THE PEDIATRICS FOR EMERGENCY PHYSICIANS NETWORK

PEDIATRIC SEPSIS AND SEPTIC SHOCK

I. Introduction

In the ED, sepsis is the most commonly missed life-threatening diagnosis in pediatric patients. This is largely because kids often present to the ED very early-on in the course of illness when they are either only mildly ill-appearing, or completely well-appearing and afebrile with only non-specific findings and nothing in the history or exam to even suggest an infection. These children often give the clinical impression of a non-infectious illness, dehydration, more benign viral illness, or an isolated localized infection such as pneumonia or UTI. However, in reality such patients are already in the early stage of Sepsis.

II. ED Definition for Pediatric Sepsis:

The PALS/ SIRS Criteria for Pediatric Sepsis and Septic Shock were developed by a panel of pediatric critical care experts for use in the ICU setting , and are NOT appropriate for use in ED patients, because:

1. Septic children may present to the ED very early-on in their course, when essential PALS/ SIRS criteria (including both fever & elevated WBC) are not yet apparent, and may remain absent until many hours later into the ED visit, or only after discharge from the ED has already occurred.

2. Some PALS/ SIRS criteria are not useful in the ED, since they are not readily available (e.g. -"urine output < 0.5 ml/ kg/hr.").

3. Some PALS/SIRS criteria are either unclear or not practical for use by emergency physicians (e.g. - "HR or RR 2 SD above normal for age", and "core to peripheral temp gap > 3 C").

Instead, USE CRITERIA DEVELOPED FOR THE ED, THAT ARE DESIGNED TO CAPTURE TYPICAL ED PEDIATRIC PRESENTATIONS, EVEN IN THE VERY EARLIEST STAGES OF SEPSIS OR SEPTIC SHOCK:

The ED diagnosis of SEPSIS is made either **IMMEDIATELY** (ie-pts with higher probability of sepsis) or **DELAYED** (ie-previously healthy, lower risk pts), as shown in the box below:

PRACTICAL DEFINITION OF PEDIATRIC SEPSIS FOR THE ED

EITHER

1) IMMEDIATE: (HIGHER PROBABILITY OF SEPSIS)

DIAGNOSE SEPSIS IMMEDIATELY FOR ANY PATIENT WITH *CLINICAL INDICATION(S) FOR THE RAPID CARDIOPULMONARY ASSESSMENT ("RCPA"), WHO HAS **ANY ONE** OF THE FOLLOWING:

1) **WIDE PULSE-PRESSURE** (NOTED ON INITIAL VITALS & INDICATION FOR RCPA)
2) **VERY ILL** (AS PER RESULTS OF RCPA- eg- LETHARGY or VERY MOTTLED, etc)
3) **ANY RISK-FACTORS(S) FOR SEPSIS**** (SEEK ON HISTORY FOR ANY SICK PT!)

*** CLINICAL INDICATIONS FOR RAPID CARDIOPULMONARY ASSESSMENT**:

1. ILL GENERAL APPEARANCE
2. EXTREME VITAL SIGNS (i.e.-HR OR RR)
3. ANY SIGN OF HYPO-PERFUSION
4. ABNORMAL PULSE PRESSURE

OR

2) DELAYED: (PREVIOUSLY HEALTHY, LOWER RISK PATIENT)

DIAGNOSE SEPSIS FOLLOWING A THERAPEUTIC TRIAL / OBSERVATION PERIOD IN THE ED WHEN **ANY** *CLINICAL INDICATION(S) FOR THE RAPID CARDIOPULMONARY ASSESSMENT **EITHER** 1) **PERSIST(S)** AND FAIL(S) TO RESOLVE WHILE IN THE ED **OR** 2) **NEWLY EVOLVE** WHILE IN THE ED:

i.e. – **ANY** OF THE FOLLOWING:

1**) PERSISTENT**** OR **NEW** ill-appearance
2) **PERSISTENT**** OR **NEW** Extreme vital signs
3**) PERSISTENT**** OR **NEW** Sign(s) of hypo-perfusion

****RISK FACTORS FOR SEPSIS**

IMMUNOCOPROMISED
HIV,DM, Cancer, Hemogobinopathies, Asplenia, etc,
CHRONIC ILLNESS/ CO-MORBIDITIES
CHD, debilitated, etc.
INDWELLING INTRAVENOUS PORTS
PREVIOUS H/O SEPSIS
IMMUNOSUPPRESENT MEDICATION USE

NOTE: While a history or presence of fever and other signs of infection would heighten suspicion for sepsis, these are not essential to consider the diagnosis of sepsis in children who have persistent clinical indications for Rapid Cardiopulmonary Assessment. The rationale behind this is based on extensive clinical experience from Pediatric ED's : Development of fever and/or other overt signs of infection often only become apparent much later in the course of the illness and withholding treatment for sepsis until these features develop is associated with a poor outcome. Sepsis is treatable, early treatment improves outcome, and therapies have low risk of adverse effects so it is prudent to initiate therapy if the above criteria are met.

** **Why is the word "PERSISTENT" necessary for an ED diagnosis of Pediatric Sepsis?** The majority of these previously healthy children (ie- no risk factors for sepsis) who present to the ED mildly ill-appearing, or febrile with extreme vital signs are NOT septic. They will usually improve and normalize their appearance & vital signs with a trial of several hours of treatment as indicated by H&P (i.e.- usual ED interventions include antipyretics, IVF, and/ or a nap). Nevertheless, all such patients who have any ***Clinical Indication(s) For The RAPID CARDIOPULMONARY ASSESSMENT** identified at triage, must be treated **expediently** (i.e. - they shouldn't be waiting hours before being evaluated), since one of them really **IS** a septic patient. You can only identify that septic patient by failure to normalize vitals or appearance after a therapeutic trial in the ED, so you need to get the antipyretics and IV fluids started !

** **2 CAVEATS:**

1) **In infants (i.e.- < 1 yo), bradycardia (i.e.- HR < 100) may occur instead of extreme tachycardia.**
2) In the absence of an explanation i.e. fever, mild dehydration from vomiting or diarrhea **ANY degree of PERSISTENT resting tachycardia or tachypnea (even if NOT extreme) in a child is concerning**, and a diagnosis of Sepsis should be considered early.

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SUMMARY

ANY SINGLE ONE of the following may be the ONLY clue to the presence of sepsis in a child presenting to the ED, and therefore ALWAYS demands that the possibility of a diagnosis of sepsis be considered and definitively ruled out in the ED. Even in the absence of fever & when other history or exam seems to be leading you in another direction, away from the diagnosis of sepsis, these red-flags must not be ignored :

1) **General ill-appearance –** From ANY cause---since unsuspected co-existing Sepsis may be present together with another unrelated more obvious diagnosis. Sepsis should be considered immediately in any VERY ill-appearing patient, or if lesser degrees of ill-appearance remain persistent even after therapeutic interventions in the ED (e.g.- IV fluids, antipyretics, etc).
2) **Extreme vitals (HR or RR) –** Even in the absence of any other symptoms or history suggesting infection. Sepsis is the most common cause of unexplained extreme vitals that persist in the ED.
3) **Wide pulse-pressure –** In the absence of another diagnosis, (e.g.-anaphylaxis), this is a hard finding and should lead to early diagnosis of sepsis! It may be the ONLY manifestation of early sepsis in a child in the ED.
4) **Any sign(s) of hypo-perfusion –** (e.g. - mottling, lethargy, etc.)- Even in the absence of any other symptoms or history suggestive of infection, failure to resolve with treatment in the ED for other presumed causes points to a diagnosis of sepsis.

NOTE: Even when another serious diagnosis is apparent, in such patients it is prudent to obtain a blood culture and cover with antibiotics !

QUESTION: Why is it so important to make an early diagnosis of sepsis even in a case where the child already has been diagnosed with a localized infection (i.e.- UTI, pneumonia) and is already being admitted anyway?
ANSWER: Sepsis may deteriorate into septic shock, even after initiation of therapy with antibiotics so once sepsis is recognized, your plan may change in several ways: 1) **inpatient admission** 2) **more aggressive with IV fluid resuscitation,** 3) **broader antibiotic coverage (**i.e. - should be considered), and 4) **close monitoring for the development of shock** while in the ED.

III. Clinical Application of the ED Defintion of Sepsis

Introduction

A STEP-BY-STEP GUIDE:

THE ED RULE-OUT PEDIATRIC SEPSIS ALGORITHM

(HOW TO AVOID MISSING SEPSIS IN A WELL-APPEARING CHILD)

RATIONALE: The need to avoid missing sepsis in a well-appearing child presenting to the ED early-on in the course of illness with only nonspecific symptoms, often masquerading as either a non-infectious illness or a more benign infection. Therefore, in order to avoid missing the diagnosis, the following screening questions must ALWAYS be part of your thought process on your initial encounter with ANY pediatric patient :

STEP 1: ABC's + General appearance

STEP 2: Do your own vitals (HR + RR) and feel the belly

STEP 3:

ANY CLINICAL INDICATIONS for Rapid Cardiopulmonary Assessment?

ie- ANY of the following ?

1) ill-appearance (even mild) ? OR 2) Extreme Vital Signs ? OR

3) Wide pulse-pressure ? OR 4) Signs(s) of hypo-perfusion (even mild) ?

IF NO, → STOP! Sepsis ruled out* Pt stable, appears well → **STEP 4:** Full H&P

*But reassess patient again before discharge:

*Febrile children's vital signs and general appearance should routinely be reassessed & documented prior to discharge, since criteria for sepsis may develop over several hours while patient is in the ED.

(STEP 3 CONTINUED):

IF YES, then perform Rapid Cardiopulmonary Assessment

The Rapid Cardiopulmonary Assessment

Rapidly assesses both 1)WOB & 2) End-organ perfusion to diagnose (or rule out) Respiratory Failure and/or Compensated Shock, or the presence of other illness severity that requiries immediate treatment:

A -	**Airway**	
B -	**WOB**	Lethargy, head-bobbing, grunting (**Severe signs-→** impending apnea) Mental status, aeration, RR, SaO2, retractions, I: E
C -	**End-organ Perfusion**	Brain: mental status, tone Skin: mottled, pale, cyanosis, cap refill / pulses (feet)

and proceed with algorithm:

STEP 4: Rapid Cardiopulmonary Assessment ("RCPA") has been performed.

RESULTS: Are ANY of the following findings present ?

1) Wide* pulse pressure? 2) VERY ill ?**? 3) ANY **Risk Factor(s) for Sepsis?

Presence of ANY ONE of these 3 findings is presumed to be Sepsis !

***WIDE PULSE PRESSURE:** Once an unexplained wide pulse-pressure at triage is confirmed by repeating the BP, even if the child is afebrile & well (ie-RCPA is completely normal) with normal HR & RR, the diagnosis is SEPSIS. A wide pulse pressure alone is a hard finding for sepsis and must not be ignored !

****VERY ill PATIENT:** Whether patient is **"VERY ill"** at this point, is determined by the results of your RCPA (eg- either a very ill general appearance OR moderate to severe mottling OR very pale OR very low-energy or lethargy, OR equivalent findings would indicate patient as "VERY ill" .

****ANY RISK FACTOR(S) FOR SEPSIS:** Note that while listed here following performance of the RCPA and together with exam findings from the RCPA, in actual clinical practice this information (ie- whether patient has any Risk Factor(s) for Sepsis) is obtained by HISTORY and not from the RCPA. In fact once an examiner identifies a patient has Clinical Indication(s) for the RCPA (ie- see STEP 3 above) already indicates the child is at least mildly ill, and at that point (ie- BEFORE performing RCPA) experienced clinicians may already carefully seek a history to identify **ANY Risk Factor for Sepsis**** (see box below) in order to make an IMMEDIATE diagnosis of Sepsis and initiate antibiotics and aggressive treatment asap. (ie- PEARL: **Risk factor(s) for Sepsis +** P**resence of any Indication for the RCPA = Sepsis).** Note that even though you may diagnose Sepsis based on the presence of Risk Factor(s) for Sepsis + Clinical Indications for RCPA, you'll still need to proceed and perform the RCPA in these patients too, in order to assess the severity of their sepsis and assess for presence of shock and/or respiratory compromise.

STEP 4 Recap: Are ANY of the following findings present ?

1) Wide* pulse pressure? 2) VERY ill ?**? 3) ANY **Risk Factor(s) for Sepsis?

IF YES → Diagnosis: SEPSIS!

TREAT IMMEDIATELY treat as sepsis :

1) Cultures
2) Aggressive fluid management
3) Broaden antibiotic coverage
4) Close monitoring in ED for development of shock
5) Admit

****RISK FACTORS FOR SEPSIS:**
Immunocompromised (HIV, Cancer, hemoglobinopathies, asplenia, DM, etc), chronic Illness, indwelling intravenous ports, Co-morbidities (ie- debilitated, CHD, etc), Previous h/o sepsis, use of immunosuppressant medications.

IF NO, then Sepsis is much LESS likely, but still a possibility.

NOTE: "**IF NO"** at this point in the algorithm means that **EITHER** possibility/concern for sepsis remains in an otherwise healthy patient (febrile or afebrile) due to presence of either extreme vital(s) or sign(s) of hypo-perfusion but that patient is otherwise well-appearing; **OR** concern for sepsis remains due to either a mildly ill-appearance or sign(s) of hypo-perfusion but vitals are NOT extreme.

Therefore, proceed with the algorithm as follows:

STEP 5:

PERFORM A FULL H&P:

BASED ON YOUR FULL H&P, rule-out and treat other possible causes of the patient's mildly-ill appearance (ie- dehydration, etc), sign(s) of hypoperfusion (ie- skin exposure to cold room temp, dehydration, etc), or *extreme vital signs :

ie- CONSIDER *DIFFERENTIAL DIAGNOSIS OF TACHYCARDIA :
Fever Anxiety Pain Hypovolemia Anemia Hypoxemia Hypercarbia Hyperthyroidism .

ie- CONSIDER *DIFFERENTIAL DIAGNOSIS OF TACHYPNEA :
Fever Anxiety Pain Asthma Bronchiolitis Pneumonia Croup, Nasal congestion (if <6mo).

STEP 6:

THERAPEUTIC TRIAL IN ED :

Based on benign diagnoses suggested from H&P (eg- viral illness, dehydration, etc), a therapeutic trial/ observation period of up to 4-6 hours in the ED to improve the patient's appearance and vital signs:

3 Common ED Interventions to Improve Vital Signs and Appearance/Behavior (Based on your H&P)
1. Antipyretics **2. A nap (ie-sleep)** **3. IV hydration** NOTE: Consider drawing blood culture & checking labs, as indicated, during this period

STEP 7:

PERFORM A REASSESSMENT:

IS APPEARANCE OR EXTREME VITAL SIGN(S) RESOLVED?

If YES, SEPSIS RULED OUT * → Further Rx and disposition as indicated

* NOTE: Also assuming, of course, that in addition to resolution of the original finding(s), that no new Indications for the Rapid Cardiopulmonary are present on REASSESSMENT of the patient.

IF NO → **Diagnosis: SEPSIS!**

Blood culture, IV antibiotics, observe closely for progression to shock and admit!

WARNING:

IF THE PATIENT NOW HAS A PERSISTENT (OR NEW) HARD FINDING , WHICH HAS FAILED TO IMPROVE (OR HAS NEWLY EVOLVED) IN THE ED DESPITE PROLONGED OBSERVATION AND TREATMENT FOR MORE BENIGN CONDITIONS. THIS IS CONSISTENT WITH EARLY SEPSIS , AND WARRANTS AGGRESSIVE TREATMENT AND ADMISSION. **DO NOT BE FOOLED BY VERY WELL-APPEARANCE OR BY THE ABSENCE OF FEVER OR ANY OTHER SUGGESTIONS OF INFECTION!**

All of these steps have been incorporated into the Algorithm which follows:

THE ED "RULE-OUT PEDIATRIC SEPSIS" ALGORITHM:

Step 1: ABC's + General appearance
Step 2: Do your own Vitals (HR + RR) and examine the abdomen

IS THERE ANY " CLINICAL INDICATION TO PERFORM A RAPID CARDIOPULMONARY ASSESSMENT"?

NO

SEPSIS RULED OUT
- Do full H&P
- Treatment as directed by H&P
- Reassess during ED stay and before discharge*

YES

ANY ONE OF 3 FEATURES PRESENT?
1) Wide pulse pressure
2) **VERY** ill-appearance
3) At-risk for sepsis**

NO

PERFORM A FULL H&P
- Sepsis much less likely but still a possibility
- Do a full H&P
- **Rule out and treat other possible causes of**
  - Extreme VS***, signs of hypo-perfusion, mild ill-appearance

YES

DIAGNOSIS IS SEPSIS !
Start treatment immediately
- Cultures
- Aggressive fluid management
- Broad spectrum antibiotics
- Close monitoring for signs of shock
- Admission

THERAPEUTIC TRIAL IN THE ED
Based on diagnoses suggested by H&P, a therapeutic trial / observation period of up to 4-6 hours in the ED to see if patient's appearance and VS improve
3 common interventions in the ED
- **Antipyretics, a Nap, IV hydrations, consider drawing Blood cultures and labs**

PERFORM A REASSESSMENT

HAVE ILL-APPEARANCE, SIGN(S) OF HYPOPERFUSION, OR EXTREME VS RESOLVED?

NO

DIAGNOSIS IS SEPSIS !
Treat immediately: Cultures, aggresssive IVF, antibiotics, & admit. Monitor closely for signs of shock.

YES

SEPSIS RULED OUT
Treatment and follow up as indicated by final diagnosis and work up. Remember to reassess at discharge*

* **Febrile children's vital signs and general appearance** should routinely be re-assessed and documented prior to discharge since sepsis criteria may not be present initially but may develop over several hours while in the ED

** **RISK FACTORS FOR SEPSIS:** Immunocompromised (HIV, cancer, hemoglobinopathies, asplenia, DM, etc.), co-morbidity or chronic illness**,** indwelling catheters, previous h/o sepsis, immunosuppressive therapy

*** **DIFFERENTIAL DIAGNOSIS OF TACHYCARDIA:** fever, pain, anxiety, hypovolemia, anemia, hypoxemia, hypercarbia, hyperthyroidism, myocarditis, sepsis

DIFFERENTIAL DIAGNOSIS OF TACHYPNEA: fever, pain, anxiety, asthma, bronchiolitis, croup, pneumonia, nasal congestion <6 mo, myocarditis, sepsis

IV. Clinical Pearl: Always Watch Out For Myocarditis!

Though much less common than sepsis, myocarditis can appear clinically identical to sepsis. Therefore, myocarditis should always be considered along with sepsis (as well as for any patient in shock) in children who continue to appear ill or have persistent extreme vital signs (HR and /or RR) or sign(s) of hypo-perfusion and do not improve clinically despite correction of fever, pain and/or dehydration.

Clinical Strategy to Rule-Out Myocarditis: For any patient presumed to be either septic or in septic shock, obtain a CXR and EKG early-on to rule out myocarditis. Absence of both cardiomegaly or CHF (on CXR) or EKG changes is good evidence that you are dealing with sepsis and not myocarditis. Testing for troponin is also reasonable. However, troponin levels take time, and with a negative CXR and EKG, the diagnosis of myocarditis is sufficiently ruled out to proceed with further aggressive fluid resuscitation and management for sepsis*

*PEARLS/ TAKE-HOME MESSAGES:

1) SEPSIS, MYOCARDITIS, & SHOCK : Always consider these 3 diagnoses as "Married" to each other in the sense that in the ED these 3 differential diagnoses ALWAYS 'run together' and all 3 MUST be considered for any very sick pediatric patient , or for lesser degrees of illness whenever Clinical Indication(s) for the Rapid Cardiopulmonary Assesssment do not resolve with ED treatment (or newly evolve while in the ED) for what you initially presume to be a more benign diagnosis. Also, even when one of these 3 diagnoses seems clear to you from the H&P , you still might get tricked unless you make sure to rule out the other two:
SEPSIS: When indicated (see "Rule Out Pediatric Sepsis Algorithm" above) , obtain labs & culture(s) and cover with antibiotics.
SHOCK: Ruled out by performing Rapid Cardiopulmonary Assessment (see Section V below).
MYOCARDITIS: Obtain EKG & CXR. (Also consider sending troponin)

2) When to obtain EKG & CXR:
As a general rule, the sicker the patient (eg-shock or very ill-appearing, etc), the earlier these tests should be done. For instance, a child in shock who you're going to very aggressively bolus with IV fluids should get a stat EKG & CXR done at the same time you're giving your 1st normal saline bolus . Absence of both EKG and CXR findings suggestive of Myocarditis in such a sick patient, along with clinical improvement with your IV fluid bolus(es), would be reassuring that you're dealing with sepsis and/or other non-cardiac etiologies, and that you can safely continue aggressive IV fluid management.

V. Compensated Septic Shock

Definition: **Shock with normal BP.**

Significance: **Shock often missed in children due to normal BP. Significance:**

Children in shock often look deceptively well.

Children in compensated shock may suddenly arrest & die

TAKE-HOME POINTS:

1.Children in shock very often look well !

2.Diagnosis must be based on OBJECTIVE criteria… NOT BP or appearance alone!

HOW DO YOU AVOID MISSING SEPTIC SHOCK?

1) Always remember to do a Rapid Cardiopulmonary Assessment:

The 5 Indications for A Rapid Cardiopulmonary Assessment:

1) Ill-appearance
2) Extreme tachycardia/ tachypnea or hemodynamically unstable
3) Abnormal pulse pressure (wide or narrow)
4) Any signs of hypo-perfusion
5) Very young infants

The Rapid Cardiopulmonary Assessment

Rapidly assesses both 1)WOB & 2) End-organ perfusion to diagnose (or rule out) Respiratory Failure and/or Compensated Shock, or the presence of other illness severity that requiries immediate treatment:

A -	**Airway**	
B -	**WOB**	Lethargy, head-bobbing, grunting (**Severe signs-→** concern for impending apnea)
		Mental status, aeration, RR, SaO2, retractions, I: E
C -	**End-organ**	Brain: mental status, tone
	Perfusion	Skin: mottled, pale, cyanosis, cap refill / pulses (feet)

2) USE THE EM PRACTICAL DEFINITION FOR PEDIATRIC SEPTIC SHOCK:

A. If Patient Previously Healthy: (ie- NO RISK FACTORS FOR SEPSIS)

EITHER

EXTREME VITALS (HR or RR) **+ 2 *CLINICAL SIGNS OF SHOCK"**

OR

ANY 3 *CLINICAL SIGNS OF SHOCK

*"CLINICAL SIGN OF SHOCK" = ANY SIGN OF HYPOPERFUSION THAT IS MODERATE TO SEVERE .

(EXAMPLE: LETHARGY (mentation) + VERY PALE (skin) + THREADY DP PULSES (feet) = 3 CLINICAL SIGNS OF SHOCK)

B. If Patient Has Known Risk Factors for Sepsis:

(LOWER THRESHOD FOR DIAGNOSIS OF SHOCK BY ONE)

EITHER

EXTREME VITALS (HR or RR) **+ ANY** (≥ 1) ***CLINICAL SIGN OF SHOCK**

OR

ANY 2 *CLINICAL SIGNS OF SHOCK

* "CLINICAL SIGN OF SHOCK" = ANY SIGN OF HYPOPERFUSION THAT IS MODERATE TO SEVERE

VI. Common Pitfalls : Missing Sepsis/Septic Shock In the ED:

(DON"T FALL INTO ANY OF THESE YOURSELF!)

1. "The patient looks 'too good' to be septic" **(persistent bad vitals not noted by ED staff).**
2. One diagnosis has already been made, i.e. - UTI, etc **(co-existing dx of sepsis not considered).**
3. Abnormal vitals or appearance is attributed to another cause (i.e - fever, tired, crying, etc.)*.
4. No strictly objective criteria of shock (based on Rapid Cardiopulmonary Assessment) used.
5. Using SIRS Criteria for diagnosis (**SIRS are critical care criteria, & NOT for the ED setting).**
6. Extreme ** tachycardia or tachypnea, or abnormal pulse pressure, is not appreciated.

* **Sepsis is not ruled out** unless you obtain & document acceptable vitals prior to discharge (ie- Either HR & RR NOT extreme,(ie- if there's an explanation for having ↑HR or ↑RR), OR completely WNL for patients without any reasonable explanation for ↑HR or ↑RR (If child is anxious/crying, febrile, etc -→ give antipyresis, consider rechecking vitals when asleep, or get HR from pulse ox monitor, etc).

****YOU!!** MUST memorize & always know the upper limits of normal HR & RR for age--ie-**Module 1!**

(or else you'll miss sick kids!)

VII. Septic Shock Treatment Summary:

1) **Resuscitation leader (MD) MUST remain at bedside until Goal/Endpoint of ED resuscitation is achieved**

2) **Goal / Endpoint of ED Resuscitation: Clinical shock reversal (i.e. - normalization of vitals & mental status, cap refill, etc.) the quicker shock is reversed IN THE ED, the better the outcome**

3) **1st Line Rx: IV Fluids! NS boluses (20cc/kg, given by IV push as fast as possible Then reassess; How much fluid? May push up to 5 boluses in 1st 60-90 minutes. (i.e.- after each bolus, reassess response and need for further boluses based on normalizing vital signs, mental status, capillary refill, urine output, etc.—Feel for liver edge and examine lungs for early signs of CHF/fluid overload)**

4) **PEARL: A single 22GA or 24G does not suffice for fluid resuscitation in children in shock (who require much more fluids compared to adults in shock). Start multiple IV's (at least 2) & don't hesitate to use IO's as additional (or initial) IV access**

5) **Early broad spectrum antibiotics**

6) **Second line Rx (i.e.- for Fluid-Refractory Shock): Vasopressors First-line vasopressor: Dopamine**

7) **PEARL: All vasopressors and inotropes may be infused through a peripheral IV until central venous access is available.**

8) **Titrate Rx: Reassess for improved clinical end-organ perfusion (i.e. - normalizing vital signs, mental status, capillary refill, urine output, etc.)**

8) **Maintain adequate MAP (MAP = 1/3 systolic BP + 2/3 diastolic BP)**

ADEQUATE MAP'S FOR AGE:

Neonate (<1mo)	**MAP ≥ 55**
Infant (1mo -1yr)	**MAP ≥ 60**
Child (>1yr)	**MAP ≥ 65**

9) Consider intubate early-on for respiratory distress or increased WOB (may reverse shock, since 40% of circulation diverted to diaphragm and inefficient WOB in shock).

10) For severe septic shock refractory to fluids and requiring 2nd line vasopressor, consider Hydrocortisone (for possible adrenal insufficiency causing refractory shock)

11) Always check/normalize glucose and ionized calcium.

12) Choosing 2nd-Line Vasopressor: (i.e. for Dopamine/fluid - refractory shock)

* **Cold shock** (*presumed low CO - clammy/cool skin, mottled, poor cap refill, thready distal pulses): **Dobutamine**

** **Warm shock** (**presumed low SVR - warm skin, flushed, bounding distal pulses, 'flash' cap refill): **Levophed**

13) Refractory Shock,* not improving AT ALL after BOTH maximal NS fluid boluses (i.e.- up to 5 boluses within 1st 60-90 minutes of resuscitation) in addition to both 1st and 2nd line vasopressors, warrants an echocardiogram in the ED to more accurately assess the patient's hemodynamics for the appropriate class of vasopressor therapy.**

*** **The term "Refractory Shock" here would refer to a patient who shows no improvement at all in vital signs or cap refill, mental status, etc. While not all patients will completely reverse their shock in the ED, all of them should exhibit some degree of response during ED treatment (i.e. - improved cap refill, more alert, decreased HR toward normal, etc.).**

14) 3rd-Line Vasopressors: Amrinone (for low-CO shock) and vasopressin (for low SVR shock)

NOTE: Usually not started in ED unless with subspecialty consultation/input.

***** **END MODULE 4** *****