Child Abuse Recognition Training using Deliberate Practice for Prehospital Providers

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Background:
Abused children often have encounters with prehospital providers (PHP) prior to the recognition of abusive injuries. Despite the fact that PHP are mandated reporters, they frequently cite lack of training as a challenge to recognizing and reporting abuse. Identifying abuse among children presenting for acute injury requires the ability to differentiate accidental from abusive injury. Patterns of cutaneous injury (burns and bruises) suggestive of abuse are well described. The method of deliberate practice, a teaching method where a learner is given direct real-time feedback during the practice of a skill, provides educators with the ability to determine a learner's baseline skill and track change over the course of an educational intervention. Given the importance in accurately distinguishing between abusive and accidental injury, an educational module simulating presentations of abusive and accidental injuries is critical.

Objective:
To develop and evaluate a web-based educational module using deliberate practice methodology to train PHPs to distinguish between abusive and accidental cutaneous injury in children.

Methods:
This is a pilot study of a web-based educational module using deliberate practice.
The educational module includes a case bank of 117 authentic cases of children with burns and bruises who presented to 2 trauma centers with active child abuse evaluation teams. Cases were obtained from hospital trauma and burn registries representing a range of age, race, and ethnicity to matching demographics and physical characteristics of patients in the community. The case bank contains a 60:40 ratio of abusive injury to accidental injury. PHPs were recruited from a state EMS list-serve. Participants reviewed a case, indicated if it was consistent with abusive or accidental injury and after submitting a response, were given immediate text and visual feedback. Learning effectiveness was measured by calculating terminal accuracy, sensitivity and specificity on the last 25 questions answered. We also calculated the odds of interpretation accuracy of burn versus bruise cases. Finally, we assessed the change in self-efficacy for interpreting cutaneous injury and knowing which cases to report to child protective services using a validated pre-post survey asking the question "***As compared to before*** I participated in this educational module, I am more comfortable…" for each item. Responses were collected using a 6-point Likert scale (1=strongly disagree to 6=strongly agree).

Results:
We recruited 61 PHPs that completed the module. The majority of participants were male (63.9%) with median age is 43 years (IQR 35, 53), and median years of practice of 13 years (IQR 5, 25). Approximately 61% reported having prior child abuse training education and 39% report having made a report to child protective services in the past. The mean terminal sensitivity (accurately identifying abuse) for our learners was 87.6% (95 % CI 85.5, 89.6). Mean terminal specificity (accurately identifying accidental injury) and learner accuracy (overall proportion correctly answered) was 88.4% (95% CI 83, 91.2) and 87.5 (85.8, 89.1%), respectively. Participants were more likely to be correct in distinguishing between abuse and accidental injury when examining cases of bruising versus burn injuries (OR 1.45 95% CI 1.26, 1.67). The majority participants reported increased comfort in knowing which circumstances require a report to child protective services (80.3% Moderately to Strongly Agree) and interpreting the exam of a bruised and burned child (83.6% and 77.1% Moderately to Strongly Agree, respectively).

Conclusion:
A web-based educational module using deliberate practice is feasible way to assist prehospital providers in learning to distinguish between accidental and abusive cutaneous injury. To date, the educational module increased self-efficacy in recognizing abusive injury and knowing which circumstances require a report to child protective services among it learners with high terminal sensitivity, specificity, and learner accuracy. Future research is needed to determine the optimum nature of the cases to maximize learner accuracy.

Estimating Statewide Cost Saving Based on North Carolina Community Paramedic Pilot Programs

Introduction: The North Carolina Office of EMS (NCOEMS) recently collaborated with three EMS Systems to assess community paramedicine pilot programs. The three program sites represent the three NCOEMS geographic regions of the State (East, Central, and West) and each represented a different community size (Micropolitan, Medium Metropolitan, Large Central Metropolitan). Each program targeted a different area of preventative patient care however, all had the goal of reducing the utilization of EMS and ultimately reduce healthcare costs

Objective: The objective of this study was to utilize the reduction in EMS utilization and cost savings realized by the community paramedicine pilot program to estimate the statewide impact if community paramedic programs were put in place throughout North Carolina (NC).

Methods: The North Carolina Office of EMS adapted the definition used by the Centers for Medicare and Medicaid Services (CMS) and the Center for Medicaid and Children's Health Insurance Program (CHIP) Services (CMCS) to define high utilizers as anyone who is transported by EMS four or more times in a year. Data for this study was obtained from the NC EMS Data System located within the EMS Performance Improvement Center at the University of North Carolina – Chapel Hill. All patient care reports from 2015 were assessed to determine how many people met the criteria as high utilizers and how many times each of these individuals were transported to the ED by EMS. Using the information from the pilot programs, a range of potential call and transport reduction was calculated, then applied to every county in the State, using the high utilizer counts. To estimate cost savings, the North Carolina Division of Medical Assistance (DMA) provided NCOEMS with the average amount paid, per claim, per county in North Carolina. These figures were applied to all payer groups.

Results: A total of 17,763 patients met the stated definition of a high utilizer in NC for calendar year 2015. These patients accounted for a total of 141,176 EMS calls for service and were transported to the ED a total of 103,221 times. It was estimated that the potential decrease in call volume would range from 32.7% to 37.1%, for a total reduction of 46,164 to 51,376 EMS calls statewide. The potential decrease in transports ranged from 27.9% to 38.8%, for a total reduction of 28,798 to 40,049 EMS transports statewide, in a single year. Using the information above and estimates provided by NCDMA, we estimated a potential savings of between $2,126,213 and $2,956,885, statewide, in a single year.

Conclusion: This study specifically assessed reduction in EMS utilization. These estimates are very broad and make several assumptions that need further research. Applying the NCDMA figures to all payer groups lead to very conservative estimates of potential cost savings. In addition to the EMS transport savings, the costs savings of ED outpatient and inpatient care should also be considered.

Epidemiology of Patients meeting the South Carolina Prehospital Sepsis Care Protocol

Introduction: Early identification of a septic patient can lead to earlier intervention and a potential decrease in mortality. Systemic Inflammatory Response Syndrome (SIRS) criteria has been used in-hospital to aide in sepsis identification. In January 2016, the South Carolina Bureau of EMS & Trauma developed a sepsis treatment protocol that incorporated SIRS criteria as a screening tool for potential septic patients. These criteria, matched with a source of infection, would allow for prehospital sepsis treatment including antibiotics prior to arrival at the emergency department.

Objective: The study objectives were to quantify the number of 2016 emergency 911 patients in South Carolina (SC) that would meet the newly developed prehospital sepsis care protocol. Secondarily, this study sought to describe these patients based on patient demographics and incident location community size.

Methods: This retrospective observational study examined all 911 Emergency Medical Service (EMS) patients in SC in 2016 who met the newly developed sepsis prehospital care protocol. Study data were obtained from the SC State EMS Data System located within the EMS Performance Improvement Center. In accordance with the SC prehospital sepsis care protocol, patients were included if they were ≥18 years old, had a pulse rate >90 beats per minute (BPM), and met at least two of the following: temperature >38 ^{0}C or < 36 ^{0}C, Systolic Blood Pressure (SBP) <90 mmHg, respiratory rate >20 breaths per minute, had ventilations assisted via bag valve mask (BVM), or had an advanced airway placed. Cardiac arrest and trauma calls were excluded from this analysis. Descriptive statistics were calculated to quantify the number of patients who met the SC sepsis protocol and to evaluate the number of patients who met the SIRS criteria. Additionally, patient's level of consciousness, provider's primary impression, primary symptom, age, gender, race, ethnicity, and community size were described.

Results: In 2016, there were 5,155 patients that met the criteria outlined in the SC sepsis care protocol. Of these patients, 4,831 (93.7%) presented with 2 of the 4 SIRS criteria. There were 317 (6.2%) who met 3 of the 4 SIRS criteria and 7 patients (0.1%) who met all 4 SIRS criteria. The most frequently reported provider's primary impression was respiratory distress (1,257; 36.7%), followed by altered level of consciousness (660; 19.3%), abdominal pain/problems (269; 7.9%), chest pain/discomfort (179; 5.2%), cardiac rhythm disturbance (155; 4.5%), and hypovolemia/shock (140; 4.1%). The most frequently reported primary symptom was breathing problems (1,332; 29.5%), followed by change in responsiveness (1,063; 23.6%), fever (436; 9.7%), pain (424; 9.4%), weakness (396; 8.8%), and "none" (181; 4.0%). The majority of patients were alert (3,536; 74.1%). There were 482 (10.1%) patients that were unresponsive, 459 (9.6%) responded to verbal commands, and 297 (6.2%) responded only to painful stimulus. Patients' age ranged from 18 to 116 years old with an average of 63.1 (±17.9) and a median of 65. There were 2,596 (50.5%) females and 2,548 (49.5%) males. There were 3,552 (70.3) patients whose race was reported as white, 1,440 (28.5%) black, 64 (1.3%) other, and 4,733 (98.4%) were not Hispanic or Latino. Finally, 4,534 (88.5) patients were located in urban areas of SC and 587 (11.5) were located in rural areas.

Conclusion: Respiratory distress was the primary patient presentation when SIRS criteria was used as a screening tool for septic patients in the prehospital setting. Directed education in the pulmonary source of sepsis could potentially increase the ability of paramedics to identify sepsis in the field. This can also aide in antibiotic selection and future protocol development for this subgroup of patients.

A Description of South Carolina Patients who Repeatedly Utilize EMS for Naloxone Administration

Introduction: The opioid overdose problem has reached epidemic proportions with no end in sight. Opioid overdoses are not definitively confirmed by EMS in the field. EMS uses a set of signs and symptoms to indicate the likelihood of an opioid overdose and the subsequent need for administration of naloxone. Among the common misconceptions both in EMS and in the general public is that EMS is "enabling" the addicts by administering naloxone.

Objective: To quantify and describe patients in South Carolina who repeatedly utilized EMS for administration of naloxone from 2014 to 2016.

Methods: This was a retrospective observational study. Patients who utilized EMS for repeat naloxone administrations within 24 hours, 1 week, and anytime from 2014 to 2016 were assessed. Study data were obtained from the SC State EMS Data System located within the EMS Performance Improvement Center at the University of North Carolina – Chapel Hill. All patients with at least one repeated use of EMS for naloxone administration were included. To ensure that the administration represented an additional utilization of EMS and not simply additional administrations during the same call, administrations within two-hours were omitted. Prehospital Care Reports with incomplete date and time data were also omitted. Analysis included calculation of the percent change in patients who utilized EMS for repeat naloxone administrations. Descriptive statistics were also calculated to assess demographics (age, race, ethnicity, sex, and community size). The analysis did not differentiate between accidental or intentional overdoses, nor did it discriminate between prescription or non-prescription sources of the overdose.

Results: During the study period, there were 1040 patients who utilized EMS for repeat naloxone administrations. There were 46 patients omitted because the repeat use was within 2 hours and 69 were omitted due to missing date and time data, leaving a study population of 925 patients. There was a 263.0% increase in patients who utilized EMS for repeat naloxone administrations from 2014 (138) to 2016 (501). There were more males than females, 57.6% vs. 42.4%, respectively. White patients accounted for 88.7% of the study population (black = 10.1%, other race = 1.2%) and 99.0% were not Hispanic or Latino. Age ranged from 16 to 94 years. The average age of the population was 45.9 (±16.3) with a median age of 46. There were more of these patients in urban environments (86.7%) than in rural environments (13.3%). There was no statistically significant change in the demographics of this population from 2014 to 2016 (p-value >0.05). The overwhelming majority (843, 91.1%) of these patients required repeat administration in greater than one week following the initial administration. However, 58 (6.3%) patients utilized EMS for repeat naloxone in less than a week and 24 (2.6%) utilized EMS for repeat naloxone in less than 24 hours. While there was an increase in the overall number of patients from 2014 to 2016, the proportions of patients who utilized EMS for repeat naloxone administrations within 24 hours, 1 week, or anytime within the study period remained consistent (p-value >0.05) and there were no differences among these groups with respect to race, ethnicity, or community size (p-value >0.05). While the majority of this population was male, they tended to represent an even higher proportion of those in the 24 hour and 1 week groups (<24 hours = 75.0% male, <1 week = 69.0% male, anytime = 56.3% male; p-value = 0.04). Finally, as the timeframe for repeat EMS use for naloxone decreased, there was a statistically significant decrease in the patients' average age (p-value = 0.01). The average age for those in the 24 hour group was 40.3 (±16.6) with a median age of 31.5. The average age for those in the 1 week group was 40.7 (±14.6) with a median age of 36.5 and the average age for the anytime group was 46.4 (±16.3) with a median age of 46.

Conclusion: There was a dramatic increase in the number of patients who utilized EMS for repeat naloxone administrations. It is important to identify this segment of the at-risk population since they are the most likely to have a repeat overdose with a fatal outcome.

Time spent on scene with patient during emergency medical service has survival impact on out-of-hospital cardiac arrest

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Introduction: Each year, more than 350,000 emergency medical services (EMS)-assessed out-of-hospital cardiac arrests occur in the United States. The average survival rate of out-of-hospital cardiac arrest is 10.6% and survival with good neurologic function is 8.3% (2015 Heart and Stroke Statistics). It is known that, following a cardiac arrest, each minute without treatment decreases the likelihood of surviving without disability. However, it is not known if more time on the scene with cardiac arrest patients by EMS personnel are associated with improved survival.

Objective: This study was performed to determine the survival impact on the time-of-staying (the difference between time of EMS arrived at patient and left scene time) with cardiac arrest patients on scene during an emergency medical service.

Method: Patients with non-traumatic cardiac arrest were selected from the 2015 Florida EMS database and linked to the Hospital Discharge data (both ED (emergency department) and Inpatient data). A stepwise selection model was develop to determine potential confounders. We then evaluated survival to hospital discharge according to time-of staying with patients (<= 10, 10-- 20, 20 --30 and > 30 minutes).

Result: Data were available for 6,079 patients (1,372 survived at hospital discharge, approximately 22.6%). The crude survival rate was highest in the less than 10 minute time group (25.98%) compared to the 10-20 minute group (22.90%), 20-30 minute group (18.22%), and the more than 30 minute group (20.84%, p<0.001). Any return of spontaneous circulation, advanced airway attempts, CPR, first monitored rhythm of the patient and age were selected as potential confounders. Adjusted model showed that both the >30 minute group and the 20-30 minute group were approximate 1.6 times more likely to have "expired" hospital discharge outcome compared to the <=10 minute group, the odd ratios were 1.67(1.16-2.39, P=0.0058) and 1.63(1.25-2.12, P=0.0003) respectively. No significant difference was found between the 10-20 minute group and <=10 minute group.

Conclusion: In this statistical analysis, the length of time-of staying by EMS with a patient is negatively associated with survival to discharge following out-of-hospital cardiac arrest. Whereas a longer stay is associated with decreased chance of survival to hospital discharge. Further study will be needed to investigate the meaning behind this result.

The Underutilization of Intravenous Cannulation in Prehospital Pediatric Seizure Patients in North Carolina

Introduction: One of the most common causes of pediatric emergencies is seizures. The most common type of seizures children have are simple febrile seizures. Febrile seizures are the most benign type of seizure. There are many debates on how to approach febrile seizures. One intervention typically performed is intravenous cannulation. Several studies have described the underutilization of intravenous cannulation in adults as well as pediatric populations and in both emergency department as well as prehospital settings.

Objective: The objective of this study was to compare the placement and utilization of intravenous cannulation among prehospital pediatric seizure and non-seizure patients in North Carolina (NC).

Method: Prehospital data were obtained from the North Carolina State EMS Data System located within the EMS Performance Improvement Center at the University of North Carolina – Chapel Hill. Prehospital pediatric patient who were $\leq$15 years of age were included in the study. The patients that had intravenous cannulation performed and those who had the intravenous line utilized for medication or fluid administration were analyzed. To ensure that every seizure call was included in this study, calls were identified by evaluating multiple NEMSIS version 2 elements for the report of seizure, including Provider's Primary Impression (E09_15), Provider's Secondary Impression (E09_16), Neurological Assessment (E16_24), and Protocol Used (E17_01). Analysis included the assessment of incident location community size (urban/rural). Descriptive statistics, univariate odds ratios (OR) and 95% Confidence Intervals (95%CI) were calculated.

Result: In 2015, there were a total of 1,386,028 9-1-1 calls in North Carolina. Of these, 64,186 were pediatric emergency calls. Seizures as the primary impression were reported 5,303 (15.4%) times statewide, 1,117 (15.2%) times in rural areas and 4,050 (15.4%) times in urban areas. Seizure protocols were utilized 2,567 (5.7%) times statewide, 428 (4.1%) times in rural areas, and 2,098 (6.3%) times in urban areas. In total 7,998 (12.8%) intravenous cannulations were performed. Of those, 2,766 (4.4%) had intravenous medication or fluid administered. Intravenous cannulation was performed in 28.9% of pediatric seizure and 11.1% of non-seizure pediatric cases (OR: 3.27, 95%CI: 3.07–3.48, p<0.01). Conversely, intravenous medication or fluid was administered in 19.8% of pediatric seizure and 36.8% of non-seizure pediatric cases (OR: 0.43, 95%CI: 0.37-0.48, p<.01). Anticonvulsant medications were administered to pediatric patients 1,059 (4.4%) times statewide, 237 (4.6%) times in rural areas and 822 (4.5%) in urban areas.

Conclusion: Pediatric patients with seizures were more likely to have intravenous cannulation performed but significantly less likely to receive intravenous medication or fluid. It appears that intravenous cannulation was performed "just in case". Pediatric patients routinely should not be treated after a first seizure and it is important to consider the recurrence rate and risk. Emergency care providers should continue to be educated to assess seizures in pre-hospital setting and utilize intravenous cannulation only for appropriate cases. Pre-hospital venous cannulation is difficult to perform. Numerous factors including poor lighting, vein visibility and palpability may lead to cannulation failure. This study may help to improve pre-hospital education and protocols for management of Pediatric Seizures.