Update on Pediatric Community-Acquired Pneumonia

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Introduction

Main Resource

The Management of Community-Acquired Pneumonia in Infants and Children Older Than 3 Months of Age: Clinical Practice Guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America

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IDSA Guidelines

- 2011
- Children older than 3 months of age
- Issues addressed:
  - Who to hospitalize
  - What tests to order
  - Drugs of choice
  - Treatment failures

YK Guidelines

- Updated May 2015
- Based on IDSA Guidelines
- Input from ID experts, PICU, ANMC, and YOU!!
- Covers children >3 months old

REMEMBER:
If patient is <90 days and febrile, please see fever guidelines.

What's changed?

- Inpatient IV therapy:
  - First-line: ampicillin
  - Second-line: Unasyn
  - Third-line: ceftriaxone
- New emphasis on supportive measures.
- Evaluating and treating based on severity of respiratory distress AFTER supportive measures.
- Formatting mirrors other pediatric respiratory guidelines.

Background

Epidemiology

- Pneumonia is the leading cause of death in children worldwide.
- In the developed world, the annual incidence of pneumonia is 3-4 cases per 100 children <5 years old.
- We have very high rates of pediatric pneumonia in the YK Delta.
  - Recurrent pneumonia leads to chronic lung disease and bronchiectasis.
  - Bronchiectasis has a high mortality rate, with patients dying in their 30's in local study cohorts.

Etiology

- Difficult to determine true pathogen in most cases.
- Viruses more common in infants and toddlers.
  - RSV detected in 40% of children <2 years.
- Bacteria more common in older children.

Etiology - Common Trends

- *S. pneumoniae* is the most common bacterial cause of pneumonia in children.
- Viruses account for 14-35% of pneumonia cases, and as high as 50% of cases in young children.
- Viruses are more commonly identified in children <5 years.
- In children >5 years, *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* are more common.

Source: UpToDate

Bacterial Causes in Children <5 Years

- *S. pneumoniae* is the single most common bacterial pathogen causing pneumonia in all patients beyond the first few weeks of life.
- *H. influenzae* type b is a rare cause of pneumonia in countries with universal childhood immunization.
- *S. aureus* (particularly CA-MRSA) and *S. pyogenes* are becoming increasingly frequent causes of CAP, particularly those complicated by necrosis and empyema.
- The prevalence of *M. pneumoniae* and *C. pneumoniae* may be increasing in preschool children with CAP.

Source: UpToDate

Bacterial Causes in Children >5 Years

- *S. pneumoniae* is the most common typical bacterial cause of pneumonia in children older than five years.
- *M. pneumoniae* is more common among children ≥5 years than among younger children.
- *C. pneumoniae* also is emerging as a frequent cause of pneumonia in older children and young adults.

Source: UpToDate

So…

- *Strep pneumo*
- *Strep pneumo*
- *Strep pneumo*!!

Diagnosis

Pneumonia is a clinical diagnosis.

- CXR findings are not required to make the diagnosis of pneumonia. Consistent history and focal crackles on exam are sufficient.
- However, given the high incidence of chronic lung disease in our population, physical exam findings are not always reliable.
  - A child can have clear lungs with an infiltrate.
  - A child can have frank crackles with a clear CXR.
- Thus, we have a low threshold to order CXRs in our patients and interpret the results in light of the entire clinical picture.

Treatment decision should be based on severity of respiratory distress.

Signs of Respiratory Distress
1. Tachypnea, respiratory rate, breaths/min[a]
Age 0–2 months: >60
Age 2–12 months: >50
Age 1–5 Years: >40
Age >5 Years: >20
2. Dyspnea
3. Retractions (suprasternal, intercostals, or subcostal)
4. Grunting
5. Nasal flaring
6. Apnea
7. Altered mental status
8. Pulse oximetry measurement <90% on room air

[a] Adapted from World Health Organization criteria.

Tachypnea
0-2 mo: >60
2-12 mo: >50
12-24 mo: >40

Hypoxia
<90% while awake
<88% while asleep
Sustained for >10 minutes

Moderate to severe respiratory distress
Sustained tachypnea, increased work of breathing, and/or hypoxia

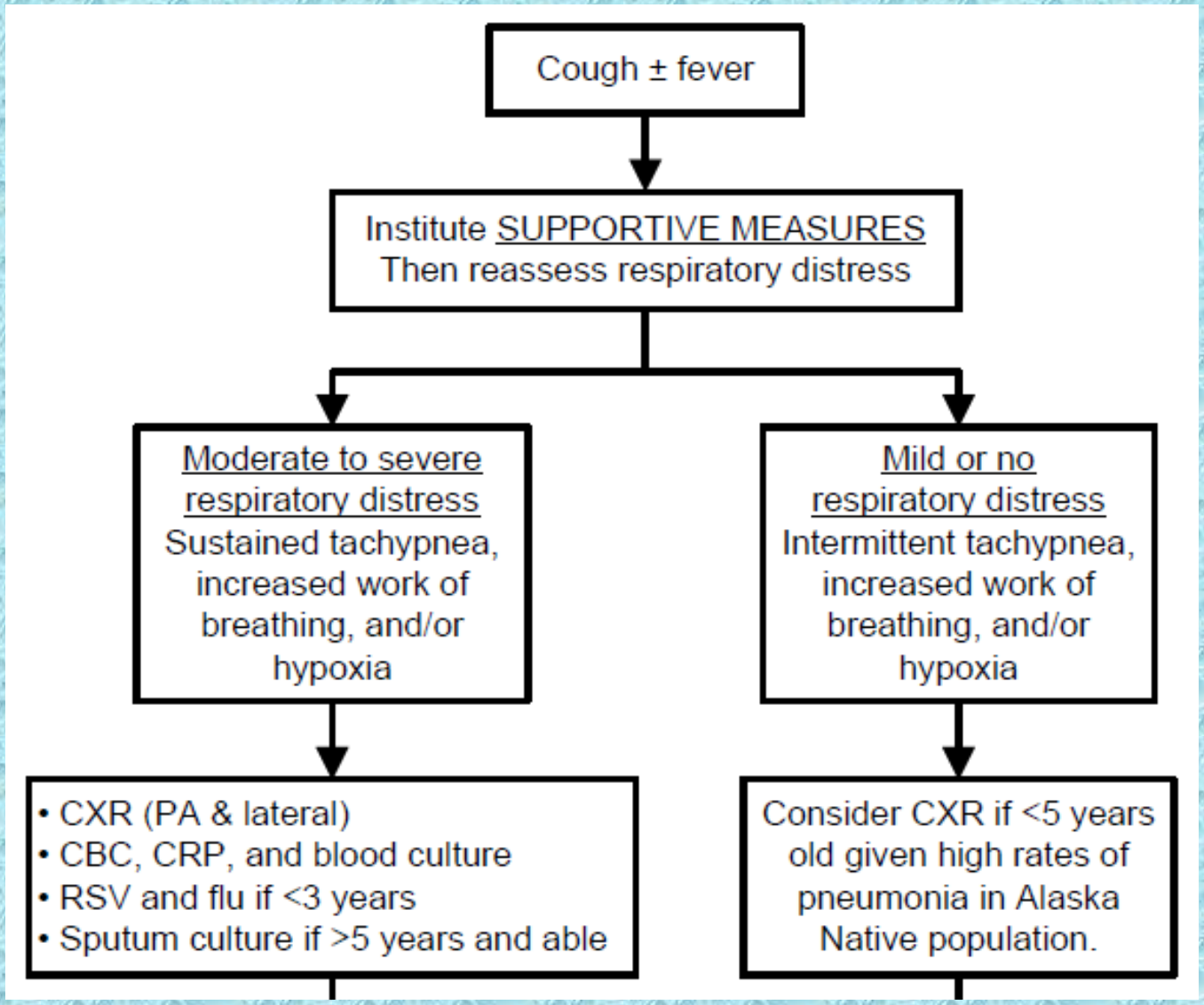
Mild or no respiratory distress
Intermittent tachypnea, increased work of breathing, and/or hypoxia

To admit or not to admit?

- Children with moderate to severe respiratory distress after supportive measures should be admitted to YK or sent to Anchorage by medevac.
- Who stays? Who goes?
  - Stay tuned for exciting developments in this area!
  - A multidisciplinary team is working on this!

Labwork

- Moderate to severe respiratory distress (admission anticipated):
  - CBC
  - CRP
  - Blood culture
  - RSV and flu (if <3 years)
  - Sputum and culture (if >5 years)
- Mild or no respiratory distress (outpatient management): No labwork required


Cough ± fever
Institute SUPPORTIVE MEASURES
Then reassess respiratory distress
Moderate to severe respiratory distress
Sustained tachypnea, increased work of breathing, and/or hypoxia
Mild or no respiratory distress
Intermittent tachypnea, increased work of breathing, and/or hypoxia
• CXR (PA & lateral)
• CBC, CRP, and blood culture
• RSV and flu if <3 years
• Sputum culture if >5 years and able
Consider CXR if <5 years old given high rates of pneumonia in Alaska Native population.

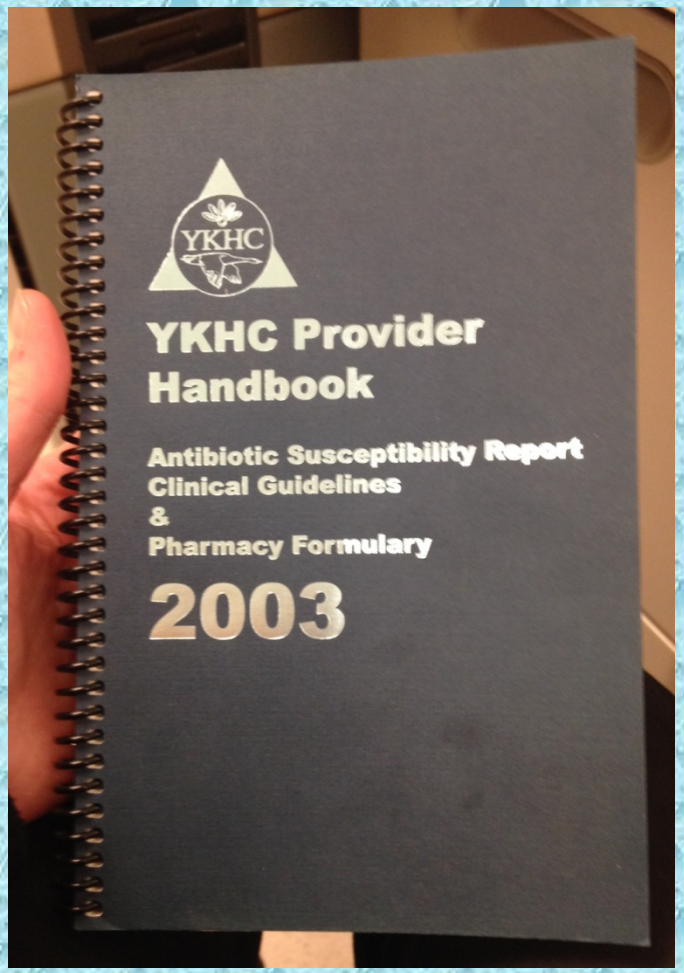
SUPPORTIVE MEASURES

-control fever, as it can be an independent cause of respiratory distress and tachycardia
-nasal suction with nasal bulb syringe and olive tip plus saline
-hydration
-gentle P&PD/CPT if helpful
-saline neb (0.9%)
-consider albuterol trial, especially in Alaska Native patients as they have high rates of RAD

Management
Now what?

Management/Treatment?

Some background…



Look what Leslie found in the Kasigluk clinic!
(That's where she is right now.)

2003 Antibiogram

YKDRH LAB

Antibiotic Susceptibility Report

Non-Urines 01/02/02 – 01/04/03

Top Organisms/ #	Amox/clav	Ampicillin	Cefazolin	Cefepime	Cefotaxime	Cefotetan	Cefoxitin	Ceftriazone	Cefuroxime	Ciprofloxacin	Clorampheni col	Clindamycin	Gentamicin	Erythromycin	Levofloxacin	Cephalothin	Oxacillin	Penicillin	Piperacillin	Rifampin	Tetracyline	Tobramycin	Trimet/Sulfa	Vancomycin
Enterococcus faecalis (D) /41		100							98	93			0	100			100		83	10			95
Beta Strep, nonA,NonB /33		100												97			100						
Streptococcus agalactiae (B) /13		100												100			100						
Streptococcus pyogenes (A) /62		100												98			100			100			
Streptococcus pneumoniae /47					90			100			98	100		74			60			83		83	100
Staphylococcus aureus-All /1483	15	2	15	15	15			14	20	97	91	73	95	26	99	15	15		98	92		100	99
Staphylococcus epidermidis /25	25	10	25	25	25			25	0	88	100	80	84	36	84	25	25		96	58		84	100
Haemophilus influenzae /31	81	83						100	94	88	100									100		71	
Pseudomonas aeruginosa /49					20			29		92			82		90			76			90		
Proteus vulgaris /30	97	7	40		100	100	100	100	73	97			100		100	60		73		93	100	100	
Proteus mirabilis /48	98	94	98		100	100	98	100	96	100			100		100	98		92		2	100	96	
Klebsiella pneumoniae /50	92	8	88		94	100	88	96	90	100			98		100	70		60		92	94	92	
Klebsiella oxytoca /44	98	2	18		93	98	100	95	84	98			98		98	27		36		98	98	98	
E. coli /711	91	47	86		98	99	98	98	96	99			97		99	47		49		78	97	68	
Enterobacter Cloacae /29	10	17	10		79	66	17	83	41	100			90		100	0		83		83	86	93	

Non urines – includes wounds, ears, positive blood cultures, anything EXCEPT urines

Strep pneumo

- Historically, the YK Delta has had high resistance rates of *S pneumo* for penicillins.
- As a result, we used ceftriaxone as the first-line treatment for pneumonia.
- However, resistance rates are decreasing.

2014 Antibiogram

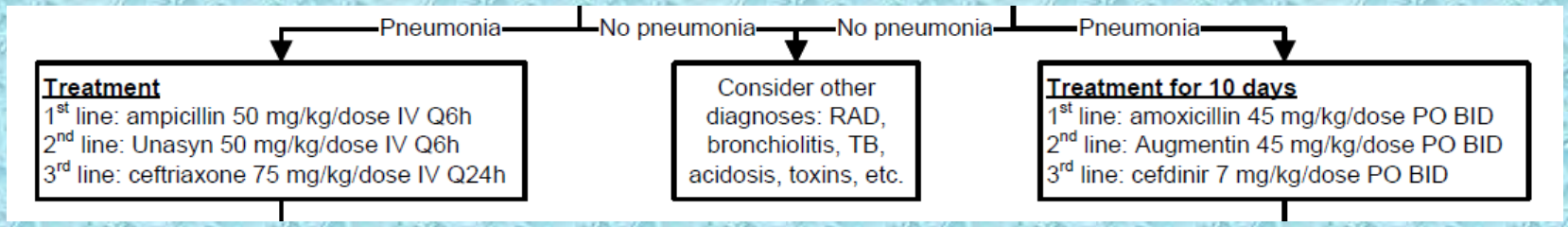
Organism	# Isolates Tested	Interpretation	Penicillin	Ampicillin	Oxacillin	Cefuroxime	Cefotaxime	Ceftriaxone	Levofloxacin	Trimeth/sulfa	Clindamycin	Erythromycin	Nitrofurantoin	Vancomycin	Tetracycline
MS *S. aureus*	396	S	17	--	100	--	--	100	92	100	94	73	100	100	97
		I	0	--	0	--	--	0	2	0	0	1	0	0	0
		R	83	--	0	--	--	0	6	0	6	26	0	0	3
			396	--	396	--	--	396	396	395	387	387	9	396	396
MR *S. aureus*	400	S	0	--	0	--	--	0	37	99	98	17	100	100	95
		I	0	--	0	--	--	0	30	0	0	1	0	0	0
		R	100	--	100	--	--	100	33	1	2	82	0	0	5
			400	--	400	--	--	400	400	400	399	399	400	400	400
Total *S. aureus*	796	S	9	--	50	--	--	50	64	99	97	44	100	100	96
		I	0	--	0	--	--	0	16	0	0	1	0	0	0
		R	91	--	50	--	--	50	20	1	3	55	0	0	4
			796	--	796	--	--	796	796	795	786	786	10	796	796
Coagulase Negative *Staphylococcus*	255	S	20	--	51	--	--	50	88	78	74	36	100	100	90
		I	0	--	0	--	--	0	3	0	3	1	0	0	0
		R	80	--	49	--	--	50	9	22	23	63	0	0	10
			255	--	255	--	--	255	255	254	149	149	106	255	255
E. faecalis	45	S	100	100	--	--	--	--	96	--	--	34	100	98	24
		I	0	0	--	--	--	--	0	--	--	33	0	0	0
		R	0	0	--	--	--	--	4	--	--	33	0	2	76
			45	45	--	--	--	--	45	--	--	6	39	45	45
Streptococcus pneumoniae	82	S	93	--	--	90	95	97	100	84	92	78	--	99	83
		I	0	--	--	4	4	2	0	6	1	1	--	0	2
		R	7	--	--	6	1	1	0	10	7	21	--	1	15
			82	--	--	82	82	82	82	82	82	82	--	82	82

Zoomed in…

Organism	# Isolates Tested	Interpretation	Penicillin	Ampicillin	Oxacillin	Cefuroxime	Cefotaxime	Ceftriaxone	Levofloxacin	Trimeth/sulfa	Clindamycin	Erythromycin	Nitrofurantoin	Vancomycin	Tetracycline
Streptococcus pneumoniae	82	S	93	--	--	90	95	97	100	84	92	78	--	99	83
		I	0	--	--	4	4	2	0	6	1	1	--	0	2
		R	7	--	--	6	1	1	0	10	7	21	--	1	15
			82	--	--	82	82	82	82	82	82	82	--	82	82

Low penicillin resistance for *S pneumo*

- Ampicillin and amoxicillin are now the first-line drugs of choice for CAP.
- Dosing on guideline is based on local MIC:
  - Ampicillin 50 mg/kg/dose IV Q6h
  - Amoxicillin 45 mg/kg/dose PO Q12h


Pneumonia
No pneumonia
No pneumonia
Pneumonia
Treatment
1st line: ampicillin 50 mg/kg/dose IV Q6h
2nd line: Unasyn 50 mg/kg/dose IV Q6h
3rd line: ceftriaxone 75 mg/kg/dose IV Q24h
Consider other diagnoses: RAD, bronchiolitis, TB, acidosis, toxins, etc.
Treatment for 10 days
1st line: amoxicillin 45 mg/kg/dose PO BID
2nd line: Augmentin 45 mg/kg/dose PO BID
3rd line: cefdinir 7 mg/kg/dose PO BID

This is in line with national guidelines.

Table 5. Selection of Antimicrobial Therapy for Specific Pathogens

Pathogen	Parenteral therapy	Oral therapy (step-down therapy or mild infection)
Streptococcus pneumoniae with MICs for penicillin ≤2.0 μg/mL	Preferred: ampicillin (150–200 mg/kg/day every 6 hours) or penicillin (200 000–250 000 U/kg/day every 4–6 h); Alternatives: ceftriaxone (50–100 mg/kg/day every 12–24 hours) (preferred for parenteral outpatient therapy) or cefotaxime (150 mg/kg/day every 8 hours); may also be effective: clindamycin (40 mg/kg/day every 6–8 hours) or vancomycin (40–60 mg/kg/day every 6–8 hours)	Preferred: amoxicillin (90 mg/kg/day in 2 doses or 45 mg/kg/day in 3 doses); Alternatives: second- or third-generation cephalosporin (cefpodoxime, cefuroxime, cefprozil); oral levofloxacin, if susceptible (16–20 mg/kg/day in 2 doses for children 6 months to 5 years old and 8–10 mg/kg/day once daily for children 5 to 16 years old; maximum daily dose, 750 mg) or oral linezolid (30 mg/kg/day in 3 doses for children <12 years old and 20 mg/kg/day in 2 doses for children ≥12 years old)

Caveats

For PCN allergy: If reaction was non-anaphylactic, may trial amoxicillin with monitoring. If reaction was anaphylaxis, treat with a cephalosporin. If any questions, please obtain a pediatrics consult.

Azithromycin: Do not prescribe azithromycin unless there is evidence of an atypical pathogen and child is >5 years.

RUL infiltrate: consider starting with Augmentin/ Unasyn to cover for oral anaerobes.

Exceptions

- RUL infiltrate → consider antibiotic with oral anaerobe coverage
  - Augmentin/Unasyn
  - Clindamycin
- Child received amoxicillin/ampicillin in last 30 days → go to second-line: Augmentin/Unasyn.
- Child is incompletely immunized: consider broader-spectrum coverage.
- Effusion in patient with possible sepsis, consider Vanco

When is ceftriaxone indicated as first-line therapy?

- Hospitalized patients who are not appropriately immunized.
- In regions where pneumococcus has high-level penicillin resistance.
- Patients with life-threatening infection, including empyema. (also consider adding Vanco)

Translation:
"Are your shots up-to-date?"

Definitions: Fully Immunized – Hib

Age	No. doses of vaccine
<4 months	1 dose
<6 months	2 doses
6-12 months	3 doses
≥12 months	2 total doses of vaccine, the first of which was at 12-14 months of age
≥12 months	3 total doses of vaccine, the first at <12 months of age, the second at <15 months of age, and the third at ≥12 months of age
≥15 months	first dose of vaccine was at or after 15 months of age

[LOE: ✪✪✪○ Moderate quality] (ASA, 2011)

Seattle Children's
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Hideous Table of Antimicrobial Therapy Choices

Table 5. Selection of Antimicrobial Therapy for Specific Pathogens

Pathogen	Parenteral therapy	Oral therapy (step-down therapy or mild infection)
Streptococcus pneumoniae with MICs for penicillin ≤2.0 μg/mL	Preferred: ampicillin (150–200 mg/kg/day every 6 hours) or penicillin (200 000–250 000 U/kg/day every 4–6 h); Alternatives: ceftriaxone (50–100 mg/kg/day every 12–24 hours) (preferred for parenteral outpatient therapy) or cefotaxime (150 mg/kg/day every 8 hours); may also be effective: clindamycin (40 mg/kg/day every 6–8 hours) or vancomycin (40–60 mg/kg/day every 6–8 hours)	Preferred: amoxicillin (90 mg/kg/day in 2 doses or 45 mg/kg/day in 3 doses); Alternatives: second- or third-generation cephalosporin (cefpodoxime, cefuroxime, cefprozil); oral levofloxacin, if susceptible (16–20 mg/kg/day in 2 doses for children 6 months to 5 years old and 8–10 mg/kg/day once daily for children 5 to 16 years old; maximum daily dose, 750 mg) or oral linezolid (30 mg/kg/day in 3 doses for children <12 years old and 20 mg/kg/day in 2 doses for children ≥12 years old)
S. pneumoniae resistant to penicillin, with MICs ≥4.0 μg/mL	Preferred: ceftriaxone (100 mg/kg/day every 12–24 hours); Alternatives: ampicillin (300–400 mg/kg/day every 6 hours), levofloxacin (16–20 mg/kg/day every 12 hours for children 6 months to 5 years old and 8–10 mg/kg/day once daily for children 5–16 years old; maximum daily dose, 750 mg), or linezolid (30 mg/kg/day every 8 hours for children <12 years old and 20 mg/kg/day every 12 hours for children ≥12 years old); may also be effective: clindamycin[a] (40 mg/kg/day every 6–8 hours) or vancomycin (40–60 mg/kg/day every 6–8 hours)	Preferred: oral levofloxacin (16–20 mg/kg/day in 2 doses for children 6 months to 5 years and 8–10 mg/kg/day once daily for children 5–16 years, maximum daily dose, 750 mg), if susceptible, or oral linezolid (30 mg/kg/day in 3 doses for children <12 years and 20 mg/kg/day in 2 doses for children ≥12 years); Alternative: oral clindamycin[a] (30–40 mg/kg/day in 3 doses)
Group A *Streptococcus*	Preferred: intravenous penicillin (100 000–250 000 U/kg/day every 4–6 hours) or ampicillin (200 mg/kg/day every 6 hours); Alternatives: ceftriaxone (50–100 mg/kg/day every 12–24 hours) or cefotaxime (150 mg/kg/day every 8 hours); may also be effective: clindamycin, if susceptible (40 mg/kg/day every 6–8 hours) or vancomycin[b] (40–60 mg/kg/day every 6–8 hours)	Preferred: amoxicillin (50–75 mg/kg/day in 2 doses), or penicillin V (50–75 mg/kg/day in 3 or 4 doses); Alternative: oral clindamycin[a] (40 mg/kg/day in 3 doses)
Staphylococcus aureus, methicillin susceptible (combination therapy not well studied)	Preferred: cefazolin (150 mg/kg/day every 8 hours) or semisynthetic penicillin, eg oxacillin (150–200 mg/kg/day every 6–8 hours); Alternatives: clindamycin[a] (40 mg/kg/day every 6–8 hours) or >vancomycin (40–60 mg/kg/day every 6–8 hours)	Preferred: oral cephalexin (75–100 mg/kg/day in 3 or 4 doses); Alternative: oral clindamycin[a] (30–40 mg/kg/day in 3 or 4 doses)
S. aureus, methicillin resistant, susceptible to clindamycin (combination therapy not well-studied)	Preferred: vancomycin (40–60 mg/kg/day every 6–8 hours or dosing to achieve an AUC/MIC ratio of >400) or clindamycin (40 mg/kg/day every 6–8 hours); Alternatives: linezolid (30 mg/kg/day every 8 hours for children <12 years old and 20 mg/kg/day every 12 hours for children ≥12 years old)	Preferred: oral clindamycin (30–40 mg/kg/day in 3 or 4 doses); Alternatives: oral linezolid (30 mg/kg/day in 3 doses for children <12 years and 20 mg/kg/day in 2 doses for children ≥12 years)
S. aureus, methicillin resistant, resistant to clindamycin (combination therapy not well studied)	Preferred: vancomycin (40–60 mg/kg/day every 6-8 hours or dosing to achieve an AUC/MIC ratio of >400); Alternatives: linezolid (30 mg/kg/day every 8 hours for children <12 years old and 20 mg/kg/day every 12 hours for children ≥12 years old)	Preferred: oral linezolid (30 mg/kg/day in 3 doses for children <12 years and 20 mg/kg/day in 2 doses for children ≥12 years old); Alternatives: none; entire treatment course with parenteral therapy may be required

Hideous Table of Antimicrobial Therapy Choices

Pathogen	Parenteral therapy	Oral therapy (step-down therapy or mild infection)
Haemophilus influenza, typeable (A-F) or nontypeable	Preferred: intravenous ampicillin (150-200 mg/kg/day every 6 hours) if β-lactamase negative, ceftriaxone (50–100 mg/kg/day every 12-24 hours) if β-lactamase producing, or cefotaxime (150 mg/kg/day every 8 hours); Alternatives: intravenous ciprofloxacin (30 mg/kg/day every 12 hours) or intravenous levofloxacin (16-20 mg/kg/day every 12 hours for children 6 months to 5 years old and 8-10 mg/kg/day once daily for children 5 to 16 years old; maximum daily dose, 750 mg)	Preferred: amoxicillin (75-100 mg/kg/day in 3 doses) if β-lactamase negative) or amoxicillin clavulanate (amoxicillin component, 45 mg/kg/day in 3 doses or 90 mg/kg/day in 2 doses) if β-lactamase producing; Alternatives: cefdinir, cefixime, cefpodoxime, or ceftibuten
Mycoplasma pneumoniae	Preferred: intravenous azithromycin (10 mg/kg on days 1 and 2 of therapy; transition to oral therapy if possible); Alternatives: intravenous erythromycin lactobionate (20 mg/kg/day every 6 hours) or levofloxacin (16-20 mg/kg/day every 12 hours; maximum daily dose, 750 mg)	Preferred: azithromycin (10 mg/kg on day 1, followed by 5 mg/kg/day once daily on days 2–5); Alternatives: clarithromycin (15 mg/kg/day in 2 doses) or oral erythromycin (40 mg/kg/day in 4 doses); for children >7 years old, doxycycline (2–4 mg/kg/day in 2 doses; for adolescents with skeletal maturity, levofloxacin (500 mg once daily) or moxifloxacin (400 mg once daily)
Chlamydia trachomatis or *Chlamydophila pneumoniae*	Preferred: intravenous azithromycin (10 mg/kg on days 1 and 2 of therapy; transition to oral therapy if possible); Alternatives: intravenous erythromycin lactobionate (20 mg/kg/day every 6 hours) or levofloxacin (16-20 mg/kg/day in 2 doses for children 6 months to 5 years old and 8-10 mg/kg/day once daily for children 5 to 16 years old; maximum daily dose, 750 mg)	Preferred: azithromycin (10 mg/kg on day 1, followed by 5 mg/kg/day once daily days 2–5); Alternatives: clarithromycin (15 mg/kg/day in 2 doses) or oral erythromycin (40 mg/kg/day in 4 doses); for children >7 years old, doxycycline (2-4 mg/kg/day in 2 doses); for adolescents with skeletal maturity, levofloxacin (500 mg once daily) or moxifloxacin (400 mg once daily)

Hideous Table of Empiric Antibiotic Choices

Site of care	Empiric therapy		
	Presumed bacterial pneumonia	Presumed atypical pneumonia	Presumed influenza pneumonia[a]
Outpatient			
<5 years old (preschool)	Amoxicillin, oral (90 mg/kg/day in 2 doses[b]) Alternative: oral amoxicillin clavulanate (amoxicillin component, 90 mg/kg/day in 2 doses[b])	Azithromycin oral (10 mg/kg on day 1, followed by 5 mg/kg/day once daily on days 2–5); Alternatives: oral clarithromycin (15 mg/kg/day in 2 doses for 7-14 days) or oral erythromycin (40 mg/kg/day in 4 doses)	Oseltamivir
≥5 years old	Oral amoxicillin (90 mg/kg/day in 2 doses[b] to a maximum of 4 g/day[c]); for children with presumed bacterial CAP who do not have clinical, laboratory, or radiographic evidence that distinguishes bacterial CAP from atypical CAP, a macrolide can be added to a β-lactam antibiotic for empiric therapy; alternative: oral amoxicillin clavulanate (amoxicillin component, 90 mg/kg/day in 2 doses[b] to a maximum dose of 4000 mg/day, eg, one 2000-mg tablet twice daily[c])	Oral azithromycin (10 mg/kg on day 1, followed by 5 mg/kg/day once daily on days 2–5 to a maximum of 500 mg on day 1, followed by 250 mg on days 2–5); alternatives: oral clarithromycin (15 mg/kg/day in 2 doses to a maximum of 1 g/day); erythromycin, doxycycline for children >7 years old	Oseltamivir or zanamivir (for children 7 years and older); alternatives: peramivir, oseltamivir and zanamivir (all intravenous) are under clinical investigation in children; intravenous zanamivir available for compassionate use
Inpatient (all ages)[d]			
Fully immunized with conjugate vaccines for *Haemophilus influenzae* type b and *Streptococcus pneumoniae*; local penicillin resistance in invasive strains of pneumococcus is minimal	Ampicillin or penicillin G; alternatives: ceftriaxone or cefotaxime; addition of vancomycin or clindamycin for suspected CA-MRSA	Azithromycin (in addition to β-lactam, if diagnosis of atypical pneumonia is in doubt); alternatives: clarithromycin or erythromycin; doxycycline for children >7 years old; levofloxacin for children who have reached growth maturity, or who cannot tolerate macrolides	Oseltamivir or zanamivir (for children ≥7 years old; alternatives: peramivir, oseltamivir and zanamivir (all intravenous) are under clinical investigation in children; intravenous zanamivir available for compassionate use
Not fully immunized for *H. influenzae* type b and *S. pneumoniae*; local penicillin resistance in invasive strains of pneumococcus is significant	Ceftriaxone or cefotaxime; addition of vancomycin or clindamycin for suspected CA-MRSA; alternative: levofloxacin; addition of vancomycin or clindamycin for suspected CA-MRSA	Azithromycin (in addition to β-lactam, if diagnosis in doubt); alternatives: clarithromycin or erythromycin; doxycycline for children >7 years old; levofloxacin for children who have reached growth maturity or who cannot tolerate macrolides	As above

Change is scary.
What if it doesn't work?

Follow-up Studies

- Dinur-Scheiter *et al* (2013): 319 children aged 3 months to 2 years admitted with non-complicated pneumonia between 2003-2008 treated with either penicillin/ampicillin or cefuroxime.
  - No difference in number of days of IV treatment, days of supplemental oxygen requirement, or length of hospitalization.
  - No significant difference in treatment failures.
  - One week after admission, no difference between the groups.

Follow-up Studies

- Amarilvo *et al* (2014): prospective, randomized study with 58 children aged 3 months to 15 years with community-acquired pneumonia. Children were randomly assigned to receive low-dose penicillin G, high-dose penicillin G, or cefuroxime IV for 4-7 days.
  - No significant difference in time to defervescence or duration of hospitalization.
  - There were differences in leukocyte counts and C-reactive protein at discharge, but these "were of questionable clinical significance."

YUKON-KUSKOKWIM HEALTH CORPORATION

Clinical Guidelines / Treatment Protocols • May 2015

Pediatric Community-Acquired Pneumonia (CAP) >3 months

REMEMBER:
If patient is <90 days and febrile, please see fever guidelines.

Tachypnea
0-2 mo: >60
2-12 mo: >50
12-24 mo: >40

Hypoxia
<90% while awake
<88% while asleep
Sustained for >10 minutes

Cough ± fever

Institute SUPPORTIVE MEASURES
Then reassess respiratory distress

Moderate to severe respiratory distress
Sustained tachypnea, increased work of breathing, and/or hypoxia

Mild or no respiratory distress
Intermittent tachypnea, increased work of breathing, and/or hypoxia

- CXR (PA & lateral)
- CBC, CRP, and blood culture
- RSV and flu if <3 years
- Sputum culture if >5 years and able

Consider CXR if <5 years old given high rates of pneumonia in Alaska Native population.

Pneumonia — No pneumonia — No pneumonia — Pneumonia

Treatment
1st line: ampicillin 50 mg/kg/dose IV Q6h
2nd line: Unasyn 50 mg/kg/dose IV Q6h
3rd line: ceftriaxone 75 mg/kg/dose IV Q24h

Consider other diagnoses: RAD, bronchiolitis, TB, acidosis, toxins, etc.

Treatment for 10 days
1st line: amoxicillin 45 mg/kg/dose PO BID
2nd line: Augmentin 45 mg/kg/dose PO BID
3rd line: cefdinir 7 mg/kg/dose PO BID

- Place PPD if older than 6 months and no PPD in past 6 months.
- Discharge home with follow-up within 48-72 hours.

- Requires >2 L supplemental oxygen to prevent hypoxia or improve WOB?
- Requires neb treatments more frequently than Q2-3h for >8 hours?
- Sustained tachycardia, tachypnea, or respiratory distress despite treatment?
- Significant pleural effusion?

Yes — No

Transfer to Anchorage

Admit to YKHC Peds Inpatient Unit, using PED Admission/ Respiratory Infection PowerPlan

After 48-72 hours

No

Improvement? — Yes

- Patient improving with increased appetite and activity, less WOB, and decreasing fever curve?
- No hypoxia on room air?
- Tolerating home therapy with competent caregivers?
- Immunizations UTD?
- Negative PPD?

No — Yes

- Consult pediatrics.
- Consider repeating CXR and labs.
- Consider IVF.

- Change to oral antibiotics for total of 10 days of treatment.
- Discharge home with follow-up within 48-72 hours.

SUPPORTIVE MEASURES
-control fever, as it can be an independent cause of respiratory distress and tachycardia
-nasal suction with nasal bulb syringe and olive tip plus saline
-hydration
-gentle P&PD/CPT if helpful
-saline neb (0.9%)
-consider albuterol trial, especially in Alaska Native patients as they have high rates of RAD

Pneumonia is a clinical diagnosis and does not require X-ray findings.
Any child <5 years with suspected pneumonia should be evaluated in Bethel or an SRC.

For PCN allergy: If reaction was non-anaphylactic, may trial amoxicillin with monitoring. If reaction was anaphylaxis, treat with a cephalosporin. If any questions, please obtain a pediatrics consult.
Azithromycin: Do not prescribe azithromycin unless there is evidence of an atypical pathogen and child is >5 years.
RUL infiltrate: consider starting with Augmentin/ Unasyn to cover for oral anaerobes.

This guideline is designed for the general use of most patients but may need to be adapted to meet the special needs of a specific patient as determined by the medical practitioner.

Approved by MSEC 5/13/15

Case Scenarios

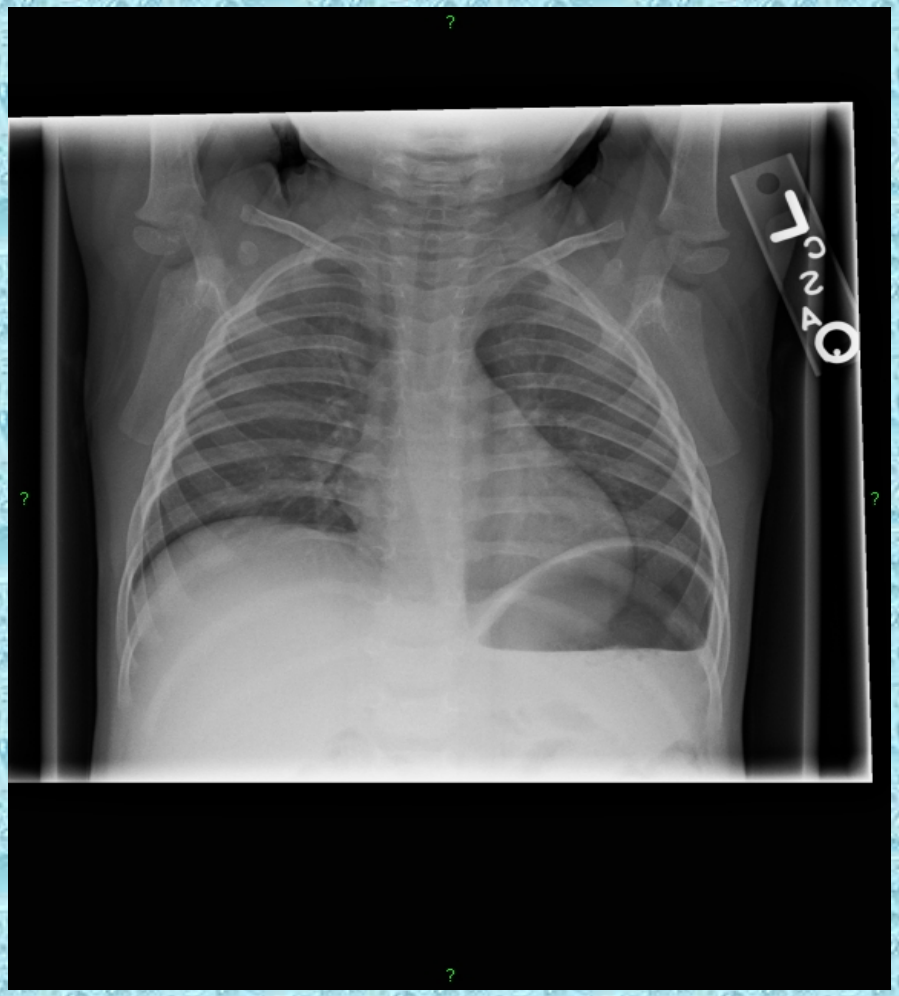
Treatment for CAP

- **Outpatient**
  - Amoxicillin 45mg/kg PO BID X 10d
  - Augmentin 45mg/kg PO BID X 10d
  - Cefdinir 14mg/kg/d div BID

- **Inpatient/Transfer**
  - Ampicillin 50mg/kg/dose IV q6h
  - Unasyn 50mg/kg/dose IV q6
  - Ceftriaxone 75mg/kg dose IV q12

Case Scenario

- 14 month old female with h/o previous RUL PNA 1/2015 presents to ED with 1 wk cough and runny nose, fever
- v/s: T 102.8 HR 185 RR 52 SpO2 98 % RA
- PE: lungs clear
- TX: Amoxicillin 45mg/kg PO bid X 10d



Follow Up Exam

- 14 month old presents for f/u evaluation with increased lethargy, decreased oral intake, decreased number of wet diapers, moaning at times
- v/s T 98.9 HR 154 RR 34 SpO2 98% on RA
- PE: pale, child laying on mother, course breath sounds, dry mucous membranes, cap refill < 4 sec
- What do we do now?

Case Scenario 2

- 12 month old female presents to health aide at 3PM with cough X 4 days , fever X 2 days Tm 101 and pulling at ears. Diffuse wheezing course crackles.
- V/S: T101.4 HR 170 RR 64 sats 95% RA
- Albuterol nebs given in village clinic
- V/S: 100.7 HR 174 RR 72 sats 95% RA
- Arrives in ED commercial flight 6PM

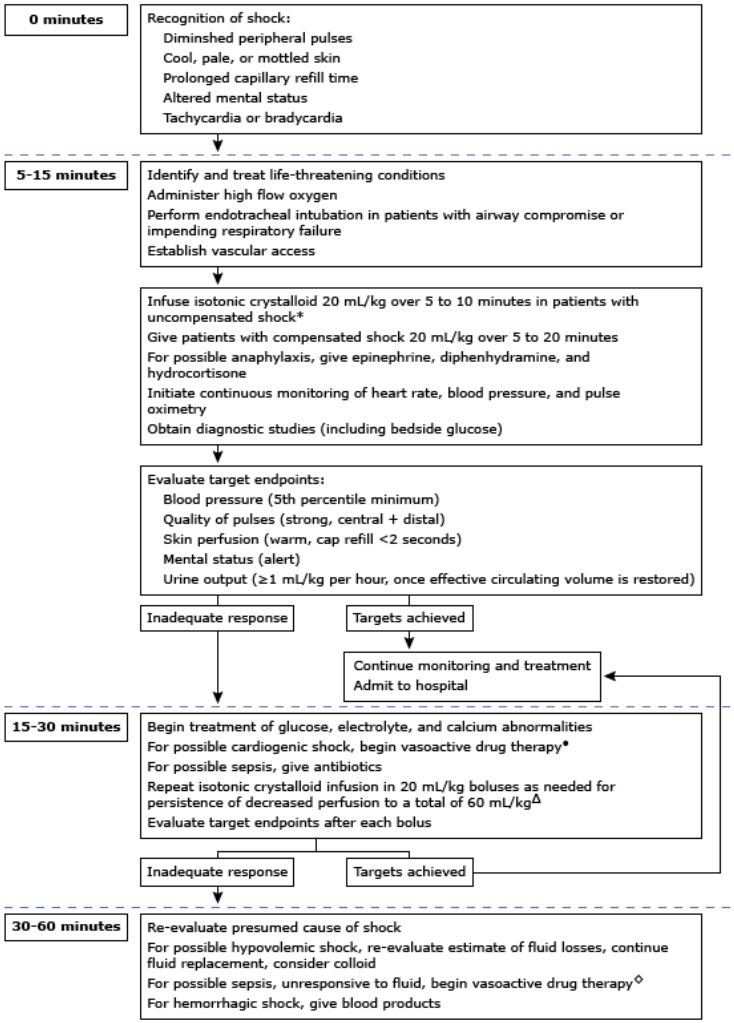
Pediatric systemic inflammatory response syndrome criteria

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

NA: not applicable.

Originally published in: Goldstein B, Giroir B, Randolph A, et al. International pediatric spesis consensus conference: Definitions for sepsis and organ dysfunction in pediatrics. Pediatr Crit Care Med 2005; 6:2. Correction published in: Gebara BM. Values for systolic blood pressure. Pediatr Crit Care Med 2005; 6:500.

Initial management of shock in children



* For possible cardiogenic shock with hypovolemia, give 5 to 10 mL/kg of isotonic fluids (eg, normal saline or Ringers lactate), infused over 10 to 20 minutes. Evaluate target end points and slowly give another 5 to 10 cc/kg if there has been improvement or no change. For patients with diabetic ketoacidosis, give 10 mL/kg of isotonic fluids over one hour.

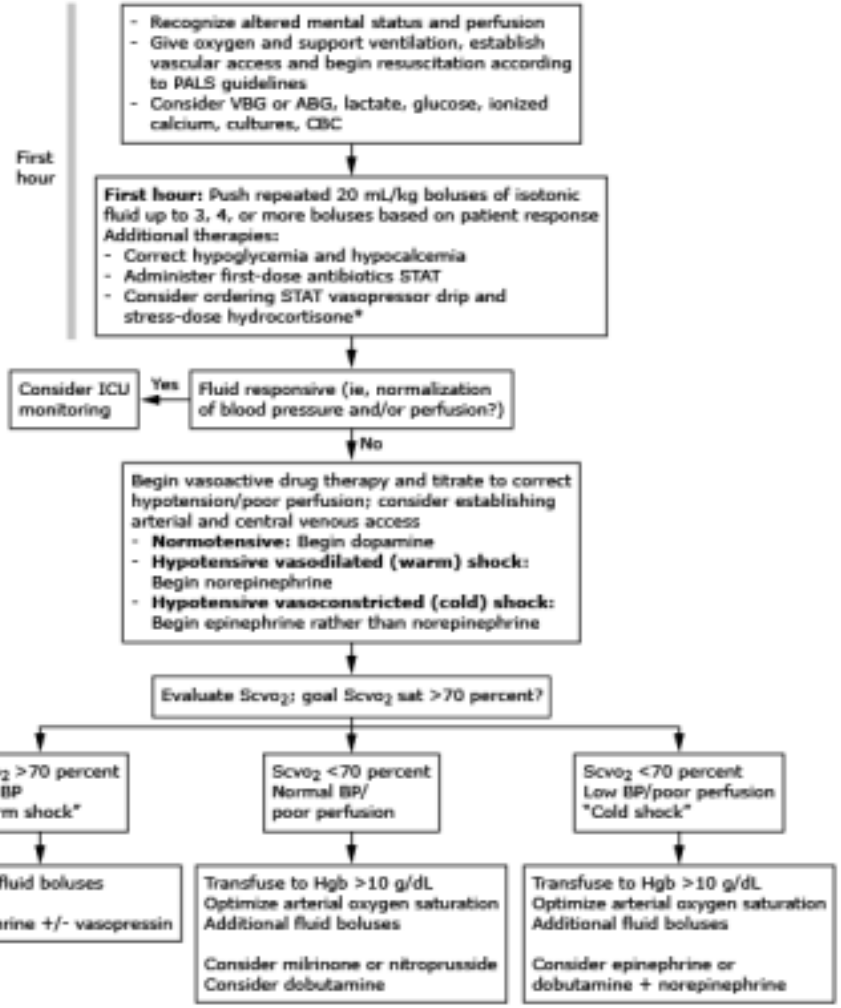
• Such as inotropes or vasodilators. For newborns, prostaglandin E1.

Δ For patients with DKA who do not improve with 20 mL/kg, look for another cause of shock before administering additional crystalloid. For possible cardiogenic shock, slowly give another 5 to 10 mL/kg if there has been improvement or no change.

◇ Dopamine if normotensive, norepinephrine if hypotensive and vasodilated, and epinephrine if hypotensive and vasoconstricted.

Adapted from: Carcillo JA, Fields AI. Clinical practice parameters for hemodynamic support of pediatric and neonatal patients in septic shock. Crit Care Med 2002; 30:1365.

Pediatric Advance Lifes Support septic shock algorithm



* **NOTE**: Fluid refractory and dopamine- or norepinephrine-dependent shock defines patient at risk for adrenal insufficiency. Draw baseline cortisol; consider ACTH stimulation test if unsure of need for steroids. If adrenal insufficiency is suspected give hydrocortisone ≅2 mg/kg bolus IV; maximum 100 mg.

References

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- UpToDate
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- Amarilyo *et al*. "IV penicillin G is as effective as IV cefuroxime in treating community-acquired pneumonia in children." *American Journal of Therapeutics* 2014 Mar-Apr;21(2):81-4.
- Lodha R, Kabra SK, Pandey RM. "Antibiotics for community-acquired pneumonia in children." *Cochrane Database of Systematic Reviews* 2013 Jun 4;6:CD004874.