fixed wing propeller, Helicopter, Ground ambulance, and Fixed wing lear jet), procedures/treatments provided at the referral hospitals between the two time periods: (i) PT-era (2000–2007, when physicians regularly accompanied the transport team); and (ii) PLT-era (2010–2015, when physician non-accompanying transport team was increasingly used). Each variable's distribution was described by its median and inter-quartile range (IQR). Mann-Whitney *U* test and Chi-Square test (or Fisher's exact test if needed) were used to compare the continuous and nominal variables, respectively, between the two eras.

Logistic regression was employed to compare the two eras, so as to estimate odds ratios, with 95% confidence intervals (CIs), of having the following transport-related outcomes in the PT-era relative to the PLT-era: admission to the PICU within 24 h of referral call; having unsuccessful procedures performed during the transports; the need for endotracheal intubation at the referral hospital; and vital sign changes (i.e., improved/remained the same or deteriorated; please refer supplemental document) during transports. The median regression was employed to evaluate the differences in the continuous outcome variables (i.e., transport-related times) by the two eras. We performed the regression analyses above, adjusting for propensity scores created as described in the supplemental document [13,14].

For the transports (patients) admitted to the PICU within 24 h of referral call, PICU and hospital outcomes were compared with respect to the two eras. Logistic regression was employed to estimate odds of death during transport or after PICU admission, endotracheal intubation at the referral hospital or after PICU admission, pediatric risk of mortality (PRISMIII), and treatments/procedures provided in the PICU. The median regression was employed to evaluate differences in the PICU length of stay (LOS), hospital LOS, and the number of invasive ventilation days, between the two eras.

For the second part of our study, transport and patient characteristics and treatments/procedures performed at the referral hospitals before the transport team arrival were examined to identify factors associated with selection of transport team compositions. The examined variables included patient's weight, prior transport experience of each PCC transport practitioner (respiratory therapists (RTs) and nurses (RNs)), modality of the transport, level of care available at the referral hospital (with adult ICU or not), transport distances (supplementary document), vital sign values in the age-appropriate normal values (Y/N) for the four vital signs (HR, RR, SpO_2, and SBP; measured at the transport team's arrival), and treatments/procedures performed at the referral hospitals prior to the team arrival in which significant differences (P-values <0.001) were observed, with relatively high incidence between the two transport-team compositions. Multivariable logistic regressions with the triage physicians as random effects were employed to estimate odds of sending a physician accompanying transport team in each triage