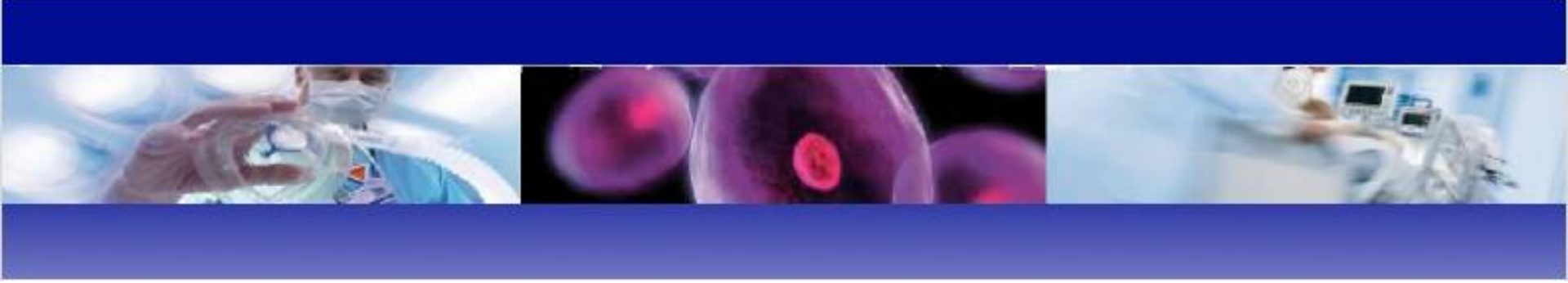


CHU ORAN
المركز الإستشفائي الجامعي لوهران
CENTRE HOSPITALO-UNIVERSITAIRE ORAN

22ème Congrès National de la Société Algérienne d'Anesthésie, de Réanimation, de soins intensifs, et d'urgence : SAARSIU
15, 16 & 17 Décembre 2022 à Alger, Hôtel Mercure

جامعة وهران
Université Oran 1
أحمد بن بلة

Actualité sur le choc septique chez l'enfant : Reconnaissance et Management

Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children

K. ELHALIMI. MD Ph D

Maître de Conférences classe « A »

Service de Réanimation Médicale Pédiatrique, CHU Oran

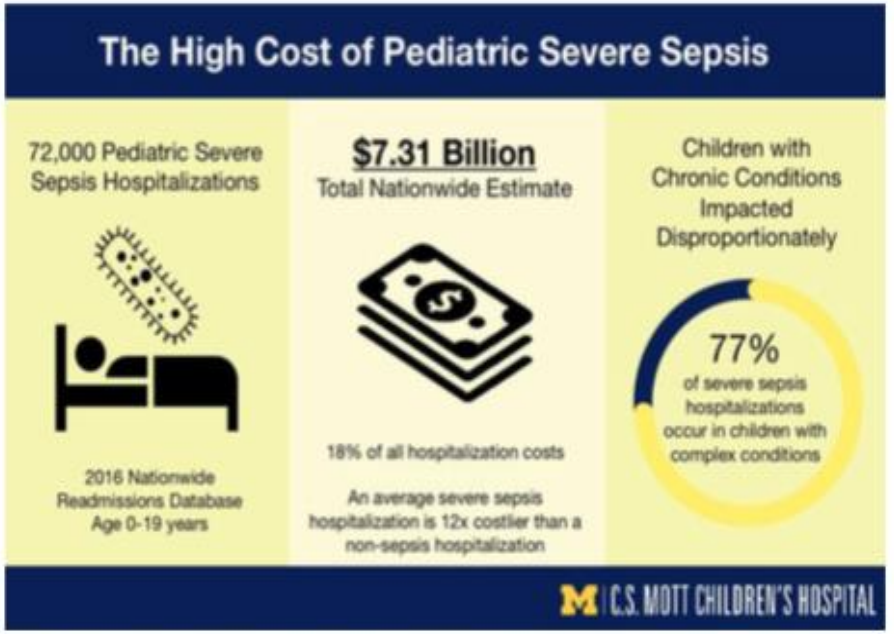
Faculté de Médecine d'Oran, Université Oran 1

Objectives

- At the end of this presentation, learners will be able to:
  - Appreciate the difficulty in defining and recognizing pediatric sepsis
  - Acknowledge the importance of standardized screening and management in pediatric sepsis
  - Initiate appropriate treatment in potentially septic patients

Why is Sepsis Important?

- Sepsis is leading cause of pediatric mortality worldwide[1]
  - 25% mortality rate for patients admitted to PICU
- Prevalence of severe sepsis has increased to 7.7%[2]
- 1/5th of sepsis survivors have a moderate disability[1]
- Severe sepsis accounts for $7.31 billion in healthcare costs[3]



Paper cited: Carlton, E., Barbaro, R., Iwashyna, T., Prescott, H. "Cost of Pediatric Severe Sepsis Hospitalizations" *JAMA Pediatrics*. DOI: :10.1001/jamapediatrics.2019.2570

Weiss, S. L. *et al.* Global epidemiology of pediatric severe sepsis: the sepsis prevalence, outcomes, and therapies study. *Am. J. Respir. Crit. Care Med.* **191**, 1147–1157 (2015).
Ruth, A. *et al.* Pediatric severe sepsis: current trends and outcomes from the Pediatric Health Information Systems database. *Pediatr Crit Care Med* **15**, 828–838 (2014).
Carlton, E. F., Barbaro, R. P., Iwashyna, T. "Jack" & Prescott, H. C. Cost of Pediatric Severe Sepsis Hospitalizations. *JAMA Pediatr.* (2019) doi:10.1001/jamapediatrics.2019.2570.

ELSEVIER

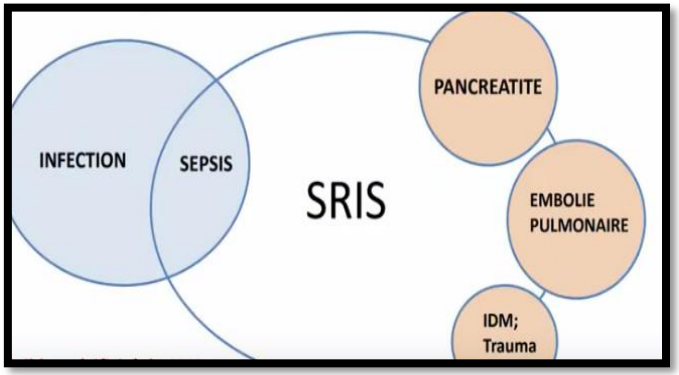
Anesthésie & Réanimation

Volume 8, Issue 5, September 2022, Pages 506-511

Recognition
Pediatric sepsis

Définitions du Choc septique pédiatrique MAIS …….!

Faible spécifiés du SIRS !



Limites des anciennes définitions !

Nouvelles définitions pour l'adulte

3ième Conférence de Consensus international (Sepsis-3) 2016 2020

INFECTION ~~SRIS~~ ~~SEPSIS SEVERE~~ CHOC SEPTIQUE

Nouvelle définition du Sepsis

- Score SOFA ≥ 2 ou augmentation de ≥ 2 points si dysfonction d'organe présente avant infection

Nouvelle définition du Choc Septique (tous les critères ci-dessous)

- Sepsis
- Recours au Vasopresseurs QSP PAM ≥ 65 mmHg
- Lactate >2 mmol/L (18 mg/dL)
- malgré la correction d'une hypovolémie

Adult Sepsis-3 Defi

- Life-threatening organ dysfunctio
  caused by a dysregulated hos
  to infection
  - Sequential Organ
    (SOFA) char
    dysfu

Surviving Sepsis Campa
Guidelines for the M
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ce to the site of infection? ONE
ee opposite):

- ssure
  OR Mean arterial
  ure <65mmHg
  ystolic blood pressure
  >40mmHg below baseline
- Creatinine >175mmol/L **OR** urine output 0.5ml/kg/hour for more than 2 hours

- Bilateral pulmonary infiltrates **PLUS** O_2 required to keep O_2 saturations >92%
- Bilateral pulmonary infiltrates **PLUS** PaO_2/FiO_2 ratio <300*
- Bilirubin >34 mmol/L
- Coagulopathy INR >1.5 **OR** APTT >60 seconds
- Platelet count $<100x10^9$/L

If YES to questions 1 +2 + 3 = criteria for SEPSIS

Note: *PaO_2 measured in mmHg (1kPa = 7.5mmHg), FiO_2 as % converted into a decimal e.g. 32% = 0.32

Adapted from: Surviving Sepsis Campaign: International Guidelines for Management of Severe Sepsis and Septic Shock www.survivingsepsis.org

we chose not to require a specific definition or scheme for this purpose

Schlapbach LJ, Kissoon N. Defining Pediatric Sepsis. *JAMA Pediatr*. 2018; 172(4):312-314.

, San ion of a Pediatric Sequential Organ Failure Assessment Score and Evaluation of the Sepsis-3 Definitions in Critically Ill Children. *JAMA Pediatr. 2017; 171*(10): E172352.

Singer M et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016; *315*(8): 801-810.

Goldst , Randolph ce on Pediatric Sepsis. International pediatric sepsis consensus conference: definitions for sepsis and organ dysfunction in pediatrics. *Pediatr Crit Care Med*. 2005; 6(1):2-8.

2017 Pediatric sepsis updates

- Adult definitions attempted to be applied but never formally adopted
- Adaptations to create pSOFA
- >8 points associated with increased mortality

Table 1. Pediatric Sequential Organ Failure Assessment Score

	Score[a]				
Variables	0	1	2	3	4
Respiratory					
$Pao_2:Fio_2$[b] or $Spo_2:Fio_2$[c]	≥400	300-399	200-299	100-199 With respiratory support	<100 With respiratory support
	≥292	264-291	221-264	148-220 With respiratory support	<148 With respiratory support
Coagulation					
Platelet count, $\times 10^3/\mu L$	≥150	100-149	50-99	20-49	<20
Hepatic					
Bilirubin, mg/dL	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Cardiovascular					
MAP by age group or vasoactive infusion, mm Hg or μg/kg/min[d]					
<1 mo	≥46	<46	Dopamine hydrochloride ≤5 or dobutamine hydrochloride (any)	Dopamine hydrochloride >5 or epinephrine ≤0.1 or norepinephrine bitartrate ≤0.1	Dopamine hydrochloride >15 or epinephrine >0.1 or norepinephrine bitartrate >0.1
1-11 mo	≥55	<55			
12-23 mo	≥60	<60			
24-59 mo	≥62	<62			
60-143 mo	≥65	<65			
144-216 mo	≥67	<67			
>216 mo[e]	≥70	<70			
Neurologic					
Glasgow Coma Score[f]	15	13-14	10-12	6-9	<6
Renal					
Creatinine by age group, mg/dL					
<1 mo	<0.8	0.8-0.9	1.0-1.1	1.2-1.5	≥1.6
1-11 mo	<0.3	0.3-0.4	0.5-0.7	0.8-1.1	≥1.2
12-23 mo	<0.4	0.4-0.5	0.6-1.0	1.1-1.4	≥1.5
24-59 mo	<0.6	0.6-0.8	0.9-1.5	1.6-2.2	≥2.3
60-143 mo	<0.7	0.7-1.0	1.1-1.7	1.8-2.5	≥2.6
144-216 mo	<1.0	1.0-1.6	1.7-2.8	2.9-4.1	≥4.2
>216 mo[e]	<1.2	1.2-1.9	2.0-3.4	3.5-4.9	≥5

Matics T, Sanchez-Pinto L. Adaptation and Validation of a Pediatric Sequential Organ Failure Assessment Score and Evaluation of the Sepsis-3 Definitions in Critically Ill Children. *JAMA Pediatr. 2017; 171*(10): E172

What is Pediatric Sepsis?

- Pediatric sepsis definitions (2005)
  - **Sepsis** - SIRS associated with infection (2/4 criteria, one of which must be abnormal temperature or leukocyte count):
    - Core temperature of > 38.5°C or < 36°C
    - Tachycardia or for children <1 yr old: bradycardia
    - Tachypnea
    - Leukocyte count elevated or depressed for age (not secondary to chemotherapy-induced leukopenia) or >10% immature neutrophils.
    - Infection: A suspected or proven infection caused by any pathogen OR a clinical syndrome associated with a high probability of infection.
  - **Severe sepsis** - sepsis + cardiovascular dysfunction OR ARDS OR ≥2 other organ dysfunction
  - **Septic shock** - sepsis with cardiovascular dysfunction

Schlapbach LJ, Kissoon N. Defining Pediatric Sepsis. *JAMA Pediatr*. 2018; 172(4):312-314.
Matics T, Sanchez-Pinto L. Adaptation and Validation of a Pediatric Sequential Organ Failure Assessment Score and Evaluation of the Sepsis-3 Definitions in Critically Ill Children. *JAMA Pediatr. 2017; 171*(10): E172352.
Singer M et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). *JAMA*. 2016; *315*(8): 801-810.
Goldstein B, Giroir B, Randolph A. International Consensus Conference on Pediatric Sepsis. International pediatric sepsis consensus conference: definitions for sepsis and organ dysfunction in pediatrics. *Pediatr Crit Care Med*. 2005; 6(1):2-8.

What Does Pediatric Sepsis Look Like?

- Fever or hypothermia (<36°C or ≥38°C)
- Tachycardia or bradycardia if < 1yo
- Tachypnea
- Altered perfusion → delayed capillary refill, mottled, poor pulses OR bounding pulses, flash capillary refill, flushed
- Hypotension → LATE SIGN

Pediatric sepsis can look like many other disease processes

Flowchart - Paediatric Sepsis Pathway

Child UNWELL? Concerned with observations?

CONSIDER SEPSIS

RECOGNISE

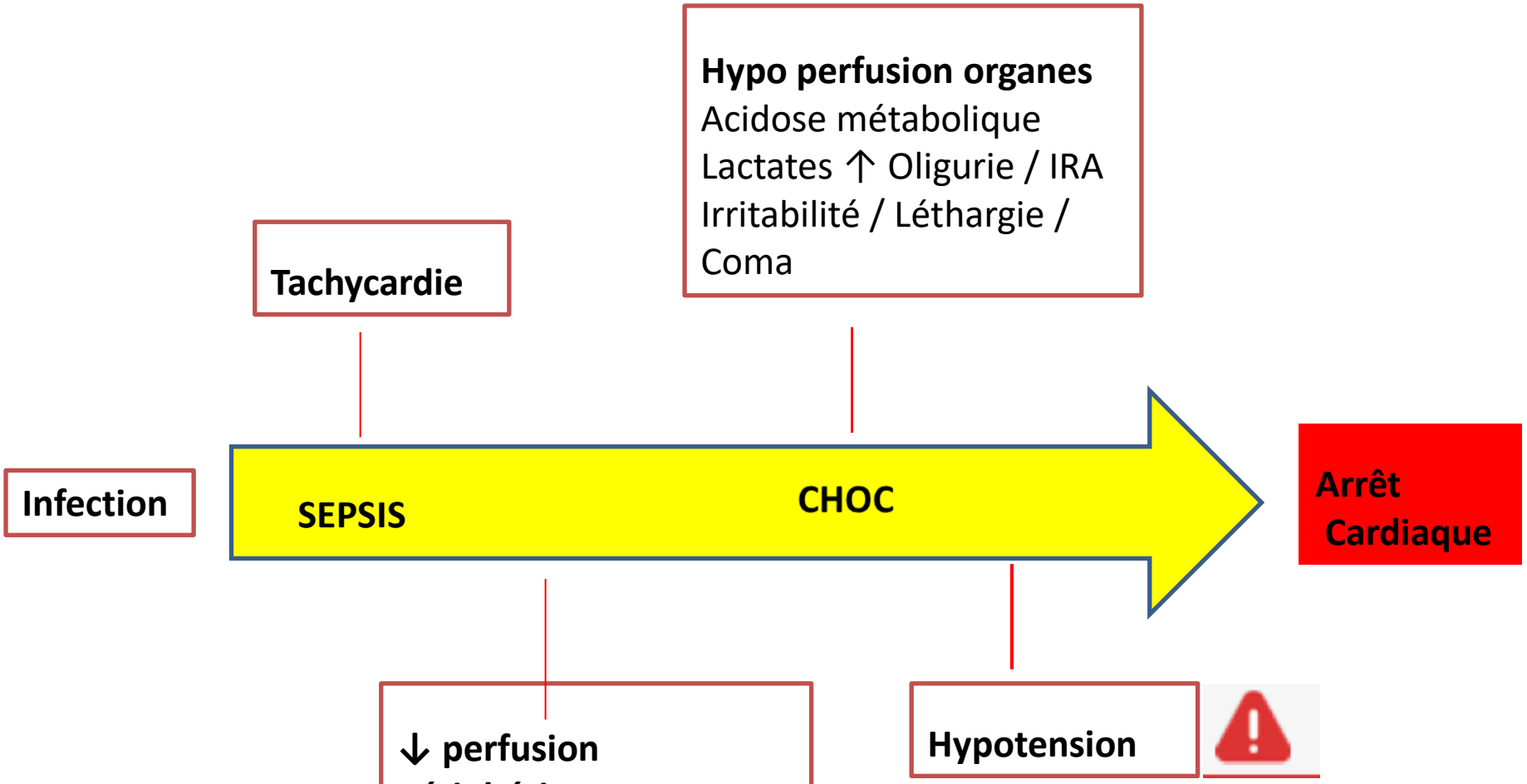
Does your patient have ANY of the following signs or symptoms of infection?

- Fever (≥38°C) or hypothermia (<36°C)
- Altered conscious state
- Marked or persistent tachycardia
- **Signs of toxicity:**
  Decreased alertness, arousal or activity; pale or mottled; cool peripheries; weak cry; grunting; rigors; bounding or weak pulses; wide pulse pressure
- Non-blanching rash
- Hypotension
- Lactate 2-4 mmol/L concerning, >4 mmol/L high risk
- Unexplained generalised pain

AND

- **ANY Purple Zone observation on RDR chart**
  OR
- **TWO OR MORE Red Zone observations**
  OR
- **Additional response criteria** (on Rapid Detection and Response Chart)
  OR
- **SERIOUS CLINICAL CONCERN**

Take home messages



Standardizing Pediatric Sepsis Care

Treating Pediatric Sepsis 2020

- Panel of 49 international experts provided 77 statements on management and resuscitation of children with septic shock and other sepsis-associated organ dysfunction
  - "In children who present as acutely unwell, we suggest implementing **systematic screening** for timely recognition of septic shock and other sepsis-associated organ dysfunction (weak recommendation, very low quality of evidence)."
  - "We *recommend* **implementing a protocol/guideline** for management of children with septic shock or other sepsis-associated organ dysfunction (BPS)."

Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children

Standardizing Pediatric Sepsis Care

- Surviving Sepsis Campaign and American College of Critical Care Medicine (ACCM) recommend **implementing sepsis bundles** to
  - Improve sepsis recognition
  - Increase efficacy of treatment
- Standardized care throughout the institution → **improved recognition and treatment**

Standardize Care for Sepsis: Sepsis Bundles

Bundle	Elements
Recognition Bundle	- Implementation of sepsis screening tool • Rapid identification • Prompt assessment
Resuscitation & Stabilization Bundle	- Blood culture collection - Prompt antibiotic administration - Early rapid fluid bolus with crystalloid - Early lactate measurement
Performance Bundle	- Monitor and measure processes - Continued improvement and sustainability

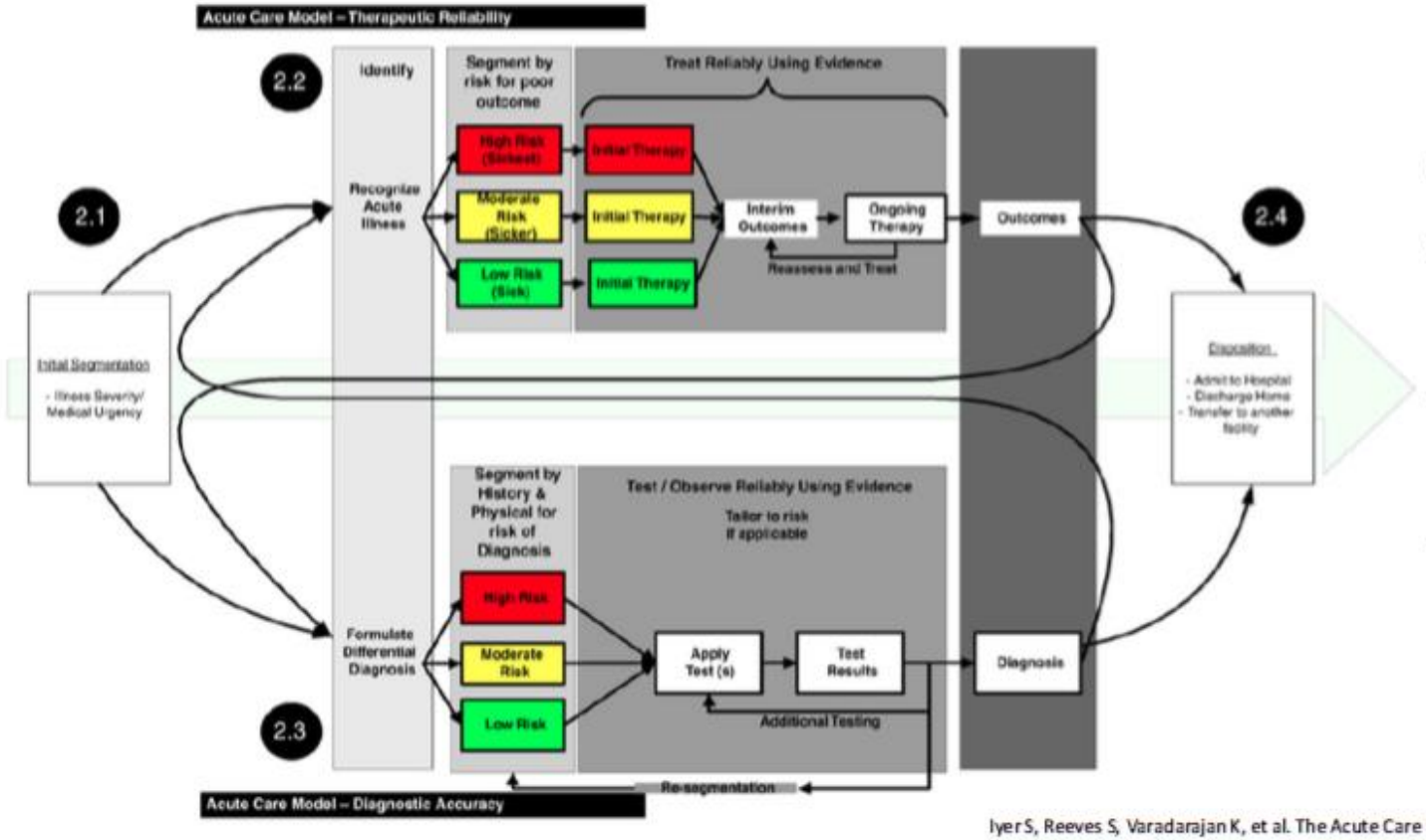
Why standardize care?

- Healthcare delivery has many characteristics of high-risk processes that increase the risk of failure:
  - Variable input
  - Complexity
  - Inconsistency
  - Tight coupling
  - Human intervention
  - Tight time constraints
  - Hierarchical culture

https://images.app.goo.gl/8jq9iN8E1nR7kmZM6

Spath, P. (2011). Error reduction in health care a systems approach to improving patient safety (2nd ed.). San Francisco, Calif.: Jossey-

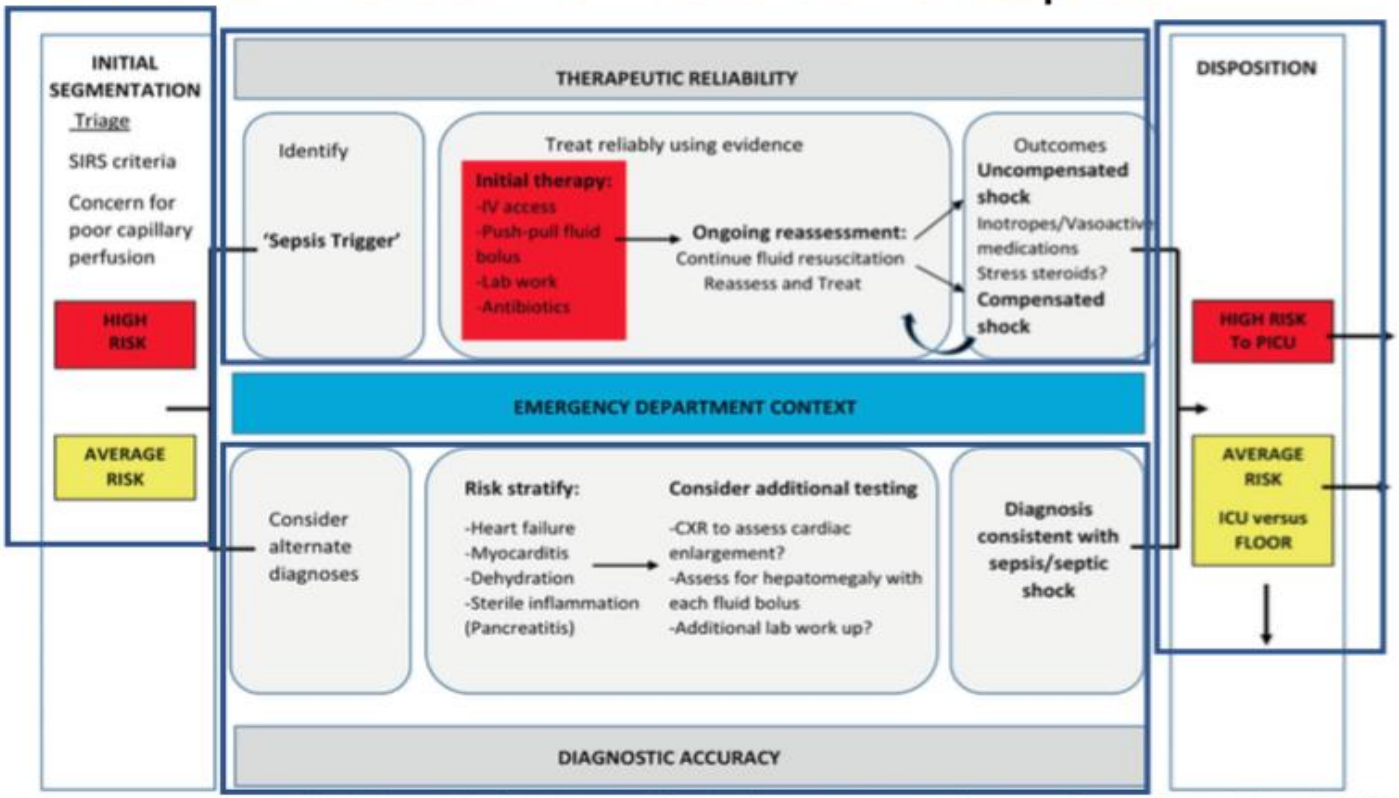
Acute Care Model



- Segmentation
- Therapeutic Reliability
- Diagnostic Accuracy
- Disposition

Iyer S, Reeves S, Varadarajan K, et al. The Acute Care Model: A New Framework for Quality Care in Emergency Medicine. Clin Pediatr Emerg Med 2011;12:91-101.

Acute Care Model for Pediatric Sepsis



Vidrine R, Atreya MR, Stalets EL. Continuum of care in pediatric sepsis: a prototypical acute care delivery model. Transl Pediatr 2018;7(4):253-261. doi: 10.21037/tp.2018.10.01
Zackoff MW, Iyer S, Dewan M. An overarching approach for acute care delivery: extension of the acute care model to the entire inpatient admission. *Transl Pediatr.* 2018;7(4):246-252. doi:10.21037/tp.2018.09.14

JAMA | Original Investigation

Association Between the New York Sepsis Care Mandate and In-Hospital Mortality for Pediatric Sepsis

Idris V. R. Evans, MD, MSc; Gary S. Phillips, MAS; Elizabeth R. Alpern, MD, MSCE; Derek C. Angus, MD, MPH; Marcus E. Friedrich, MD; Niranjan Kissoon, MD; Stanley Lemeshow, PhD; Mitchell M. Levy, MD; Margaret M. Parker, MD; Kathleen M. Terry, PhD; R. Scott Watson, MD, MPH; Scott L. Weiss, MD, MSCE; Jerry Zimmerman, MD, PhD; Christopher W. Seymour, MD, MSc

Completion of 1 hour sepsis bundle within 1 hour compared with not completing the bundle within 1 hour was associated with **lower risk adjusted in-hospital mortality** among patients with pediatric sepsis and septic shock

Study Design

- All NY hospitals are required to have pediatric sepsis protocols that include the following interventions within 1 hour:
  - Blood culture collected before antibiotics
  - Broad spectrum antibiotics
  - 20ml/kg fluid bolus

Evans, I. V. R. *et al.* Association Between the New York Sepsis Care Mandate and In-Hospital Mortality for Pediatric Sepsis. *JAMA* **320**, 358–367 (2018).

Table 1. Patient Characteristics (continued)

Characteristic[a]	No. (%)			P Value[b]
	All Patients	1-h Bundle Completed in 1 h		
		Yes	No	
Type of pathogen				
Gram positive	139 (11.8)	47 (16.0)	92 (10.4)	<.001
Gram negative	104 (8.8)	27 (9.2)	77 (8.7)	
Other[e]	87 (7.4)	4 (1.4)	83 (9.4)	
None reported	849 (72.0)	216 (73.5)	633 (71.5)	
Hospital with pediatric intensive care	1031 (87.4)	258 (87.8)	773 (87.3)	.85
Hospital length of stay, median (IQR), h	235 (118-496)	198 (101-358)	244 (123-554)	<.001[d]
In-hospital death	139 (11.8)	22 (7.5)	117 (13.2)	.008

Abbreviations: HMO, health maintenance organization; IQR, interquartile range.

[a] No data were missing among individual bundle elements, transfer status, age, payer, place of protocol initiation, septic shock, site of infection, platelet count at protocol initiation, chronic renal disease or liver failure, diabetes, mechanical ventilation prior to protocol initiation, mortality, and length of stay.

[b] *P* values are based on Pearson χ^2 test unless otherwise noted.

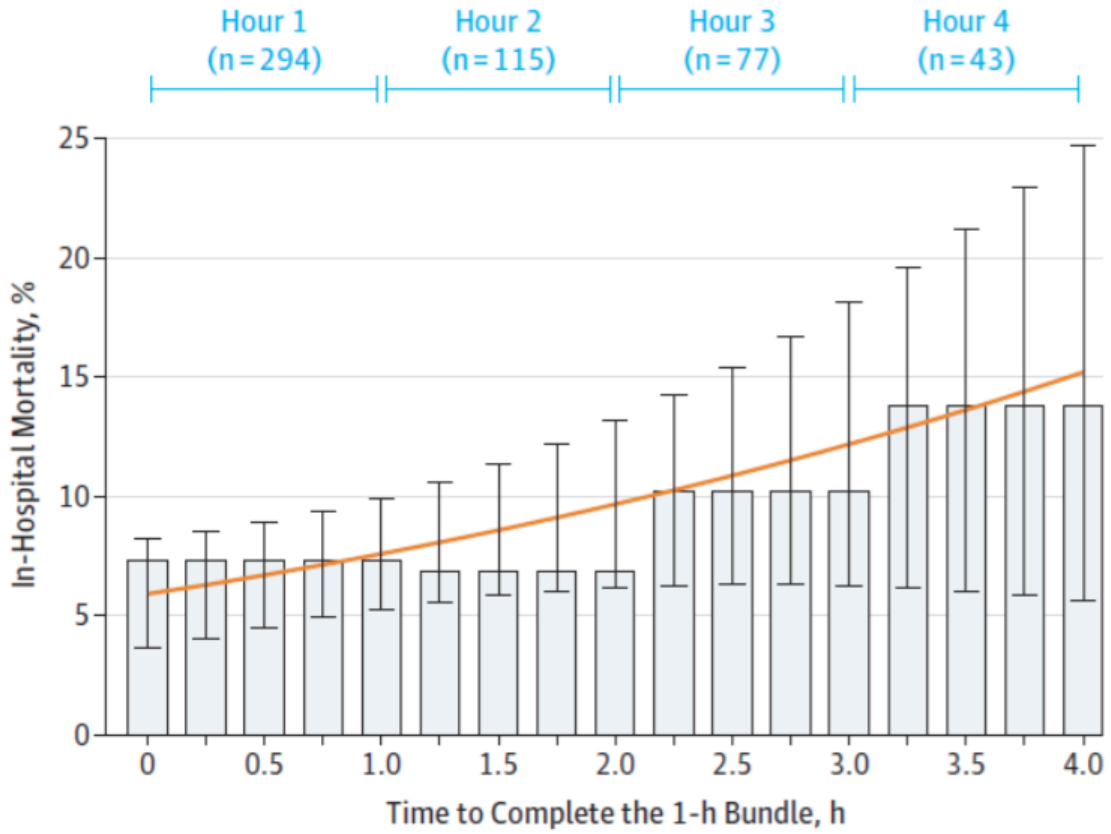
[c] *P* value based on Fisher exact test.

[d] *P* value based on Wilcoxon rank-sum test.

[e] Anaerobic bacteria, yeast, fungus, mixed pathogens, and viruses.

Evans, I. V. R. *et al.* Association Between the New York Sepsis Care Mandate and In-Hospital Mortality for Pediatric Sepsis. *JAMA* **320**, 358–367 (2018).

Figure 3. Crude In-Hospital Mortality and Predicted Risk of In-Hospital Death After the Time of Sepsis Protocol Initiation



Evans, I. V. R. *et al.* Association Between the New York Sepsis Care Mandate and In-Hospital Mortality for Pediatric Sepsis. *JAMA* **320**, 358–367 (2018).

Published in final edited form as:
Ann Emerg Med. 2017 December ; 70(6): 759–768.e2. doi:10.1016/j.annemergmed.2017.03.019.

Improving Recognition of Pediatric Severe Sepsis in the Emergency Department: Contributions of a Vital Sign Based Electronic Alert and Bedside Clinician Identification

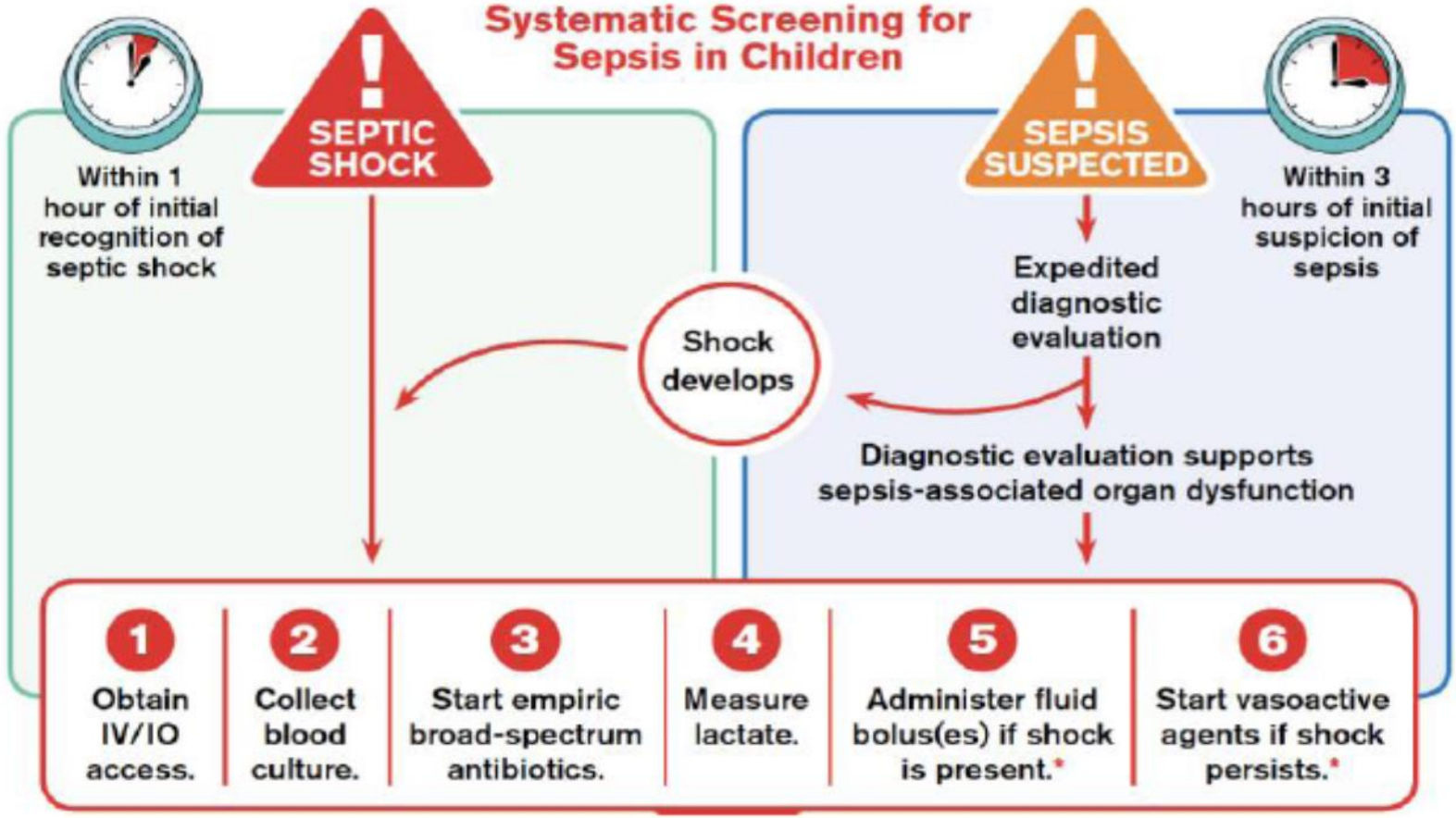
Fran Balamuth, MD, PhD, MSCE[1,2], Elizabeth R. Alpern, MD, MSCE[3,4], Mary Kate Abaddessa, MSN, RN[1], Katie Hayes, BS[1], Aileen Schast, PhD[7], Jane Lavelle, MD[1,2], Julie C. Fitzgerald, MD, PhD[5,6], Scott L. Weiss, MD, MSCE[5,6], and Joseph J. Zorc, MD, MSCE[1,2]

- Compared 2 cohorts- pre and post sepsis alert
- Positive alert= tachycardia or hypotension, concern for infection, and at least one of the following: abnormal cap refill, abnormal mental status, or high risk condition
- Positive sepsis alert→ team huddle and decision to place on sepsis protocol
- Alert sensitivity 86%, specificity 99%.
- Sepsis alert increased ED sepsis recognition from 83% to 96%

Management of Pediatric Sepsis

Initial Resuscitation Algorithm for Children

Surviving Sepsis Campaign



Prise en charge du choc septique pédiatrique

Traitement

O_2 : sepsis = apport d'oxygène même si **SAT N** : optimiser la délivrance d'O2 +++

masque à haute concentration

oxygénation à haut débit /canule nasale

↓ le travail ventilatoire : DR / hypoxie

Voie périphérique

Cathlon jaune 24 G débit maximal 750 ml/h bleu 22G débit maximal 1500ml/h

Si échec après 5 min : Mettre une VOIE INTRA OSSEUSE

Nourrisson **< 5 kg** aiguille rose 15 G 15 mm

Nourrisson **> 5 kg** et enfant aiguille bleue 15 G 25 mm

Pas d'indication de voie centrale aux urgences

Prise en charge du choc septique pédiatrique

Traitement

Bilan indispensable initial à prélever (sauf si purpura fulminans hors hôpital)

Bilan microbiologique idéalement avant début ATB mais ne doivent pas la retarder (MAX 1 heure)

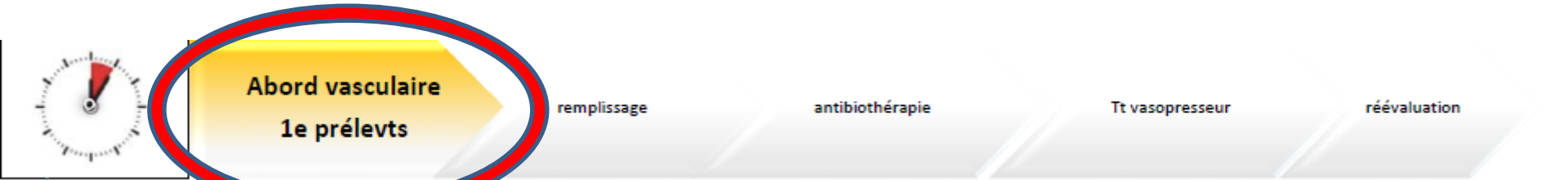
- ECBU
- pneumopathie : ECBC, Binax (pneumocoque / LP)
- streptocoques : StreptoTest (tout liquide biologique)
- PL : Ag solubles (méningocoque et pneumocoque et PCR méningocoque)

  CI la PL :

  Instabilité HMD

  Trble de l'hémostase

  HIC
- Prélèvements cutanés si purpura ou lésions purpuriques : méningocoque
- Prélèvements mycologiques : immunodéprimé
- PCR SARS CoV2 et PCR multiplex virus respiratoire



Surviving Sepsis

Abord vasculaire
1e prélevts

remplissage

ntibiothérapie

Tt vasopresseur

réévaluation

Fluid Resuscitation

No ICU Care Available

- *in the absence of hypotension*, we recommend against bolus fluid administration while starting maintenance fluids (strong recommendation, high quality of evidence).
- *if hypotension is present*, we suggest administering up to 40 mL/kg in bolus fluid (10–20 mL/kg per bolus)

ICU Care Available

- we *suggest* administering up to 40-60 mL/kg in bolus fluid (10-20 mL/ kg per bolus) over the first hour (weak recommendation, low quality of evidence).
  - Titrate to clinical markers of cardiac output
    - HR, BP, cap refill, level of consciousness, UOP, serial lactate, advanced monitoring
  - Discontinue if signs of fluid overload develop
    - Pulmonary edema, hepatomegaly

Weiss, S. L. *et al.* Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatric Critical Care Medicine | Society of Critical Care Medicine* **21**, e52 (2020).

Surviving Sepsis

Abord vasculaire
1e prélevts

remplissage

ntibiothérapie

Tt vasopresseur

réévaluation

Fluid Resuscitation

- We *suggest* using balanced/buffered crystalloids, rather than 0.9% saline (weak recommendation, very low quality of evidence)
  - Hyperchloremia→ metabolic acidosis, systemic inflammation, AKI, coagulopathy, and mortality when compared with resuscitation with more balanced/buffered crystalloids (LR, PlasmaLyte)

Initial Diagnosis / Review of Previous Work

- ☐ ***Fluid resuscitation 20 mL/kg (max 1L)*** *(unless signsof cardiac dysfunction)*
- ☐ ***Administer O_2*** *(min of 10 L NRB)*
- ☐ ***Antibiotics***
  - ☐ *Order/administer*
  - ☐ *Broaden if already on antibiotics*

Initial Sepsis Labs *(tube colors for labs)*

- ☐ CBC (purple)
- ☐ POC glucose
- ☐ Blood gas
- ☐ Blood cx
- ☐ CMP (mint gr)
- ☐ Urine cx (if foley)
- ☐ Procal(mint gr)
- ☐ Resp cx (if ETT/trach)
- ☐ Lactate (on blood gas)

0 - 20 minutes

Weiss, S. L. *et al.* Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatric Critical Care Medicine | Society of Critical Care Medicine* **21**, e52 (2020).

Abord vasculaire
1e prélevts

remplissage

antibiothérapie

Tt vasopresseur

réévaluation

Antimicrobial Therapy

- In children with septic shock, we *recommend* starting antimicrobial therapy, within 1 hour of recognition (strong recommendation, very low quality of evidence)

- In children with sepsis-associated organ dysfunction but without shock, we *suggest* starting antimicrobial therapy, within 3 hours of recognition (weak recommendation, very low quality of evidence)

Weiss, S. L. *et al*. Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatric Critical Care Medicine | Society of Critical Care Medicine* **21**, e52 (2020).

Surviving Sepsis

Abord vasculaire
1e prélevts

remplissage

antibiothérapie

Tt vasopresseur

réévaluation

ANTIBIOTIC CHOICES

Previously Healthy Patient (>2 months)

- Unknown Source → Ceftriaxone + Vancomycin*
- Intra-Abdominal Source → Cefepime + Flagyl +/- Vancomycin*
- Concern for Toxic Shock → Cefepime+ Vancomycin + Clindamycin

Medically Complex Patient

- Immunocompromised (cardiac, transplant, cancer, suppressive meds) or CVL present → Cefepime+ Vancomycin*

Ill appearing Neonates

- Neonates < 28 days → Ampicillin + Cefotaxime + Acyclovir +/- Vancomycin +
- Neonates 29-60 days → Ceftriaxone + Vancomycin + Ampicillin +/- Acyclovir if high risk+

+ HSV risk factors:Start Acyclovir infants 29 to 40 days with ≥ 1 of the following: Ill appearing, abnormal neurologic status, seizures, vesicular rash, hepatitis, mom known to have primary HSV infection at delivery

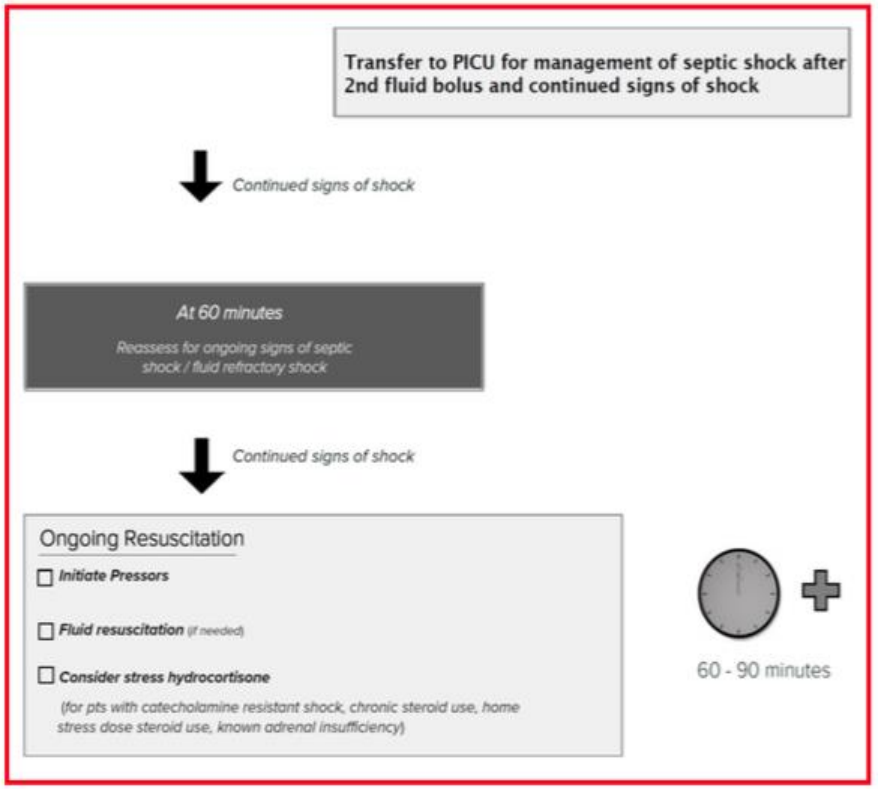
*Vancomycin is indicated for children with **MRSA risk factors** or **highly-resistant S. pneumoniae**. When Vancomycin is ordered it should be administered ***after*** the antibiotic listed above.

- **MRSA risk factors:** bone/joint/deep tissue infection; history or family history of MRSA infection of recurrent boils,indwelling CVL/hardware or recent history of CVL/umbilical lines, neonate with focal skin or soft tissue infection
- **Highly-resistant S. pneumoniae risk factors:** recent B-lactam exposure, daycare attendance, non-vaccinated

Fluid Refractory Shock

- We *suggest* using epinephrine or norepinephrine, rather than dopamine, in children with septic shock (weak recommendation, low and very low quality of evidence, respectively).

- May be administered through a peripheral vein (or intraosseous, if in place) if central venous access is not readily accessible.



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Prise en charge du choc septique pédiatrique

Traitement

En 1° intention surtout si vasoplégie (=choc chaud): **NORADRENALINE** (quel que soit âge).

0.05 à 2 µg/kg/mn

[ ]20 µg/ml si < 4 ans ou < 15 kg

(Dilution 1 mg dans 50ml de G5%)

débit de 0.1 µg/kg/mn correspond à une vitesse = poids/3

En 2° intention ou d'emblée ou si :

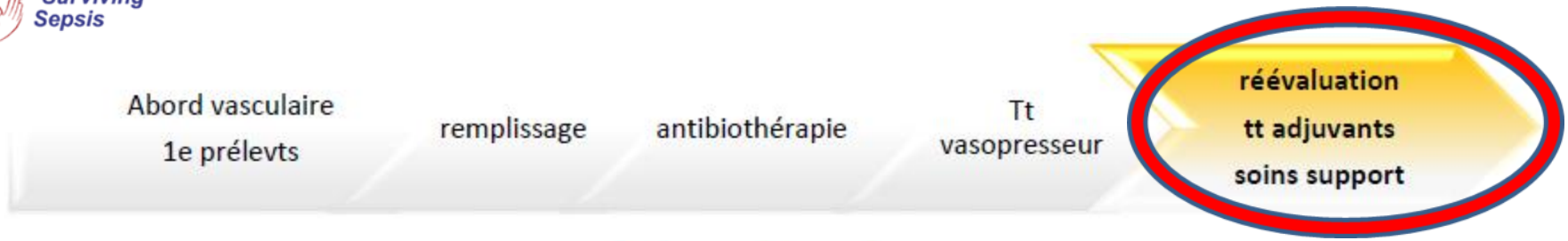
- **vasoconstriction importante**
- **dysfonction myocardique,**
- **bas débit**
- **signes de surcharge**

ADRENALINE

Posologie initiale **0.05 à 0.3 µg/kg/mn**

indication	Nom	posologie	concentration	dilution	effet
>1 mois- 4 ans	NORADRENALINE	0.05 à 2 µg/kg/mn	20µg/ml Si < 15 kg	1 mg dans 50 ml G5%	Vasopresseur ↗ RVS
>4 ans	NORADRENALINE	0.05 à 2 µg/kg/mn	100µg/ml Si >15 kg	4 mg dans 40 ml G5%ou NaCl 0.9%	Vasopresseur ↗ RVS
1° intention < 1 à 3 mois	DOPAMINE	5 à 15 µg/kg/mn	1000µg/ml	5 mg dans 50 ml G5% ou nacl0.9%	
< 15 kg	ADRENALINE	0.05 à 1 µg/kg/mn	20µg/ml Si < 15 kg	1 mg dans 50 ml G5%	Vasodilatateur < 0.3 µg/kg/min Et inotrope
>15 kg	ADRENALINE	0.05 à 1 µg/kg/mn	100µg/ml Si >15kg	5 mg dans 50 ml G5% ou Nacl 0.9%	Vasodilatateur < 0.3 µg/kg/min Et inotrope

Surviving Sepsis



Monitoring

- We *suggest* using advanced hemodynamic variables, when available, in addition to bedside clinical variables to guide the resuscitation of children with septic shock or other sepsis-associated organ dysfunction (weak recommendation, low quality of evidence).

- We *suggest* using trends in blood lactate levels, in addition to clinical assessment, to guide resuscitation of children with septic shock and other sepsis-associated organ dysfunction (weak recommendation, very low quality of evidence).

Weiss, S. L. *et al.* Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatric Critical Care Medicine | Society of Critical Care Medicine* **21**, e52 (2020).

Surviving Sepsis

Abord vasculaire
1e prélevts

remplissage

antibiothérapie

Tt vasopresseur

réévaluation
tt adjuvants
soins support

Echocardiography provides essential data that cannot be obtained by clinical examination alone. Serial echocardiography allowed optimal adjustment of therapy, significantly improved all hemodynamic parameters, and reduced shock reversal time. The authors recommend that PICU resident curricula should include echocardiogram education focused on hands-on training to allow the incorporation of echocardiography into septic shock management.

CLINICAL INVESTIGATIONS
ECHOCARDIOGRAPHY IN CHILDREN

Systemic Venous Diameters, Collapsibility Indices, and Right Atrial Measurements in Normal Pediatric Subjects

Shelby Kutty, MD, FASE, Ling Li, MD, PhD, RDMS, Rimsha Hasan, MD, Qinghai Peng, MD, PhD, Sheela Rangamani, MD, and David A. Danford, MD, *Omaha, Nebraska*

J Pediatr (Rio J). 2018;94(1):31–39

SBP SOCIEDADE BRASILEIRA DE PEDIATRIA

Jornal de Pediatria
www.jped.com.br

ORIGINAL ARTICLE

Role of echocardiography in reducing shock reversal time in pediatric septic shock: a randomized controlled trial☆

CrossMark

Ahmed A. El-Nawawy[a], Aly M. Abdelmohsen[b], Hadir M. Haroun[a,*]

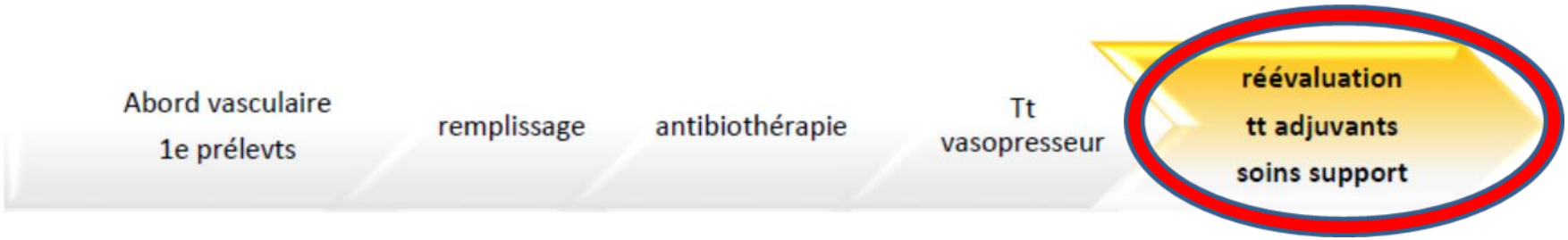


TABLE 5. Normal Ranges for Advanced Monitoring

Variable	Formula	Normal Range	Units
CI	CI = cardiac output/body surface area	3.5–5.5	L/min/m^2
SI	SI = CI/heart rate	30–60	mL/m^2
SVRI	SVRI = 80 × (mean arterial pressure−central venous pressure)/CI	800–1600	dyne-s/cm^5/m^2

CI = cardiac index, SI = stroke index, SVRI = systemic vascular resistance index.

TABLE 3: Monitor the shock index in the management of septic shock.

Shock index	Heart rate (HR)/systolic blood pressure 1.2 for 4–6 years; 1 for 6–12 years; and 0.9 for >12 years For normal healthy adults: 0.5–0.7

Indian Academy of Pediatrics (IAP)

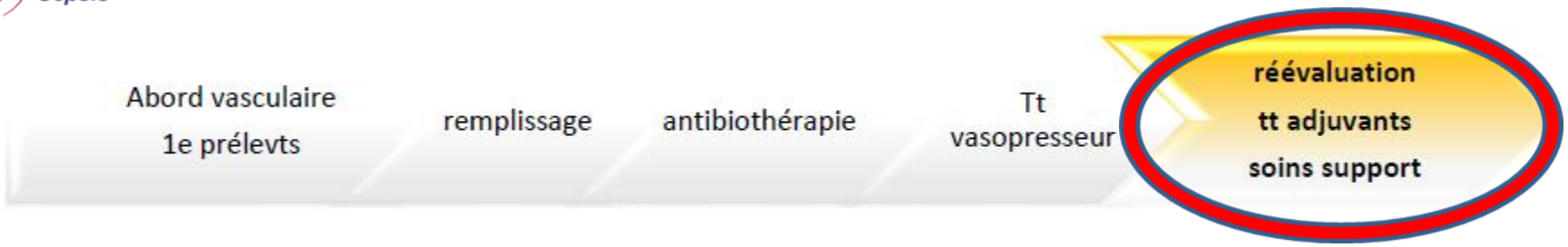
Shock in Office Practice Lokesh Tiwari STANDARD TREATMENT GUIDELINES 2022

Catecholamine Refractory Shock

- We *suggest* **against** using intravenous hydrocortisone to treat children with septic shock if adequate fluid resuscitation and vasopressor therapy are able to restore hemodynamic stability (weak recommendation, low quality of evidence).
- We *suggest* that either intravenous hydrocortisone or no hydrocortisone may be used if adequate fluid resuscitation and vasopressor therapy are not able to restore hemodynamic stability (weak recommendation, low quality of evidence).
- Patients with adrenal insufficiency ?

Weiss, S. L. *et al.* Surviving Sepsis Campaign International Guidelines for the Management of Septic Shock and Sepsis-Associated Organ Dysfunction in Children. *Pediatric Critical Care Medicine | Society of Critical Care Medicine* **21**, e52 (2020).

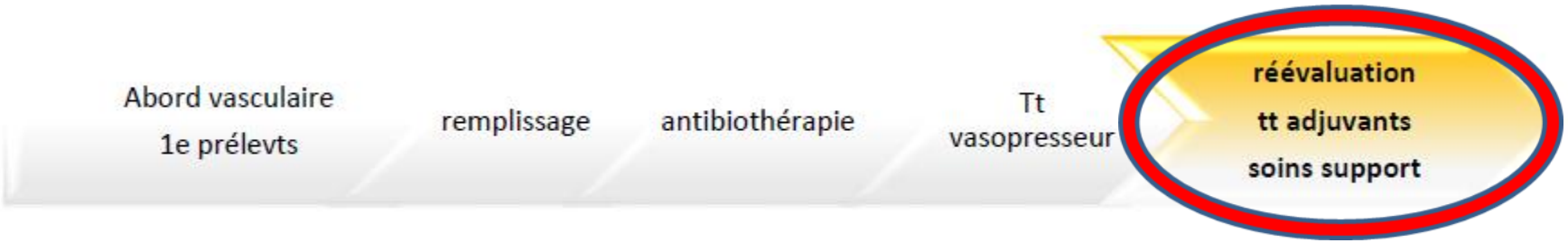
Surviving Sepsis



- **Correction des troubles électrolytiques**

Dellinger RP. Crit Care Med. 2013;41(2):580-637
Davis A et al. Crit Care Med. 2017. Vol 45. No. 6

	Définition	Traitement
Hypoglycémie	Glycémie < 3 mmol/l ou < 0.55g/l	3 ml/kg de G10 % IVD
Hypocalcémie	Calcium ionisé <1 mmol/l Calcium < 2 mmol/l	0.3ml/kg de gluconate de calcium 10% 30min Max 2g Ou 0.1 ml/kg de chlorure de calcium à 10%
Hypomagnésémie	Magnésium < 0.75 mmol/l	0.2ml/kg de MgSO4 en 30 min Max 1 g
Hypophosphorémie	Phosphore < 0.7mmol/l	0.2ml/kg de phosphate de sodium en 30 min
Hypokaliémie	Potassium < 3 mmol/l	0.25 ml/kg de Kcl 10%en 30 min Max 1 g



Hematologic ressucitation :

CGR : Pour objectif > 10 g/dl en période aigüe de choc et hypoxie

. Pour objectif > 7 g/dl une fois stabilisé

CGR = 15 ml/kg

CP uniquement si thrombopénie (seuil > 50 000/mm3) et hémorragies

PFC 20 ml/kg si TP < 40% ET syndrome hémorragique

Dellinger RP. Crit Care Med. 2013;41(2):580-637
Rhodes A. Crit Care Med. 2017;45(3):486-552

Surviving Sepsis

Abord vasculaire
1e prélevts

remplissage

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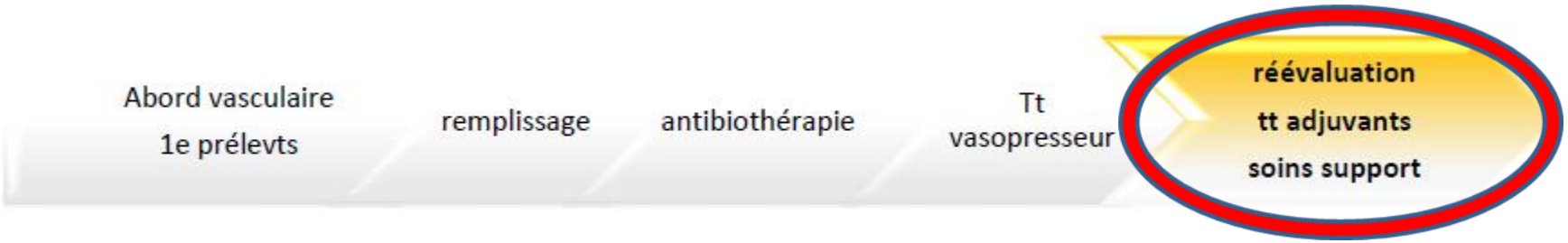
OBJECTIFS ++++

Signe clinique	Valeur visée		
Perfusion périphérique	temps de recapillarisation ≤ 2 sec.		
Etat de veille	éveillé		
Lactatémie	< 2 mmol/l		
SO_2 veineuse centrale ($SvcO_2$)	> 70%		
Fréquence cardiaque	se normalisant		
Pouls	bien palpable		
Pression artérielle (TA)	TA moyenne	prématuré	> 30–35 mmHg
		nouveau-né à terme	> 40 mmHg
		nourrisson	> 45 mmHg
		petit enfant	> 50 mmHg
		âge scolaire	> 50 mmHg
Diurèse	> 1 ml/kg/h		
Contractilité et état de remplissage cardiaque (échocardiographie)	Contractilité normale, bon remplissage cardiaque		
Pression veineuse centrale(PVC)	8–12 mmHg (respiration spontanée) 12–15 mmHg (respiration artificielle)		
Hémoglobine	100 g/l		

Surviving Sepsis



INTUBATION ET VENTILATION

Indications : détresse respiratoire, hypoxie, G < 8, choc persistant

Induction :

Si < 2 ans

Médicaments	Posologie
Atropine	20 µ/kg
KETAMINE	3 mg/kg
CELOCURINE	< 2 A : 2 mg/kg > 2 A : 1 mg/kg

[ ]10 mg/ml (dilution 100 mg dans 10 ml)

Si hyperk / patient neuromusculaire **ROCURONIUM** 1 mg/kg

Ventilation protectrice :

Vt 6 ml/kg, PEEP élevée, P plat < 30 cm H20, Objectifs Etco2 = 4.5 à 5.5 KPA (35-42 mm Hg), SpO2 >95%

Davis A et al. Crit Care Med. 2017. Vol 45. No. 6
Rhodes A. Crit Care Med. 2017;45(3):486-552

Sédation

- SUFENTANIL 0.2 µg/kg/h ([ ] 1 µg/ml) KETAMINE 1 à 4 mg/kg/h ([ ] 10mg/ml)
- Si besoin curare NIMBEX® (Cisatracurium) 0.15mg/kg/h

Prise en charge du choc septique pédiatrique

Traitement

Abord vasculaire
1e prélevts

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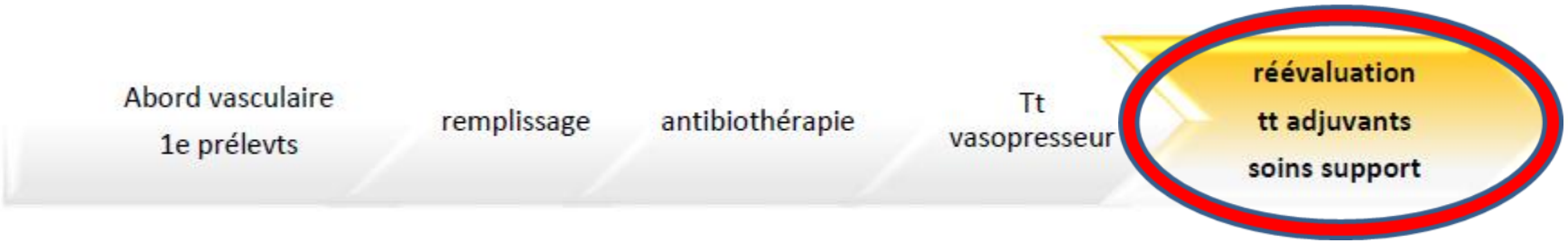
INTUBATION ET VENTILATION

Intubation à risque de décompensation hémodynamique +++ :
débuter amines avant l'induction

Contre-indication à l'étomidate (risque insuffisance surrénalienne)

attention aux autres médicaments sédatifs : hypotension ?

Éviter les médicaments à inotropie négative (Midazolam / Propofol)
dose d'adrénaline IV prête



AKI/ARF, surcharge hydrique

Sepsis associé à un syndrome de fuite capillaire souvent majeur

> Surcharge hydrique ++

Furosémide
EER

Indication :

Surcharge hydrique avant que > 10%

Dellinger RP. Crit Care Med. 2013;41(2):580-637
Davis A et al. Crit Care Med. 2017. Vol 45. No. 6

Consider Risk Factors
(See Box A)

CONSULT SENIOR DOCTOR
COULD THIS CHILD HAVE SEPSIS?

LIKELY SEPSIS

1.	Send For Help	0 min
2.	Assess Airway/Breathing	<5 min

- Apply oxygen if required to keep SaO_2 ≥92%
- Attach cardiorespiratory monitoring
- Senior operator if intubation required

3.	Vascular Access	<15 min

- Perform IO after 2 failed IV attempts
- Send bloods: blood gas (lactate, BSL), FBE, blood cultures, UEC/LFTs, CRP, sterile site PCR, +/- coags, +/- procalcitonin

4.	Empiric Antibiotics +/- Antivirals	<30 min

- See Page 7 for empiric antimicrobial guidelines
- If no IV/IO access, consider IM antibiotics

5.	Cautious Fluid Resuscitation	<30 min
6.	Consider Early Inotropic Support	<60 min

- Careful fluid resuscitation: Senior clinician to decide on need for fluid bolus (10-20 ml/kg 0.9% NaCl).
- Each time assess response
  - Aim: improved HR, mentation, perfusion
  - Overload: hepatomegaly, crepitations, oedema
- Decide need for early inotropic/vasopressor support for persisting circulatory failure. See Page 2 for inotropic guidelines.
- Treat hypoglycaemia (2 ml/kg 10% dextrose)

7.	Further Investigations	

Safely perform appropriate investigations seeking potential source (e.g. CXR, urine, NPA, LP, stool, wound swabs, etc.)

NO or UNSURE

1.	Repeated Medical Review	Every hour
2.	Repeat Observations	Every 30 mins
3.	Consider Differential Diagnoses	

- Anaphylaxis
- Cardiac causes
- Toxins/Ingestion
- Metabolic conditions (incl. DKA)
- Trauma/NAI
- Surgical causes (incl. intussusception)
- Paediatric Multisystem Inflammatory Syndrome

IF SEPSIS THOUGHT LIKELY, COMMENCE SEPSIS MANAGEMENT

Box A — Risk Factors for Sepsis

- ☐ Age <3 months
- ☐ Indwelling medical device
- ☐ Indigenous
- ☐ Unimmunised
- ☐ Immunocompromised
- ☐ Chronic disease or congenital disorder
- ☐ Recent trauma, surgery, invasive procedure or wound
- ☐ Known malignancy

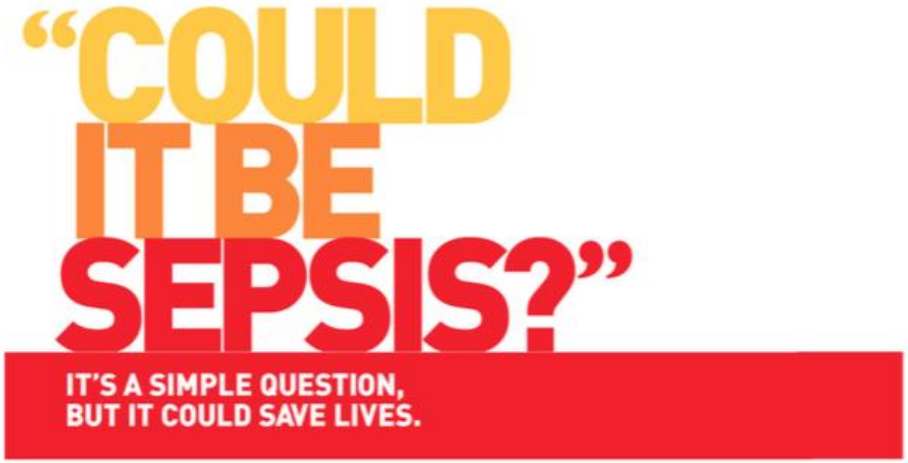
Note that the absence of risk factors DOES NOT exclude sepsis

RESPOND AND ESCALATE

Commence all elements within 1 hour

Take Home Messages

- Pediatric sepsis is often difficult to recognize
- Standardized care reduces variation, waste and error
- Sepsis bundles improve pediatric sepsis recognition and treatment



Vidrine R, Atreya MR, Stalets EL. Continuum of care in pediatric sepsis: a prototypical acute care delivery model. Transl Pediatr 2018;7(4):253-261. doi: 10.21037/tp.2018.10.01


THANKS