

14. ULUSAL ACİL TIP KONGRESİ

5TH

19-22 Nisan 2018 Kaya Palazzo Golf Resort Otel

INTERCONTINENTAL EMERGENCY MEDICINE CONGRESS
INTERNATIONAL CRITICAL CARE AND EMERGENCY MEDICINE CONGRESS



Update on pediatric sepsis-ED setting

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Disclosure

I do not have an affiliation (financial or otherwise) with any commercial organization that may have a direct or indirect connection to the content of my presentation.

March 29 2012

- 12 yo M, cuts arm in gym -> develops myalgias, vomiting, fever
- ED diagnoses with gastroenteritis, receives Zofran and IVF, discharged
- Exam noted mottling of skin
 - Discharge Vitals: HR 143, RR 22, T 102 (no BP reported)
 - CBC drawn at that time showed WBC 14.7 (39%N, 53% bands) but patient discharged before resulted

Our case

- Back to ED the following day in septic shock, admitted to ICU
 - Blood cultures: Group A Streptococcus
 - Date of initial presentation – March 29
 - Date of death - April 1



Could this happen in my ED?

- >40,000 US pediatric severe sepsis cases/year
- ~20,000 pediatric septic shock/year
- Mortality in US 4-10% for severe sepsis and septic shock
 - Previously well children ~4%
 - High risk or chronically ill 7-10%
- Sepsis or related issues causes 7-9% of all pediatric deaths

**SEPSIS
KILLS**

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We offer emergency and urgent care in Manhattan and Brooklyn.

At NYU Langone Health, we know that emergencies can happen anywhere. That's why we offer emergency care at several Manhattan locations, as well as in Brooklyn, so you can easily access immediate medical treatment for injuries and illnesses.

SHARE:



An Infection, Unnoticed, Turns Unstoppable

About New York

By JIM DWYER JULY 11, 2012



TRAG

MEDIA

medpageTODAY'S
KevinMD.com
Social media's leading physician voice



ALL | KEVIN'S TAKE | PHYSICIAN | PATIENT | POLICY | TECH | SOCIAL MEDIA | MEDS

SCANDAL

New York State Department of Health ;

NYU Langone Emergency Room in New York City

“did not meet the basic standards of care”

THE BLOG

The Death Of Rory Staunton: When Than Doctors

27/12/2012 11:48 am ET | Updated Sep 11, 2012

890



Lisa Stalton
Senior Columnist, The Huffington Post

Parents Know More

Jim Dwyer New York Times Article - Irresponsible Journalism?



Goals

- Definitions for sepsis, SIRS and organ dysfunction in pediatrics
- Review the evidence based guidelines for the management of sepsis/septic shock
- Overall recommendations **(2017)**
 - ❖ **Diagnosis**
 - ❖ **First hour of resuscitation (ED setting)**
 - ❖ **Therapeutic Endpoints (Level 1C)**
 - ❖ **Monitoring (Level 1C)**
 - ❖ **Fluid Resuscitation (Level 1C)**
 - ❖ **Hemodynamic Support (Level 1C)**
 - ❖ **Hydrocortisone Therapy (Level 1C)**

Definitions

Special Article

International pediatric sepsis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics*

Brahm Goldstein, MD; Brett Giroir, MD; Adrienne Randolph, MD; and the Members of the International Consensus Conference on Pediatric Sepsis

Table 1. Pediatric age groups for severe sepsis definitions

1	Newborn	0 days to 1 wk
2	Neonate	1 wk to 1 mo
3	Infant	1 mo to 1 yr
4	Toddler and preschool	2–5 yrs
5	School age child	6–12 yrs
6	Adolescent and young adult	13 to <18 yrs

Definitions

Table 2. Definitions of systemic inflammatory response syndrome (SIRS), infection, sepsis, severe sepsis, and septic shock

SIRS^a

The presence of at least two of the following four criteria, one of which must be abnormal temperature or leukocyte count:

- **Core^b temperature** of $>38.5^{\circ}\text{C}$ or $<36^{\circ}\text{C}$.
- **Tachycardia**, defined as a mean heart rate >2 SD above normal for age in the absence of external stimulus, chronic drugs, or painful stimuli; or otherwise unexplained persistent elevation over a 0.5- to 4-hr time period OR for children <1 yr old: bradycardia, defined as a mean heart rate <10 th percentile for age in the absence of external vagal stimulus, β -blocker drugs, or congenital heart disease; or otherwise unexplained persistent depression over a 0.5-hr time period.
- **Mean respiratory rate** >2 SD above normal for age or mechanical ventilation for an acute process not related to underlying neuromuscular disease or the receipt of general anesthesia.
- **Leukocyte count elevated or depressed for age** (not secondary to chemotherapy-induced leukopenia) or $>10\%$ immature neutrophils.

Infection

A suspected or proven (by positive culture, tissue stain, or polymerase chain reaction test) infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection. Evidence of infection includes positive findings on clinical exam, imaging, or laboratory tests (e.g., white blood cells in a normally sterile body fluid, perforated viscus, chest radiograph consistent with pneumonia, petechial or purpuric rash, or purpura fulminans)

Sepsis

SIRS in the presence of or as a result of suspected or proven infection.

Severe sepsis

Sepsis plus one of the following: cardiovascular organ dysfunction OR acute respiratory distress syndrome OR two or more other organ dysfunctions. Organ dysfunctions are defined in Table 4.

Septic shock

Sepsis and cardiovascular organ dysfunction as defined in Table 4.

Modifications from the adult definitions are highlighted in boldface.

^aSee Table 3 for age-specific ranges for physiologic and laboratory variables; **^bcore temperature must be measured by rectal, bladder, oral, or central catheter probe.**

Definitions

Goldstein: Pediatric SIRS

Age group	Heart rate (beats/minute)		Respiratory rate (breaths/minute)	Leukocyte count (leukocytes x 10 ³ /mm ³)	Systolic blood pressure (mmHg)
	Tachycardia	Bradycardia			
Newborn (0 days to 1 week)	>180	<100	>50	>34	<59
Neonate (1 week to 1 month)	>180	<100	>40	>19.5 or <5	<79
Infant (1 month to 1 year)	>180	<90	>34	>17.5 or <5	<75
Toddler and preschool (>1 to 5 years)	>140	NA	>22	>15.5 or <6	<74
School age (>5 to 12 years)	>130	NA	>18	>13.5 or <4.5	<83
Adolescent (>12 to <18 years)	>110	NA	>14	>11 or <4.5	<90

Definitions

➤ **Severe sepsis** = Sepsis + 1 of the following:

1. Cardiovascular organ dysfunction
2. Acute respiratory distress syndrome (ARDS)
3. Evidence of ≥ 2 organ dysfunction (e.g., respiratory, renal, neurologic, hematologic, or hepatic)

➤ **Septic Shock** = Severe Sepsis + Cardiovascular Dysfunction (despite adequate fluid resuscitation)

Unlike with adults, **hypotension is not required**
to make the diagnosis of Septic Shock !!!!

Table 4. Organ dysfunction criteria

Cardiovascular dysfunction

Despite administration of isotonic intravenous fluid bolus ≥ 40 mL/kg in 1 hr

- Decrease in BP (hypotension) < 5 th percentile for age or systolic BP < 2 SD below normal for age^a
OR
- Need for vasoactive drug to maintain BP in normal range (dopamine > 5 μ g/kg/min or dobutamine, epinephrine, or norepinephrine at any dose)
OR
- Two of the following
 - Unexplained metabolic acidosis: base deficit > 5.0 mEq/L
 - Increased arterial lactate > 2 times upper limit of normal
 - Oliguria: urine output < 0.5 mL/kg/hr
 - Prolonged capillary refill: > 5 secs
 - Core to peripheral temperature gap $> 3^{\circ}\text{C}$

Respiratory^b

- $\text{PaO}_2/\text{FiO}_2 < 300$ in absence of cyanotic heart disease or preexisting lung disease
OR
- $\text{PaCO}_2 > 65$ torr or 20 mm Hg over baseline PaCO_2
OR
- Proven need^c or $> 50\%$ FiO_2 to maintain saturation $\geq 92\%$
OR
- Need for nonelective invasive or noninvasive mechanical ventilation^d

Neurologic

- Glasgow Coma Score ≤ 11 (57)
OR
- Acute change in mental status with a decrease in Glasgow Coma Score ≥ 3 points from abnormal baseline

Hematologic

- Platelet count $< 80,000/\text{mm}^3$ or a decline of 50% in platelet count from highest value recorded over the past 3 days (for chronic hematology/oncology patients)
OR
- International normalized ratio > 2

Renal

- Serum creatinine ≥ 2 times upper limit of normal for age or 2-fold increase in baseline creatinine

Hepatic

- Total bilirubin ≥ 4 mg/dL (not applicable for newborn)
OR
- ALT 2 times upper limit of normal for age

QUESTION 1

- If the patient does not meet these criteria can you rule out severe sepsis or septic shock ?



ONLY 2/3 of children treated for severe sepsis or septic shock met consensus criteria at the time of clinical diagnosis

Defining pediatric sepsis by different criteria: Discrepancies in populations and implications for clinical practice

Scott L. Weiss, MD; Brandon Parker, MD; Maria E. Bullock, RN, MSN, CPNP-AC/PC; Sheila Swartz, BS; Carolynn Price, BS; Mark S. Wainwright, MD, PhD; Denise M. Goodman, MD, MS

Objective: Pediatric patients with sepsis are identified using related but distinct criteria for clinical, research, and administrative purposes. The overlap between these criteria will affect the validity of extrapolating data across settings. We sought to quantify the extent of agreement among different criteria for pediatric severe sepsis/septic shock and to detect systematic differences between these cohorts.

Design: Observational study

0.52 \pm 0.05 for research-administrative, and 0.55 \pm 0.04 for clinical-administrative. Of the patients in the clinical cohort, 67% met research and 58% met administrative criteria. The research cohort exhibited a higher Pediatric Index of Mortality-2 score (median, interquartile range 5.2, 1.6-13.3) than the clinical (3.6, 1.1-6.2) and administrative (3.9, 1.0-6.0) cohorts ($p < .005$).

Clinical suspicion for sepsis often occurs even though all components of the consensus criteria are not present.

(5.2%) patients were identified by research, 50 (5.0%) by clinical, and 103 (6.0%) by administrative criteria. The $\kappa \pm$ standard error for pair-wise comparisons was 0.67 \pm 0.04 for research-clinical,

KEY WORDS: biomedical research; clinical trials; intensive care units; International Classification of Disease; pediatric; sepsis; septic shock

Review the EBG for the management of sepsis/septic shock





Clinical practice parameters for hemodynamic support of pediatric and neonatal patients in septic shock* **2002**

Joseph A. Carcillo, MD; Alan I. Fields, MD; Task Force Committee Members

Published in final edited form as:

Crit Care Med. 2009 February; 37(2): 666–688. doi:10.1097/CCM.0b013e31819323c6.

Clinical practice parameters for hemodynamic support of pediatric and neonatal septic shock: **2007** update from the American College of Critical Care Medicine



2002

2007

2014

2017

Clinical practice recommendations for hemodynamic support of pediatric and neonatal patients

Joseph A. Caruso

Background: Development of clinical practice guidelines for the management of pediatric patients with shock.

Objective: To develop clinical guidelines for the management of pediatric patients with shock.

Setting: Pediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU).

Methods: The following guidelines were developed by a panel of experts in pediatric critical care medicine, neonatology, and pediatric intensive care medicine. The panel members were selected through a process of nomination and review by the American Society of Pediatric Critical Care Medicine.

Results: Only one study was identified that evaluated the use of dopamine in the management of pediatric patients with shock. The study was a retrospective analysis of patients who were treated with dopamine in the PICU. The study found that patients who were treated with dopamine had a higher mortality rate than those who were not treated with dopamine.

0 min
5 min

Recognize decreased mental status and perfusion.
Maintain airway and establish access according to PALS guidelines.

Push 20cc/kg isotonic saline or colloid boluses up to and over 60 cc/kg
Correct hypoglycemia and hypocalcemia

15 min

Fluid refractory shock

Fluid responsive

Establish central venous access, begin dopamine therapy and establish arterial monitoring.

Fluid refractory-dopamine resistant shock

Observe in PICU

Titrate epinephrine for cold shock, norepinephrine for warm shock

Catecholamine-resistant shock

At Risk of Adrenal Insufficiency?

Not at Risk?

60 min

Give hydrocortisone

Do not give hydrocortisone

Normal Blood Pressure
Cold Shock,
SVC O₂ sat < 70%

Add Vasodilator or Type III PDE inhibitor with Volume loading

Low Blood Pressure
Cold Shock,
SVC O₂ sat < 70%

Titrate Volume and Epinephrine

Low Blood Pressure
Warm Shock

Titrate Volume and Norepinephrine
Low dose vasopressin or angiotensin?

Persistent Catecholamine-resistant shock

Place pulmonary artery catheter and direct fluid, inotrope, vasopressor, vasodilator, and hormonal therapies to attain normal MAP-CVP and CI > 3.3 and < 6.0 L/min/m²

Refractory shock

Consider ECMO

series, and age of Critical literature, out- in the 1960s U.S. hospital d with adults biology and re- diac failure is children, but adults. Ino- e (neonates), more impor- ons, whereas to adult sur-

the adult guide- application to Studies are cal Care Medi- and neonatal improved out-

Clinical practice parameters for hemodynamic support of pediatric and neonatal septic shock: **2007 update** from the American College of Critical Care Medicine

A full list of authors and affiliations appears at the end of the article.

Implementation of 2002 guidelines improved the outcome from **mortality 1%–3%** in previously healthy

2007 update continues to emphasize early use of age-specific therapies to attain time-sensitive goals

0 min
5 min
60 min
Emergency Department
Pediatric Intensive Care Unit

First hour Fluid resuscitation

HR
BP
CR ≤ 2 secs

Recognize decreased mental status and perfusion.
Begin high flow O_2 Establish IV/IO access.

Initial resuscitation: Push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
Correct hypoglycemia & hypocalcemia. Begin antibiotics.

shock not reversed?

Fluid refractory shock: Begin inotrope IV/IO. use atropine/ketamine IV/IO/IM to obtain central access & airway if needed.
Reverse cold shock by titrating central dopamine or, if resistant, titrate central epinephrine
Reverse warm shock by titrating central norepinephrine.

shock not reversed?

Catecholamine resistant shock: Begin hydrocortisone if at risk for absolute adrenal insufficiency

Monitor CVP in PICU, attain normal MAP-CVP & $ScvO_2 > 70\%$

Cold shock with normal blood pressure:
1. Titrate fluid & epinephrine, $ScvO_2 > 70\%$, Hgb > 10 g/dL
2. If $ScvO_2$ still $< 70\%$
Add vasodilator with volume loading (nitrovasodilators, milrinone, imrinone, & others)
Consider levosimendan

Cold shock with low blood pressure:
1. Titrate fluid & epinephrine, $ScvO_2 > 70\%$, Hgb > 10 g/dL
2. If still hypotensive consider norepinephrine
3. If $ScvO_2$ still $< 70\%$ consider dobutamine, milrinone, enoximone or levosimendan

Warm shock with low blood pressure:
1. Titrate fluid & norepinephrine, $ScvO_2 > 70\%$,
2. If still hypotensive consider vasopressin, terlipressin or angiotensin
3. If $ScvO_2$ still $< 70\%$ consider low dose epinephrine

shock not reversed?

Persistent catecholamine resistant shock: Rule out and correct pericardial effusion, pneumothorax, & intra-abdominal pressure > 12 mm/Hg.
Consider pulmonary artery, PICCO, or FATD catheter, &/or doppler ultrasound to guide fluid, inotrope, vasopressor, vasodilator and hormonal therapies.
Goal C.I. > 3.3 & < 6.0 L/min/m²

shock not reversed?

Refractory shock: ECMO

If 2nd PIV start inotrope.

Earlier use of inotrope support via PIV until central access is attained

dose range:
dopamine up to 10 mcg/kg/min,
epinephrine 0.05 to 0.3 mcg/kg/min.

Figure 1: Stepwise management of hemodynamic support in infants and children

2014 ACCM/PALS Guidelines New Major Recommendations /

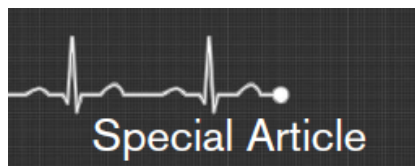


to
n.
[Yellow box]



rope
when
not
with
c QIM
n)

Refractory shock: ECMO (110 mL/Kg/min) &/or CRRT (> 35 mL/Kg/hr)



American College of Critical Care Medicine Clinical Practice Parameters for Hemodynamic Support of Pediatric and Neonatal Septic Shock

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Overall Recommendations - 2017

Septic shock is suspected in children with the inflammatory triad: fever (or hypothermia), tachycardia & vasodilation (common in benign pediatric infections) + signs of low perfusion such as →

- CNS changes

Altered mental status, inappropriate crying, drowsiness, confusion, poor interaction with parents, lethargy, or becoming unarousable.
- Prolonged capillary fill (> 2 sec, 'cold shock') -> common
- Flash capillary fill ('warm shock') -> less common
- ↓ urine output

34 days old baby boy fever (38.9 °C)

poor feeding
Irritability

HR:198/bpm
RR: 48
SBP:70mmHg
CR > 2''



Clinical Diagnosis

1. Children who have **a suspected infection** manifested by **hypothermia or hyperthermia ***



2. Clinical signs of **inadequate tissue perfusion** including any of the following:

1. decreased or altered mental status,
2. prolonged capillary refill > than 2 seconds,
3. diminished pulses, mottled
4. cool extremities, or flash capillary refill,
5. bounding peripheral pulses
6. wide pulse pressure
7. decreased urine output < 1 mL/kg/hr

* 0-3 mos <36, >38 °C and other ages <36, >38.5°C

2017 recommends;

each institution implements their
own adopted

or

home-grown bundles ;



Recognition bundle ;

1. A trigger tool
2. Clinician assessment within 15 minutes
3. Activation of a sepsis resuscitation bundle within 15 minutes



Resuscitation @ stabilization bundle ;

1. IV/IO access within 5 minutes
2. Initiate appropriate fluid res. within 30 minutes
3. Initiate broad spectrum antibiotics within 60 minutes
4. Use of peripheral or central inotrope within 60 minutes
5. Multimodal monitoring to guide fluid, hormonal, and cardiovascular therapies to attain MAP-CVP ($55 + 1.5 \times \text{age in yr}$), and $\text{Scvo}_2 > 70\%$
6. Administration of appropriate antibiotic therapy and source control.



Performance bundle ;

1. Measure adherence to trigger resuscitation and stabilization bundles
2. Perform root cause analysis to identify barriers to adherence
3. Provide an action plan to address identified barriers

Septic Shock Trigger/Identification Tool

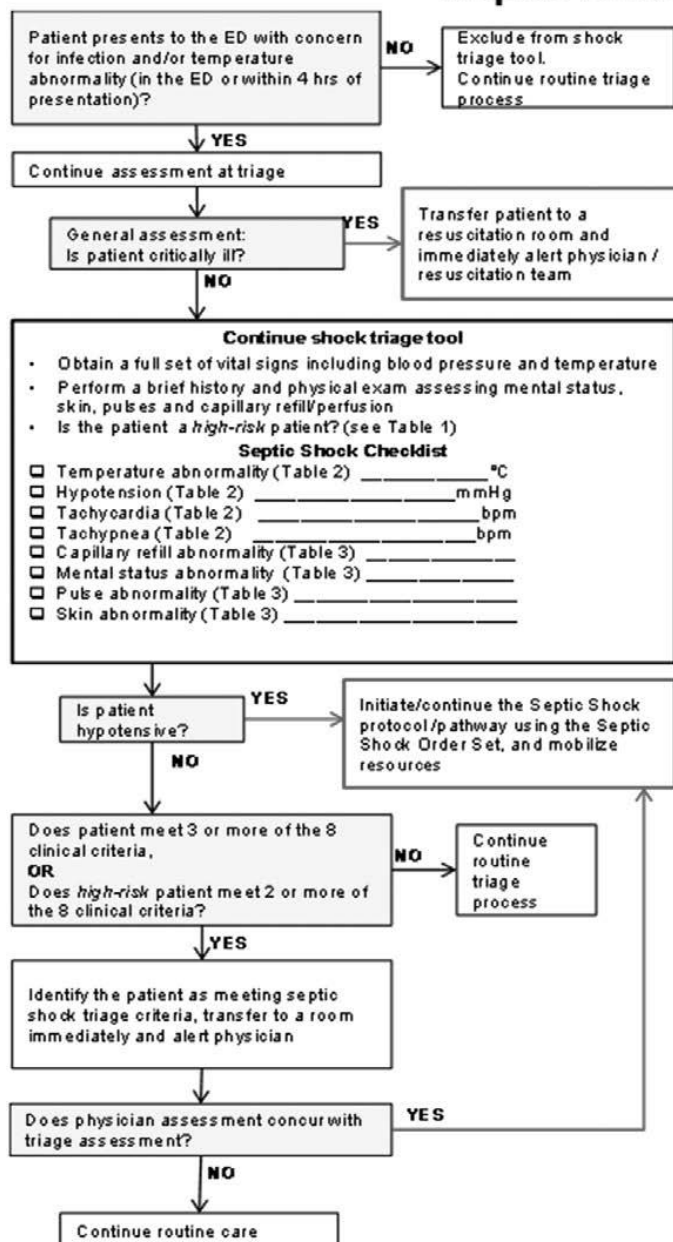


Table 1. High Risk Conditions

- Malignancy
- Asplenia (including SCD)
- Bone marrow transplant
- Central or indwelling line/catheter
- Solid organ transplant
- Severe MR/CP
- Immunodeficiency, immunocompromise or immunosuppression

Table 2. Vital Signs (PALS)

Age	Heart Rate	Resp Rate	Systolic BP	Temp (°C)
0 d - 1 m	> 205	> 60	< 60	<36 or >38
≥ 1 m - 3 m	> 205	> 60	< 70	<36 or >38
≥ 3 m - 1 r	> 190	> 60	< 70	<36 or >38.5
≥ 1 y - 2 y	> 190	> 40	< 70 + (age in yr x 2)	<36 or >38.5
≥ 2 y - 4 y	> 140	> 40	< 70 + (age in yr x 2)	<36 or >38.5
≥ 4 y - 6 y	> 140	> 34	< 70 + (age in yr x 2)	<36 or >38.5
≥ 6 y - 10 y	> 140	> 30	< 70 + (age in yr x 2)	<36 or >38.5
≥ 10 y - 13 y	> 100	> 30	< 90	<36 or >38.5
> 13 y	> 100	> 16	< 90	<36 or >38.5

Table 3. Exam Abnormalities

	Cold Shock	Warm Shock	Non-specific
Pulses (central vs. peripheral)	Decreased or weak	Bounding	
Capillary refill (central vs. peripheral)	≥ 3 sec	Flash (< 1 sec)	
Skin	Mottled, cool	Flushed, ruddy, erythroderma (other than face)	Petechiae below the nipple, any purpura
Mental status			Decreased, irritability, confusion, inappropriate crying or drowsiness, poor interaction with parents, lethargy, diminished arousability, obtunded

Our baby case ?

Patient presents to the ED with concern for infection and/or temperature abnormality (in the ED or within 4 hours of presentation)?

Table 1. High-risk conditions

■ Malignancy

Table 3. Exam abnormalities

	Cold shock	Warm shock	Non-specific
Pulses (central versus peripheral)	Decreased or weak	Bounding	
Capillary refill (central versus peripheral)	≥3 seconds	Flash (<1 second)	
Skin	Mottled, cool	Flushed, ruddy, erythroderma (other than face)	Petechiae below the nipple, any purpura
Mental status			Decreased, irritability, confusion, <i>inappropriate</i> crying or drowsiness, poor interaction with parents, lethargy, diminished arousability, obtunded

Yes

Transfer patient to resuscitation and immediately alert physician for resuscitation

Temperature (°C)

1.5

1.5

1.5

1.5

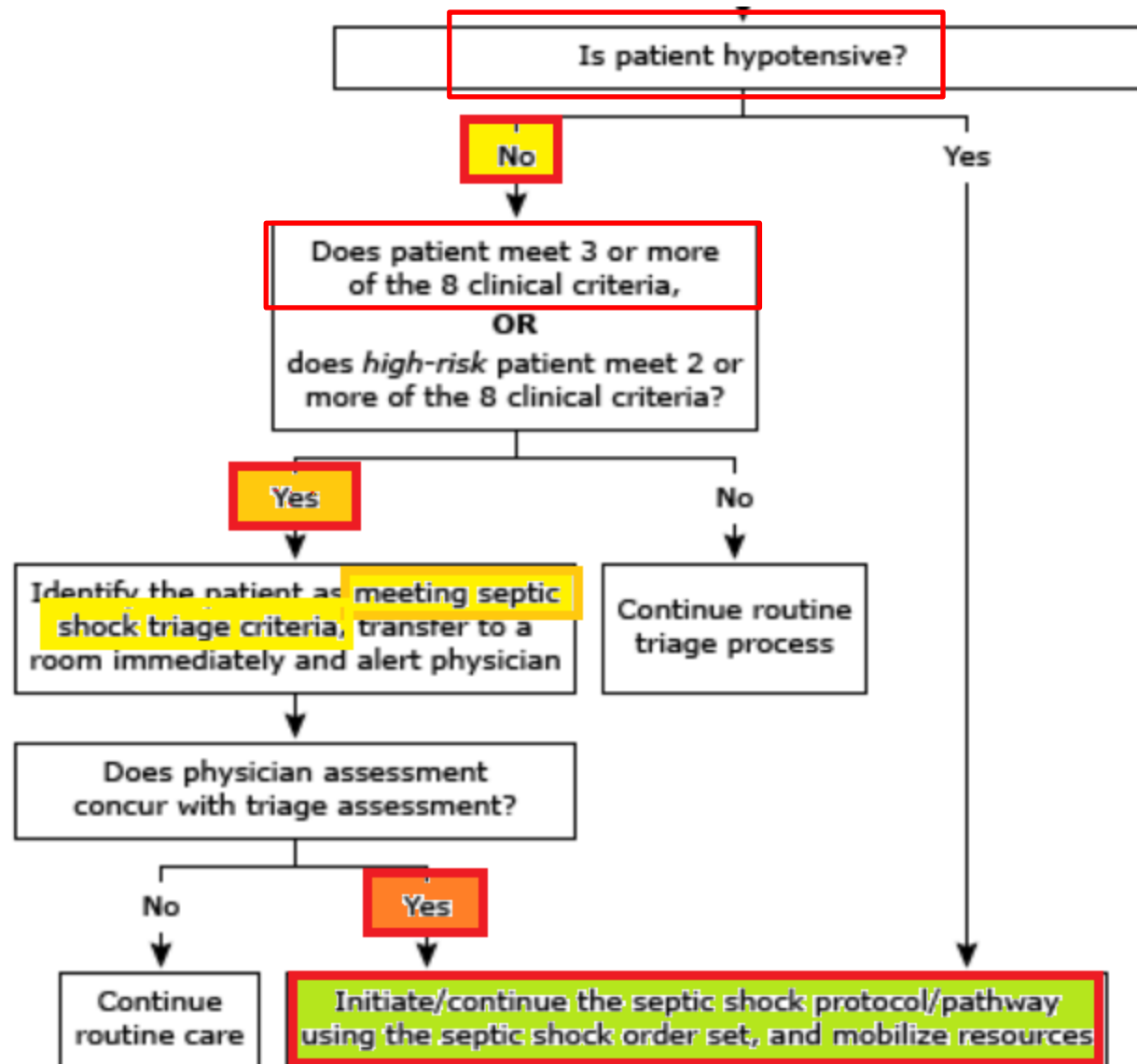
1.5

1.5

✓ Skin abnormality (Table 3) **+**

Is patient hypotensive?

>13 years >100 >16 <90 <36 or >38.5



ABCs: The First Hour of Resuscitation (Emergency Department Resuscitation) Goals: (Level 1C)



- Maintain or restore ;

ABC

- (airway, oxygenation, ventilation, circulation, defined as normal perfusion and blood pressure)
- threshold HR

Therapeutic Endpoints (Level 1C).

1. Capillary refill $\leq 2''$
2. Normal pulses (peripheral and central pulses, warm extremities)
3. Urine output $> 1 \text{ mL/kg/hr}$,
4. Normal mental status,
5. Normal blood pressure for age (only reliable when pulses palpable),
6. Normal glucose, normal ionized calcium concentration

Monitoring (Level 1C)



- Pulse oximeter
- Continuous electrocardiogram (ECG)
- Blood pressure and pulse pressure
- Temperature
- Urine output
- Glucose, ionized calcium

Airway and Breathing (Level 1C)

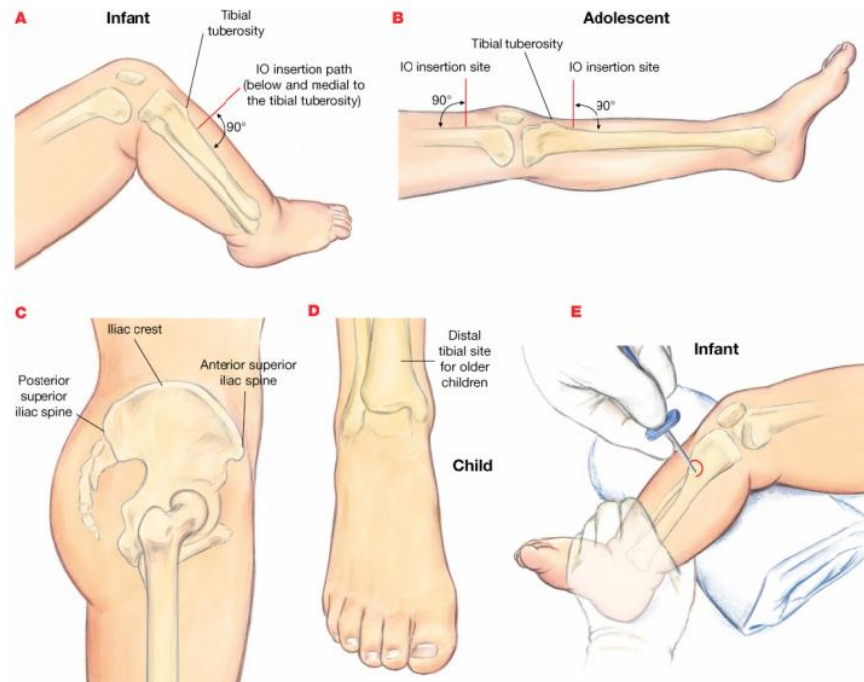
Supplemental oxygen / HFNC (Spo2 100%) **

Decision ; Intubation and ventilation =

Based on clinical assessment of increased work of breathing,
hypoventilation, or impaired mental status

Circulation (Level 1C)

IV/IO access



Fluid resuscitation (Level 1C)



0 min

Recognize decreased mental status and perfusion.
Begin high flow O₂ and establish IO/IV access according to PALS.

5 min

If no hepatomegaly or rales / crackles then push 20 mL/kg isotonic saline boluses
Press after each bolus up to 60 mL/kg until improved perfusion. Stop for
crackles or hepatomegaly. Correct hypoglycemia and hypocalcemia.
Begin antibiotics.

- 2.5 mL/kg of D10W (to 12 yrs)
- 1 ml/kg D25W (adolescents)

Catecholamine-resistant shock?

- Calcium gluconate 10 %

- 0.5 to 1 mL/kg

- IV or IO infusion (5 min)

- Choice of antimicrobials is complex

- should consider the child's age, history, comorbidities, clinical syndrome, Gram stain data, and local resistance patterns.

Persistent Catecholamine-resistant shock?

Evaluate Pericardial Effusion or Pneumothorax,
Maintain IAP < 12mmHg

Refractory

0 min

Recognize decreased mental status and perfusion.
Begin high flow O₂ and establish IO/IV access according to PALS.

5 min

If no hepatomegaly or rales / crackles then push 20 mL/kg isotonic saline boluses and reassess after each bolus up to 60 mL/kg until improved perfusion. Stop for rales, crackles or hepatomegaly. Correct hypoglycemia and hypocalcemia.
Begin antibiotics.

Children >28 days immunosuppressed or at risk for infection with Pseudomonas species:

- [Vancomycin](#) (15 mg/kg, maximum 1 to 2 g, for the initial dose)
 - + [cefepime](#) (50 mg/kg, maximum 2 g, for the initial dose)
- OR [ceftazidime](#) (50 mg/kg, maximum 2 g, for the initial dose) **OR** carbapenem (eg, [imipenem](#), [meropenem](#))

0 min

Recognize decreased mental status and perfusion.
Begin high flow O₂ and establish IO/IV access according to PALS.

5 min

If no hepatomegaly or rales / crackles then push 20 mL/kg isotonic saline boluses and reassess after each bolus up to 60 mL/kg until improved perfusion. Stop for rales, crackles or hepatomegaly. Correct hypoglycemia and hypocalcemia.
Begin antibiotics.

15 min

Fluid refractory shock?

Begin peripheral IV/IO inotrope infusion, preferably Epinephrine 0.05 – 0.3 µg/kg/min
Use Atropine / Ketamine IV/IO/IM if needed for Central Vein or Airway Access

~~Titrate Epinephrine 0.05 – 0.3 µg/kg/min for Cold Shock~~
(Titrate central Dopamine 5 – 9 µg/kg/min if Epinephrine not available)
~~Titrate central Norepinephrine from 0.05 µg/kg/min and upward to reverse Warm Shock~~
(Titrate central Dopamine ≥ 10 µg/kg/min if Norepinephrine not available)

Catecholamine-resistant shock?

- **Atropine** (0.02 mg/kg)
- **Ketamine** (1-2mg/kg)

for Absolute Adrenal Insufficiency consider Hydrocortisone.
CCO, FATD or PAC to Direct Fluid, Inotrope, Vasopressor, Vasodilators
normal MAP-CVP, ScvO₂ > 70%* and CI 3.3 – 6.0 L/min/m²

ScvO₂ < 70% / Hgb > 10g/dL
on Epinephrine?

Low Blood Pressure
Cold Shock
ScvO₂ < 70%* / Hgb > 10g/dL
on Epinephrine?

Low Blood Pressure
Warm Shock
ScvO₂ > 70%*
on Norepinephrine?

15 min

Fluid refractory shock?

Begin peripheral IV/IO inotrope infusion, preferably Epinephrine 0.05 – 0.3 µg/kg/min
Use Atropine / Ketamine IV/IO/IM if needed for Central Vein or Airway Access

Titrate Epinephrine 0.05 – 0.3 µg/kg/min for Cold Shock.
(Titrate central Dopamine 5 – 9 µg/kg/min if Epinephrine not available)
Titrate central Norepinephrine from 0.05 µg/kg/min and upward to reverse Warm Shock.
(Titrate Central Dopamine ≥ 10 µg/kg/min if Norepinephrine not available)

60 min

Catecholamine-resistant shock?

If at risk for Absolute Adrenal Insufficiency consider Hydrocortisone.
Use Doppler US, PICCO, FATD or PAC to Direct Fluid, Inotrope, Vasopressor, Vasodilators
Goal is normal MAP-CVP, ScvO₂ > 70%* and CI 3.3 – 6.0 L/min/m²

Normal Blood Pressure
Cold Shock
ScvO₂ < 70%* / Hgb > 10g/dL
on Epinephrine?

Begin Milrinone infusion.
Add Nitroso-vasodilator if CI < 3.3L/min/m² with High SVRI and/or poor skin perfusion.
Consider Levosimendan if unsuccessful.

Low Blood Pressure
Cold Shock
ScvO₂ < 70%* / Hgb > 10g/dL
on Epinephrine?

Add Norepinephrine to Epinephrine to attain normal diastolic blood pressure. If CI < 3.3 L/min/m² add Dobutamine, Enoximone, Levosimendan, or Milrinone.

Low Blood Pressure
Warm Shock
ScvO₂ > 70%*
on Norepinephrine?

If euvolemic, add Vasopressin, Terlipressin, or Angiotensin. But, if CI decreases below 3.3 L/min/m² add Epinephrine, Dobutamine, Enoximone, Levosimendan.

15 min

Fluid refractory shock?

Begin peripheral IV/IO inotrope infusion, preferably Epinephrine 0.05 – 0.3 µg/kg/min
Use Atropine / Ketamine IV/IO/IM if needed for Central Vein or Airway Access

Titrate Epinephrine 0.05 – 0.3 µg/kg/min for Cold Shock.
(Titrate central Dopamine 5 – 9 µg/kg/min if Epinephrine not available)
Titrate central Norepinephrine from 0.05 µg/kg/min and upward to reverse Warm Shock.
(Titrate Central Dopamine ≥ 10 µg/kg/min if Norepinephrine not available)

60 min

Catecholamine-resistant shock?

If at risk for Absolute Adrenal Insufficiency consider Hydrocortisone.

50 to 100 mg/m²/day or 2 to 4 mg/kg/day

Normal Blood Pressure
Cold Shock
ScvO₂ < 70%* / Hgb > 10g/dL
on Epinephrine?

Low Blood Pressure
Cold Shock
ScvO₂ < 70%* / Hgb > 10g/dL
on Epinephrine?

Low Blood Pressure
Warm Shock
ScvO₂ > 70%*
on Norepinephrine?

Begin Milrinone infusion.
Add Nitroso-vasodilator if CI < 3.3L/min/m² with High SVRI and/or poor skin perfusion.
Consider Levosimendan if unsuccessful.

Add Norepinephrine to Epinephrine to attain normal diastolic blood pressure. If CI < 3.3 L/min/m² add Dobutamine, Enoximone, Levosimendan, or Milrinone.

If euvolemic, add Vasopressin, Terlipressin, or Angiotensin. But, if CI decreases below 3.3 L/min/m² add Epinephrine, Dobutamine, Enoximone, Levosimendan.

Back to our patient



- Fever would have mandated use of tool
 - (T 102 F)
- Exam noted **mottling of skin**
- VS HR **143**, RR **22**

Sepsis Trigger Tool Criteria

Patient Vital Signs		Check box if:								
Check box if ABNORMAL	Enter patient vital signs	Age <1m	Age ≥1m -2m	Age 3m- 12m	Age 1y-2y	Age 3y-4y	Age 5y-6y	Age 7y- 10y	Age 11y- 13y	Age >13y

= 3 points

- Would have triggered closer evaluation

<input type="checkbox"/>	Refill		<1 sec (flash) or ≥3 secs
<input type="checkbox"/>	Mental Status		Irritability, confusion, inappropriate crying or drowsiness, poor interaction with parents, lethargy, decreased arousability, obtunded
<input type="checkbox"/>	Pulses		Decreased/weak or Bounding
<input checked="" type="checkbox"/>	Skin		Petechiae blow the nipple, any purpura, mottled and cool flushed, ruddy, erythroderma other than on face
<input type="checkbox"/>	High Risk Condition		Malignancy, asplenia, Sickle Cell Disease, bone marrow or solid organ transplant, central or indwelling line/catheter, severe MRCP, immunodeficiency or immunosuppression
<div> <div>3</div> <div>Number of boxed checked</div> </div>			

The Future?

- ED Sepsis Team
 - Decision making: Launching the pathway?
- Prehospital Alert /treatment
 - Maryland protocol (2016)
- Other areas of the hospital (PICU, Heme Onc)
 - CHA collaborative



Questions?