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Documentation of pediatric vital signs by EMS providers over time

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ABSTRACT

Background: Pediatric patients make up approximately 10% of EMS transports nationwide. Previous studies demonstrated that pediatric patients do not consistently have a full set of vitals signs obtained in the prehospital setting [1]. In certain conditions, such as traumatic head injury and shock, unrecognized hypotension and/or hypoxia are associated with increased morbidity and mortality [2,3].
Objectives: Primary Objective: To measure how often EMS providers obtain blood pressure (BP), heart rate (HR), pulse oximetry (Po), and respiratory rate (RR) on pediatric transport patients in the state of Utah from 2007 to 2014. Secondary Objective: To assess whether educational interventions improved the percentage of pediatric transport patients with a full set of vital signs documented.
Results: The trend of documenting the four critical vital signs improved over time for all four categories. Measurement of Po increased most consistently across all age groups. Blood pressure remained the most inconsistently obtained vital sign, especially in younger pediatric patients. The educational interventions introduced in late 2010 correlated with an increase in vital sign attainment.
Conclusions: Assessment of pediatric vitals signs is a critical part of the evaluation and care of pediatric patients in the prehospital setting. Utah EMS providers improved their practice of documenting four pediatric vital signs over time after educational interventions. Obtaining a BP, especially in younger children, continues to be a challenge. More work remains to achieve the state goal of documenting all vital signs in >90% of pediatric transports.

1. Background

Although the majority of emergency medical services (EMS) calls result in care of adult patients, 10% of EMS transports nationally involve pediatric patients [1]. In the state of Utah, the percentage is even higher (12%). Previous studies have demonstrated that pediatric patients often do not have vital signs documented consistently in the prehospital setting [1,2]. In one study, only respiratory rate was documented in >90% of transports, and attainment of other vitals signs, such as pulse oximetry was as low as 33% [1].

As part of the state trauma performance improvement process, the Utah Department of Health reviewed retrospective data from 2007 to 2009 analyzing how often pediatric EMS transport patients had four critical vital sign obtained: heart rate (HR), respiratory rate (RR), systolic blood pressure (BP), and pulse oximetry (Po). The data demonstrated variable attainment of vital signs, but in general, the four vital signs were measured less than 80% of the time across all ages in the prehospital setting. In younger children, the numbers were even lower, and up to 70% of patients, especially infants and toddlers, never had a documented blood pressure.

In response to this initial vital sign data, and with concern that inadequate recognition of conditions such as hypoxia and hypotension was potentially contributing to preventable pediatric morbidity and mortality, we undertook a study to evaluate vital sign documentation during pediatric transports before and after educational interventions aimed at improving EMS vital sign attainment.

2. Objectives

2.1. Primary objective

To measure how often EMS agencies obtain BP, HR, Po, and RR on pediatric transport patients in the state of Utah from 2007 to 2014.

2.2. Secondary objective

To assess whether educational interventions improved the percentage of pediatric transport patients with a full set of vital signs documented.

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3. Methods

This project was part of a combined State Trauma and EMS performance improvement project. We used the EMS POLARIS database (Prehospital Online Active Reporting Information System, Utah's prehospital data collection system) to review EMS run sheet documentation of pediatric (<18 years of age) vital signs during transports between 2007 and 2014. All pediatric ground transports throughout the state were included, and we did not differentiate transports based on distance from accepting center, length of transport, or type of EMS team (ALS vs. BLS team). For this study, we did not collect data concerning patient diagnosis.

After reviewing vital sign data from 2007 to 2009, three educational interventions were developed to improve how often EMS teams obtain HR, RR, BP and Po during pediatric transports. As the educational interventions were implemented, we continued to gather information from the database to follow vital sign attainment prospectively.

The three educational interventions included the following:

First, in June 2010, the initial data were presented to the Utah EMS for children (EMSC) coordinators, who serve as the pediatric champions and educational leads for regional EMS providers around the state. The data results were divided by region, and regional data were compared against each other and to the state average. The EMSC coordinators then disseminated this information to their local EMS providers, highlighting areas for improvement that were region-specific.

Second, starting in 2010 the state EMS medical director conducted 15 short lectures across the state highlighting the retrospective data from 2007 to 2009 and the deficiencies in vital sign documentation. These short lectures emphasized the importance of obtaining, interpreting, and documenting vital signs during pediatric transports.

Third, throughout 2013, a 6-hour training program was given directly to state EMS providers across the state. The training program included information on performance improvement, the importance of pediatric vital signs, and hands-on practice with helpful ways to obtain vital signs in young patients. The course was taught by either a pediatric trauma charge nurse, the state EMS medical director, or the state EMSC medical director.

The percentage of transports in which each of the four vital signs was documented was averaged for each year data were analyzed. The numerator was the number of records with that specific vital sign recorded during an EMS pediatric patient interaction; the denominator was the total number of EMS pediatric patient transports that year for that patient's age. The number of total pediatric patient transports/year ranged between 7514 in 2007 and 19,806 in 2011 (mean for all years 16,315 pediatric patient transports, median 18,083 pediatric patient transports).

4. Results

The trend of documenting the four critical vital signs increased over time for all four categories. Measurement of Po increased most consistently across all age groups over time, increasing from 60% to 70% of transports to 80% to 90% across all ages by 2014 (Fig. 1). Providers obtained RR and HR near 90% of the time across all age groups after the educational training (Figs. 2 and 3). There was improvement in documentation of BP over time in all ages, with children >13 having a documented BP during 90% of transports by 2014. However, blood pressure remained the most inconsistently obtained vital sign, especially in younger pediatric patients, with children <3 years of age having a documented BP in <50% of transports (Fig. 4). The educational interventions introduced in late 2010 correlated with an increase in attainment of all 4 vital signs after that time.

5. Discussion

This retrospective review of vital sign documentation by Utah EMS providers shows considerable improvement in the percentage of pediatric transport patients with documentation of HR, RR, Po and BP over time, especially after specific education interventions designed for state EMS providers on the topic. The data concerning vital signs during pediatric transport between 2007 and 2009 were initially collected as part of the Utah Preventable Mortality Study, completed in 2009. The results of this study led to discussions among state EMS and trauma representatives concerning IV fluid resuscitation by EMS providers, and the realization that vital signs, especially blood pressure, were inconsistently obtained. Therefore, abnormalities were likely not recognized and responded to appropriately. Further concern about inadequate response to hypotension and hypoxia, especially in the setting of pediatric traumatic brain injury was raised after the findings by Zebrack et al. [2], showing one third of pediatric patients with moderate to severe traumatic brain injury did not have documentation of the four critical vital signs at some portion of their early medical care. Inadequate recognition of and response to hypotension and hypoxia was associated with higher odds of disability and death.

The reasons for incomplete documentation of pediatric vital signs are likely complex. All Utah EMS agencies are required to report their data to the state, and adhere to the National EMS Information System data dictionary. The data elements entered have not changed since 2007, so data should not be missing because of any changes in the data collecting system. Vital sign data are not an absolutely required field; however, if a patient care report is entered without vital sign data, that provider will receive a warning prompting him or her to enter any vital sign data obtained. Therefore, the records likely reflect the vital signs measured during transport, and missing data were not

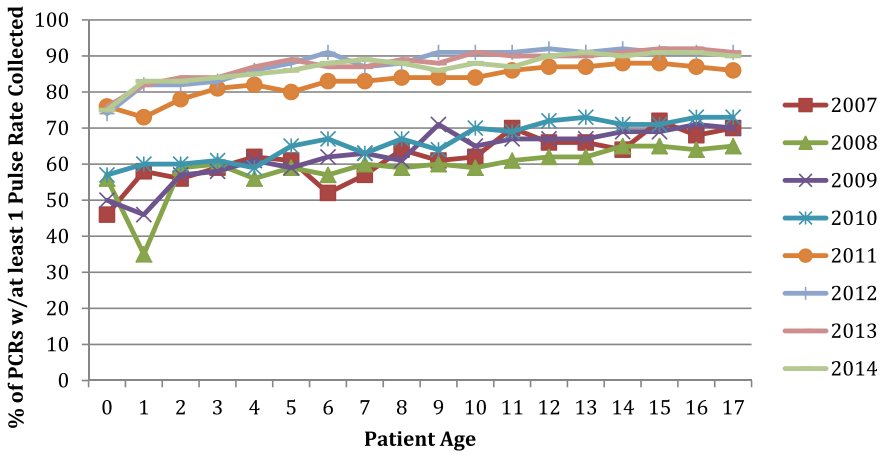

Fig. 1. Collection of pulse oximetry in pediatric patients, 2007–2014.