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An Emergency Department Septic Shock Protocol and Care Guideline for Children Initiated at Triage

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KEY WORDS

septic shock, emergency department, goal-directed therapy, triage, care guideline

ABBREVIATIONS

ED—emergency department
VS—vital sign
NS—normal saline
PCMC—Primary Children's Medical Center
LOS—length of stay

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abstract

BACKGROUND: Unrecognized and undertreated septic shock increases morbidity and mortality. Septic shock in children is defined as sepsis and cardiovascular organ dysfunction, not necessarily with hypotension.

OBJECTIVE: Cases of unrecognized and undertreated septic shock in our emergency department (ED) were reviewed with a focus on (1) increased recognition at triage and (2) more aggressive treatment once recognized. We hypothesized that septic shock protocol and care guideline would expedite identification of septic shock, increase compliance with recommended therapy, and improve outcomes.

METHODS: We developed an ED septic shock protocol and care guideline to improve recognition beginning at triage and evaluated all eligible ED patients from January 2005 to December 2009.

RESULTS: We identified 345 pediatric ED patients (49% male, median age: 5.6 years), and 297 (86.1%) met septic shock criteria at triage. One hundred ninety-six (56.8%) had ≥1 chronic complex condition. Hypotension was present in 34% ($n = 120$); the most common findings were tachycardia ($n = 251$ [73%]) and skin-color changes ($n = 269$ [78%]). The median hospital length of stay declined over the study period (median: 181–140 hours; $P < .05$); there was no change in mortality rate, which averaged 6.3% (22 of 345). The greatest gains in care included more complete recording of triage vital signs, timely fluid resuscitation and antibiotic administration, and serum lactate determination.

CONCLUSIONS: Implementation of an ED septic shock protocol and care guideline improved compliance in delivery of rapid, aggressive fluid resuscitation and early antibiotic and oxygen administration and was associated with decreased length of stay. *Pediatrics* 2011;127: e1585–e1592

Early recognition of septic shock and aggressive, goal-directed treatment is associated with improved outcomes for pediatric patients.[1–4] Clinical practice guidelines have been published by the American College of Critical Care Medicine and incorporated into the American Heart Association Pediatric Advanced Life Support (PALS) courses,[5,6] which indicate that early recognition and treatment of pediatric septic shock improves survival in both academic and community settings.[1,3,5,7] The definition of septic shock differs for children compared with adults in that it is defined as sepsis and cardiovascular organ dysfunction; systemic hypotension is not required to meet criteria for septic shock, because shock may occur in children long before hypotension.[8] Although implementation of pediatric septic shock guidelines poses substantial challenges, the rewards may be high. Shock reversal from early aggressive fluid administration and vasoactive agent support for pediatric patients can substantially decrease mortality; for each unrecognized and untreated hour of shock, the mortality rate is estimated to increase twofold.[3]

In an emergency department (ED), the function of triage is to assess patients on arrival and assign disposition on the basis of acuity level. This assessment includes a determination of vital signs (VSs), airway patency, respiratory function, and adequacy of circulation and perfusion. The warm and cold shock definitions as described by the American College of Critical Care Medicine depend on clinical presentation and, therefore, are amenable to the ED triage setting.[5,6] The key tasks recommended by Pediatric Advanced Life Support guidelines for treatment of septic shock include (1) maintaining an airway and rapidly establishing intravenous or intraosseous access, (2) administering 20 mL/kg of normal saline (NS) boluses up to and over 60 mL/kg within the first 15 minutes, (3) correcting electrolyte abnormalities, (4) administering antibiotics, and (5) and initiating vasoactive agent support if hypoperfusion persists after administration of 60 mL/kg NS.[1,5,6,9] Accomplishing these key tasks early depends on disease recognition, ideally by the first trained clinical staff member who interacts with the patient. In the case of patients presenting to an ED, this earliest recognition could be made by an ED triage nurse.

In 2006, a hospital-wide goal to improve the recognition and care of patients with septic shock in the hospital setting at Primary Children's Medical Center (PCMC) in Salt Lake City, Utah, was proposed. Although many inpatient criteria for recognition and treatment were transferable to the ED, it was clear that the ED needed a different process for recognizing affected children. In the unique setting of the ED, patients may wait several hours before being evaluated by a physician. Patients arrive to the ED by various modes of transportation (private car, ambulance, and air transport) and are assigned a specific level of acuity. Only patients with the highest level of acuity are evaluated immediately by a physician. We recognized the need for an ED process to identify patients at risk for septic shock who present at triage or whose course worsens during their ED stay. The goal would be earlier physician evaluation and to provide nursing staff with guidelines to initiate timely care.

We evaluated an early septic shock–recognition protocol and treatment guideline. Our aims were to (1) identify pediatric patients with early signs and symptoms of septic shock by completely ascertaining VSs and clinical status, (2) improve compliance with septic shock treatment guidelines for goal-directed care of patients who meet the triage criteria, and (3) assess the impact of the program on hospital length of stay (LOS) and mortality.

PATIENTS AND METHODS

Setting

PCMC is a 252-bed, freestanding, university-affiliated, tertiary pediatric hospital with an average of 45 300 ED visits, 15 000 patients admitted, and 2200 patients admitted to the PICU annually. The study was approved and a waiver of informed consent granted by the University of Utah institutional review board and the PCMC privacy board.

Development of ED Septic Shock Protocol and Care Guideline

In 2006, a team of PCMC ED physicians and nurses, PICU physicians, and system-improvement support staff reviewed existing national guidelines[1,10] and developed (1) a reference tool that defined abnormal age-appropriate VSs and physical findings[5,6] and (2) a care guideline for patients with suspected septic shock. The purpose of the care guideline was to define specific care processes and track compliance once a patient met septic shock triage criteria.

Planning the Intervention

In January 2007 after the triage tool, septic shock protocol, and hospital policy were developed, an educational program for the ED physicians, nurses, and technicians regarding the national pediatric septic shock guidelines, including the need for timely clinical interventions and the potential impact on mortality rate, was initiated. In February 2007, the tool (a 1-page document) was displayed in the ED triage nurses' station and in the protocol drawer. On an approximately weekly basis during the first month of implementation, the ED nurse clinical specialist (Ms Mecham) and ED physician

(Dr Greenberg) spoke to the ED nurses and physicians regarding the triage tool and guideline. After monthly case review, Ms Mecham identified representative or problematic cases and reviewed details of triage delays, missing VSs, errors in triage, management issues, or exceptional work with the individual nurses involved. The lead ED physician (Dr Greenberg) provided periodic feedback about individual cases at monthly ED staff meetings.

One project barrier that was identified early was the lack of ED point-of-care lactate testing. Support was solicited from the chief of pathology/laboratory medicine and the central laboratory technicians to make necessary supplies available in the ED so that serum lactate could be analyzed from the same sample drawn for blood gas and electrolyte testing. Approval for ED bedside lactate measurements occurred in January 2007.

Another identified project need was a study coordinator and administrative help to access patient records, electronic data, and chart review and to generate reports. PCMC provided a study coordinator for the first 2 years (2007–2008). Salary support and responsibilities as study coordinator shifted to the project nurse clinical specialist (Ms Mecham) thereafter. Within the PCMC Division of System Improvement, data were collected and stored to facilitate quarterly reports for hospital executive meetings and to identify barriers.

During the implementation phase, it became apparent that there were several barriers to achieving rapid fluid resuscitation in the first 30 minutes from triage, particularly among patients without intravenous access. We modified our goals and identified 3 key care elements for monitoring program compliance: administration of at least 20 mL/kg NS in the first hour; initial assessment of lactate for those patients who meet shock criteria; and administration of antibiotics within 3 hours.

Investigators met as a group during the first year of monthly chart reviews to ensure data-element consistency. Data were maintained within the PCMC Division of System Improvement and provided to the ED staff through both individual feedback and annual reports. Statistical process control charts were used to track changing compliance over time with individual interventions and were created by using Minitab 15 (Minitab Inc, State College, PA) (Fig 1).

Study Population

Preprotocol and Care Guideline Implementation in a Cohort of Patients With Septic Shock

By using an electronic Intermountain Healthcare database, all patients treated in the PCMC ED between January 1, 2005, and January 31, 2007, with septic shock, as identified by *International Classification of Diseases, Ninth Revision* (ICD-9) codes at the time of discharge (see Appendix), were identified. Patients between 1 day (24 hours) and 18 years of age evaluated in the PCMC ED were eligible for inclusion, but those with acute trauma were excluded. The identified ED records were reviewed to determine if and at what time patients met septic shock criteria, whether the shock was attributed to causes other than an infection or inflammation, and whether individual elements in the care guideline were met (see Tables 1–3).

Postprotocol and Care Guideline Implementation in a Cohort of Patients With Septic Shock

Using the Intermountain Healthcare electronic database and an electronic PCMC ED database, all patients evaluated in the PCMC ED between February 1, 2007, and December 31, 2009, who (1) died, (2) were admitted to the PICU either immediately or within 12 hours of admission to the general ward service, excluding trauma victims, or (3) had a discharge ICD-9 diagnosis associated with sepsis (see Appendix) were eligible. This screening was used to "cast a broad net" to ensure that all potential patients with shock were included. The hospital records of the screened patients were reviewed monthly to identify patients with abnormal VSs or clinical findings of shock (see Tables 1 and 2) during their ED visit. The triage and ED patient records from each patient in this shock cohort were reviewed by using the septic shock protocol (see Tables 1 and 2) to identify, according to VS and physical description, whether the patients met criteria at (1) triage, (2) later during the ED course, or (3) never. The ED records were reviewed to assess whether individual elements of the septic shock care guideline were followed. Cases of shock attributable to causes other than infection or inflammation were excluded from the final analysis. The Intermountain Healthcare electronic database was used to determine the mortality rate and hospital LOS.

Data collected included patients' demographic information, completeness of VSs (heart rate, blood pressure, respiratory rate), physical examination findings, timing and volume of intravenous fluid administration, diagnoses at time of discharge, Pediatric Risk of Mortality III (PRISM III)[11] score, chronic medical conditions,[12] and hospital LOS. Data about the ED interventions were gathered with specific attention to the following categories to track compliance: (1) triaged as "resuscitation" (our highest level of acuity) into the ED; (2) attending ED physician at bedside within 15 minutes of triage designation as "resuscitation"; (3) blood drawn for culture before antibiotics;

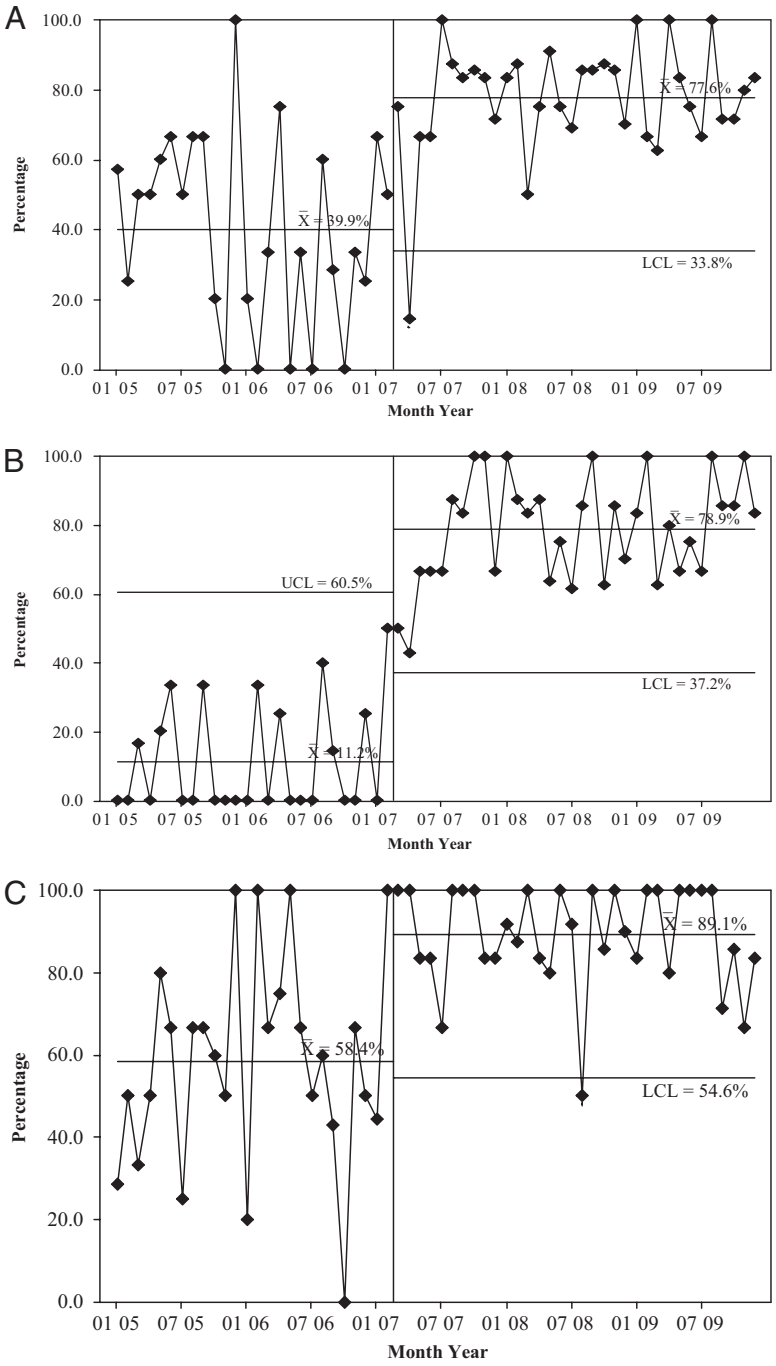

FIGURE 1

Statistical process control charts demonstrating gains in achieving predefined goals for our ED septic shock project. A, Percentage of patients with septic shock who received at least 20 mL/kg in the first hour; B, percentage of patients with septic shock who lactate level was assessed; C, percentage of patients with septic shock who received antibiotics within 3 hours.

(4) antibiotics given within 3 hours; (5) at least 20 mL/kg NS fluid bolus in 1 hour; and (6) blood drawn in ED for lactate measurement. Also assessed was 20 mL/kg NS fluid bolus in first 15 minutes and 60 mL/kg in the first hour. The individual care elements were chosen to track compliance with the septic shock protocol and care guideline to provide consistency with national recommendations for the care of pediatric patients with septic shock.

TABLE 1 Septic Shock Triage Clinical Criteria

Central capillary refill time	Flash (<1 s) or >3 s
Mental status	Decreased, irritable, and/or confused
Pulses	Decreased or bounding
Skin	Cool, mottled or flushed, or ruddy
Heart rate	Greater than normal limit for age
Respiratory rate	Greater than normal limit for age
Temperature	Less than or greater than normal limit for age
Systolic blood pressure	Less than normal limit for age

This shock/septic shock protocol should be initiated if the patient meets a combination of any 3 clinical criteria or hypotension and 1 other criterion.
Data source: Brierley J, Carcillo JA, Choong K, et al. *Crit Care Med.* 2009;37(2):666–688.

Statistical Analyses

Patient clinical and demographic characteristics were reported as medians, with interquartile ranges, and were compared between 3 times: the preimplementation phase (January 2005 through January 2007); the implementation phase (February 2007 to December 2007) to allow for time to implement the protocol and care guideline with education and feedback to practitioners; and the postimplementation phase (January 2008 through December 2009) using the Wilcoxon rank-sign test. Categorical data were compared with a χ^2 analysis. Analyses of individual care elements included percentage compliance with each element of the protocol during their ED visit. Significance was defined as $P < .05$, and SPSS 14 for windows (SPSS Inc, Chicago, IL) was used for the analysis.

RESULTS

During the study period, a total of 360 pediatric patients with shock were treated in the ED. Of these, 15 (4.2%) were patients with signs of shock not attributed to septic shock who either did not receive antibiotics or had

TABLE 2 PALS VS Parameters for Age

Age	Heart Rate, Beats per Minute	Respiratory Rate, Breaths per Minute	Systolic Blood Pressure, mm Hg	Temperature, °C	
				Low	High
0 d to <1 mo	>205	>60	<60	<36	>38
≥1 to <3 mo	>205	>60	<70	<36	>38
≥3 mo to <1 y	>190	>60	<70	<36	>38.5
≥1 to <2 y	>190	>40	<70 + (age × 2)	<36	>38.5
≥2 to <4 y	>140	>40	<70 + (age × 2)	<36	>38.5
≥4 to <6 y	>140	>34	<70 + (age × 2)	<36	>38.5
≥6 to <10 y	>140	>30	<70 + (age × 2)	<36	>38.5
≥10 to <13 y	>100	>30	<90	<36	>38.5
≥13 y	>100	>16	<90	<36	>38.5

Data source: American Heart Association. *Pediatrics*. 2006;117(5). Available at: www.pediatrics.org/cgi/content/full/117/5/e989.

TABLE 3 Septic Shock Care Guideline: Individual Care Elements

Attending ED physician notified	Attending ED physician at bedside within 15 min of triage designation of "resuscitation"
Monitoring	Patient placed on continuous pulse oximetry and cardiac monitoring; obtain a full set of VSs, including manual blood pressure
Oxygenation	Patient placed on oxygen regardless of O_2 saturation level
Intravenous access and laboratory studies	Start peripheral intravenous line; order the following laboratory work: capillary blood gas, ionized calcium, lactate, and glucose levels, a complete blood count, and a blood culture
Intravenous fluids	Within the first 5 min in the ED: administer a rapid fluid bolus of 20 mL/kg NS by push method; if there are no signs of rales, gallop rhythm, or increased work of breathing or increased oxygen need, reassess the patient's clinical status and prepare for second bolus Within the first 15 min in the ED: administer a second rapid fluid bolus of 20 mL/kg NS by push method (total of 40 mL/kg); if there are no signs of rales, gallop rhythm, or increased work of breathing or increased oxygen need, reassess the patient's clinical status and prepare for third bolus Within the first 30 min in the ED: administer a third rapid fluid bolus of 20 mL/kg NS by push method (total of 60 mL/kg); fluid should be pushed with the goal of attaining normal perfusion and blood pressure, so the patient must be reassessed between each bolus, and the reassessment must be documented on the ED nursing flow sheet
Antibiotics	Within 3 h of identification, administer antibiotics if septic shock is suspected (eg, ceftriaxone)

Data sources: Brierley J, Carcillo JA, Choong K, et al. *Crit Care Med*. 2009;37(2):666–688; and Carcillo JA, Fields AI. *Crit Care Med*. 2002;30(6):1365–1378.

diagnosis-related limitations on prescribed amount of fluid resuscitation and, thus, were excluded. The associated diagnoses of those excluded were diabetic ketoacidosis without concern for infection, anaphylaxis, status asthmaticus, and isolated cardiogenic shock.

We identified 345 ED patients with septic shock, all of whom met septic shock protocol criteria in the ED; 297 (86.1%) met septic shock criteria at the time of triage. The demographic and clinical features of the patients with septic shock are listed in Table 4, divided into 3 phases (preimplementation, during implementation, and postimplementation). There were no differences in median age, gender, or number of chronic conditions per time periods. The cohort had a median age of 5.7 years, and 49% were male. Of the 345 patients, 196 (56.8%) had 1 or more complex conditions. Hypotension was documented in 120 patients (34%); the most common clinical findings were tachycardia (n = 251 [73%]), tachypnea (n = 228 [66%]), and skin-color changes (n = 269 [78%]).

During preimplementation, compliance with the individual care elements ranged from 7% to 84%, and there was >50% compliance in drawing blood for culture and timely administration of antibiotics only. There was a significant increase in provision of all care elements during the postimplementation phase compared with the preimplementation phase ($P < .05$) with the exception of ensuring cultures before antibiotic administration, which exceeded 80% during the preimplementation phase ($P > .05$). One notable improvement occurred in obtaining a complete set of VSs from the first encounter, which improved from 83% to 98% ($P < .05$) (see Table 5). Statistical process control charts presenting percentage of patients who received the 3 key care elements (20 mL/kg of NS in the first hour, lactate assessment, and antibiotics within 3 hours) demonstrated improving compliance over time (see Fig 1).

Two hundred thirty-eight (68%) patients throughout the 3 phases were admitted to the PICU, and there was an increase after protocol implementation from 60% to 85% ($P < .05$). The median LOS declined over the duration of the study from a median of 181 to 140 hours ($P < .05$). The median adjusted ED and hospital costs did not change over the study period. Overall, the mortality rate for the cohort was 6.4% (22 of 345), which did not differ significantly from 7.1% (7 of 98) before implementation to 6.2% (11 of 177) after implementation ($P = .93$). There was also a statistically insignificant decline in mortality rate among those patients with 1 or more chronic conditions (preimplementation mortality rate: 13.5% [7 of 52]; after implementation mortality rate: 7.0% [7 of 100]) ($P = .19$). For the entire study period (2005–2009), of those patients who received 3 key care elements (20 mL/kg of NS in the first hour, lactate assessment, and antibiotics within 3 hours), 5 children died (3.5%) compared with 17 (8.4%) patients

TABLE 4 Select Demographic and Clinical Features According to Time Period

Features	Before Implementation (Jan 2005–Jan 2007) ($N = 98$)	During Implementation (Feb–Dec 2007) ($N = 70$)	After Implementation (Jan 2008–Dec 2009) ($N = 177$)
Age, median (IQR), y	5.5 (0–13)	5.5 (0–14)	6.0 (0–13)
Age group, *n* (%)			
0–2 mo	12 (12)	7 (10)	20 (11)
2.01–12 mo	19 (19)	12 (17)	23 (13)
1–3 y	11 (11)	7 (10)	27 (15)
3.01–10 y	21 (21)	12 (17)	38 (22)
>10.01 y	35 (36)	32 (45)	69 (39)
Gender, male, *n* (%)	49 (50)	32 (47)	89 (50)
Any chronic condition, *n* (%)	52 (53)	44 (62)	100 (57)
Chronic conditions, median (IQR), *n*	1 (0–2)	1 (0–3)	1 (0–2)
Chronic conditions, *n* (%)			
Prematurity	8 (8)	3 (4)	11 (6)
Neuromuscular	17 (18)	9 (13)	31 (18)
Cardiovascular[a]	22 (23)	29 (27)	55 (32)
Respiratory	6 (6)	7 (10)	23 (14)
Renal[a]	5 (5)	11 (16)	9 (5)
Gastrointestinal	8 (8)	11 (16)	16 (9)
Hematologic/immunologic	4 (4)	3 (4)	11 (6)
Metabolic[a]	18 (19)	22 (32)	21 (12)
Congenital/genetic	15 (16)	11 (16)	32 (19)
Malignancy	7 (7)	10 (15)	17 (10)
Unit of admission, *n* (%)[a]			
PICU	59 (60)	65 (93)	151 (85)
Immunocompromised unit	34 (35)	4 (6)	23 (13)
Other	5 (5)	1 (1)	3 (2)
VSs, *n* (%)			
Hypotension	29 (30)	32 (46)	59 (33)
Tachycardia	72 (73)	49 (70)	130 (73)
Fever or hypothermia	53 (54)	47 (67)	99 (56)
Tachypnea	61 (62)	49 (70)	118 (67)
Clinical criteria, *n* (%)			
Capillary refill time	29 (30)	28 (40)	83 (47)
Mental status changes	52 (53)	18 (26)	86 (49)
Peripheral pulse quality	13 (13)	8 (11)	36 (20)
Skin appearance (eg, flushed, pallor), *n* (%)	81 (83)	47 (67)	141 (80)
LOS for survivors, median (IQR), h[a]	181 (103–328)	128 (86–214)	140 (70–264)
Total ED cost, median (IQR), $[b]	707 (605–877)	686 (562–900)	681 (600–847)
Total hospital costs, median (IQR), $[b]	23 093 (10 904–41 903)	21 862 (9995–43 460)	21 687 (10 162–39 386)
PRISM III, median (IQR)[c]	6 (2–13)	8 (4–14)	6 (2–11)
Death, *n* (%)	7 (7)	4 (6)	11 (6)
Chronic condition, *n* (%)			
No	0 (0)	3 (12)	3 (4)
Yes	7 (13)	1 (2)	8 (8)

IQR indicates interquartile range; PRISM III, Pediatric Risk of Mortality III.[11]

[a] $P < .05$.

[b] Adjusted for general medical care, consumer price index for western US cities between 50 000 and 1.5 million population.

[c] Missing 46 PRISM scores.

who died who did not receive those same care elements ($P = .07$).

DISCUSSION

We report here the successful implementation of an ED septic shock protocol to identify pediatric patients with septic shock beginning at the time of triage. The emphasis on the need to recognize pediatric patients at the earliest possible opportunity led to a more complete VS and clinical status ascertainment for a greater number of patients from the first moment of ED encounter. We were successful in increasing compliance with many elements of the protocol and, importantly, key interventions known to decrease mortality and morbidity, particularly aggressive fluid resuscitation and timely antibiotic therapy. Use of the septic shock protocol and care guideline in our study was associated with a significant decrease in LOS and a trend toward decreased mortality among those who received 3 key elements of treatment compared with those who did not: initial fluid resuscitation of at least 20 mL/kg NS within an hour; an assessment of serum lactate; and antibiotics within 3 hours of ED admission.

A unique aspect of this project is the focus on recognition during ED triage, which requires keen observation skills, knowledge of age-appropriate VSs, and a complete assessment of patient VSs and physical findings indicative of shock by an ED nurse. We developed an easy-to-use reference tool for patient assessment by the triage nurses (see Tables 1 and 2).[5,6] From a quality-improvement standpoint, a central aspect of this project is the process of providing both individual timely feedback and overall project results to the ED staff involved in patient care, including both missed cases and cases managed well. We were able to increase compliance with the individual clinical tasks and, in most cases, meet or exceed published compliance achievement.[13]

The effective implementation of septic shock care targeted to rapidly reverse a shock state can decrease the mortality rate.[3,14,15] Authors of a recent study that used the Kids' Inpatient Database reported a hospital mortality rate attributable to septic shock of 4.2% (2.3% in previously healthy children; 7.8% in chronically ill children).[16] The change in mortality rate in our study did not achieve statistical significance;

TABLE 5 Compliance With Septic Shock Care Individual Clinical Tasks According to Time Period

Clinical Task	Before Implementation (2005–2007) ($N = 98$), n (%)	During Implementation (2007) ($N = 70$), n (%)	After Implementation (2008–2009) ($N = 177$), n (%)
Attending ED physician to bedside within 15 min[a]			
Yes	32 (33)	50 (71)	11 (63)
Unknown	13 (13)	1 (1)	5 (3)
Oxygen within 15 min[a]			
Yes	31 (32)	40 (59)	104 (60)
Unknown	0 (0)	0 (0)	1 (0.6)
Culture before antibiotics			
Yes	83 (84)	65 (93)	158 (89)
Unknown	1 (1)	1 (1)	8 (5)
Antibiotics within 3 h[a]			
Yes	52 (53)	63 (90)	144 (81)
Unknown	0 (0)	1 (1)	11 (6)
Measured lactate[a]			
Yes	10 (10)	49 (70)	143 (81)
Unknown	0 (0)	2 (3)	0 (0)
20 mL/kg NS in 1 h[a]			
Yes	42 (43)	49 (70)	140 (79)
Unknown	0 (0)	0 (0)	0 (0)
20 mL/kg NS in 15 min[a]			
Yes	10 (10)	29 (41)	83 (47)
Unknown	0 (0)	0 (0)	0 (0)
60 mL/kg NS in 1 h[a]			
Yes	7 (7)	28 (33)	49 (28)
Unknown	0 (0)	0 (0)	0 (0)
No documented blood pressure[a]	17 (17)	2 (3)	4 (2)
Complete set of VS (heart rate, respiratory rate, blood pressure, O_2 saturation, temperature)[a]	81 (83)	68 (97)	173 (98)
Compliance with 3 key care elements,[b] n (%)[a]	5 (5)	41 (59)	96 (54)

[a] $P < .05$ compared to baseline.

[b] Administration of 20 mL/kg NS in first hour, assessment of serum lactate, and antibiotic administration within 3 hours of meeting Septic Shock triage criteria.

however, the median LOS decreased significantly. In addition, median adjusted ED and hospital costs did not increase over the duration of the study, which could be considered an accomplishment in the face of the growing US gross domestic product devoted to health care over the same period of time.[17]

Our study has several limitations. Our goals were to implement a septic shock protocol and assess adherence to an accepted care guideline designed to assess and efficiently treat septic shock. We did not assess shock reversal for individual patients, and it is possible that some were either underresuscitated or overresuscitated; however, cases of fluid overload were not identified in PICU morbidity and mortality conferences. The study design prevents conclusions regarding causality, because the children were not randomly assigned to treatment groups, and other factors that were unappreciated may have affected LOS or mortality. We cannot separately evaluate the impact of individual components of the care guidelines and their impact on LOS or mortality. To effectively implement a quality-improvement project, feedback needs to be timely, and we have since implemented a process to improve the turnaround on case review with a plan of quarterly reports and control charts demonstrating changing compliance with the key care elements over time for the ED staff. This study was conducted in a children's hospital and may not be representative of other emergency medicine practices, although the explicit nature of the guidelines and protocol could be used to assist providers who do not exclusively treat children.

CONCLUSIONS

Consistent successful treatment of septic shock cannot begin in the ICU for patients who present to the ED in shock; it must begin at the time of triage in the ED. Early recognition and treatment of septic shock benefits all ED patients, because the effort to recognize early shock leads to a more meticulous patient assessment from the initial encounter. We developed a septic shock protocol and care guideline that led to improved compliance in delivery of rapid, aggressive fluid resuscitation, early antibiotic and oxygen administration, and decreased hospital LOS.

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APPENDIX *International Classification of Diseases, Ninth Revision* Codes for Septic Shock[18]

Code	Label
036.2	Meningococcemia
038.0–038.9	Septicemia (staphylococcus, streptococcus)
040.0–041.9	Various bacterial infections
054.5	Herpetic septicemia
286.6, 286.9	Defibrination syndrome, coagulation defect
682.0–682.9	Other cellulitis and abscess
785.52	Septic shock
785.59	Other shock, not trauma
790.7	Bacteremia, not otherwise specified
995.90–995.94	Systemic inflammatory response syndrome (SIRS), multiple organ dysfunction syndrome (MODS)
999.3	Other infection due to medical care, not elsewhere classified
996.60–996.69	Infection and inflammatory reaction due to unspecified device, implant, and graft

An Emergency Department Septic Shock Protocol and Care Guideline for Children Initiated at Triage

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